JUNIPER NETWORKS

Junos® OS

Layer 2 Configuration Guide

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Junos® OS Layer 2 Configuration Guide
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The information in this document is current as of the date on the title page.

YEAR 2000 NOTICE

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

END USER LICENSE AGREEMENT

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About This Guide

This preface provides the following guidelines for using the *Junos® OS* :

Junos Documentation and Release Notes

For a list of related Junos documentation, see http://www.juniper.net/techpubs/software/junos/ .

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

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

Juniper Networks supports a technical book program to publish books by Juniper Networks engineers and subject matter experts with book publishers around the world. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration using the Junos operating system (Junos OS) and Juniper Networks devices. In addition, the Juniper Networks Technical Library, published in conjunction with O'Reilly Media, explores improving network security, reliability, and availability using Junos OS configuration techniques. All the books are for sale at technical bookstores and book outlets around the world. The current list can be viewed at http://www.juniper.net/books .

Objectives

This guide provides an overview of the Layer 2 features supported in this release of Junos OS and describes how to configure the features to provide solutions to several network scenarios.

NOTE: For additional information about the Junos OS—either corrections to or information that might have been omitted from this guide—see the software release notes at http://www.juniper.net/ .

Audience

This guide is designed for network administrators who are configuring and monitoring Layer 2 features.

To use this guide, you need a broad understanding of networks in general, the Internet in particular, networking principles, and network configuration. You must also be familiar with one or more of the following Internet routing protocols:

- Border Gateway Protocol (BGP)
- Distance Vector Multicast Routing Protocol (DVMRP)
- Intermediate System-to-Intermediate System (IS-IS)
- Internet Control Message Protocol (ICMP) router discovery
- Internet Group Management Protocol (IGMP)
- Multiprotocol Label Switching (MPLS)
- Open Shortest Path First (OSPF)
- Protocol-Independent Multicast (PIM)
- Resource Reservation Protocol (RSVP)
- Routing Information Protocol (RIP)
- Simple Network Management Protocol (SNMP)

Personnel operating the equipment must be trained and competent; must not conduct themselves in a careless, willfully negligent, or hostile manner; and must abide by the instructions provided by the documentation.

Supported Routing Platforms

For the Layer 2 features described in this manual, the Junos OS currently supports the following routing platforms:

- Juniper Networks MX Series 3D Universal Edge Routers

Using the Indexes

This reference contains a standard index with topic entries.

Using the Examples in This Manual

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

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

```
}
```

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

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

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

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

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

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

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

Documentation Conventions

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

Table 1: Notice Icons

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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the **configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`
Italic text like this	• Introduces important new terms. • Identifies book names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS System Basics Configuration Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; interface names; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Enclose optional keywords or variables.	**stub** <**default-metric** *metric*>**;**

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

Convention	Description	Examples
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** (***string1*** **|** ***string2*** **|** ***string3***)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Enclose a variable for which you can substitute one or more values.	**community name members [** ***community-ids*** **]**

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

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

Documentation Feedback

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

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

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract,

or are covered under warranty, and need postsales technical support, you can access our tools and resources online or open a case with JTAC.

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

Self-Help Online Tools and Resources

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

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

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

Opening a Case with JTAC

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

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

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

PART 1

Overview

CHAPTER 1

Layer 2 Services for MX Series Routers Overview

MX Series Router Architecture

The key components of the Juniper Networks MX Series 3D Universal Edge Routers are the Dense Port Concentrators (DPCs), Modular Port Concentrators/Modular Interface Cards (MPCs/MICs), the Routing Engine (RE), and the Switch Control Board (SCB).

The DPCs are optimized for Ethernet density and are capable of supporting up to 40 Gigabit Ethernet or 4 10-Gigabit Ethernet ports. The DPC assembly combines packet forwarding and Ethernet interfaces on a single board, with four 10-Gbps Packet Forwarding Engines. Each Packet Forwarding Engine consists of one chip for Layer 3 processing and one Layer 2 network processor. The DPCs interface with the power supplies and Switch Control Boards.

Designed for flexibility, MPCs leverage the Junos Trio chipset to deliver the industry's highest density GbE, 10GbE, and 100GbE, as well as the flexibility of modular interfaces, across the MX Series portfolio. These advanced capabilities allow mix and match interfaces to create service-specific and "pay as you grow" configurations. The MPC houses the PFEs to deliver up to 120 Gbps of comprehensive Layer 3 routing (IPv4 and IPv6), and Layer 2 switching. These MPCs also support inline services and advanced Heirarchical QoS (H-QoS) per MX Series slot.

Modular Interface Cards (MICs) install into Modular Port Concentrators (MPCs) and provide the physical connections to various network media types. MICs allow different physical interfaces to be supported on a single line card. You can install MICs of different media types on the same router as long as the router supports those MICs. MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type.

Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received. MICs are hot-removable and hot-insertable. You can install up to two MICs in the slots in each MPC.

The RE provides control plane functions and runs Junos OS. Software processes that run on the RE maintain the routing tables, manage the routing protocols used on the router, control the router interfaces, control some chassis components, and provide the interface for system management and user access to the router. REs communicate with DPCs and MPCs via dedicated out-of-band management channels, providing a clear distinction between the control and forwarding planes. Integrated into the SCB is the switch fabric, which interconnects all of the DPCs and MPCs within the chassis. The RE installs directly into the SCB.

The SCB powers cards on and off; controls clocking, resets and booting; and monitors and controls systems functions, including fan speed, board power status, Power Distribution Module (PDM) status and control, and the system front panel. Integrated into the SCB is the switch fabric, which interconnects all of the DPCs and MPCs within the chassis, supporting up to 48 Packet Forwarding Engines. The Routing Engine installs directly into the SCB.

NOTE: The MX80 3D Universal Edge Router leverages the technology used in the MPCs, common across the MX Series, and can accommodate multiple combinations of Modular Interface Cards (MICs) for increased flexibility. The MX80 is a single board router with a built-in RE and one Packet Forwarding Engine (PFE). The PFE has two “pseudo” Flexible PIC Concentrators (FPC 0 and FPC 1). Because there is no switching fabric, the single PFE takes care of both ingress and egress packet forwarding.

The MX Series router has been optimized for Ethernet services. Examples of the wide range of Ethernet services provided by the MX Series include:

- Virtual private LAN service (VPLS) for multipoint connectivity—Native support for VPLS services
- Virtual leased line (VLL) for point-to-point services—Native support for point-to-point services
- RFC 2547.bis IP/MPLS VPN (L3VPN)—Full support for MPLS VPNs throughout the Ethernet network
- Video distribution IPTV services
- Ethernet aggregation at the campus/enterprise edge—Supports dense 1-Gigabit Ethernet, 10-Gigabit Ethernet, and 100-Gigabit Ethernet configurations, and provides full Layer 3 support for campus edge requirements
- Ethernet aggregation at the multiservice edge—Supports up to 480 1-Gigabit Ethernet ports or 48 10-Gigabit Ethernet ports for maximum Ethernet density along, with full Layer 2 and Layer 3 VPN support for MSE applications

Related Documentation

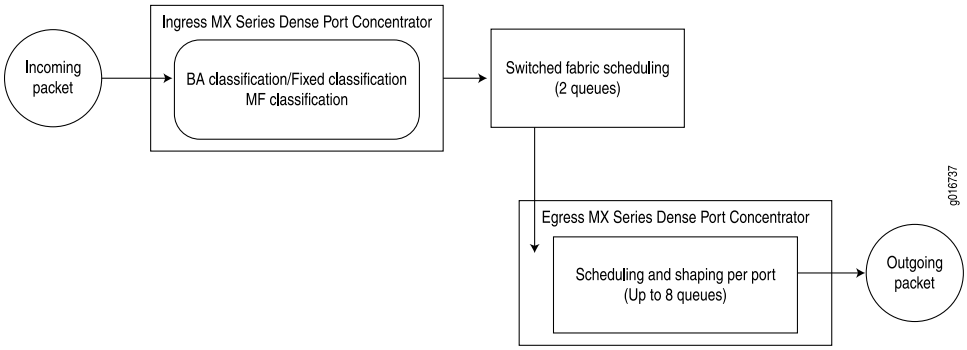
- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 8
- Ethernet Frame Counts and Statistics on MX Series Routers on page 10

MX Series Router Packet Forwarding and Data Flow

The architecture for Juniper Networks MX Series 3D Universal Edge Routers such as the MX960 Ethernet Services Router is similar in concept, but different in particulars, from other routing platforms.

The general architecture for the MX Series router is shown in Figure 1 on page 5.

Figure 1: MX Series Router Packet Forwarding and Data Flow



Related Documentation

- MX Series Router Architecture on page 3
- Line Cards Supported on MX Series Routers on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 8
- Ethernet Frame Counts and Statistics on MX Series Routers on page 10

Line Cards Supported on MX Series Routers

Juniper Networks MX Series 3D Universal Edge Routers process incoming and outgoing packets on several different types of line cards, including Dense Port Concentrators (DPCs), Flexible Port Concentrators (FPCs) with associated Physical Interface Cards (PICs), Trio Modular Port Concentrators (MPCs) with associated Modular Interface Cards (MICs). FPCs are populated with PICs for various interface types. DPCs and MPCs combine the functions of FPCs and the PICs, and with associated physical interfaces support a

variety of interface types. The configuration syntax for each type of line card is the same: *type-fpc/pic/port*.

FPCs and PICs

An FPC occupies two slots when installed in an MX Series router. The maximum number of supported FPCs varies per router:

- MX960 router—6 FPCs
- MX480 router—3 FPCs
- MX240 router—1 FPC

PICs provide the physical connection to various network media types. The PICs are inserted into a slot in a router. You can install PICs of different media types on the same router as long as the router supports those PICs.

MX Series 3D Universal Edge Routers support 2 PICs per Flexible PIC Concentrator (FPC). The maximum number of supported PICs varies per router:

- MX960 router—12 PICs
- MX480 router—6 PICs
- MX240 router—2 PICs

DPCs

A DPC provides multiple physical interfaces and Packet Forwarding Engines on a single board that installs into a slot within the MX Series 3D Universal Edge Routers. The maximum number of supported DPCs varies per router:

- MX960 router—12 DPC slots
- MX480 router—6 DPC slots
- MX240 router—3 DPC slots

NOTE: In the Junos OS CLI, you use the FPC syntax to configure or display information about DPCs, and you use the PIC syntax to configure or display information about Packet Forwarding Engines on the DPCs.

In addition to Layer 3 routing capabilities, the DPCs also have many Layer 2 functions that allow MX Series routers to be used for many virtual LAN (VLAN) and other Layer 2 network applications.

Modular Port Concentrator (MPC) and Modular Interface Card (MIC) Interfaces

A Modular Port Concentrator supports two Modular Interface Card (MIC) interfaces. The maximum number of supported MPCs varies per router:

- MX960 router—12 MPC slots
- MX480 router—6 MPC slots
- MX240 router—3 MPC slots
- MX80 router—One fixed 10-Gigabit Ethernet MIC with four ports for uplink connections.

NOTE: The MX80 router is available as a modular (MX80) or fixed (MX80-48T) chassis. Both chassis have a fixed Modular Interface Card (MIC) that has 3 10-Gigabit Ethernet ports. The fixed MX80 router has an additional 48 10/100/1000Base-T RJ45 ports. The modular chassis has two dedicated slots for MICs.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 8
- Ethernet Frame Counts and Statistics on MX Series Routers on page 10

Understanding Trio Layer 2 Feature Parity

A variety of Layer 2 features are supported on M Series and MX Series routers. The features supported by the Trio family of line cards are listed in Table 3 on page 7.

Table 3: Trio Layer 2 Feature Parity

Feature	Feature Parity with Junos OS Release	Feature Supported in Junos OS Release
MX routers only: load balancing enhancements for Layer 2 Link Aggregation	9.1R1	10.4R1
Ethernet OAM IEEE 802.1ag MIP support	9.1R1	10.4R1
Link Layer Discovery Protocol (LLDP)	9.1R1	10.4R1
MX routers only: BPDU guard	9.1R1	10.4R1
MX routers only: BPDU loop guard	9.1R1	10.4R1
For next generation VPNs: IRB support with LDP-VLPS and BGP-VPLS interworking	9.1R1	10.4R1
MPLS: BGP multihoming for inter-AS VPLS	9.1R1	10.4R1

Table 3: Trio Layer 2 Feature Parity *(continued)*

Feature	Feature Parity with Junos OS Release	Feature Supported in Junos OS Release
MX routers only: Ethernet as a core-facing interface in VPLS	9.1R1	10.4R1
Disables next-hop flood in connectivity fault management (CFM)	9.1R1	10.4R1

Features Operating Over Layer 2 but Configured at Layer 3

The following topics describe features that operate over Layer 2 networks but are configured at Layer 3:

- Layer 2 and Layer 3 Features on MX Series Routers on page 8
- Multicast Snooping on MX Series Routers on page 8
- VPLS on page 9
- Layer 2 VPNs on page 9

Layer 2 and Layer 3 Features on MX Series Routers

You can configure MX Series routers to provide simultaneous support for Layer 2 and Layer 3 Ethernet services. In many cases, Layer 2 protocols run on some interfaces, and Layer 3 protocols run on others.

The *Junos OS Layer 2 Configuration Guide* discusses Layer 2 configurations on supported routers, including Layer 2 statement summaries and configuration statement examples. For more complete Layer 2 configuration examples for MX Series routers, see the *Junos OS MX Series 3D Universal Edge Routers Solutions Guide*.

For more information about configuring Layer 3 features and functions (such as class of service), see the relevant Junos configuration guides.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5
- Ethernet Frame Counts and Statistics on MX Series Routers on page 10

Multicast Snooping on MX Series Routers

Because MX Series routers can support both Layer 3 and Layer 2 functions at the same time, you can configure the Layer 3 multicast protocols Protocol Independent Multicast (PIM) and the Internet Group Membership Protocol (IGMP) as well as Layer 2 VLANs on an MX Series router.

Normal encapsulation rules restrict Layer 2 processing to accessing information in the frame header and Layer 3 processing to accessing information in the packet header. However, in some cases, an interface running a Layer 2 protocol needs information

available only at Layer 3. In multicast applications, the VLANs need the group membership information and multicast tree information available to the Layer 3 IGMP and PIM protocols. In these cases, the Layer 3 configurations can use PIM or IGMP snooping to provide the needed information at the VLAN level.

For information about configuring multicast snooping for the operational details of a Layer 3 protocol on behalf of a Layer 2 spanning-tree protocol process, see "Understanding Multicast Snooping and VPLS Root Protection" on page 21.

Snooping configuration statements and examples are not included in the *Junos OS Layer 2 Configuration Guide*. For more information about configuring PIM and IGMP snooping, see the *Junos OS Multicast Protocols Configuration Guide*.

Related Documentation

- Understanding Multicast Snooping and VPLS Root Protection on page 21
- Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages on page 23
- Example: Configuring Multicast Snooping for a Bridge Domain on page 24

VPLS

In a Layer 3 network only, you can configure virtual private LAN service (VPLS), which is an Ethernet-based point-to-multipoint Layer 2 VPN. It enables you to connect geographically dispersed Ethernet local area networks (LAN) sites to each other across an MPLS backbone. For ISP customers who implement VPLS, all sites appear to be in the same Ethernet LAN even though traffic travels across the service provider's network.

For information about configuring VPLS, see the *Junos OS VPNs Configuration Guide*.

Related Documentation

- MX Series Router Architecture on page 3
- Layer 2 and Layer 3 Features on MX Series Routers on page 8

Layer 2 VPNs

In a Layer 3 network only, you can configure Layer 2 virtual private network (VPN) under a Layer 2 VPN routing instance type **l2vpn**.

In a Layer 2 environment, you can use a **l2vpn** routing instance to transparently carry Layer 2 traffic over an IP/MPLS backbone. Layer 2 traffic is sent to the provider edge (PE) router in Layer 2 format. The PE router encapsulates the frames and transports them over the IP/MPLS backbone to the PE router on the other side of the cloud. The remote PE router removes encapsulation and sends the frames to the receiving site in Layer 2 format.

For information about configuring an **l2vpn** routing instance and Layer 2 VPNs, see the *Junos OS VPNs Configuration Guide*.

For a detailed Layer 2 VPN example configuration, see the *Junos OS Feature Guides*.

For information about tunnel interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

Related Documentation

- MX Series Router Architecture on page 3
- Layer 2 and Layer 3 Features on MX Series Routers on page 8

Ethernet Frame Counts and Statistics on MX Series Routers

The following considerations apply to Ethernet frame counts and statistics on Juniper Networks MX Series 3D Universal Edge Routers:

- Interface counters *do not* include the 7-byte Ethernet frame preamble and the frame delimiter byte.
- In Media Access Control (MAC) statistics. the frame size includes the MAC header and cyclical redundancy check (CRC) *before* any VLAN rewrite or other rules are applied.
- In traffic statistics, the frame size includes the Layer 2 header without the trailer CRC and *after* any VLAN rewrite or other rules are applied.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 8

PART 2

Configuration Basics for Layer 2 Services

CHAPTER 2

Configuring Routing Instances for Layer 2 Services

Routing Instances Overview

A routing instance is a routing entity for a router. You can create multiple instances of BGP, IS-IS, OSPF, OSPFv3, RIP, and static routes. Each instance contains a routing table, applied routing policies, routing table group, interfaces that belong to that instance, and a protocol-specific route configuration related to that instance.

You configure a primary routing instance at the **[edit protocols]** hierarchy level. You configure additional routing instances at the **[edit routing-instances]** or **[edit logical-systems *logical-system-name* routing-instance]** hierarchy level.

You use routing instances to:

- Create administrative separation in a large network to segregate customer traffic and associated settings. The customers see only the routes belonging to them.
- Create overlay networks in which separate services are routed only towards routers participating in that service, such as voice. The overlay network isolates routes belonging to one service from another service by exporting routes, applying tags, and filtering based on tags.

Each routing instance consists of sets of the following:

- A set of routing tables
- A set of interfaces that belong to these routing tables
- A set of routing option configurations

Each routing instance has a unique name and a corresponding IP unicast table. For example, if you configure a routing instance with the name **my-instance**, its corresponding IP unicast table will be **my-instance.inet.0**. All routes for **my-instance** are installed into **my-instance.inet.0.**

Routes are installed into the default routing instance **inet.0** by default, unless a routing instance is specified.

For details about configuring interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

Related Documentation

- Layer 2 Routing Instance Types on page 14
- Layer 2 Routing Instances Configuration Hierarchy on page 15
- Configuring a VPLS Routing Instance on page 16
- Configuring a Virtual Switch Routing Instance on page 17
- Configuring a Layer 2 Control Protocol Routing Instance on page 18

Layer 2 Routing Instance Types

Although routing instances are primarily intended to maintain separation of tables and protocols at Layer 3 (mirroring the traditional IP network separation at Layer 3), many aspects of routing instances make them convenient to use for Layer 2 applications and architectures as well. In Layer 2 applications, routing instances still help to maintain table, interface, and customer insulation, but with regard to media access control (MAC) addresses and VLAN tags as much as IP addresses.

You can configure three types of routing instances in Layer 2 networks on MX Series routers, as described in the indicated sections:

- **layer2-control** (MX Series routers only)—Layer 2 control protocol routing instance. For configuration information, see "Configuring Layer 2 Protocol Tunneling" on page 237, "Configuring BPDU Protection on Individual Interfaces" on page 223, and "Configuring BPDU Protection on All Edge Ports" on page 225.
- **virtual-switch** (MX Series routers only)—Virtual switch routing instance. For configuration information, see "Configuring a Layer 2 Virtual Switch" on page 144.
- **vpls**—Virtual private LAN service (VPLS) routing instance. For configuration information, see "Configuring a Bridge Domain" on page 135.

The other five types of routing instances are configured only for Layer 3 networks, and are described in the indicated Junos configuration guide:

- **forwarding**—Forwarding instance. For more information, see the *Junos OS Routing Protocols Configuration Guide*.
- **l2vpn**—Layer 2 VPN routing instance. For more information, see the *Junos OS VPNs Configuration Guide*.

- **no-forwarding**—Nonforwarding routing instance. For more information, see the *Junos OS Routing Protocols Configuration Guide*.
- **virtual-router**—Virtual routing instance. For more information, see the *Junos OS Routing Protocols Configuration Guide*.
- **vrf**—VPN routing and forwarding (VRF) instance. For more information, see the *Junos OS Routing Protocols Configuration Guide*.

Related Documentation

- Routing Instances Overview on page 13
- Layer 2 Routing Instances Configuration Hierarchy on page 15
- Configuring a VPLS Routing Instance on page 16
- Configuring a Virtual Switch Routing Instance on page 17
- Configuring a Layer 2 Control Protocol Routing Instance on page 18

Layer 2 Routing Instances Configuration Hierarchy

Use the **vpls** routing instance type for point-to-multipoint LAN implementations between a set of sites in a VPN.

To configure routing instances for Layer 2 networks, include the following statements:

```
routing-instances {
  routing-instance-name {
    description text;
    forwarding-options {
      ...forwarding-options...
    }
    instance-type (layer2-control | virtual-switch | vpls);
    interface interface-name;
    no-vrf-advertise;
    route-distinguisher (as-number:number | ip-address:number);
    vrf-export [ policy-names ];
    vrf-import [ policy-names ];
    vrf-table-label;
    vrf-target {
      export community-name;
      import community-name;
    }
    protocols {
      ... protocols-configuration ...
    }
    routing-options {
      ... routing-options-configuration ...
    }
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        routing-interface routing-interface-name;
        vlan-id (Bridge Domain) (none | all | number);
```

```
            vlan-tags outer number inner number;
            bridge-options {
              interface-mac-limit limit {
                packet-action drop;
              }
              interface interface-name {
                interface-mac-limit limit {
                  packet-action drop;
                }
              }
              mac-statistics;
              mac-table-size limit {
                packet-action drop;
              }
              no-mac-learning;
              static-mac mac-address;
            }
          }
        }
      }
    }
```

With the exception of the **instance-type virtual-switch** statement (which configures a virtual-switch routing instance), you can include the statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

The **instance-type virtual-switch** statement is not supported at the **[edit logical-systems *logical-system-name*]** hierarchy level.

Related Documentation

- Routing Instances Overview on page 13
- Layer 2 Routing Instance Types on page 14
- Configuring a VPLS Routing Instance on page 16
- Configuring a Virtual Switch Routing Instance on page 17
- Configuring a Layer 2 Control Protocol Routing Instance on page 18

Configuring a VPLS Routing Instance

Use the **vpls** routing instance type for point-to-multipoint LAN implementations between a set of sites in a VPN.

To create a routing instance for VPLS, include at least the following statements in the configuration:

```
routing-instances {
  routing-instance-name {
    instance-type vpls;
    interface interface-name;
    route-distinguisher (as-number:number | ip-address:number);
```

```
        vrf-import [ policy-names ];
        vrf-export [ policy-names ];
        protocols {
          vpls {
            ... vpls configuration ...
          }
        }
      }
    }
```

You can include these statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

For more information about configuring VPLS, see the *Junos OS VPNs Configuration Guide*. For a detailed VPLS example configuration, see the *Junos OS Feature Guides*.

Related Documentation

- Routing Instances Overview on page 13
- Layer 2 Routing Instance Types on page 14
- Layer 2 Routing Instances Configuration Hierarchy on page 15
- Configuring a Virtual Switch Routing Instance on page 17
- Configuring a Layer 2 Control Protocol Routing Instance on page 18

Configuring a Virtual Switch Routing Instance

On MX Series routers only, use the **virtual-switch** routing instance type to isolate a LAN segment with its spanning-tree instance and to separate its VLAN ID space. A bridge domain consists of a set of ports that share the same flooding or broadcast characteristics. Each virtual switch represents a Layer 2 network. You can optionally configure a virtual switch to support Integrated Routing and Bridging (IRB), which facilitates simultaneous Layer 2 bridging and Layer 3 IP routing on the same interface. You can also configure Layer 2 control protocols to provide loop resolution. Protocols supported include the Spanning-Tree Protocol (STP), Rapid Spanning-Tree Protocols (RSTP), Multiple Spanning-Tree Protocol (MSTP), and VLAN Spanning-Tree Protocol (VSTP).

To create a routing instance for a virtual switch, include at least the following statements in the configuration:

```
[edit]
routing-instances {
  routing-instance-name
    instance-type virtual-switch;
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        vlan-id (all | none | number);
        vlan-tags outer number inner number;
      }
```

```
        }
        protocols {
          (rstp | mstp | vstp) {
            ...stp-configuration ...
          }
        }
      }
    }
```

The **instance-type virtual-switch** statement is not supported at the **[edit logical-systems *logical-system-name*]** hierarchy level.

For more information about configuring virtual switches, see "Configuring a Layer 2 Virtual Switch" on page 144.

Related Documentation

- Routing Instances Overview on page 13
- Layer 2 Routing Instance Types on page 14
- Layer 2 Routing Instances Configuration Hierarchy on page 15
- Configuring a VPLS Routing Instance on page 16
- Configuring a Layer 2 Control Protocol Routing Instance on page 18

Configuring a Layer 2 Control Protocol Routing Instance

On MX Series routers only, use the **layer2-control** routing instance type for Rapid Spanning-Tree Protocol (RSTP) or Multiple Spanning-Tree Protocol (MSTP) in customer edge interfaces of a VPLS routing instance. Layer 2 control protocols enable features such as Layer 2 protocol tunneling or nonstop bridging. This instance type cannot be used if the customer edge interface is multihomed to two provider edge interfaces. If the customer edge interface is multihomed to two provider edge interfaces, use the default bridge protocol data unit (BPDU) tunneling.

To create a routing instance for Layer 2 control protocols, include at least the following statements in the configuration:

```
routing-instances {
  routing-instance-name {
    instance-type layer2-control;
    interface interface-name;
    route-distinguisher (as-number:number | ip-address:number);
    vrf-import [ policy-names ];
    vrf-export [ policy-names ];
    protocols {
      mstp {
        ... interface options ...
        msti msti-id {
          ... MSTP MSTI configuration ...
        }
      }
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

Related Documentation

- Routing Instances Overview on page 13
- Layer 2 Routing Instance Types on page 14
- Layer 2 Routing Instances Configuration Hierarchy on page 15
- Configuring a VPLS Routing Instance on page 16
- Configuring a Virtual Switch Routing Instance on page 17

CHAPTER 3

Configuring Basic Layer 2 Services

Multicast Snooping and VPLS Root Protection

The following sections describe the configuration of multicast snooping with VPLS root protection for spanning-tree protocols:

Understanding Multicast Snooping and VPLS Root Protection

Snooping occurs when a Layer 2 protocol such as a spanning-tree protocol is aware of the operational details of a Layer 3 protocol such as the Internet Group Management Protocol (IGMP) or other multicast protocol. Snooping is necessary when Layer 2 devices such as VLAN switches must be aware of Layer 3 information such as the media access control (MAC) addresses of members of a multicast group.

VPLS root protection is a spanning-tree protocol process in which only one interface in a multihomed environment is actively forwarding spanning-tree protocol frames. This protects the root of the spanning tree against bridging loops, but also prevents both devices in the multihomed topology from snooped information, such as IGMP membership reports.

For example, consider a collection of multicast-capable hosts connected to two customer edge (CE) routers (CE1 and CE2) which are connected to each other (a CE1–CE2 link is configured) and multihomed to two provider edge (PE) routers (PE1 and PE2, respectively). The active PE only receives forwarded spanning-tree protocol information on the active PE-CE link, due to root protection operation. As long as the CE1–CE2 link is operational, this is not a problem. However, if the link between CE1 and CE2 fails, and the other PE becomes the active spanning-tree protocol link, no multicast snooping information is available on the new active PE. The new active PE will not forward multicast traffic to the CE and the hosts serviced by this CE router.

The service outage is corrected once the hosts send new group membership IGMP reports to the CE routers. However, the service outage can be avoided if multicast snooping information is available to both PEs in spite of normal spanning-tree protocol root protection operation.

NOTE: You can configure multicast snooping to ignore messages about spanning tree topology changes for the virtual-switch routing-instance type only.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227 in the *Junos OS Layer 2 Configuration Guide*
- Multicast Snooping on MX Series Routers on page 8 in the *Junos OS Layer 2 Configuration Guide*
- Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages on page 23 in the *Junos OS Layer 2 Configuration Guide*
- Example: Configuring Multicast Snooping for a Bridge Domain on page 24 in the *Junos OS Layer 2 Configuration Guide*
- *Junos OS Multicast Protocols Configuration Guide*

Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages

You can configure the multicast snooping process for a virtual switch to ignore VPLS root protection topology change messages.

Before you begin, complete the following tasks:

1. Configure the spanning-tree protocol. For configuration details, see one of the following topics:
   - Configuring Rapid Spanning-Tree Protocol on page 201
   - Configuring Multiple Spanning-Tree Protocol on page 204
   - Configuring VLAN Spanning-Tree Protocol on page 210
2. Configure VPLS root protection. For configuration details, see one of the following topics:
   - Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
   - Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233

To configure multicast snooping to ignore spanning tree topology change messages:

1. Configure a **virtual-switch** routing instance to isolate a LAN segment with its VSTP instance.
   a. Enable configuration of a virtual switch routing instance:

      ```
      [edit]
      user@host# edit routing-instances routing-instance-name
      user@host# set instance-type virtual-switch
      ```

      You can configure multicast snooping to ignore messages about spanning tree topology changes for the **virtual-switch** routing-instance type only.

   b. Enable configuration of a bridge domain:

      ```
      [edit routing-instances routing-instance-name]
      user@host# edit bridge-domains bridge-domain-name
      user@host# set domain-type bridge
      ```

   c. Configure the logical interfaces for the bridge domain in the virtual switch:

      ```
      [edit routing-instances routing-instance-name bridge-domains bridge-domain-name]
      user@host# set interface interface-name
      ```

   d. Configure the VLAN identifiers for the bridge domain in the virtual switch. For detailed information, see "Configuring a Virtual Switch Routing Instance" on page 17.

2. Configure the multicast snooping process to ignore any spanning tree topology change messages sent to the virtual switch routing instance:

   [edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]
   user@host# **set multicast-snooping-options ignore-stp-topology-change**

3. Verify the configuration of multicast snooping for the virtual-switch routing instance to ignore spanning tree topology change messages:

   [edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]
   user@host# **top**
   user@host# **show routing-instances**

```
routing-instance-name {
    instance-type virtual-switch;
    bridge-domains {
        bridge-domain-name {
            domain-type bridge {
            interface interface-name;
            ...VLAN-identifiers-configuration...
            multicast-snooping-options {
                ignore-stp-topology-change;
            }
        }
    }
}
```

Related Documentation

- Multicast Snooping on MX Series Routers on page 8
- Understanding Multicast Snooping and VPLS Root Protection on page 21
- Example: Configuring Multicast Snooping for a Bridge Domain on page 24

Example: Configuring Multicast Snooping for a Bridge Domain

This example configures the multicast snooping option for a bridge domain named **Ignore-STP** in a virtual switch routing instance named **vs_routing_instance_multihomed_CEs**:

```
[edit]
routing-instances {
    vs_routing_instance_multihomed_CEs {
        instance-type virtual-switch;
        bridge-domains {
            bd_ignore_STP {
                multicast-snooping-options {
                    ignore-stp-topology-change;
                }
            }
        }
    }
}
```

NOTE: This is not a complete router configuration.

Related Documentation
- Multicast Snooping on MX Series Routers on page 8
- Understanding Multicast Snooping and VPLS Root Protection on page 21
- Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages on page 23

Load Balancing and Ethernet Link Aggregation

The following sections describe load balancing and Ethernet link aggregation:

- Load Balancing and Ethernet Link Aggregation Overview on page 25
- Configuring Load Balancing on a LAG Link on page 25
- Example: Configuring Load Balancing on a LAG Link on page 26

Load Balancing and Ethernet Link Aggregation Overview

You can create a link aggregation group (LAG) for a group of Ethernet ports. Layer 2 bridging traffic is load balanced across the member links of this group, making the configuration attractive for congestion concerns as well as for redundancy. You can configure up to 480 LAG bundles on a Juniper Networks MX Series Ethernet Services Router. Each LAG bundle contains up to 16 links.

By default, the hash key mechanism to load-balance frames across LAG interfaces is based on Layer 2 fields (such as frame source and destination address) as well as the input logical interface (unit). No Layer 3 or Layer 4 fields are examined and are part of the default hash process, so the default is not optimized for Layer 2 switching (the frame source and destination MAC addresses are the same). In a Layer 2 switch, one link is overutilized and other links are underutilized.

Related Documentation
- Configuring Load Balancing on a LAG Link on page 25
- Load Balancing on a LAG Link on page 26

Configuring Load Balancing on a LAG Link

You can configure the load balancing hash key for Layer 2 traffic to use fields in the Layer 3 and Layer 4 headers inside the frame payload for load-balancing purposes using the **payload** statement. You can configure the statement to look at **layer-3** (and **source-address-only** or **destination-address-only** packet header fields) or **layer-4** fields. You configure this statement at the **[edit forwarding-options hash-key family multiservice]** hierarchy level.

You can configure Layer 3 or Layer 4 options, or both. The **source-address-only** or **destination-address-only** options are mutually exclusive. The **layer-3-only** statement is not available on MX Series routers.

NOTE: Any change in the hash key configuration requires a reboot of the FPC for the changes to take effect.

For more information about link aggregation group (LAG) configuration, see the *Junos OS Network Interfaces Configuration Guide*.

Related Documentation

- Load Balancing and Ethernet Link Aggregation on page 25
- Load Balancing on a LAG Link on page 26

Example: Configuring Load Balancing on a LAG Link

This example configures the load-balancing hash key to use the source Layer 3 IP address option and Layer 4 header fields as well as the source and destination MAC addresses for load balancing on a link aggregation group (LAG) link:

```
[edit]
forwarding-options {
  hash-key {
    family multiservice {
      source-mac;
      destination-mac;
      payload {
        ip {
          layer-3 {
            source-address-only;
          }
          layer-4;
        }
      }
    }
  }
}
```

Related Documentation

- Load Balancing and Ethernet Link Aggregation on page 25
- Configuring Load Balancing on a LAG Link on page 25

Layer 2 Learning and Forwarding in a Logical System

The following sections describe Layer 2 learning and forwarding in a logical system:

- Layer 2 Learning and Forwarding in a Logical System Overview on page 27
- Enabling Layer 2 Learning and Forwarding in a Logical System on page 27
- Example: Configuring Layer 2 Learning and Forwarding and RSTP in a Logical System on page 28

Layer 2 Learning and Forwarding in a Logical System Overview

You can partition a single physical router into multiple logical devices called *logical systems* that perform independent routing tasks. Logical systems perform a subset of the actions of a physical router and have their own unique routing tables, interfaces, policies, and routing instances. On MX Series routers only, you can enable Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances.

When enabling Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances, the following guidelines apply:

- You can only configure 16 logical systems.
- Logging is performed for the entire device and not per logical system.
- You cannot restart Layer 2 learning for an individual logical system.

Related Documentation

- Enabling Layer 2 Learning and Forwarding in a Logical System on page 27
- Layer 2 Learning and Forwarding and RSTP in a Logical System on page 28

Enabling Layer 2 Learning and Forwarding in a Logical System

On MX Series router, you can enable Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances.

Before you begin, configure the interfaces for the logical system.

To configure Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances:

1. Enable configuration of a logical system:

   ```
   [edit]
   user@host# edit logical-systems logical-system-name
   ```

   For detailed information about logical systems, see the *Junos OS Routing Protocols Configuration Guide*.

2. Enable configuration of a virtual-switch routing instance:

   ```
   [edit logical-systems logical-system-name]
   user@host# edit routing-instances routing-instance-name
   user@host# set instance-type virtual-switch
   ```

3. Configure the set of bridge-domains or other virtual-switch routing instances.

4. Configure Layer 2 learning and forwarding properties for a set of bridge domains:

   a. Enable configuration of Layer 2 learning and forwarding properties:

      ```
      [edit logical-systems logical-system-name]
      user@host# edit switch-options
      ```

   b. Configure Layer 2 learning and forwarding properties. For more information, see "Layer 2 Learning and Forwarding for Bridge Domains Overview" on page 133.

5. Verify the configuration:

   ```
   [edit logical-systems logical-system-name switch-options]
   user@host# top
   user@host# show logical-systems

   logical-system-name {
     interfaces {
       ...interface-configurations...
     }
     routing-instances {
       instance-type virtual-switch;
     }
     bridge-domains{
       ...bridge-domain-configuration...
     }
     switch-options {
       interface logical-interface-name {
         ...layer-2-learning-and-forwarding-configuration...
       }
     }
     protocols {
       (rstp | mstp | vstp) {
         interface interface-name;
         ...spanning-tree-protocol-configuration...
       }
     }
   }
   ```

Related Documentation

- Layer 2 Learning and Forwarding in a Logical System on page 27
- Layer 2 Learning and Forwarding and RSTP in a Logical System on page 28

Example: Configuring Layer 2 Learning and Forwarding and RSTP in a Logical System

The following example configures a logical system and routing instance with its own bridge domain (**bd1**), switch options, and spanning- tree protocol (**rstp**).

```
[edit]
interfaces {
  ge-5/0/1 {
    flexible-vlan-tagging;
  }
}
logical-systems {
```

```
logical-sys1 {
  interfaces {
    ge-5/0/1 {
      unit 0 {
        family bridge {
          interface-mode trunk;
          vlan-id-list 1–5;
        }
      }
      unit 3 {
        family bridge {
          interface-mode trunk;
          vlan-id-list 11–15;
        }
      }
    }
    ge-5/0/2 {
      unit 0 {
        family bridge {
          interface-mode trunk;
          vlan-id-list 1–5;
        }
      }
    }
  }
  routing-instances {
    routing-inst-1 {
      interface ge-5/0/2;
      instance-type virtual-switch;
      bridge-domains {
        vlan-id 1;
      }
      protocols {
        rstp {
          interface ge-5/0/2;
        }
      }
    }
  }
  bridge-domains {
    bd-1 {
      vlan-id 1;
    }
  }
  switch-options {
    interface ge-5/0/1.3 {
      interface-mac-limit {
        1400;
        packet-action drop;
      }
    }
  }
  protocols {
    rstp {
      interface ge-5/0/1;
    }
```

```
    }
  }
}
```

NOTE: This is not a complete router configuration.

Related Documentation

- Layer 2 Learning and Forwarding in a Logical System on page 27
- Enabling Layer 2 Learning and Forwarding in a Logical System on page 27

CHAPTER 4

Configuring Multiple VLAN Registration Protocol

Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers

You can configure Multiple VLAN Registration Protocol (MVRP) on Juniper Networks MX Series routers. The primary purpose of MVRP is to manage dynamic VLAN registration in switching networks. In managing dynamic VLAN registration, MVRP also prunes VLAN information.

MVRP is an Layer 2 application protocol of the Multiple Registration Protocol (MRP) and is defined in the IEEE 802.1ak standard. MRP and MVRP were designed by IEEE to perform the same functions as Generic Attribute Registration Protocol (GARP) and GARP VLAN Registration Protocol (GVRP) while overcoming some GARP and GVRP limitations, in particular limitations involving bandwidth usage and convergence time in large networks with large numbers of VLANs.

MVRP was created by IEEE as a replacement application for GVRP. MVRP and GVRP cannot be run concurrently to share VLAN information in a switching network.

This topic describes:

How MVRP Works on MX Series Routers

The VLAN registration information sent by MVRP protocol data units (PDUs) includes the current VLANs membership—that is, which routers are members of which VLANs—and which router interfaces are in which VLAN. MVRP shares all information in the PDU with all routers participating in MVRP in the switching network.

MVRP stays synchronized using these PDUs. The routers in the network participating in MVRP receive these PDUs during state changes and update their MVRP states accordingly. MVRP timers dictate when PDUs can be sent and when routers receiving MVRP PDUs can update their MVRP information.

VLAN information is distributed as part of the MVRP message exchange process and can be used to dynamically create VLANs, which are VLANs created on one switch and propagated to other routers as part of the MVRP message exchange process. Dynamic VLAN creation using MVRP is enabled by default but can be disabled.

As part of ensuring that VLAN membership information is current, MVRP removes routers and interfaces from the VLAN information when they become unavailable. Pruning VLAN information has these benefits:

- Limits the network VLAN configuration to active participants only, reducing network overhead.
- Targets the scope of broadcast, unknown unicast, and multicast (BUM) traffic to interested devices only.

Basics of MVRP on MX Series Routers

MVRP is disabled by default on all MX Series routers. You can configure MVRP on MX Series router interfaces to participate in MVRP for the switching network. MVRP can only be enabled on trunk interfaces, and dynamic VLAN configuration through MVRP is enabled by default when MVRP is enabled.

MVRP Registration Modes

The MVRP registration mode defines whether an interface does or does not participate in MVRP.

The following MVRP registration modes are configurable:

- forbidden—The interface does not register or declare VLANS (except statically configured VLANs).
- normal—The interface accepts MVRP messages and participates in MVRP. This is the default registration mode setting.
- restricted—The interface—The interface ignores all MVRP JOIN messages received for VLANs that are not statically configured on the interface.

MRP Timers

MVRP registration and updates are controlled by timers that are part of the MRP protocol. These timers are set on a per-interface basis and define when MVRP PDUs can be sent and when MVRP information can be updated on a switch.

The following timers are used to control the operation of MVRP:

- Join timer—Controls the interval for the next MVRP PDU transmit opportunity.
- Leave timer—Controls the period of time that an interface on the switch waits in the Leave state before changing to the unregistered state.
- LeaveAll timer—Controls the frequency with which the interface generates LeaveAll messages.

BEST PRACTICE: **Maintain default timer settings unless there is a compelling reason to change the settings. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.**

MRP VLAN Messages

MVRP uses MRP messages to register and declare MVRP states for a switch and to inform the switching network that a switch is leaving MVRP. These messages are communicated as part of the PDU to communicate the state of a particular switch interface on the switching network to the other switches in the network.

The following messages are communicated for MVRP:

- Empty—VLAN information is not being declared and is not registered.
- In—VLAN information is not being declared but is registered.
- JoinEmpty—VLAN information is being declared but not registered.
- JoinIn—VLAN information is being declared and is registered.
- Leave—VLAN information that was previously registered is being withdrawn.
- LeaveAll—All registrations will be de-registered. Participants that want to participate in MVRP will need to re-register.
- New—VLAN information is new and possibly not previously registered.

MVRP Limitations

The following limitations apply when configuring MVRP:

- MVRP works with Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning Tree Protocol (MSTP), but not with VLAN Spanning Tree Protocol (VSTP).
- MVRP is allowed only on single tagged trunk ports.

- MVRP is not allowed if a physical interface has more than one logical interface.
- MVRP is only allowed if a logical has one trunk interface (unit 0).

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure) on page 49
- Verifying That MVRP Is Working Correctly on page 52

Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers

Multiple VLAN Registration Protocol (MVRP) is used in carrier Ethernet networks to dynamically share virtual LAN (VLAN) information and to automatically configure necessary VLAN information. Automatically configuring VLANs on ports based on the current network configuration ensures that a router does not send traffic to an interface on the network with an inactive VLAN. In this way, MVRP reduces network overhead by limiting the scope of broadcast, unknown unicast, and multicast (BUM) traffic to interested devices only. MVRP also provides for rapid healing of network failures without interrupting services to unaffected VLANs and improves convergence times.

MVRP is a Layer 2 network protocol based on the IEEE standard 802.1ak amendment to 802.1Q-2005, *Standard for Local and Metropolitan Area Networks Virtual Bridged Local Area Networks - Amendment 07: Multiple Registration Protocol*.

This example describes how to use MVRP to automate administration of VLAN membership changes within your network and to dynamically create VLANs:

Requirements

This example uses the following hardware and software components:

- Two MX Series routers acting as edge switches
- One MX Series router acting as aggregation switch
- Junos OS Release 10.1 or later for MX Series routers

Overview and Topology

VLANs are statically configured on access interfaces on MX Series routers acting as edge switches. The VLAN membership information is propagated to the MX Series router

acting as an aggregation switch at the core by enabling MVRP on two trunk interfaces—one connecting edge switch 1 (ES1) to aggregation switch 1 (AS1) and the other connecting ES2 to AS1. Enabling MVRP on the trunk interface of each MX Series router in your network ensures that the active VLAN information for the routers in the network is propagated to each router through the trunk interfaces (the default registration mode for MVRP).

MVRP ensures that the VLAN membership information on the trunk interface is updated as the edge switch's access interfaces become active or inactive.

You do not need to explicitly bind a VLAN to the trunk interface. When MVRP is enabled, the trunk interface advertises all the VLANs that are active (bound to access interfaces) on that switch. An MVRP-enabled trunk interface does not advertise VLANs that have been configured on the switch but that are not currently bound to an access interface. For example, ES1 in the topology does not forward traffic to inactive VLAN 300 on ES2.

Rapid Spanning Tree Protocol (RSTP) is also configured on the trunk interfaces to promote a loop-free topology.

This example shows a network with two customer sites, **site–1** and **site–2**, using VLANs **100**, **200**, and **300**.

ES1 supports all three VLANS and all three VLANS are active and bound to interfaces that are connected to three customers at **site–1**:

- **ge-11/2/6**—Access port connecting customer3–site1, VLAN ID 100.
- **ge-11/2/7**—Access port connecting customer2–site1, VLAN ID 200.
- **ge-11/2/8**—Access port connecting customer1–site1, VLAN ID 300.
- **ge-11/3/0**—Trunk port connecting ES1 to AS1.

ES2 has been configured to support two VLANS, and both VLANS are active and bound to interfaces that are connect to two customers at **site–2**:

- **ge-0/1/1**—Access port connecting customer1–site2, VLAN ID 100.
- **ge-0/2/0**—Access port connecting customer2–site2, VLAN ID 200.
- **ge-0/0/5**—Trunk port connecting ES2 to AS1.

AS1 learns the VLANs dynamically using MVRP through the connection to the edge switches. AS1 has two trunk interfaces:

- **ge-3/3/0**—Connects the router to edge switch ES1 on interface **ge-11/3/0**.
- **ge-3/0/5**—Connects the router to edge switch ES2 on interface **ge-0/0/5**.

The default MVRP interface registration mode is **normal** and is used in this example. An interface in normal registration mode participates in MVRP when MVRP is enabled on the router. For information about changing the MVRP registration mode, refer to "Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure)" on page 49.

Figure 1 shows MVRP configured on three MX Series routers; two routers operating as edge switches and one router operating as an aggregation switch.

Figure 2: MVRP Configured on Three MX Series Routers for Automatic VLAN Administration

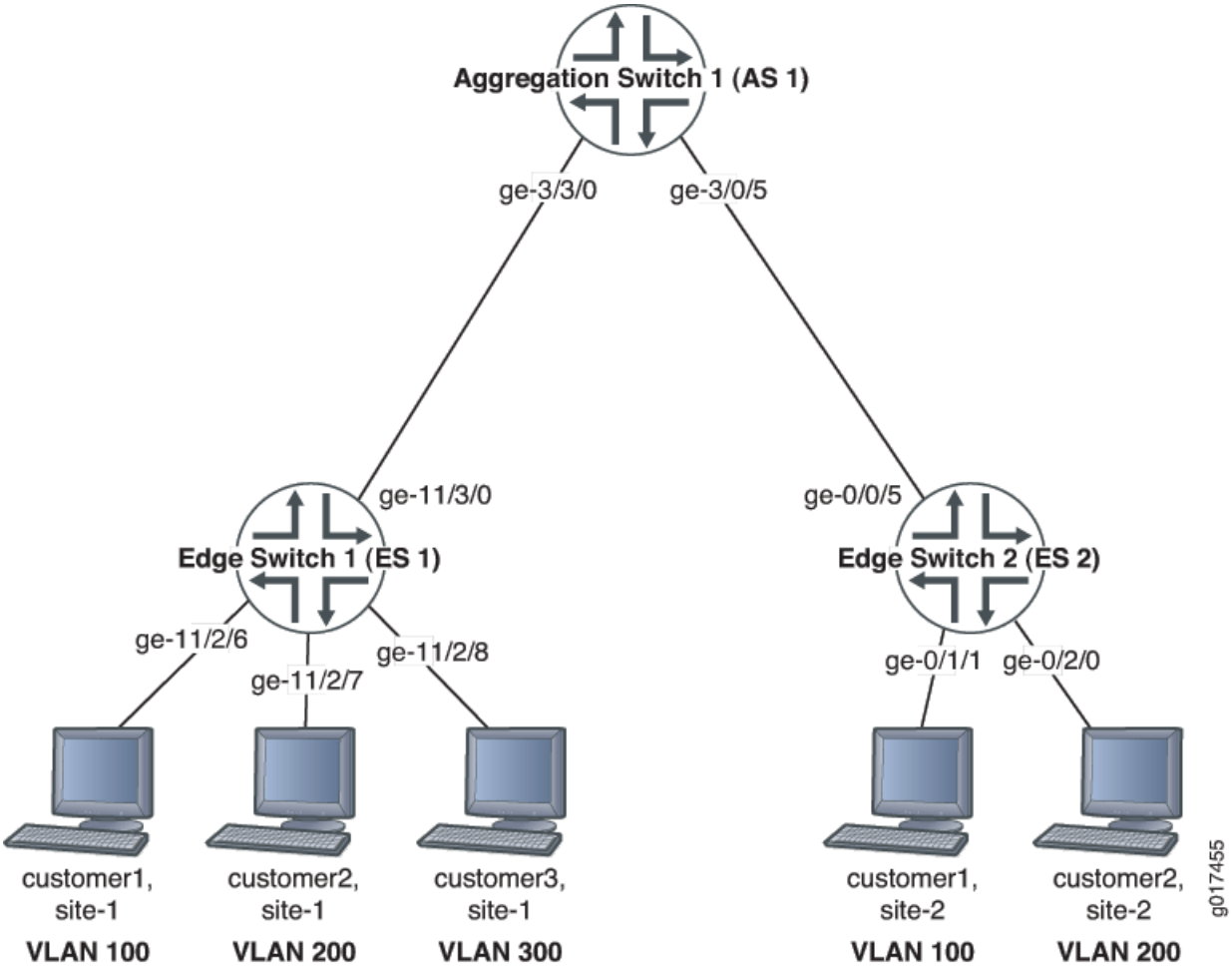


Table 4 on page 36 explains the components of the example topology.

Table 4: Components of the Network Topology

Property	Settings
MX Series routers	• ES1 • ES2 • AS1
VLAN tag IDs associated with bridge domain **bd**	**100**, **200**, and **300**

Table 4: Components of the Network Topology *(continued)*

Property	Settings
ES1 interfaces	ES1 interfaces: • **ge-11/2/6**—Access port connecting customer3–site1, VLAN ID 100. • **ge-11/2/7**—Access port connecting customer2–site1, VLAN ID 200. • **ge-11/2/8**—Access port connecting customer1–site1, VLAN ID 300. • **ge-11/3/0**—Trunk port connecting ES1 to AS1.
ES2 interfaces	ES2 interfaces: • **ge-0/1/1**—Access port connecting customer3–site2, VLAN ID 100. • **ge-0/2/0**—Access port connecting customer3–site2, VLAN ID 200. • **ge-0/0/5**—Trunk port connecting ES2 to AS1.
AS1 interfaces	AS1 interfaces: • **ge-3/3/0**—Trunk port connected to ES1. • **ge-3/0/5**—Trunk port connected to ES2.

Configuration

To enable MVRP and RSTP on the trunk interface as well as configure ES1 access interfaces and the bridge domain, perform these tasks:

- Configuring MVRP on ES1 on page 37
- Configuring MVRP on ES2 on page 39
- Configuring MVRP on AS1 on page 41

Configuring MVRP on ES1

CLI Quick Configuration

To quickly configure ES1 for MVRP, copy the following commands and paste them into the switch terminal window of ES1:

```
[edit]
set interfaces ge-11/2/6 description "connected to customer3-site-1"
set interfaces ge-11/2/6 unit 0 family bridge interface-mode access
set interfaces ge-11/2/6 unit 0 family bridge vlan-id 300
set interfaces ge-11/2/7 description "connected to customer2-site-1"
set interfaces ge-11/2/7 unit 0 family bridge interface-mode access
set interfaces ge-11/2/7 unit 0 family bridge vlan-id 200
set interfaces ge-11/2/8 description "connected to customer1-site-1"
set interfaces ge-11/2/8 unit 0 family bridge interface-mode access
set interfaces ge-11/2/8 unit 0 family bridge vlan-id 100
set ge-11/3/0 description "connected to AS1 interface ge-3/3/0"
set ge-11/3/0 unit 0 family bridge interface-mode trunk
set bridge-domains bd vlan-id-list [100 200 300]
set protocols mvrp interface ge-11/3/0
set protocols rstp interface ge-11/3/0
```

NOTE: As we recommend as a best practice, default MVRP timers are used in this example. The default values associated with each MVRP timer are 200 ms for the join timer, 1000 ms for the leave timer, and 10000 ms for the leaveall timer. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.

Step-by-Step Procedure

To configure MVRP on ES1:

1. Configure the access interfaces for customers at customer-site 1 and the trunk interface connecting ES1 to AS1:

```
[edit interfaces]
user@es1# set ge-11/2/6 description "connected to customer3-site-1"
user@es1# set ge-11/2/6 unit 0 family bridge interface-mode access
user@es1# set ge-11/2/6 unit 0 family bridge vlan-id 300
user@es1# set ge-11/2/7 description "connected to customer2-site-1"
user@es1# set ge-11/2/7 unit 0 family bridge interface-mode access
user@es1# set ge-11/2/7 unit 0 family bridge vlan-id 200
user@es1# set ge-11/2/8 description "connected to customer1-site-1"
user@es1# set ge-11/2/8 unit 0 family bridge interface-mode access
user@es1# set ge-11/2/8 unit 0 family bridge vlan-id 100
user@es1# set ge-11/3/0 description "connected to AS1 interface ge-3/3/0"
user@es1# set ge-11/3/0 unit 0 family bridge interface-mode trunk
```

2. Configure the bridge domain **bd** and the VLAN IDs associated with the bridge domain:

```
[edit bridge-domains]
user@es1# set bd vlan-id-list [100 200 300]
```

3. Enable MVRP on the trunk interface:

```
[edit protocols]
user@es1# set mvrp interface ge-11/3/0
```

4. Enable RSTP on the trunk interface:

```
[edit protocols]
user@es1# set rstp interface ge-11/3/0
```

Results

Check the results of the configuration:

```
user@es1> show configuration
interfaces {
    ge-11/2/6 {
        description "connected to customer3-site-1";
        unit 0 {
            family bridge {
                interface-mode access;
                vlan-id 300;
            }
        }
    }
    ge-11/2/7 {
        description "connected to customer2-site-1";
```

```
    unit 0 {
      family bridge {
        interface-mode access;
        vlan-id 200;
      }
    }
  }
  ge-11/2/8 {
    description "connected to customer1-site-1";
    unit 0 {
      family bridge {
        interface-mode access;
        vlan-id 100;
      }
    }
  }
  ge-11/3/0 {
    description "connected to AS1 interface ge-3/3/0";
    unit 0 {
      family bridge {
        interface-mode trunk;
      }
    }
  }
}
bridge-domains {
  bd {
    vlan-id-list [ 100 200 300 ];
  }
}
protocols {
  mvrp {
    interface ge-11/3/0;
  }
  rstp {
    interface ge-11/3/0;
  }
}
```

Configuring MVRP on ES2

CLI Quick Configuration

To quickly configure ES2 for MVRP, copy the following commands and paste them into the switch terminal window of ES2:

```
[edit]
set interfaces ge-0/0/5 description "connected to AS1 interface ge-3/0/5"
set interfaces ge-0/0/5 unit 0 family bridge interface-mode trunk
set interfaces ge-0/1/1 description "connected to customer1-site-2"
set interfaces ge-0/1/1 unit 0 family bridge interface-mode access
set interfaces ge-0/1/1 unit 0 family bridge vlan-id 100
set interfaces ge-0/2/0 description "connected to customer2-site-2"
set interfaces ge-0/2/0 unit 0 family bridge interface-mode access
set interfaces ge-0/2/0 unit 0 family bridge vlan-id 200
set bridge-domains bd vlan-id-list [100 200]
set protocols mvrp interface ge-0/0/5
set protocols rstp interface ge-0/0/5
```

NOTE: As we recommend as a best practice, default MVRP timers are used in this example. The default values associated with each MVRP timer are 200 ms for the join timer, 1000 ms for the leave timer, and 10000 ms for the leaveall timer. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.

Step-by-Step Procedure

To enable MVRP and RSTP on the trunk interface as well as configure ES2 access interfaces and the bridge domain, perform these tasks:

1. Configure the access interfaces for customers at customer site **site-2** and the trunk interface connecting ES2 to AS1:

```
[edit interfaces]
user@es2# set ge-0/0/5 description "connected to AS1 interface ge-3/0/5"
user@es2# set ge-0/0/5 unit 0 family bridge interface-mode trunk
user@es2# set ge-0/1/1 description "connected to customer1-site-2"
user@es2# set ge-0/1/1 unit 0 family bridge interface-mode access
user@es2# set ge-0/1/1 unit 0 family bridge vlan-id 100
user@es2# set ge-0/2/0 description "connected to customer2-site-2"
user@es2# set ge-0/2/0 unit 0 family bridge interface-mode access
user@es2# set ge-0/2/0 unit 0 family bridge vlan-id 200
```

2. Configure the bridge domain **bd** and the VLAN IDs associated with the bridge domain:

```
[edit bridge-domains]
user@es2# set bd vlan-id-list [100 200]
```

3. Enable MVRP on the trunk interface:

```
[edit protocols]
user@es2# set mvrp interface ge-0/0/5
```

4. Enable RSTP on the trunk interface:

```
[edit protocols]
user@es2# set rstp interface ge-0/0/5
```

Results

Check the results of the configuration:

```
user@es2> show configuration
interfaces {
    ge-0/0/5 {
        description "connected to AS1 interface ge-3/0/5";
        unit 0 {
            family bridge {
                interface-mode trunk;
            }
        }
    }
    ge-0/1/1 {
        description "connected to customer1-site-2";
        unit 0 {
            family bridge {
```

```
            interface-mode access;
            vlan-id 100;
          }
        }
      }
      ge-0/2/0 {
        description "connected to customer2-site-2";
        unit 0 {
          family bridge {
            interface-mode access;
            vlan-id 200;
          }
        }
      }
    }
    bridge-domains {
      bd {
        vlan-id-list [ 100 200 ];
      }
    }
    protocols {
      mvrp {
        interface ge-0/0/5;
      }
      rstp {
        interface ge-0/0/5;
      }
    }
```

Configuring MVRP on AS1

CLI Quick Configuration

To quickly configure AS1 for MVRP, copy the following commands and paste them into the switch terminal window of AS1:

```
[edit]
set interfaces ge-3/0/5 description "connected to ES2 interface ge-0/0/5”
set interfaces ge-3/0/5 unit 0 family bridge interface-mode trunk
set interfaces ge-3/3/0 description "connected to ES1 interface ge-11/3/0"
set interfaces ge-3/3/0 unit 0 family bridge interface-mode trunk
set protocols mvrp interface ge-3/0/5
set protocols mvrp interface ge-3/3/0
set protocols rstp bridge-priority 0
set protocols rstp interface ge-3/0/5
set protocols rstp interface ge-3/3/0
```

NOTE: As we recommend as a best practice, default MVRP timers are used in this example. The default values associated with each MVRP timer are 200 ms for the join timer, 1000 ms for the leave timer, and 10000 ms for the leaveall timer. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.

Step-by-Step Procedure

To enable MVRP and RSTP on the trunk interfaces on AS1, perform these tasks:

1. Configure the trunk interfaces connecting AS1 to ES1 and ES2:

```
[edit interfaces]
user@as1# set ge-3/0/5 description "connected to ES2 interface ge-0/0/5”
user@as1# set ge-3/0/5 unit 0 family bridge interface-mode trunk
user@as1# set ge-ge-3/3/0 description "connected to ES1 interface ge-11/3/0"
user@as1# set ge-3/3/0 unit 0 family bridge interface-mode trunk
```

2. Enable MVRP on the trunk interfaces:

```
[edit protocols]
user@as1# set mvrp interface ge-3/0/5
user@as1# set mvrp interface ge-3/3/0
```

3. Enable RSTP on the trunk interfaces:

```
[edit protocols]
user@as1# set rstp bridge-priority 0
user@as1# set rstp interface ge-3/0/5
user@as1# set rstp interface ge-3/3/0
```

Results

Check the results of the configuration:

```
user@as1> show configuration
interfaces {
    ge-3/0/5 {
        description "connected to ES2 interface ge-0/0/5";
        unit 0 {
            family bridge {
                interface-mode trunk;
            }
        }
    }
    ge-3/3/0 {
        description "connected to ES1 interface ge-11/3/0";
        unit 0 {
            family bridge {
                interface-mode trunk;
            }
        }
    }
}
protocols {
    mvrp {
        interface ge-3/0/5;
        interface ge-3/3/0;
    }
    rstp {
        bridge-priority 0;
        interface ge-3/0/5;
        interface ge-3/3/0;
    }
}
```

Verification

To confirm that the configuration is updating VLAN membership, perform these tasks:

Verifying That MVRP Is Enabled on ES1

Purpose Verify that MVRP is enabled on ES1.

Action Show the MVRP applicant state:

```
user@es1> show mvrp applicant-state
MVRP applicant state for routing instance 'default-switch'
 (VO) Very anxious observer, (VP) Very anxious passive, (VA) Very anxious new,
 (AN) Anxious new, (AA) Anxious active, (QA) Quiet active, (LA) Leaving active,
 (AO) Anxious observer, (QO) Quiet observer, (LO) Leaving observer,
 (AP) Anxious passive, (QP) Quiet passive

VLAN Id     Interface          State
    100     ge-11/3/0          Declaring (QA)
    200     ge-11/3/0          Declaring (QA)
    300     ge-11/3/0          Declaring (QA)
```

Meaning The output displayed shows that trunk interface **ge-11/3/0** on ES1 is declaring (sending out) interest in the VLAN IDs **100**, **200**, and **300**.

Verifying the MVRP Registration on ES1

Purpose Verify the VLANs that are registering on ES1.

Action List VLANs in the registered state:

```
user@es1> show mvrp registration-state
MVRP registration state for routing instance 'default-switch'

VLAN Id   Interface   Registrar   Forced      Managed    STP
                      State       State       State      State
    100   ge-11/3/0   Registered  Registered  Normal     Forwarding
    200   ge-11/3/0   Registered  Registered  Normal     Forwarding
    300   ge-11/3/0   Empty       Empty       Normal     Forwarding
```

Meaning The output displayed shows the registrar state for VLANs **100** and **200** is **Registered** indicating that these VLANs are receiving traffic from customer site site-2. VLAN **300** is in an **Empty** state and is not receiving traffic from site-2.

Verifying Dynamic VLAN Members on ES1

Purpose Verify that flooding is not occurring on unregistered VLANs.

Action List dynamic VLAN membership:

```
user@es1> show mvrp dynamic-vlan-memberships
MVRP dynamic vlans for routing instance 'default-switch'
 (s) static vlan, (f) fixed registration

VLAN Id            Interfaces
    100 (s)        ge-11/3/0
    200 (s)        ge-11/3/0
    300 (s)
```

Meaning The output displayed shows that VLAN **300** is not associated with the trunk interface **ge-11/3/0** connected to AS1. No unnecessary traffic is flooding the interface for VLAN **300** towards ES2 site-2.

Verifying That MVRP Is Enabled on ES2

Purpose Verify that MVRP is enabled on ES2.

Action Show the MVRP applicant state:

```
user@es2> show mvrp applicant-state
MVRP applicant state for routing instance 'default-switch'
 (VO) Very anxious observer, (VP) Very anxious passive, (VA) Very anxious new,
 (AN) Anxious new, (AA) Anxious active, (QA) Quiet active, (LA) Leaving active,
 (AO) Anxious observer, (QO) Quiet observer, (LO) Leaving observer,
 (AP) Anxious passive, (QP) Quiet passive

VLAN Id     Interface          State
    100     ge-0/0/5           Declaring (QA)
    200     ge-0/0/5           Declaring (QA)
    300     ge-0/0/5           Idle      (VO)
```

Meaning The output displayed shows that trunk interface **ge-0/0/5** on ES2 is declaring (sending out) interest in VLAN IDs **100** and **200** but is not declaring interest for VLAN **300**. The state displayed for VLAN **300** is **Idle**.

Verifying the MVRP Registration on ES2

Purpose Verify the VLANs that are registering on ES2.

Action List VLANs in the registered state:

```
user@es2> show mvrp registration-state
MVRP registration state for routing instance 'default-switch'
```

```
VLAN Id   Interface   Registrar   Forced      Managed    STP
                      State       State       State      State
    100   ge-0/0/5    Registered  Registered  Normal     Forwarding
    200   ge-0/0/5    Registered  Registered  Normal     Forwarding
    300   ge-0/0/5    Registered  Registered  Normal     Forwarding
```

Meaning The output displayed shows that the registrar state for VLANs **100**, **200**, and **300** is **Registered** indicating that these VLANs are receiving traffic from customer site site-1.

Verifying Dynamic VLAN Members on ES2

Purpose Verify dynamic VLAN membership.

Action List dynamic VLAN membership:

```
user@es2> show mvrp dynamic-vlan-memberships
MVRP dynamic vlans for routing instance 'default-switch'
 (s) static vlan, (f) fixed registration

VLAN Id            Interfaces
    100 (s)        ge-0/0/5
    200 (s)        ge-0/0/5
    300            ge-0/0/5
```

Meaning The output displayed shows that VLAN **300** is not a static VLAN. A static VLAN is (indicated by the **s** beside the VLAN ID. VLAN **300** added to ES2 shows the VLAN membership is being updated.

Verifying That MVRP Is Enabled on AS1

Purpose Verify that MVRP is enabled on AS1.

Action Show the MVRP applicant state:

```
user@es2> show mvrp applicant-state
MVRP applicant state for routing instance 'default-switch'
 (VO) Very anxious observer, (VP) Very anxious passive, (VA) Very anxious new,
 (AN) Anxious new, (AA) Anxious active, (QA) Quiet active, (LA) Leaving active,
 (AO) Anxious observer, (QO) Quiet observer, (LO) Leaving observer,
 (AP) Anxious passive, (QP) Quiet passive

VLAN Id     Interface          State
    100     ge-3/3/0           Declaring (QA)
            ge-3/0/5           Declaring (QA)
    200     ge-3/3/0           Declaring (QA)
            ge-3/0/5           Declaring (QA)
    300     ge-3/3/0           Idle      (VO)
            ge-3/0/5           Declaring (QA)
```

Meaning The output displayed shows that trunk interfaces **ge-3/3/0** (connected to ES1) and **ge-3/0/5** (connected to ES2) are declaring (sending out) interest in the VLAN IDs **100** and **200**. Interface **ge-3/0/5** is declaring interest for VLAN **300** (towards ES2) but not declaring interest for VLAN **300** on interface **ge-3/3/0** (towards ES1).

Verifying the MVRP Registration on AS1

Purpose Verify the VLANs that are registering on AS1.

Action List VLANs in the registered state:

```
user@as1> show mvrp registration-state
MVRP registration state for routing instance 'default-switch'

VLAN Id   Interface   Registrar   Forced      Managed    STP
                      State       State       State      State
    100   ge-3/3/0    Registered  Registered  Normal     Forwarding
          ge-3/0/5    Registered  Registered  Normal     Forwarding
    200   ge-3/3/0    Registered  Registered  Normal     Forwarding
          ge-3/0/5    Registered  Registered  Normal     Forwarding
    300   ge-3/3/0    Registered  Registered  Normal     Forwarding
          ge-3/0/5    Empty       Empty       Normal     Forwarding
```

Meaning The output displayed shows that the registrar state for VLANs **100** and **200** is **Registered** on both sides of AS1 (ES1 and ES2) indicating that traffic is being transmitted and received through these VLANs between customer site site-1 and site-2. The registrar state for VLAN **300** is **Registered** on interface **ge-3/3/0** (connected to ES1) but not on interface **ge-3/0/5** (connected to ES2).

Verifying That MVRP Is Updating VLAN Membership on AS1

Purpose Verify that MVRP is updating VLAN membership on AS1 by displaying the dynamic VLAN membership on AS1.

Action List the VLANs on AS1 that were created dynamically using MVRP:

```
user@as1> show mvrp dynamic-vlan-memberships
MVRP dynamic vlans for routing instance 'default-switch'
 (s) static vlan, (f) fixed registration

VLAN Id           Interfaces
    100           ge-3/3/0
                  ge-3/0/5
    200           ge-3/3/0
                  ge-3/0/5
    300           ge-3/3/0
```

Meaning VLANs are only configured statically on the edge switches. The output displayed shows that all VLANs were learned dynamically. No **(s)** is added beside the VLAN IDs, indicating that they were created dynamically and not added statically.

Related Documentation

- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure) on page 49
- Verifying That MVRP Is Working Correctly on page 52

- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

Configuring Multiple VLAN Registration Protocol (MVRP)

Multiple VLAN Registration Protocol (MVRP) is used to manage dynamic VLAN registration in Carrier Ethernet network. You can use MVRP on MX Series routers or on EX Series switches.

For information about using MVRP on EX Series switches, see Example: Configuring Automatic VLAN Administration Using MVRP on EX Series Switches.

MVRP is disabled by default on MX Series routers.

To enable MVRP or set MVRP options, follow these instructions:

- Enabling MVRP on page 47
- Disabling MVRP on page 47
- Changing the Registration Mode to Disable Dynamic VLANs on page 47
- Configuring Timer Values on page 48
- Configuring the Multicast MAC address for MVRP on page 48
- Configuring an MVRP Interface as a Point-to-Point Interface on page 49
- Configuring MVRP Tracing Options on page 49

Enabling MVRP

MVRP can only be enabled on trunk interfaces.

To enable MVRP on a specific trunk interface (here, interface **ge-3/0/5**):

```
[edit protocols mvrp]
user@host# set interfaces ge-3/0/5
```

Disabling MVRP

MVRP is disabled by default. You only need to perform this procedure if you have previously enabled MVRP.

To disable MVRP on all trunk interfaces on the router, use one of the following:

```
[edit protocols mvrp]
user@host# deactivate protocols mvrp
user@host# delete protocols mvrp
```

Changing the Registration Mode to Disable Dynamic VLANs

When the registration mode for an interface is set to **normal** (the default), dynamic VLANs are created on interfaces participating in MVRP. The dynamic VLANs created on one router are then propagated by means of MVRP to other routers in a topology.

However, Dynamic VLAN creation through MVRP can be disabled for all trunk interfaces on a router or for individual trunk interfaces.

For information about disabling dynamic VLAN creation on an interface so that the interface does not register and does not participate in MVRP, see "Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure)" on page 49.

Configuring Timer Values

The timers in MVRP define the amount of time an interface waits to join or leave MVRP or to send or process the MVRP information for the router after receiving an MVRP PDU:

- The join timer controls the amount of time the router waits to accept a registration request.
- The leave timer controls the period of time that the router waits in the Leave state before changing to the unregistered state.
- The leaveall timer controls the frequency with which the LeaveAll messages are communicated.

The default MVRP timer values are 200 ms for the join timer, 1000 ms for the leave timer, and 10000 ms for the leaveall timer.

BEST PRACTICE: **Maintain default timer settings unless there is a compelling reason to change the settings. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.**

To set the join timer for a specific interface:

```
[edit protocols mvrp]
user@host# set interfaces ge-3/0/5 join-timer 300
```

To set the leave timer for a specific interface:

```
[edit protocols mvrp]
user@host# set interfaces ge-3/0/5 leave-timer 1200
```

To set the leaveall timer for a specific interface:

```
[edit protocols mvrp]
user@host# set interface ge-3/0/5 leaveall-timerr 12000
```

Configuring the Multicast MAC address for MVRP

MVRP uses the customer MVRP multicast MAC address when MVRP is enabled. However, you can configure MVRP to instead use the provider MVRP multicast MAC address.

To configure MVRP to use the provider MVRP multicast MAC address:

```
[edit protocols mvrp]
user@host# set bpdu-destination-mac-address provider-bridge-group;
```

Configuring an MVRP Interface as a Point-to-Point Interface

Specify that a configured interface is connected point-to-point. If specified, a point-to-point subset of the MRP state machine provides a simpler and more efficient method to accelerate convergence on the network.

To specify that an MVRP interface is point-to-point (here, interface **ge-3/0/5**):

```
[edit protocols mvrp]
user@host# set interfaces ge-3/0/5 point-to-point;
```

Configuring MVRP Tracing Options

Set MVRP protocol-level tracing options.

To specify MVRP protocol tracing (here, the file is **/var/log/mvrp-log**, size is **2m**, number of files is **28**, the option **world-readable** indicates the log can be read by user, and MVRP is flagging **events**):

```
[edit protocols mvrp]
user@host# edit protocols mvrp traceoptions file /var/log/mvrp-log size 2m files 28
  world-readable flag events
```

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Verifying That MVRP Is Working Correctly

Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure)

MX Series routers use Multiple VLAN Registration Protocol (MVRP) to manage dynamic virtual LAN (VLAN) registration in switching networks. Enabling MVRP on trunk interfaces in Carrier Ethernet networks reduces network overhead by limiting the scope of broadcast, unknown unicast, and multicast (BUM) traffic to interested devices only.

Dynamic VLAN registration through MVRP is enabled by default when you enable MVRP on a trunk interface. The trunk interface automatically uses the **normal** registration mode, accepts MVRP messages, and participates in MVRP. The management state in this case is also known as **normal**. However, it can be useful to configure VLAN IDs to bypass the dynamic VLAN registration process for security reasons or when MVRP is not supported on a peer switch. You can change the management state of a VLAN independently to either exclude it entirely from the MVRP registration process and remain in an unregistered state (**forbidden** state) or to force a VLAN to always stay in a registered state and to be declared on all other forwarding ports (**fixed** state).

Three parameters are used to control the management state of a VLAN in an MVRP configuration:

- The VLAN is a member in the interface VLAN ID list (configured at the **[edit interfaces *interface-name* family bridge vlan-id-list]** hierarchy level).

- The VLAN is a member in the bridge domain VLAN ID list (configured at the **[edit bridge-domain *bridge-domain-name* vlan-id-list]** hierarchy level).
- The MVRP registration mode is configured for MVRP (configured at the **[edit protocols mvrp interface *interface-name* registration (normal | restricted | forbidden)]** hierarchy level).

When these three parameters are combined, a VLAN operates with the following MVRP management states:

- If a VLAN ID is present in both the interface and bridge domain VLAN ID list, the VLAN is in a **fixed** management state, irrespective of the MVRP registration mode.
- If a VLAN ID is present in the interface VLAN ID list but not in the bridge domain VLAN ID list and the MVRP registration mode is **forbidden**, the VLAN ID is in a **forbidden** management state. If the MVRP registration mode is not **forbidden**, the VLAN ID is in a **normal** registration state.
- If a VLAN ID is not present in the interface VLAN ID list and the MVRP registration mode is **forbidden** or **restricted**, the VLAN ID is in a **forbidden** management state. Otherwise, it is in a **normal** management state.

Table 1 defines in more detail the MVRP management state for a VLAN when the interface and bridge domain VLAN ID lists and the MVRP registration mode are configured.

Table 5 on page 50 contains the service configured for BEB2 as well as the correlating S-VLAN, I-SID, and B-VLAN.

Table 5: MVRP Management States

VLAN ID present in Interface VLAN ID List?	VLAN ID present in Bridge Domain VLAN ID List?	Interface uses MVRP Normal Registration Mode	Interface uses MVRP Restricted Registration Mode	Interface uses Forbidden Registration Mode
yes	yes	**fixed** state	**fixed** state	**fixed** state
yes	no	**normal** state	**normal** state	**forbidden** state
yes	yes/no	**normal** state	**forbidden** state	**forbidden** state

This topic describes how to configure the management state for VLANs in an MVRP configuration:

- Configure All VLANs to Operate in Normal State on page 50
- Configure VLANs to Operate with Mixed States (Fixed and Normal) on page 51
- Configure VLANs to Operate with Mixed States (Fixed, Normal, and Forbidden) on page 51

Configure All VLANs to Operate in Normal State

- To configure an interface to operate in the normal state, configure the registration state as **normal**:

```
[edit protocols]
```

```
user@host# set mvrp interface interface-name registration normal
```

For example, to configure all VLANs on trunk interface **ge-1/0/0** to operate in **normal** state:

```
[edit]
user@host# set interface ge-1/0/0 family bridge trunk
user@host# set protocols mvrp interface ge-1/0/0 registration normal
```

Configure VLANs to Operate with Mixed States (Fixed and Normal)

- To configure an interface to operate in a fixed state, add the VLANs that should operate in a fixed state to the interface VLAN ID list:

```
[edit]
user@host# set interface interface-name family bridge vlan-id-list vlan-ids
user@host# set bridge-domains bridge-domain-name vlan-id-list vlan-ids
```

For example, to configure the first 1024 VLANs on trunk interface **ge-1/0/0.0** to operate in **fixed** state, and the other VLANs to operate in **normal** state:

```
[edit]
user@host# set interface ge-1/0/0.0 family bridge trunk
user@host# set interface ge-1/0/0.0 family bridge vlan-id-list 1-1024
user@host# set bridge-domains bd vlan-id-list 1-1024
user@host# set protocols mvrp interface ge-1/0/0 registration normal
```

Configure VLANs to Operate with Mixed States (Fixed, Normal, and Forbidden)

- To configure an interface to operate in the forbidden state, configure the registration state as **restricted**:

```
[edit protocols]
user@host# set protocols mvrp interface interface-name registration restricted
```

For example, to configure the first 1024 VLANs on trunk interface **ge-1/0/0.0** to operate in **fixed** state, VLAN IDs 1024-2048 to operate in **normal** state, and the remaining VLANs to operate in **forbidden** state:

```
[edit]
user@host# set interface ge-1/0/0.0 family bridge trunk
user@host# set interface ge-1/0/0.0 family bridge vlan-id-list 1-2048
user@host# set bridge-domains bd vlan-id-list 1-1024
user@host# set protocols mvrp interface ge-1/0/0 registration restricted
```

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

Verifying That MVRP Is Working Correctly

Purpose After configuring your MX Series router to participate in Multiple VLAN Registration Protocol (MVRP), verify that the configuration is properly set and that MVRP messages are being sent and received on your switch.

Action

1. Confirm that the router is declaring Virtual LANs (VLANs).

   Show that MVRP is enabled:

   ```
   user@host> show mvrp

   MVRP configuration for routing instance 'default-switch'
   MVRP dynamic VLAN creation : Enabled
   MVRP BPDU MAC address      : Customer bridge group (01-80-C2-00-00-21)
   MVRP timers (ms)
     Interface       Join   Leave  LeaveAll
     ge-11/3/0        200     800     10000
   ```

   Show the MVRP applicant state:

   ```
   user@host> show mvrp applicant-state

   MVRP applicant state for routing instance 'default-switch'
    (VO) Very anxious observer, (VP) Very anxious passive, (VA) Very anxious
    new,
    (AN) Anxious new, (AA) Anxious active, (QA) Quiet active, (LA) Leaving
   active,
    (AO) Anxious observer, (QO) Quiet observer, (LO) Leaving observer,
    (AP) Anxious passive, (QP) Quiet passive

   VLAN Id     Interface          State
       100     ge-11/3/0          Declaring (QA)
       200     ge-11/3/0          Declaring (QA)
       300     ge-11/3/0          Declaring (QA)
   ```

2. Confirm that VLANs are registered on interfaces.

   List VLANs in the registered state:

   ```
   user@host> show mvrp registration-state

   MVRP registration state for routing instance 'default-switch'

   VLAN Id   Interface   Registrar   Forced      Managed    STP
                         State       State       State      State
       100   ge-11/3/0   Registered  Registered  Normal     Forwarding
       200   ge-11/3/0   Registered  Registered  Normal     Forwarding
       300   ge-11/3/0   Empty       Empty       Normal     Forwarding
   ```

3. Display a list of VLANs created dynamically.

   List dynamic VLAN membership:

   ```
   user@host> show mvrp dynamic-vlan-memberships

   MVRP dynamic vlans for routing instance 'default-switch'
    (s) static vlan, (f) fixed registration

   VLAN Id            Interfaces
       100            ge-3/3/0
   ```

```
                    ge-3/0/5
200                 ge-3/3/0
                    ge-3/0/5
```

Meaning The output of **show mvrp applicant-state** shows that trunk interface **ge-11/3/0** is declaring (sending out) interest in the VLAN IDs **100**, **200**, and **300** and MVRP is operating properly.

The output of **show mvrp registrant-state** shows the registrar state for VLANs **100** and **200** as **Registered**, indicating that these VLANs are receiving traffic from a customer site. VLAN **300** is in an **Empty** state and is not receiving traffic from a customer site.

The output of the **show mvrp dynamic-vlan-membership** shows that VLANs **100** and **200** are created dynamically (here, on an MX Series router operating as an aggregation switch between MX Series routers operating as edge switches). VLANs created statically are marked with an **(s)** (which is not indicated in this output).

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on EX Series Switches
- Configuring Multiple VLAN Registration Protocol (MVRP) (CLI Procedure)
- Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure) on page 49

CHAPTER 5

Summary of Multiple VLAN Registration Protocol Configuration Statements

The following sections explain each of the Multiple VLAN Registration Protocol (MVRP) configuration statements. The statements are organized alphabetically.

bpdu-destination-mac-address

Syntax bpdu-destination-mac-address provider-bridge-group;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit protocols mvrp],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type)

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description For Multiple VLAN Registration Protocol (MVRP) configurations, specifies the multicast address for MVRP. If configured, the provider MVRP multicast MAC address is used; otherwise, the Junos OS uses the customer MVRP multicast MAC address.

Default By default, the provider MVRP multicast MAC address is used (if configured). Otherwise, the customer MVRP MAC address is used.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

interface (MVRP)

Syntax

```
interface (all | interface-name) {
  join-timer milliseconds;
  leave-timer milliseconds;
  leaveall-timer milliseconds;
  point-to-point;
  registration (forbidden | normal | restricted);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit protocols mvrp],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type)

Release Information

Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description

Specify interfaces on which to configure Multiple VLAN Registration Protocol (MVRP).

Default

By default, MVRP is disabled.

Options

all—All interfaces on the router.

interface-name—Names of interface to be configured for MVRP.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

join-timer (MVRP)

Syntax join-timer *milliseconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type),
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit logical-systems *logical-system-name* protocols mvrp interface (all | *interface-name*)],
[edit protocols mvrp interface (all | *interface-name*)],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type)

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description For Multiple VLAN Registration Protocol (MVRP), configure the maximum interval interfaces must wait before sending MVRP protocol data units (PDUs).

Default 200 milliseconds

Options ***milliseconds***—Interval that the interface must wait before sending MVRP PDUs. Maintain default timer settings unless there is a compelling reason to change the settings. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31
- leaveall-timer on page 58
- leave-timer on page 59
- point-to-point on page 62
- registration on page 63

leaveall-timer (MVRP)

Syntax leaveall-timer *milliseconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type),
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit logical-systems *logical-system-name* protocols mvrp interface (all | *interface-name*)],
[edit protocols mvrp interface (all | *interface-name*)],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type)

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description For Multiple VLAN Registration Protocol (MVRP), configure the interval at which the LeaveAll state operates on the interface.

Default 10000 milliseconds

Options ***milliseconds***—Interval between the sending of Leave All messages. Maintain default timer settings unless there is a compelling reason to change the settings. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31
- join-timer on page 57
- leave-timer on page 59
- point-to-point on page 62
- registration on page 63

leave-timer (MVRP)

Syntax leave-timer *milliseconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type),
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit logical-systems *logical-system-name* protocols mvrp interface (all | *interface-name*)],
[edit protocols mvrp interface (all | *interface-name*)],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type)

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description For Multiple VLAN Registration Protocol (MVRP), configure the number of milliseconds the switch retains a VLAN in the Leave state before the VLAN is unregistered. If the interface receives a join message before this timer expires, the VLAN remains registered.

Default 1000 milliseconds

Options ***milliseconds***—Interval that the switch retains a VLAN in the Leave state before the VLAN is unregistered. At a minimum, set the leave-timer interval at twice the join-timer interval. Maintain default timer settings unless there is a compelling reason to change the settings. Modifying timers to inappropriate values might cause an imbalance in the operation of MVRP.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31
- join-timer on page 57
- leaveall-timer on page 58
- point-to-point on page 62
- registration on page 63

mvrp

Syntax

```
mvrp {
  bpdu-destination-mac-address provider-bridge-group;
  join-timer milliseconds;
  leave-timer milliseconds;
  leaveall-timer milliseconds;
  interface (all | interface-name) {
    join-timer milliseconds;
    leave-timer milliseconds;
    leaveall-timer milliseconds;
    point-to-point;
    registration (forbidden | normal | restricted);
  }
  no-dynamic-vlan;
  traceoptions {
    file filename <files number > <size size> <no-stamp | world-readable |
      no-world-readable>;
    flag flag;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]
(for virtual switch instance type)
[edit protocols],
[edit routing-instances *routing-instance-name* protocols] (for virtual switch instance type),

Release Information

Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description

For Layer 2 networks, configure Multiple VLAN Registration Protocol (MVRP) to dynamically share VLAN information and dynamically configure needed VLANs. Maintaining VLAN configurations based on active VLANs reduces the amount of traffic traveling in the network, saving network resources. MVRP is configured on trunk interfaces.

The remaining statements are explained separately.

Default

MVRP is disabled by default.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

no-dynamic-vlan

Syntax no-dynamic-vlan;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit protocols mvrp],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type)

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description Disable the dynamic creation of VLANs using Multiple VLAN Registration Protocol (MVRP) for interfaces participating in MVRP.

Dynamic VLAN configuration can be enabled on an interface independent of MVRP. The MVRP dynamic VLAN configuration setting does not override the interface configuration dynamic VLAN configuration setting. If dynamic VLAN creation is disabled on the interface in the interface configuration, no dynamic VLANs are created on the interface, including dynamic VLANs created using MVRP.

This option can only be applied globally; it cannot be applied per interface.

Default If MVRP is enabled, the dynamic creation of VLANs as a result of MVRP protocol exchange messages is enabled.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Controlling the Management State of a VLAN in MVRP Configurations on MX Series Routers (CLI Procedure) on page 49
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

point-to-point (MVRP)

Syntax point-to-point;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mvrp interface (all | *interface-name*)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type),
[edit protocols mvrp interface (all | *interface-name*)],
[edit routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type)

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description (Optional) For Multiple VLAN Registration Protocol (MVRP) configurations, configure an interface to be recognized as a point-to-point connection. If specified, a point-to-point subset of the MRP state machine is used to provide a simpler and more efficient method to accelerate convergence on the network.

Default By default, MVRP is disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31
- join-timer on page 57
- leaveall-timer on page 58
- leave-timer on page 59
- registration on page 63

registration

Syntax registration (forbidden | normal | restricted);

Hierarchy Level [edit protocols mvrp interface (all | *interface-name*)];
[edit routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type);
[edit logical-systems *logical-system-name* protocols mvrp interface (all | *interface-name*)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp interface (all | *interface-name*)] (for virtual switch instance type);

Release Information Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description For Multiple VLAN Registration Protocol (MVRP) configurations, configure the registration mode for the interface.

Default normal

Options **forbidden**—The interface or interfaces do not register and do not participate in MVRP.

normal—The interface or interfaces accept MVRP messages and participate in MVRP.

restricted—The interface or interfaces ignore all MVRP JOIN messages received for VLANs that are not statically configured for MVRP on the interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31
- join-timer on page 57
- leaveall-timer on page 58
- leave-timer on page 59
- point-to-point on page 62

traceoptions (MVRP)

Syntax

```
traceoptions {
  file name <size size> <files number>  <(world-readable | no-world-readable)>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols mvrp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type),
[edit protocols mvrp],
[edit routing-instances *routing-instance-name* protocols mvrp] (for virtual switch instance type)

Release Information

Statement introduced in Junos OS Release 10.1 for MX Series routers.

Description

For Multiple VLAN Registration Protocol (MVRP), configure tracing options.

Default

Traceoptions is disabled.

Options

disable —(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. To include the **file** statement, you must specify a filename. Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place MVRP tracing output in the file **/var/log/mvrp-log**.

files *number*—(Optional) Maximum number of trace files, in the range from 2 through 1000. The default is 1 trace file. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

flag *flag*—Specify which tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. You can include the following flags:

- **all**—Enable all trace options flags.
- **error**—Trace all failure conditions.
- **events**—Trace process state change and cleanup events.
- **pdu**—Trace RAPS PDU reception and transmission.
- **socket**—Trace socket activity.
- **state-machine**—Trace information about the state machine.
- **timers**—Trace protocol timers.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0.** When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0** . This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten. The file size range is from 10240 through 4294967295. The default file size is 1MB.

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Automatic VLAN Administration Using MVRP on MX Series Routers on page 34
- Configuring Multiple VLAN Registration Protocol (MVRP) on page 47
- Verifying That MVRP Is Working Correctly on page 52
- Understanding Multiple VLAN Registration Protocol (MVRP) on MX Series Routers on page 31

PART 3

Layer 2 Port Mirroring

CHAPTER 6

Layer 2 Port Mirroring Overview

Layer 2 Port Mirroring Overview

On routing platforms that contain an Internet Processor II ASIC, you can send a copy of any incoming packet from the routing platform to an external host address or a packet analyzer for analysis. This is known as *port mirroring*. In Junos OS Release 9.3 and later, Juniper Networks MX Series 3D Universal Edge Routers in a Layer 2 environment support port mirroring for Layer 2 bridging traffic and virtual private LAN service (VPLS) traffic. In Junos OS Release 9.4 and later, MX Series routers in a Layer 2 environment also support port mirroring for Layer 2 VPN traffic over a circuit cross-connect (CCC) that transparently connects logical interfaces of the same type.

Layer 2 port mirroring enables you to specify the manner in which incoming and outgoing packets at specified ports are monitored and the manner in which copies of selected packets are forwarded to another destination, where the packets can be analyzed. MX Series routers support Layer 2 port mirroring by performing flow monitoring functions using a class-of-service (CoS) architecture that is in concept similar to, but in particulars different from, other routing platforms.

Like the M120 Multiservice Edge Router and M320 Multiservice Edge Routers, MX Series routers support port mirroring of IPv4, IPv6, and VPLS packets simultaneously. However, the *Junos OS Layer 2 Configuration Guide* describes port mirroring only for Layer 2 bridging traffic (**family bridge**), Layer 2 VPLS traffic (**family vpls**) through an MX Series router, and Layer 2 VPN traffic that passes through a CCC (**family ccc**).

For general information about packet flow within MX Series routers and other routers, see the *Junos OS Class of Service Configuration Guide*.

In a Layer 3 environment, MX Series routers support port mirroring of IPv4 (**family inet**) and IPv6 (**family inet6**) traffic. For information about Layer 3 port mirroring, see the *Junos OS Policy Framework Configuration Guide*.

Related Documentation

- Layer 2 Port Mirroring Properties on page 70
- Restrictions on Layer 2 Port Mirroring on page 77
- Application of Layer 2 Port Mirroring Types on page 78

Layer 2 Port Mirroring Properties

Port mirroring specifies the following types of properties:

- Packet-Selection Properties on page 70
- Packet Address Family on page 70
- Mirror Destination Properties on page 71
- Mirror-Once Option on page 71

Packet-Selection Properties

The packet-selection properties of Layer 2 port-mirroring specify how the sampled packets are to be selected for mirroring:

- The number of packets in each sample.
- The number of packets to mirror from each sample.
- The length to which mirrored packets are to be truncated.

Packet Address Family

The packet address family type specifies the type of traffic to be mirrored. In a Layer 2 environment, MX Series routers support port mirroring for the following packet address families:

- Family type **bridge**—For mirroring VPLS traffic when the physical interface is configured with encapsulation type **ethernet-bridge**.
- Family type **ccc**—For mirroring Layer 2 VPN traffic.
- Family type **vpls**—For mirroring VPLS traffic.

NOTE: In typical applications, you send mirrored packets directly to an analyzer or a workstation for analysis, not to another router. If you must send mirrored packets over a network, you should use tunnels. For Layer 2 VPN implementations, you can use the Layer 2 VPN routing instance type **l2vpn** to tunnel the packets to a remote destination.

For information about configuring a routing instance for Layer 2 VPN, see the *Junos OS VPNs Configuration Guide*. For a detailed Layer 2 VPN example configuration, see the *Junos OS Feature Guides*. For information about tunnel interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

Mirror Destination Properties

For a given packet address family, the mirror destination properties of a Layer 2 port-mirroring instance specify how the selected packets are to be sent on a particular physical interface:

- The physical interface on which to send the selected packets.
- Whether filter checking is to be disabled for the mirror destination interface. By default, filter checking is enabled on all

NOTE: If you apply a filter to an interface that is also a Layer 2 port-mirroring destination, a commit failure occurs unless you have disabled filter checking for that mirror destination interface.

Mirror-Once Option

If port mirroring is enabled at both ingress and egress interfaces, you can prevent the MX Series router from sending duplicate packets to the same destination (which would complicate the analysis of the mirrored traffic).

NOTE: The mirror-once port-mirroring option is a global setting. The option is independent of the packet selection properties and the packet family type-specific mirror destination properties.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Restrictions on Layer 2 Port Mirroring on page 77
- Application of Layer 2 Port Mirroring Types on page 78

Layer 2 Port Mirroring Global Instance

On an MX Series router, you can configure a set of port-mirroring properties that implicitly apply to packets received on all ports in the router chassis. This set of port-mirroring properties is the *global instance* of Layer 2 port mirroring for the router.

Within the global instance configuration, you can specify a set of mirror destination properties for each packet address family supported by Layer 2 port mirroring.

For a general description of Layer 2 port-mirroring properties, see "Layer 2 Port Mirroring Properties" on page 70. For a comparison of the types of Layer 2 port mirroring available on an MX Series router, see "Application of Layer 2 Port Mirroring Types" on page 78.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Configuring the Global Instance of Layer 2 Port Mirroring on page 85
- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113
- Example: Layer 2 Port Mirroring to Multiple Destinations on page 124

Layer 2 Port Mirroring Named Instances

This topic describes the following information:

Layer 2 Port Mirroring Named Instances Overview

On an MX Series router, you can define a set of port-mirroring properties that you can explicitly bind to physical ports on the router. This set of port mirroring properties is known as a *named instance* of Layer 2 port mirroring.

You can bind a named instance of Layer 2 port mirroring to physical ports associated with MX Series router Packet Forwarding Engine components at different levels of the router chassis:

- At the FPC level—You can bind a named instance to the physical ports associated with a specific Dense Port Concentrator (DPC) or to the physical ports associated with a specific Flexible Port Concentrator (FPC).
- At the PIC level—You can bind a named instance of port mirroring to a specific Packet Forwarding Engine (on a specific DPC) or to a specific PIC.

NOTE: **MX Series routers support DPCs as well as FPCs and PICs. Unlike FPCs, DPCs do not support PICs. In the Junos OS CLI, however, you use FPC and PIC syntax to configure or display information about DPCs and the Packet Forwarding Engines on the DPCs.**

The following points summarize the behavior of Layer 2 port mirroring based on named instances:

- The scope of packet selection is determined by the target of the binding—At the ports (or port) bound to a named instance of Layer 2 port mirroring, the router selects input packets according to the packet-selection properties in the named instance.
- The destination of a selected packet is determined by the packet address family—Of the packets selected, the router mirrors only the packets belonging to an address family

for which the named instance of Layer 2 port mirroring specifies a set of mirror destination properties. In a Layer 2 environment, MX Series routers support port mirroring of VPLS (**family bridge** or **family vpls**) traffic and Layer 2 VPN traffic with **family ccc**.

For a general description of Layer 2 port-mirroring properties, see "Layer 2 Port Mirroring Properties" on page 70. For a comparison of the types of Layer 2 port mirroring available on an MX Series router, see "Application of Layer 2 Port Mirroring Types" on page 78.

Mirroring at Ports Grouped at the FPC Level

On an MX Series router, you can bind a named instance of Layer 2 port mirroring to a specific DPC or FPC installed in the router chassis. The port mirroring properties in the instance are applied to all Packet Forwarding Engines (and their associated ports) on the specified DPC or to all PICs (and their associated ports) installed in the specified FPC. Port mirroring properties that are bound to a DPC or FPC override any port-mirroring properties bound at the global level or the MX Series router chassis.

Mirroring at Ports Grouped at the PIC Level

On an MX Series router, you can bind a named instance of Layer 2 port mirroring to a specific Packet Forwarding Engine or PIC. The port-mirroring properties in that instance are applied to all ports associated with the specified Packet Forwarding Engine or PIC. Port-mirroring properties that are bound to a Packet Forwarding Engine or PIC override any port-mirroring properties bound at the DPC or FPC that contains them.

NOTE: For MX960 routers, there is a one-to-one mapping of Packet Forwarding Engines to Ethernet ports. Therefore, on MX960 routers only, you can configure port-specific bindings of port-mirroring instances.

Mirroring at a Group of Ports Bound to Multiple Named Instances

On an MX Series router, you can apply up to two named instances of Layer 2 port mirroring to the same group of ports within the router chassis. By applying two different port-mirroring instances to the same DPC, FPC, Packet Forwarding Engine, or PIC, you can bind two distinct Layer 2 port mirroring specifications to a single group of ports.

NOTE: You can configure only one global instance of Layer 2 port mirroring on an MX Series router.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Defining a Named Instance of Layer 2 Port Mirroring on page 88
- Binding Layer 2 Port Mirroring to Ports Grouped at the FPC Level on page 92
- Binding Layer 2 Port Mirroring to Ports Grouped at the PIC Level on page 94
- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113

Layer 2 Port Mirroring Firewall Filters

This topic describes the following information:

Layer 2 Port Mirroring Firewall Filters Overview

On an MX Series router, you can configure a firewall filter *term* to specify that Layer 2 port mirroring is to be applied to all packets at the interface to which the firewall filter is applied.

You can apply a Layer 2 port-mirroring firewall filter to the input or output logical interfaces (including aggregated Ethernet logical interfaces), to traffic forwarded or flooded to a bridge domain, or traffic forwarded or flooded to a VPLS routing instance.

MX Series routers support Layer 2 port mirroring of VPLS (**family bridge** or **family vpls**) traffic and Layer 2 VPN traffic with **family ccc** n a Layer 2 environment

Within a firewall filter **term**, you can specify the Layer 2 port-mirroring properties under the **then** statement in either of the following ways:

- Implicitly reference the Layer 2 port mirroring properties in effect on the port.
- Explicitly reference a particular named instance of Layer 2 port mirroring.

NOTE: When configuring a Layer 2 port-mirroring firewall filter, do not include the optional **from** statement that specifies match conditions based on the route source address. Omit this statement so that all packets are considered to match and all *actions* and *action-modifiers* specified in the **then** statement are taken.

If you want to mirror all incoming packets, then you must not use the from statement; /* comment: one configure filter terms with from if they are interested in mirroring only a subset of packet.

For a general description of Layer 2 port-mirroring properties, see "Layer 2 Port Mirroring Properties" on page 70. For a comparison of the types of Layer 2 port mirroring available on an MX Series router, see "Application of Layer 2 Port Mirroring Types" on page 78.

NOTE: If you associate integrated routing and bridging (IRB) with the bridge domain (or VPLS routing instance), and also configure within the bridge domain (or VPLS routing instance) a forwarding table filter with the port-mirror or port-mirror-instance action, then the IRB packet is mirrored as a Layer 2 packet. You can disable this behavior by configuring the no-irb-layer-2-copy statement in the bridge-domain (or VPLS routing instance).

For a detailed description of how to configure a Layer 2 port-mirroring firewall filter, see "Defining a Layer 2 Port-Mirroring Firewall Filter" on page 97.

For detailed information about how you can use Layer 2 port-mirroring firewall filters with MX Routers configured as provider edge (PE) routers, see "Layer 2 Port Mirroring of PE Router Logical Interfaces" on page 80. For detailed information about configuring firewall filters in general (including in a Layer 3 environment), see the *Junos OS Policy Framework Configuration Guide*.

Mirroring of Packets Received or Sent on a Logical Interface

To mirror Layer 2 traffic received or sent on a logical interface, apply a port-mirroring firewall filter to the input or output of the interface.

A port-mirroring firewall filter can also be applied to an aggregated-Ethernet logical interface. For details, see "Layer 2 Port Mirroring of PE Router Aggregated Ethernet Interfaces" on page 82.

NOTE: If port-mirroring firewall filters are applied at both the input and output of a logical interface, two copies of each packet are mirrored. To prevent the router from forwarding duplicate packets to the same destination, you can enable the "mirror-once" option for Layer 2 port mirroring in the global instance for the Layer 2 packet address family.

Mirroring of Packets Forwarded or Flooded to a Bridge Domain

To mirror Layer 2 traffic forwarded to or flooded to a bridge domain, apply a port-mirroring firewall filter to the input to the forwarding table or flood table. Any packet received for the bridge domain forwarding or flood table and that matches the filter conditions is mirrored.

For more information about bridge domains, see "Layer 2 Bridge Domains Overview" on page 131. For information about flooding behavior in a bridge domain, see "Layer 2 Learning and Forwarding for Bridge Domains Overview" on page 133.

Mirroring of Packets Forwarded or Flooded to a VPLS Routing Instance

To mirror Layer 2 traffic forwarded to or flooded to a VPLS routing instance, apply a port-mirroring firewall filter to the input to the forwarding table or flood table. Any packet received for the VPLS routing instance forwarding or flood table and that matches the filter condition is mirrored.

For more information about VPLS routing instances, see "Configuring a VPLS Routing Instance" on page 16 and "Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances" on page 136. For information about flooding behavior in VPLS, see the *Junos OS VPNs Configuration Guide*.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Example: Layer 2 Port Mirroring at a Logical Interface on page 117
- Example: Layer 2 Port Mirroring for a Layer 2 VPN on page 119
- Example: Layer 2 Port Mirroring for a Layer 2 VPN with LAG Links on page 122
- Example: Layer 2 Port Mirroring to Multiple Destinations on page 124

Layer 2 Port Mirroring to Multiple Destinations Using Next-Hop Groups

On an MX Series router, you can mirror traffic to multiple destinations by configuring next-hop groups in Layer 2 port-mirroring firewall filters applied to tunnel interfaces. The mirroring of packets to multiple destinations is also known as *multipacket port mirroring*,

NOTE: **Junos OS Release 9.5 introduced support for Layer 2 port mirroring using next-hop groups on MX Series routers, but required installation of a Tunnel PIC. Beginning in Junos OS Release 9.6, Layer 2 port mirroring using next-hop groups on MX Series routers does not require Tunnel PICs.**

On MX Series routers, you can define a firewall filter for mirroring packets to a next-hop group. The next-hop group can contain Layer 2 members, Layer 3 members, and subgroups that are either unit list (mirroring packets to each interface) or load-balanced (mirroring packets to one of several interfaces). The MX Series router supports up to 30 next-hop groups. Each next-hop group supports up to 16 next-hop addresses. Each next-hop group must specify at least two addresses.

To enable port mirroring to the members of a next-hop group, you specify the next-hop group as the filter action of a firewall filter, and then you apply the firewall filter to logical tunnel interfaces (**lt-**) or virtual tunnel interfaces (**vt-**) on the MX Series router.

NOTE: **The use of subgroups for load-balancing mirrored traffic is not supported.**

Related Documentation

- Layer 2 Port Mirroring Overview on page 69Layer 2 Port Mirroring Overview on page 69
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Defining a Next-Hop Group for Layer 2 Port Mirroring on page 108
- Example: Layer 2 Port Mirroring to Multiple Destinations on page 124

Guidelines for Configuring Layer 2 Port Mirroring

The following topics describe general guidelines for configuring Layer 2 port mirroring on an MX Series router:

Restrictions on Layer 2 Port Mirroring

The following restrictions apply to Layer 2 port mirroring:

- Only Layer 2 transit data (packets that contain chunks of data transiting the routing platform as they are forwarded from a source to a destination) can be mirrored. Layer 2 local data (packets that contain chunks of data that are destined for or sent by the Routing Engine, such as Layer 2 control packets) are not mirrored.
- If you apply a port-mirroring filter to the output of a logical interface, only unicast packets are mirrored. To mirror broadcast packets, multicast packets, unicast packets with an unknown destination media access control (MAC) address, or packets with MAC entry in the destination MAC (DMAC) routing table, apply a filter to the input to the flood table of a bridge domain or virtual private LAN service (VPLS) routing instance.
- The mirror destination device should be on a dedicated bridge domain and should not participate in any bridging activity: The mirror destination device should not have a bridge to the ultimate traffic destination, and the mirror destination device should not send the mirrored packets back to the source address.
- For either the global port-mirroring instance or a named port-mirroring instance, you can configure only one mirror output interface per port-mirroring instance and packet address family. If you include more than one **interface** statement under the **family (bridge | ccc | vpls) output** statement, the previous **interface** statement is overridden.
- Layer 2 port-mirroring firewall filtering is not supported for logical systems.

  In a Layer 2 port-mirroring firewall filter definition, the filter ***action-modifier*** (**port-mirror** or **port-mirror-instance** ***pm-instance-name***) relies on port-mirroring properties defined in the global instance or named instances of Layer 2 port mirroring, which are configured under the **[edit forwarding-options port-mirroring]** hierarchy. Therefore, the filter ***term*** cannot support Layer 2 port mirroring for logical systems.
- For a Layer 2 port mirroring firewall filter in which you implicitly reference Layer 2 port mirroring properties by including the **port-mirror** statement, if multiple named instances of Layer 2 port mirroring are bound to the underlying physical interface, then only the first binding in the stanza (or the only binding) is used at the logical interface. This is done mainly for backward compatibility.
- Layer 2 port-mirroring firewall filters do not support the use of next-hop subgroups for load-balancing mirrored traffic.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Application of Layer 2 Port Mirroring Types on page 78
- Precedence of Multiple Levels of Layer 2 Port Mirroring on a Physical Interface on page 80
- Layer 2 Port Mirroring of PE Router Logical Interfaces on page 80
- Layer 2 Port Mirroring of PE Router Aggregated Ethernet Interfaces on page 82

Application of Layer 2 Port Mirroring Types

You can apply different sets of Layer 2 port-mirroring properties to the VPLS packets at different ingress or egress points of an MX Series route.

Table 6 on page 78 describes the three types of Layer 2 port mirroring you can configure on an MX Series router: the global instance, named instances, and firewall filters.

Table 6: Application of Layer 2 Port Mirroring Types

Type of Layer2PortMirroring Definition	Point of Application	Scope of Mirroring	Description	Configuration Details
Global Instance of Layer2PortMirroring	All ports in the MX Series router chassis	VPLS packets received on all ports in the MX Series router chassis	If configured, the global port-mirroring properties implicitly apply to all VPLS packets received on all ports in the router chassis.	See "Configuring the Global Instance of Layer 2 Port Mirroring" on page 85
Named Instance of Layer2PortMirroring	Ports grouped at the FPC level See "Binding Layer 2 Port Mirroring to Ports Grouped at the FPC Level" on page 92.	VPLS packets received on ports associated with a specific DPC or FPC and its Packet Forwarding Engines.	Overrides any port-mirroring properties configured by the global port-mirroring instance.	See "Defining a Named Instance of Layer 2 Port Mirroring" on page 88. **NOTE:** The number of port-mirroring destinations supported for an MX Series router is limited to the number of Packet Forwarding Engines contained on the DPCs installed in the router chassis.
	Ports grouped at the PIC level See "Binding Layer 2 Port Mirroring to Ports Grouped at the PIC Level" on page 94.	VPLS packets received on ports associated with a specific Packet Forwarding Engine.	Overrides any port-mirroring properties configured at the FPC level or in the global port-mirroring instance.	

Table 6: Application of Layer 2 Port Mirroring Types *(continued)*

Type of Layer2PortMirroring Definition	Point of Application	Scope of Mirroring	Description	Configuration Details
Layer2Port-Mirroring Firewall Filter	Logical interface (including an aggregated Ethernet interface) See "Applying Layer 2 Port Mirroring to a Logical Interface" on page 101.	VPLS packets received or sent on a logical interface.	In the firewall filter configuration, include *action* and *action-modifier* terms to apply to the packets selected for mirroring: 1. The **accept** action is recommended. 2. Specify port mirroring by Including one of the following modifiers: • The **port-mirror** modifier implicitly references the port-mirroring properties currently bound to the underlying physical interfaces. • The **port-mirror-instance** ***pm-instance-name*** modifier explicitly references a named instance of port mirroring. 3. (Optional) For tunnel interface input packets only, to mirror the packets to additional destinations, include the **next-hop-group** ***next-hop-group-name*** modifier. This modifier references a next-hop-group that specifies the next-hop addresses (for sending additional copies of packets to an analyzer).	See "Defining a Layer 2 Port-Mirroring Firewall Filter" on page 97. **NOTE:** Layer 2 port-mirroring firewall filters are not supported for logical systems. For mirroring tunnel interface input packets to multiple destinations, also see "Defining a Next-Hop Group for Layer 2 Port Mirroring" on page 108.
	Bridge domain forwarding table or flood table See "Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a Bridge Domain" on page 104.	Layer 2 traffic forwarded or flooded to a bridge domain		
	VPLS routing instance forwarding table or flood table See "Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a VPLS Routing Instance" on page 106.	Layer 2 traffic forwarded or flooded to a VPLS routing instance		

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Restrictions on Layer 2 Port Mirroring on page 77
- Precedence of Multiple Levels of Layer 2 Port Mirroring on a Physical Interface on page 80
- Layer 2 Port Mirroring of PE Router Logical Interfaces on page 80
- Layer 2 Port Mirroring of PE Router Aggregated Ethernet Interfaces on page 82

Precedence of Multiple Levels of Layer 2 Port Mirroring on a Physical Interface

You can bind different sets of Layer 2 port mirroring properties (the global instance and one or more named instances) at various levels of an MX Series router chassis (at the chassis level, at the FPC level, or at the PIC level). Therefore, it is possible for a single group of physical interfaces to be bound to multiple Layer 2 port mirroring definitions.

If a group of ports (or, in the case of a PIC-level binding in an MX960 router, a single port) is bound to multiple Layer 2 port mirroring definitions, the router applies the Layer 2 port-mirroring properties to those ports as follows:

1. **Chassis-level port-mirroring properties implicitly apply to all ports in the chassis.** If an MX Series router is configured with the global port-mirroring instance, those port mirroring properties apply to all ports. See "Configuring the Global Instance of Layer 2 Port Mirroring" on page 85.
2. **FPC-level port-mirroring properties override chassis-level properties.** If a DPC or FPC is bound to a named instance of port mirroring, those port mirroring properties apply to all ports associated with that DPC or FPC, overriding any port mirroring properties bound at the chassis level. See "Binding Layer 2 Port Mirroring to Ports Grouped at the FPC Level" on page 92.
3. **PIC-level port-mirroring properties override FPC-level properties.** If a Packet Forwarding Engine or PIC is bound to a named instance of port mirroring, those port mirroring properties apply to all ports associated with the Packet Forwarding Engine or PIC, overriding any port mirroring properties bound to those ports at the FPC level. See "Binding Layer 2 Port Mirroring to Ports Grouped at the PIC Level" on page 94.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Restrictions on Layer 2 Port Mirroring on page 77
- Application of Layer 2 Port Mirroring Types on page 78
- Layer 2 Port Mirroring of PE Router Logical Interfaces on page 80
- Layer 2 Port Mirroring of PE Router Aggregated Ethernet Interfaces on page 82

Behavior of Layer 2 Port Mirroring of Logical Interfaces on PE Routers

The following topics describe the behavior of Layer 2 port-mirroring firewall filtering on MX Series routers configured as provider edge (PE) routers connected to customer edge (CE) devices, such as routers and Ethernet switches.

- Layer 2 Port Mirroring of PE Router Logical Interfaces on page 80
- Layer 2 Port Mirroring of PE Router Aggregated Ethernet Interfaces on page 82

Layer 2 Port Mirroring of PE Router Logical Interfaces

For an MX Series router configured as a provider edge (PE) router on the customer-facing edge of a service provider network, you can apply a Layer 2 port-mirroring firewall filter

at the following ingress and egress points to mirror the traffic between the MX Series router and customer edge (CE) devices, such as routers and Ethernet switches.

Table 7 on page 81 describes the ways in which you can apply Layer 2 port-mirroring firewall filters to an MX Series router configured as a PE router.

Table 7: Application of Layer 2 Port Mirroring Firewall Filters on PE Routers

Point of Application	Scope of Mirroring	Notes	Configuration Details
Ingress Customer-Facing Logical Interface	Packets originating within a service provider customer's network, sent first to a CE device, and sent next to the MX Series PE router.	You can also configure aggregated Ethernet interfaces between CE devices and PE routers for VPLS routing instances. Traffic is load-balanced across all of the links in the aggregated interface. Traffic received on an aggregated Ethernet interface is forwarded over a different interface based on a lookup of the destination MAC (DMAC) address: • Packets destined for a local site are sent out of the load-balanced child interface. • Packets destined for the remote site are encapsulated and forwarded over a label-switched path (LSP).	See "Applying Layer 2 Port Mirroring to a Logical Interface" on page 101. For more information about VPLS routing instances, see "Configuring a VPLS Routing Instance" on page 16 and "Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances" on page 136.
Egress Customer-Facing Logical Interface	Unicast packets being forwarded by the MX Series router to another PE router. **NOTE:** If you apply a port-mirroring filter to the output for a logical interface, only unicast packets are mirrored. To mirror multicast, unknown unicast, and broadcast packets, apply a filter to the input to the flood table of a bridge domain or VPLS routing instance.		See "Applying Layer 2 Port Mirroring to a Logical Interface" on page 101.
Input to a Bridge Domain Forwarding Table or Flood Table	Forwarding traffic or flood traffic sent to the bridge domain from a CE device.	Forwarding and flood traffic typically consists of broadcast packets, multicast packets, unicast packets with an unknown destination MAC address, or packets with a MAC entry in the DMAC routing table.	See "Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a Bridge Domain" on page 104. For information about flooding behavior in VPLS, see the *Junos OS VPNs Configuration Guide*.
Input to a VPLS Routing Instance Forwarding Table or Flood Table	Forwarding traffic or flood traffic sent to the VPLS routing instance from a CE device.		See "Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a VPLS Routing Instance" on page 106. For information about flooding behavior in VPLS, see the *Junos OS VPNs Configuration Guide*.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Example: Layer 2 Port Mirroring at a Logical Interface on page 117

Layer 2 Port Mirroring of PE Router Aggregated Ethernet Interfaces

An aggregated Ethernet interface is a virtual aggregated link that consists of a set of physical interfaces of the same speed and operating in full-duplex link connection mode. You can configure aggregated Ethernet interfaces between CE devices and PE routers for VPLS routing instances. Traffic is load-balanced across all of the links in the aggregated interface. If one or more links in the aggregated interface fails, the traffic is switched to the remaining links.

You can apply a Layer 2 port-mirroring firewall filter to an aggregated Ethernet interface to configure port-mirroring at the parent interface. However, if any child interfaces are bound to different Layer 2 port-mirroring instances, packets received at the child interfaces will be mirrored to the destinations specified by their respective port-mirroring instances. Thus, multiple child interfaces can mirror packets to multiple destinations.

For example, suppose the parent aggregated Ethernet interface instance **ae0** has two child interfaces:

- **xe-2/0/0**
- **xe-3/1/2**

Suppose that these child interfaces on **ae0** are bound to two different Layer 2 port-mirroring instances:

- **pm_instance_A**—A named instance of Layer 2 port-mirroring, bound to child interface **xe-2/0/0**.
- **pm_instance_B**—A named instance of Layer 2 port-mirroring, bound to child interface **xe-3/1/2**.

Now suppose you apply a Layer 2 port-mirroring firewall filter to the Layer 2 traffic sent on **ae0.0** (logical unit **0** on the aggregated Ethernet interface instance **0**). This enables port mirroring on **ae0.0**, which has the following effect on the processing of traffic received on the child interfaces for which Layer 2 port-mirroring properties are specified:

- The packets received on **xe-2/0/0.0** are mirrored to the output interfaces configured in port-mirroring instance **pm_instance_A**.
- The packets received on **xe-3/1/2.0** are mirrored to the output interfaces configured in port-mirroring instance **pm_instance_B**.

Because **pm_instance_A** and **pm_instance_B** can specify different packet-selection properties or mirror destination properties, the packets received on **xe-2/0/0.0** and **xe-3/1/2.0** can mirror different packets to different destinations.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Example: Layer 2 Port Mirroring for a Layer 2 VPN on page 119

CHAPTER 7

Configuring Layer 2 Port Mirroring

Configuring Layer 2 Port Mirroring for Physical Interfaces

The following topics describe the configuration of Layer 2 port mirroring for physical interfaces in MX Series routers:

Configuring the Global Instance of Layer 2 Port Mirroring

On an MX Series router, you can configure a set of Layer 2 port-mirroring properties that implicitly apply to packets received on all ports in the router chassis.

To configure the global instance of Layer 2 port mirroring on an MX Series router:

1. Enable configuration of the Layer 2 port mirroring:

   ```
   [edit]
   user@host# edit forwarding-options port-mirroring
   ```

2. Enable configuration of the packet-selection properties:

   ```
   [edit forwarding-options port-mirroring]
   user@host# edit input
   ```

3. Specify global-level packet-selection properties.

   a. Specify the number of packets to select:

      ```
      [edit forwarding-options port-mirroring input]
      user@host# set rate number
      ```

      The valid range is **1** through **65535**.

   b. Specify the number of packets to mirror from each selection:

      ```
      [edit forwarding-options port-mirroring input]
      user@host# set run-length number
      ```

      The valid range is **0** through **20**. The default value is **0**.

   c. Specify the length to which mirrored packets are to be truncated:

      ```
      [edit forwarding-options port-mirroring input]
      user@host# set maximum-packet-length number
      ```

      The valid range is **0** through **9216**. The default value is **0**, which means the mirrored packets are not truncated.

4. Specify the global-level Layer 2 address-type family from which traffic is to be selected for mirroring:

   ```
   [edit forwarding-options port-mirroring input]
   user@host# up
   [edit forwarding-options port-mirroring]
   user@host# edit family family
   ```

   The value of the *family* option can be **bridge**, **ccc**, or **vpls**.

   NOTE: Under the **[edit forwarding-options port-mirroring]** hierarchy level, the protocol family statement **family bridge** is an alias for **family vpls**. The command-line interface (CLI) displays Layer 2 port-mirroring configurations as **family vpls**, even for Layer 2 port-mirroring configured as **family bridge**. Use **family bridge** when the physical interface is configured with **encapsulation ethernet-bridge**.

5. Enable configuration of global-level mirror destination properties for this address family:

   ```
   [edit forwarding-options port-mirroring family family]
   user@host# edit output
   ```

6. Specify global-level mirror destination properties for this address family.

   a. Specify the physical interface on which to send the mirrored packets:

      ```
      [edit forwarding-options port-mirroring family family output]
      user@host# set interface interface-name
      ```

      You can also specify an integrated routing and bridging (IRB) interface as the output interface.

   b. (Optional) Allow configuration of filters on the destination interface for the named port-mirroring instance:

      ```
      [edit forwarding-options port-mirroring family family output]
      user@host# set no-filter-check
      ```

7. (Optional) Specify that any packets selected for mirroring are to be mirrored only once to any mirroring destination:

   ```
   [edit forwarding-options port-mirroring family family output]
   user@host# up 2
   [edit forwarding-options port-mirroring]
   user@host# set mirror-once
   ```

   TIP: Enable the mirror-once option when an MX Series router is configured to perform Layer 2 port mirroring at both ingress and egress interfaces, which could result in sending duplicate packets to the same destination (which would complicate the analysis of the mirrored traffic).

8. Verify the minimum configuration of the global instance of Layer 2 port mirroring:

   ```
   [edit forwarding-options ... ]
   user@host# top
   [edit]
   user@host# show forwarding-options

   forwarding-options {
     port-mirroring {
       input { # Global packet-selection properties.
         maximum-packet-length number; # Default is 0.
         rate number;
         run-length number;
       }
       family (ccc | vpls) { # Address- type 'bridge' displays as 'vpls'.
         output { # Global mirror destination properties.
           interface interface-name;
           no-filter-check; # Optional. Allow filters on interface.
         }
       }
       mirror-once; # Optional. Mirror destinations do not receive duplicate packets.
     }
   }
   ```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Global Instance on page 71
- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113

Defining a Named Instance of Layer 2 Port Mirroring

On an MX Series router, you can define a set of Layer 2 port-mirroring properties that you can bind to a particular Packet Forwarding Engine (at the PIC level of the router chassis) or to group of Packet Forwarding Engines (at the DPC or FPC level of the route chassis).

To define a named instance of Layer 2 port mirroring on an MX Series router:

1. Enable configuration of a named instance of Layer 2 port mirroring :

   ```
   [edit]
   user@host# edit forwarding-options port-mirroring instance pm-instance-name
   ```

2. Enable configuration of the packet-sampling properties:

   ```
   [edit forwarding-options port-mirroring instance pm-instance-name]
   user@host# edit input
   ```

3. Specify packet-selection properties:

   a. Specify the number of packets to select:

      [edit forwarding-options port-mirroring instance *pm-instance-name* input]
      user@host# **set rate** ***number***

      The valid range is **1** through **65535**.

   b. Specify the number of packets to mirror from each selection:

      [edit forwarding-options port-mirroring instance *pm-named-instance* input]
      user@host# **set run-length** ***number***

      The valid range is **0** through **20**. The default value is **0**.

      NOTE: **The run-length statement is not supported on MX80 routers.**

   c. Specify the length to which mirrored packets are to be truncated:

      [edit forwarding-options port-mirroring instance *pm-instance-name* input]
      user@host# **set maximum-packet-length** ***number***

      The valid range is **0** through **9216**. The default value is **0**, which means the mirrored packets are not truncated.

      NOTE: **The maximum-packet-length statement is not supported on MX80 routers.**

4. Enable configuration of the mirror destination properties for Layer 2 packets that are part of bridging domain, Layer 2 switching cross-connects, or virtual private LAN service (VPLS):

   a. Specify the Layer 2 address family type of traffic to be mirrored:

      [edit forwarding-options port-mirroring instance *pm-instance-name* input]
      user@host# **up**
      [edit forwarding-options port-mirroring instance *pm-instance-name*]
      user@host# **edit family** ***family***

      The value of the *family* option can be **bridge**, **ccc**, or **vpls**.

      NOTE: **Under the [edit forwarding-options port-mirroring] hierarchy level, the protocol family statement family bridge is an alias for family vpls. The command-line interface (CLI) displays Layer 2 port-mirroring configurations as family vpls, even for Layer 2 port-mirroring configured as family bridge. Use family bridge when the physical interface is configured with encapsulation ethernet-bridge.**

   b. Enable configuration of the mirror destination properties:

```
[edit forwarding-options port-mirroring instance pm-instance-name family family]
user@host# edit output
```

5. Specify mirror destination properties.

   a. Specify the physical interface on which to send the mirrored packets:

   ```
   [edit forwarding-options port-mirroring instance pm-instance-name family family
     output]
   user@host# set interface interface-name
   ```

   b. (Optional) Allow configuration of filters on the destination interface for the global port-mirroring instance:

   ```
   [edit forwarding-options port-mirroring instance pm-instance-name family family
     output]
   user@host# set no-filter-check
   ```

   NOTE: You cannot configure port mirroring instances on MX80 routers. You can only configure port mirroring at the global level on MX80 routers.

6. (Optional) Specify that any packets selected for mirroring are to be mirrored only once to any mirroring destination:

   ```
   [edit forwarding-options port-mirroring instance pm-instance-name family family
     output]
   user@host# up 3
   [edit forwarding-options port-mirroring]
   user@host# set mirror-once
   ```

   TIP: Enable the global mirror-once option when an MX Series router is configured to perform Layer 2 port mirroring at both ingress and egress interfaces, which could result in sending duplicate packets to the same destination (which in turn would complicate the analysis of the mirrored traffic).

7. To configure a mirroring destination for a different packet family type, repeat steps 4 through 6.

8. Verify the minimum configuration of the named instances of Layer 2 port mirroring:

   ```
   [edit forwarding-options ... ]
   user@host# top
   [edit]
   user@host# show forwarding-options

   forwarding-options {
     port-mirroring {
       ... optional-global-port-mirroring-configuration ...
       instance {
         pm-instance-name ( # A named instance of port mirroring
           input { # Packet-selection properties
   ```

```
                maximum-packet-length number; # Default is 0.
                rate number;
                run-length number;
              }
              family (ccc | vpls) { # Address- type 'bridge' displays as 'vpls'.
                output { # Mirror destination properties
                  interface interface-name;
                  no-filter-check; # Optional. Allow filters on interface.
                }
              }
            }
          }
          mirror-once; # Optional. Mirror destinations do not receive duplicate packets.
        }
      }
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Named Instances on page 72
- Binding Layer 2 Port Mirroring to Ports Grouped at the FPC Level on page 92
- Binding Layer 2 Port Mirroring to Ports Grouped at the PIC Level on page 94
- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113

Displaying Information About DPCs or FPCs in an MX Series Router

To display information about the number and types of DPCs or FPCs in an MX Series router, the number of Packet Forwarding Engines on each, and the number and types of ports per Packet Forwarding Engine, you can use the following chassis operational mode commands:

- **show chassis hardware**
- **show chassis fabric fpcs**

For more information about chassis operational mode commands, see the *Junos OS System Basics and Services Command Reference*.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Properties on page 70
- Layer 2 Port Mirroring Named Instances on page 72

Binding Layer 2 Port Mirroring to Ports Grouped at the FPC Level

On an MX Series router, you can bind a named instance of Layer 2 port mirroring to a specific DPC or to a specific FPC in the router chassis. This is known as binding a named instance of Layer 2 port mirroring *at the FPC level* of the router chassis. The port mirroring properties specified in the named instance are applied to all physical ports associated with all Packet Forwarding Engines on the specified DPC or FPC.

NOTE: You can also bind a named instance of Layer 2 port mirroring to a specific Packet Forwarding Engine on a DPC or FPC in the router chassis.

For any packet-type family supported by Layer 2 port mirroring

- Port mirroring properties bound to a specific DPC or FPC override any port-mirroring properties configured at the global level.
- Port mirroring properties bound to a specific Packet Forwarding Engine override any port-mirroring properties configured at the DPC or FPC level.

You can apply up to two named instances of Layer 2 port mirroring to the same group of ports within the router chassis. By applying two different port-mirroring instances to the same DPC or FPC, you can bind two distinct Layer 2 port mirroring specifications to a single group of ports.

Before you begin, complete the following tasks:

- Define a named instance of Layer 2 port mirroring. See "Defining a Named Instance of Layer 2 Port Mirroring" on page 88.
- Display information about the number and types of DPCs or FPCs in the MX Series router, the number of Packet Forwarding Engines on each, and the number and types of ports per Packet Forwarding Engine. See "Displaying Information About DPCs or FPCs in an MX Series Router" on page 91.

To bind a named instance of Layer 2 port-mirroring to a DPC or FPC and its Packet Forwarding Engines:

1. Enable configuration of the router chassis properties:

   ```
   [edit]
   user@host# edit chassis
   ```

2. Enable configuration of a DPC (and its corresponding Packet Forwarding Engines) or an FPC (and its installed PICs):

   ```
   [edit chassis]
   user@host# edit fpc slot-number
   ```

3. Bind a named instance of Layer 2 port mirroring (***pm-instance-name***) to the DPC or FPC:

   ```
   [edit chassis fpc slot-number]
   user@host# set port-mirror-instance pm-instance-name
   ```

4. (Optional) To bind a second named instance of Layer 2 port mirroring to the same DPC or FPC, repeat step 3 and specify a different named instance of Layer 2 port mirroring.
5. Verify the minimum configuration of the binding:

```
[edit chassis fpc slot-number port-mirror-instance pm-instance-name]
user@host# top
[edit]
user@host# show chassis

chassis {
  fpc slot-number { # Bind two port mirroring named instances at the FPC level.
    port-mirror-instance pm-instance-name-1;
    port-mirror-instance pm-instance-name-2;
  }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Named Instances on page 72
- Defining a Named Instance of Layer 2 Port Mirroring on page 88
- Binding Layer 2 Port Mirroring to Ports Grouped at the PIC Level on page 94
- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113

Binding Layer 2 Port Mirroring to Ports Grouped at the PIC Level

On an MX Series router, you can bind a named instance of Layer 2 port mirroring to the ports associated with a specific Packet Forwarding Engine (on a DPC) or to the ports associated with a specific PIC (installed in an FPC). This is known as binding a named instance of Layer 2 port mirroring *at the PIC level* of the router chassis. The port-mirroring properties specified in the named instance are applied to all physical ports associated with the specified Packet Forwarding Engine.

NOTE: **You can also bind a named instance of Layer 2 port mirroring to a specific DPC or FPC in the router chassis.**

For any packet-type family supported by Layer 2 port mirroring:

- **Port mirroring properties bound to a specific Packet Forwarding Engine override any port-mirroring properties configured at the DPC or FPC level.**
- **Port mirroring properties bound to a specific DPC or FPC override any port-mirroring properties configured at the global level.**

You can apply up to two named instances of Layer 2 port mirroring to the same group of ports within the router chassis. By applying two different port-mirroring instances to the same Packet Forwarding Engine or PIC, you can bind two distinct Layer 2 port mirroring specifications to a single group of ports.

For MX960 routers, there is a one-to-one mapping of Packet Forwarding Engines to Ethernet ports. Therefore, on MX960 routers only, you can bind a named instance of Layer 2 port mirroring to a *specific port* by binding the instance to the Packet Forwarding Engine associated with the port.

Before you begin, complete the following tasks:

- Define a named instance of Layer 2 port mirroring. See "Defining a Named Instance of Layer 2 Port Mirroring" on page 88.
- Display information about the number and types of DPCs in the MX Series router, the number of Packet Forwarding Engines on each DPC, and the number and types of ports per Packet Forwarding Engine. See "Displaying Information About DPCs or FPCs in an MX Series Router" on page 91.

To bind a named instance of Layer 2 port-mirroring to a Packet Forwarding Engine:

1. Enable configuration of the router chassis properties:

   ```
   [edit]
   user@host# edit chassis
   ```

2. Enable configuration of a Packet Forwarding Engine or PIC:

   ```
   [edit chassis]
   user@host# edit fpc slot-number
   user@host# edit pic slot-number
   ```

3. Bind a named instance of Layer 2 port mirroring (***pm-instance-name***) to the Packet Forwarding Engine or PIC:

   [edit chassis fpc *slot-number* pic *slot-number*]
   user@host# **set port-mirror-instance** ***pm-instance-name***

4. (Optional) To bind a second named instance of Layer 2 port mirroring to the same Packet Forwarding Engine or PIC, repeat step 3 and specify a different named instance of Layer 2 port mirroring.

5. Verify the minimum configuration of the binding:

```
[edit forwarding-options ... ]
user@host# top
[edit]
user@host# show chassis
chassis {
   fpc slot-number {
      ... optional-binding-of-a-port-mirroring-instance-at-the-dpc-level ...
      pic slot-number { # Bind two port-mirroring named instances at the PIC level.
         port-mirror-instance pm-instance-name-1;
         port-mirror-instance pm-instance-name-2;
      }
   }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Named Instances on page 72
- Defining a Named Instance of Layer 2 Port Mirroring on page 88
- Binding Layer 2 Port Mirroring to Ports Grouped at the FPC Level on page 92
- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113

Displaying Layer 2 Port-Mirroring Instance Settings and Status

To display the current state of port-mirroring instances, use the **show forwarding-options port-mirroring <terse | detail> <*instance-name*>** operational command.

For more information about displaying port mirroring instance settings and status, see the *Junos OS System Basics Configuration Guide*.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Global Instance on page 71
- Layer 2 Port Mirroring Named Instances on page 72
- Configuring the Global Instance of Layer 2 Port Mirroring on page 85
- Defining a Named Instance of Layer 2 Port Mirroring on page 88
- Disabling Layer 2 Port Mirroring Instances on page 96

- Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis on page 111
- Example: Layer 2 Port Mirroring with Multiple Instances on page 113

Disabling Layer 2 Port Mirroring Instances

You can disable the global instance of Layer 2 port mirroring, a particular named instance, or all instances of port mirroring:

- To disable the global instance of Layer 2 port mirroring, include the **disable** statement at the **[edit forwarding-options port-mirroring]** hierarchy level:

```
[edit]
forwarding-options {
  port-mirroring {
    disable; Disables the global instance of Layer 2 port mirroring.
    ...global-instance-of-layer-2-port-mirroring-configuration...
  }
}
```

- To disable the definition of a particular named instance of Layer 2 port mirroring, include the **disable** statement at the **[edit forwarding-options port-mirroring instance *instance-name*]** hierarchy level:

```
[edit]
forwarding-options {
  port-mirroring {
    ...optional-configuration-of-the-global-instance-of-layer-2-port-mirroring...
    instance {
      port-mirroring-instance-name {
        disable; Disables this named instance of Layer 2 port mirroring.
        ...definition-of-a-named-instance-of-layer-2-port-mirroring...
      }
    }
  }
}
```

- To disable the global instance and all named instances of Layer 2 port mirroring, include the **disable-all-instances** statement at the **[edit forwarding-options port-mirroring]** hierarchy level:

```
[edit]
forwarding-options {
  port-mirroring {
    disable-all-instances; Disables all instances of Layer 2 port mirroring.
    ...optional-configuration-of-the-global-instance-of-layer-2-port-mirroring...
    instance {
      port-mirroring-instance-name {
        ...definition-of-a-named-instance-of-layer-2-port-mirroring...
      }
    }
  }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Global Instance on page 71
- Layer 2 Port Mirroring Named Instances on page 72
- Displaying Layer 2 Port-Mirroring Instance Settings and Status on page 95

Configuring Layer 2 Port Mirroring for Logical Interfaces

The following topics describe the configuration of Layer 2 port mirroring for logical interfaces in MX Series routers:

- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Applying Layer 2 Port Mirroring to a Logical Interface on page 101
- Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a Bridge Domain on page 104
- Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a VPLS Routing Instance on page 106

Defining a Layer 2 Port-Mirroring Firewall Filter

For virtual private LAN service (VPLS) traffic (**family bridge** or **family vpls**) and for Layer 2 VPNs with **family ccc** on MX Series routers only, you can define a firewall filter that specifies Layer 2 port mirroring as the action to be performed if a packet matches the conditions configured in the firewall filter term.

You can use a Layer 2 port-mirroring firewall filter in the following ways:

- To mirror packets received or sent on a logical interface.
- To mirror packets forwarded or flooded to a bridge domain.
- To mirror packets forwarded or flooded to a VPLS routing instance.
- To mirror tunnel interface input packets only to multiple destinations.

For a summary of the three types of Layer 2 port-mirroring you can configure on an MX Series router, see "Application of Layer 2 Port Mirroring Types" on page 78.

For information about configuring firewall filters in general (including in a Layer 3 environment), see Stateless Firewall Filter Overview and How Standard Firewall Filters Evaluate Packets in the *Junos OS Firewall Filter and Policer Configuration Guide*.

To define a firewall filter with a Layer 2 port-mirroring action:

1. Enable configuration of firewall filters for Layer 2 packets that are part of a bridge domain, a Layer 2 switching cross-connect, or a virtual private LAN service (VPLS):

   ```
   [edit]
   user@host# edit firewall family family
   ```

   The value of the ***family*** option can be **bridge**, **ccc**, or **vpls**.

2. Enable configuration of a firewall filter ***pm-filter-name***:

   [edit firewall family *family*]
   user@host# **edit filter** ***pm-filter-name***

3. Enable configuration of a firewall filter term ***pm-filter-term-name***:

   [edit firewall family *family* filter *pm-filter-name*]
   user@host# **edit term** ***pm-filter-term-name***

   For more information about firewall filter terms in general (including in a Layer 3 environment), see Guidelines for Configuring Standard Firewall Filters in the *Junos OS Firewall Filter and Policer Configuration Guide*.

4. (Optional) Specify the firewall filter match conditions based on the route source address *only if* you want to mirror a subset of the sampled packets.

   For information about configuring firewall filter match conditions in general (including in a Layer 3 environment), see Firewall Filter Match Conditions Based on Numbers or Text Aliases, Firewall Filter Match Conditions Based on Bit-Field Values, Firewall Filter Match Conditions Based on Address Fields, and Firewall Filter Match Conditions Based on Address Classes, in the *Junos OS Firewall Filter and Policer Configuration Guide*.

   - For detailed information about Layer 2 bridging firewall filter match conditions (which are supported on MX Series routers only), see Standard Firewall Filter Match Conditions for Layer 2 Bridging Traffic.
   - For detailed information about VPLS firewall filter match conditions, see Standard Firewall Filter Match Conditions for VPLS Traffic.
   - For detailed information about Layer 2 circuit cross-connect (CCC) firewall filter match conditions, see Standard Firewall Filter Match Conditions for Layer 2 CCC Traffic.

   NOTE: If you want all sampled packets to be considered to match (and be subjected to the actions specified in the **then** statement), then omit the **from** statement altogether.

5. Enable configuration of the ***action*** and ***action-modifier*** to apply to matching packets:

   [edit firewall family *family* filter *pm-filter-name* term *pm-filter-term-name*]
   user@host# **edit then**

6. Specify the actions to be taken on matching packets:

   [edit firewall family *family* filter *pm-filter-name* term *pm-filter-term-name* then]
   user@host# **set** ***action***

   The recommended value for the ***action*** is **accept**. If you do not specify an action, or if you omit the **then** statement entirely, all packets that match the conditions in the **from** statement are accepted.

7. Specify Layer 2 port mirroring or a next-hop group as the ***action-modifier***:

   - To reference the Layer 2 port mirroring properties currently in effect for the Packet Forwarding Engine or PIC associated with the underlying physical interface, use the **port-mirror** statement:

     ```
     [edit firewall family family filter pm-filter-name term pm-filter-term-name then]
     user@host# set port-mirror
     ```

   - To reference the Layer 2 port mirroring properties configured in a specific named instance, use the **port-mirror-instance** ***pm-instance-name*** action modifier:

     ```
     [edit firewall family family filter pm-filter-name term pm-filter-term-name then]
     user@host# set port-mirror-instance pm-instance-name
     ```

     If the underlying physical interface is not bound to a named instance of Layer 2 port mirroring but instead is implicitly bound to the global instance of Layer 2 port mirroring, then traffic at the logical interface is mirrored according to the properties specified in the named instance referenced by the **port-mirror-instance** action modifier.

   - To reference a next-hop group that specifies the next-hop addresses (for sending additional copies of packets to an analyzer), use the **next-hop-group** ***pm-next-hop-group-name*** action modifier:

     ```
     [edit firewall family family filter pm-filter-name term pm-filter-term-name then]
     user@host# set next-hop-group pm-next-hop-group-name
     ```

     For configuration information about next-hop groups, see "Defining a Next-Hop Group for Layer 2 Port Mirroring" on page 108. If you specify a next-hop group for Layer 2 port mirroring, the firewall filter term applies to the tunnel interface input only.

8. Verify the minimum configuration of the Layer 2 port-mirroring firewall filter:

   ```
   [edit firewall ... ]
   user@host# top
   [edit]
   user@host# show firewall

   family (bridge | ccc | vpls) { # Type of packets to mirror
     filter pm-filter-name { # Firewall filter name
       term pm-filter-term-name {
         from { # Do not specify match conditions based on route source address
         }
         then {
           action; # Recommended action is 'accept'
           action-modifier; # Three options for Layer 2 port mirroring
         }
       }
     }
   }
   ```

   In the firewall filter term **then** statement, the *action-modifier* can be **port-mirror**, **port-mirror-instance** ***pm-instance-name***, or **next-hop-group** ***pm-next-hop-group-name***.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Layer 2 Port Mirroring to Multiple Destinations Using Next-Hop Groups on page 76
- Example: Layer 2 Port Mirroring at a Logical Interface on page 117
- Example: Layer 2 Port Mirroring for a Layer 2 VPN on page 119
- Example: Layer 2 Port Mirroring for a Layer 2 VPN with LAG Links on page 122
- Example: Layer 2 Port Mirroring to Multiple Destinations on page 124

Applying Layer 2 Port Mirroring to a Logical Interface

You can apply a Layer 2 port-mirroring firewall filter to the input or to the output of a logical interface, including an aggregated Ethernet logical interface. Only packets of the address-type family specified by the filter action are mirrored.

Before you begin, complete the following task:

- Define a Layer 2 port-mirroring firewall filter to be applied to the input to a logical interface or output to a logical interface. For details, see "Defining a Layer 2 Port-Mirroring Firewall Filter" on page 97.

NOTE: This configuration task shows two Layer 2 port-mirroring firewall filters: one filter applied to the logical interface ingress traffic, and one filter applied to the logical interface egress traffic.

To apply a Layer 2 port-mirroring firewall filter to an input or output logical interface:

1. Configure the underlying physical interface for the logical interface.

   a. Enable configuration of the underlying physical interface:

      [edit]
      user@host# **edit interfaces** ***interface-name***

      NOTE: A port-mirroring firewall filter can also be applied to an aggregated-Ethernet logical interface.

   b. For Fast Ethernet and Gigabit Ethernet interfaces and aggregated Ethernet interfaces configured for VPLS, enable the reception and transmission of 802.1Q VLAN-tagged frames on the interface:

      [edit interfaces *interface-name*]
      user@host# **set vlan-tagging**

   c. For Ethernet interfaces that have IEEE 802.1Q VLAN tagging and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID, set the logical link-layer encapsulation type:

      [edit interfaces *interface-name*]
      user@host# **set encapsulation extended-vlan-bridge**

2. Configure the logical interface to which you want to apply a Layer 2 port-mirroring firewall filter.

   a. Specify the logical unit number:

      [edit interfaces *interface-name*]
      user@host# **edit unit** ***logical-unit-number***

   b.

For a Fast Ethernet, Gigabit Ethernet, or Aggregated Ethernet interface, bind an 802.1Q VLAN tag ID to the logical interface:

```
[edit interfaces interface-name unit logical-unit-number]
user@host# set vlan-id number
```

3. Enable specification of an input or output filter to be applied to Layer 2 packets that are part of bridging domain, Layer 2 switching cross-connects, or virtual private LAN service (VPLS).

   - If the filter is to be evaluated when packets are received on the interface:

     ```
     [edit interfaces interface-name unit logical-unit-number]
     user@host# set family family filter input pm-filter-name-a
     ```

   - If the filter is to be evaluated when packets are sent on the interface:

     ```
     [edit interfaces interface-name unit logical-unit-number]
     user@host# set family family filter output pm-filter-name-b
     ```

   The value of the *family* option can be **bridge**, **ccc**, or **vpls**.

   NOTE: If port-mirroring firewall filters are applied at both the input and output of a logical interface, two copies of each packet are mirrored. To prevent the router from forwarding duplicate packets to the same destination, include the optional **mirror-once** statement at the **[edit forwarding-options]** hierarchy level.

4. Verify the minimum configuration for applying a named Layer 2 port mirroring firewall filter to a logical interface:

```
[edit interfaces interface-name unit logical-unit-number family family filter ... ]
user@host# top
[edit]
user@host# show interfaces

interfaces {
  interface-name {
    vlan-tagging;
    encapsulation extended-vlan-bridge;
    unit number { # Apply a filter to the input of this interface
      vlan-id number;
      family (bridge | ccc | vpls) {
        filter {
          input pm-filter-for-logical-interface-input;
        }
      }
    }
    unit number { # Apply a filter to the output of this interface
      vlan-id number;
      family (bridge | ccc | vpls) {
        filter {
          output pm-filter-for-logical-interface-output;
        }
      }
```

```
        }
    }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a Bridge Domain on page 104
- Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a VPLS Routing Instance on page 106
- Example: Layer 2 Port Mirroring at a Logical Interface on page 117
- Example: Layer 2 Port Mirroring for a Layer 2 VPN on page 119
- Example: Layer 2 Port Mirroring for a Layer 2 VPN with LAG Links on page 122

Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a Bridge Domain

You can apply a Layer 2 port-mirroring firewall filter to traffic being forwarded or flooded to a bridge domain. Only packets of the specified family type and forwarded or flooded to that bridge domain are mirrored.

Before you begin, complete the following task:

- Define a Layer 2 port-mirroring firewall filter to be applied to the traffic being forwarded to a bridge domain or flooded to a bridge domain. For details, see "Defining a Layer 2 Port-Mirroring Firewall Filter" on page 97.

NOTE: This configuration task shows two Layer_2 port-mirroring firewall filters: one filter applied to the bridge domain forwarding table ingress traffic, and one filter applied to the bridge domain flood table ingress traffic.

To apply a Layer 2 port-mirroring firewall filter to the forwarding table or flood table of a bridge domain:

1. Enable configuration of the bridge domain ***bridge-domain-name*** to which you want to apply a Layer 2 port-mirroring firewall filter for forwarded or flooded traffic:

   - For a bridge domain:

     ```
     [edit]
     user@host# edit bridge-domains bridge-domain-name
     ```

   - For a bridge domain under a routing instance:

     ```
     [edit]
     user@host# edit routing-instances routing-instance-name bridge-domains
       bridge-domain-name
     user@host# set instance-type virtual-switch
     ```

     For more detailed configuration information, see "Configuring a VPLS Routing Instance" on page 16.

2. Configure the bridge domain:

   ```
   [edit]
   user@host# set domain-type bridge
   user@host# set interface interface-name
   user@host# set routing-interface routing-interface-name
   ```

   For more detailed configuration information, see "Configuring a Bridge Domain" on page 135 and "Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances" on page 136.

3. Enable configuration of traffic forwarding on the bridge domain:

   ```
   [edit ... bridge-domains bridge-domain-name]
   user@host# edit forwarding-options
   ```

4. Apply a Layer 2 port-mirroring firewall filter to the bridge domain forwarding table or flood table.

   - To mirror packets being forwarded to the bridge domain:

     [edit ... bridge-domains *bridge-domain-name* forwarding-options]
     user@host# **set filter input *pm-filter-for-bd-ingress-forwarded***

   - To mirror packets being flooded to the bridge domain:

     [edit ... bridge-domains *bridge-domain-name* forwarding-options]
     user@host# **set flood input *pm-filter-for-bd-ingress-flooded***

5. Verify the minimum configuration for applying a Layer 2 port-mirroring firewall filter to the forwarding table or flood table of the bridge domain.

   a. Navigate to the hierarchy level at which the bridge domain is configured:

      - **[edit]**
      - **[edit routing-instances *routing-instance-name*]**

   b. Display the bridge domain configurations:

      user@host# **show bridge domains**

```
bridge-domains {
    bridge-domain-name {
        instance-type virtual-switch; # For a bridge domain under a routing instance.
        domain-type bridge;
        interface interface-name;
        forwarding-options {
            filter { # Mirror ingress forwarded traffic
                input pm-filter-for-bd-ingress-forwarded;
            }
            flood { # Mirror ingress flooded traffic
                input pm-filter-for-bd-ingress-flooded;
            }
        }
    }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Applying Layer 2 Port Mirroring to a Logical Interface on page 101
- Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a VPLS Routing Instance on page 106
- Example: Layer 2 Port Mirroring at a Logical Interface on page 117
- Example: Layer 2 Port Mirroring for a Layer 2 VPN on page 119
- Example: Layer 2 Port Mirroring for a Layer 2 VPN with LAG Links on page 122

Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a VPLS Routing Instance

You can apply a Layer 2 port-mirroring firewall filter to traffic being forwarded or flooded to a VPLS routing instance. Only packets of the specified family type and forwarded or flooded to that VPLS routing instance are mirrored.

Before you begin, complete the following task:

- Define a Layer 2 port-mirroring firewall filter to be applied to the traffic being forwarded to a VPLS routing instance or flooded to a bridge domain. For details, see "Defining a Layer 2 Port-Mirroring Firewall Filter" on page 97.

NOTE: This configuration task shows two Layer_2 port-mirroring firewall filters: one filter applied to the VPLS routing instance forwarding table ingress traffic, and one filter applied to the VPLS routing instance flood table ingress traffic.

To apply a Layer 2 port-mirroring firewall filter to the forwarding table or flood table of a VPLS routing instance:

1. Enable configuration of the VPLS routing instance to which you want to apply a Layer 2 port-mirroring firewall filter for forwarded or flooded traffic:

   ```
   [edit]
   user@host# edit routing-instances routing-instance-name
   user@host# set instance-type vpls
   user@host# set interface interface-name
   user@host# set route-distinguisher (as-number:number | ip-address:number)
   user@host# set vrf-import [policy-names]
   user@host# set vrf-export [policy-names]
   user@host# edit protocols vpls
   user@host@ ... vpls-configuration ...
   ```

   For more detailed configuration information, see "Configuring a VPLS Routing Instance" on page 16.

2. Enable configuration of traffic forwarding on the VPLS routing instance:

   ```
   [edit routing-instances routing-instance-name protocols vpls]
   user@host# up 2
   [edit routing-instances routing-instance-name]
   user@host# edit forwarding-options
   ```

3. Apply a Layer 2 port-mirroring firewall filter to the VPLS routing instance forwarding table or flood table.

   - To mirror packets being forwarded to the VPLS routing instance:

     ```
     [edit routing-instances routing-instance-name forwarding-options]
     user@host# set filter input pm-filter-for-vpls-ri-forwarded
     ```

   - To mirror packets being flooded to the VPLS routing instance:

     ```
     [edit routing-instances routing-instance-name forwarding-options]
     ```

```
user@host# set flood input pm-filter-for-vpls-ri-flooded
```

4. Verify the minimum configuration for applying a Layer 2 port-mirroring firewall filter to the forwarding table or flood table of the VPLS routing instance:

```
[edit routing-instances routing-instance-name forwarding-options]
user@host# top
[edit]
user@host# show routing-instances

routing-instances {
  routing-instance-name {
    instance-type vpls;
    interface interface-name;
    route-distinguisher (as-number:number | ip-address:number);
    vrf-import [policy-names];
    vrf-export [policy-names];
    protocols {
      vpls {
        ...vpls-configuration...
      }
    }
    forwarding-options {
      family vpls {
        filter { # Mirror ingress forwarded traffic
          input pm-filter-for-vpls-ri-forwarded;
        }
        flood { # Mirror ingress flooded traffic
          input pm-filter-for-vpls-ri-flooded;
        }
      }
    }
  }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Applying Layer 2 Port Mirroring to a Logical Interface on page 101
- Applying Layer 2 Port Mirroring to Traffic Forwarded or Flooded to a Bridge Domain on page 104
- Example: Layer 2 Port Mirroring at a Logical Interface on page 117
- Example: Layer 2 Port Mirroring for a Layer 2 VPN on page 119
- Example: Layer 2 Port Mirroring for a Layer 2 VPN with LAG Links on page 122

Configuring Layer 2 Port Mirroring to Multiple Destinations

The following topics describe the configuration of Layer 2 port mirroring to multiple destinations:

Defining a Next-Hop Group for Layer 2 Port Mirroring

On MX Series routers, you can mirror tunnel interface input traffic to multiple destinations. To this form of *multipacket port mirroring*, you specify two or more additional destinations in a next-hop group, define a firewall filter that references the next-hop group as the filter action, and then apply the filter to a logical tunnel interface (**lt-**) or virtual tunnel interface (**vt-**) on the MX Series router.

NOTE: This topic describes how to define a next-hop group for Layer 2 port mirroring to multiple destinations. For detailed information about defining a firewall filter for Layer 2 port mirroring to multiple destinations, see "Defining a Layer 2 Port-Mirroring Firewall Filter" on page 97.

To define a next-hop group for a Layer 2 port-mirroring firewall filter action:

1. Enable configuration of Layer 2 forwarding options.

   - To enable Layer 2 forwarding options at the top level:

     ```
     [edit]
     user@host edit forwarding-options port-mirroring family (ccc | vpls) output
     ```

   - To enable Layer 2 forwarding options for a routing instance:

     ```
     [edit]
     user@host edit forwarding-options port-mirroring instance instance-name
       family (ccc | vpls) output
     ```

2. Enable configuration of a next-hop-group for Layer 2 port mirroring:

   ```
   [edit forwarding-options port-mirroring ... family (ccc | vpls) output]
   user@host# edit next-hop-group pm-next-hop-group-name
   ```

3. Specify the type of addresses to be used in the next-hop group configuration. By default, the next-hop group is specified using Layer 3 addresses (**group-type inet**). To specify the next-hop group using Layer 2 addresses instead, you must include the **group-type layer-2** statement:

   ```
   [edit forwarding-options port-mirroring ... family (ccc | vpls) output next-hop-group
     pm-next-hop-group-name]
   user@host# set group-type layer-2
   ```

4. Specify the logical interfaces of the next-hop router:

   ```
   [edit forwarding-options port-mirroring ... family (ccc | vpls) output next-hop-group
     pm-next-hop-group-name]
   user@host# set interface logical-interface-name-1
   user@host# set interface logical-interface-name-2
   ```

   The MX Series router supports up to 30 next-hop groups. Each next-hop group supports up to 16 next-hop addresses. Each next-hop group must specify at least two addresses.

5. Verify the configuration of the next-hop group:

   ```
   [edit forwarding-options port-mirroring ... family (ccc | vpls) output next-hop-group
     pm-next-hop-group-name]
   user@host# top
   [edit]
   user@host# show forwarding-options

   ...
   next-hop-group pm-next-hop-group-name { # Next-hop group on a bridge domain.
     group-type layer-2;
     interface logical-interface-name-1;
     interface logical-interface-name-2;
   }
   ...
   ```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring to Multiple Destinations Using Next-Hop Groups on page 76
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Displaying Next-Hop Group Settings and Status on page 109
- Example: Layer 2 Port Mirroring to Multiple Destinations on page 124

Displaying Next-Hop Group Settings and Status

To display the current state of next-hop groups, use the **show forwarding-options next-hop-group <terse | brief | detail> <*group-name*>** operational command.

For more information, see the *Junos OS System Basics and Services Command Reference*.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring to Multiple Destinations Using Next-Hop Groups on page 76
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Defining a Next-Hop Group for Layer 2 Port Mirroring on page 108
- Example: Layer 2 Port Mirroring to Multiple Destinations on page 124

CHAPTER 8

Examples of Layer 2 Port Mirroring

Examples: Layer 2 Port-Mirroring at Multiple Levels of the Chassis

On an MX Series router, you can apply named instances of Layer 2 port mirroring at the FPC or DPC level of the chassis or at the PIC level of the chassis. However, you can configure (and implicitly apply) only one global instance of Layer 2 port mirroring to the entire chassis.

Layer 2 Port Mirroring at the FPC Level

In this example configuration of an MX Series router chassis, a named instance of Layer 2 port mirroring (**pm1**) is bound to physical ports grouped at the FPC level:

```
[edit]
chassis {
   fpc 2 {
      port-mirror-instance pm1;
   }
}
```

This is not a complete configuration. The physical interfaces associated with the FPC or DPC in slot 2 must be configured at the **[edit interfaces]** hierarchy level. The Layer 2 port mirroring named instance **pm1** must be configured at the **[edit forwarding-options port-mirroring instance]** hierarchy level.

Layer 2 Port Mirroring at the PIC Level

In this example configuration of an MX Series router chassis, a named instance of Layer 2 port mirroring (**pm2**) is bound to the physical ports grouped at the PIC level:

```
[edit]
chassis {
  fpc 2 {
    pic 0 {
      port-mirror-instance pm2;
    }
  }
}
```

This is not a complete configuration. The physical interfaces associated with the FPC or DPC in slot 2 must be configured at the **[edit interfaces]** hierarchy level. The Layer 2 port mirroring named instance **pm2** must be configured at the **[edit forwarding-options port-mirroring instance]** hierarchy level.

Layer 2 Port Mirroring at the FPC and PIC Levels

In this example configuration of an MX Series router chassis, one named instance of Layer 2 port mirroring (**pm1**) is applied at the FPC level of the router chassis. A second named instance (**pm2**) is applied at the PIC level:

```
[edit]
chassis {
  fpc 2 {
    port-mirror-instance pm1;
    pic 0 {
      port-mirror-instance pm2;
    }
  }
}
```

This is not a complete configuration. Physical interfaces associated with the FPC or DPC in slot 2, including physical interfaces associated with **pic 0**, must be configured at the **[edit interfaces]** hierarchy level. The Layer 2 port mirroring named instances **pm1** and **pm2** must be configured at the **[edit forwarding-options port-mirroring instance]** hierarchy level.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Global Instance on page 71
- Layer 2 Port Mirroring Named Instances on page 72
- Configuring the Global Instance of Layer 2 Port Mirroring on page 85
- Defining a Named Instance of Layer 2 Port Mirroring on page 88

Example: Layer 2 Port Mirroring with Multiple Instances

Because you can configure more than one port-mirroring instance, care is required when specifying which instance is meant. This topic contains the following information:

Example: Configuring Multiple Instances of Layer 2 Port Mirroring

This configuration example illustrates the configuration of Layer 2 port mirroring at the physical interfaces associated with FPC 2, PIC 0 and at two logical interfaces on one of those ports.

At the physical interface levels of the router chassis, two named instances of port mirroring are configured and then bound to the group of physical ports associated with FPC 2, PIC 0.

At two of the logical interfaces on physical interface **ge-2/0/1**, two Layer 2 port-mirroring firewall filters are applied to the input traffic. One filter *explicitly* references the port mirroring properties specified in one of the named instances of port mirroring. The other filter *implicitly* references the port mirroring properties in effect on the underlying physical interface **ge-2/0/1**.

The resulting configuration is an example of the relationships that can exist between multiple instances of Layer 2 port mirroring applied to an MX Series router.

1. Configure two named instances of Layer 2 port mirroring (**pm_instance_1** and **pm_instance_2**), and include mirror destination properties for bridge domain traffic (**family bridge**):

```
[edit]
forwarding-options {
  port-mirroring {
    instance {
      pm_instance_1 {
        input {
          ... packet-selection-properties-configuration ...
        }
        family bridge {
          ... mirror-destination-properties-configuration ...
        }
      }
      pm_instance_2 {
        input {
          ... packet-selection-properties-configuration ...
        }
        family bridge {
          ... mirror-destination-properties-configuration ...
        }
      }
```

```
    }
  }
}
```

NOTE: In this example, no global port-mirroring properties are configured on the router.

2. Apply the Layer 2 port mirroring instances to the same group of ports in the router chassis. In this example, the named instances of Layer 2 port mirroring are applied to the same group of physical interfaces specified at the PIC level of the chassis:

```
[edit]
chassis {
  fpc 2 {
    pic 0 {
      port-mirror-instance pm_instance_1;
      port-mirror-instance pm_instance_2;
    }
  }
}
```

Note that, in this example, two named instances of Layer 2 port mirroring are bound to the PIC level of the chassis at the same group of ports.

3. Configure two Layer 2 port-mirroring firewall filters, both for bridge-domain traffic and with one of the filters explicitly referencing one of the named instances of Layer 2 port mirroring:

   - Configure the filter **pm_filter_1** to use the Layer 2 port-mirroring properties configured in the named port-mirroring instance **pm_instance_1**. To refer to the Layer 2 port mirroring properties configured in a particular named instance of port mirroring, use the **port-mirror-instance** ***port-mirroring-instance-name*** statement.
   - Configure the filter **pm_filter_2** to use the Layer 2 port mirroring properties in effect on the underlying physical interface of the logical interface to which the filter is applied. To refer to the Layer 2 port mirroring properties in effect on the underlying physical interface, use the **port-mirror** statement. If two instances of port mirroring are bound to that port, then the firewall filter uses the first instance bound within the **[edit chassis fpc** ***slot-number*****]** or **[edit chassis fpc** ***slot-number*** **pic** ***slot-number*****]** hierarchy level.

```
[edit]
firewall {
  family bridge {
    filter pm_filter_1 {
      term pm {
        then port-mirror-instance pm_instance_1;
      }
    }
    filter pm_filter_2 {
      term pm {
        then port-mirror;
      }
    }
  }
```

```
}
```

NOTE: Because the **port-mirror** filter action modifier relies on the port-mirroring properties defined at the **[edit forwarding-options port-mirroring]** hierarchy level, the **port-mirror** filter action is not supported for logical systems.

4. Apply the two Layer 2 port-mirroring firewall filters to logical interfaces on interface **ge-2/0/1**:

```
[edit]
interfaces {
  ge-2/0/1 {
    flexible-vlan-tagging;
    encapsulation ethernet-bridge;
    unit 0 {
      vlan-id 201;
      family bridge {
        filter { # Explicitly references a named instance of port mirroring.
          input pm_filter_1;
        }
      }
    }
    unit 1 {
      vlan-id 202;
      family bridge {
        filter { # Implicitly references the underlying port mirroring.
          input pm_filter_2;
        }
      }
    }
  }
}
```

Explicit Reference of a Port Mirroring Instance

On logical interface **ge-2/0/1.0**, the **port-mirror-instance** statement explicitly references the Layer 2 port mirroring properties in the named instance **pm_instance_1**. In this example, the port mirroring properties specified in **pm_instance_1** remain in effect at logical interface **ge-2/0/1.0** under the following conditions:

- The firewall filter **pm_filter_1** remains configured (as shown in step 3).
- The named instance **pm_instance_1** remains configured (as shown in step 1).

Even if the named instance **pm_instance_1** is no longer configured or no longer bound to the router chassis at FPC 2, PIC 0, the port mirroring properties specified in **pm_instance_1** remain in effect at logical interface **fe-2/0/1.0** through firewall filter **pm_filter_1**.

Implicit Reference of Port Mirroring on the Underlying Physical Interface

On logical interface **ge-2/0/1.1**, the **port-mirror** statement implicitly references the Layer 2 port mirroring properties in effect at the underlying physical interface **ge-2/0/1**. In this example, the port mirroring properties specified in **pm_instance_2** remain in effect at the ports associated with FPC 2, PIC 0 under the following conditions:

- The firewall filter **pm_filter_2** remains configured (as shown in step 3).
- The named instance **pm_instance_2** remains configured (as shown in step 1).
- The named instance **pm_instance_2** remains bound to the router chassis at FPC 2, PIC 0 (as shown in step 2).

If you disable the named instance **pm_instance_2** or delete its binding to the physical ports associated with FPC 2, PIC 0, then—if global Layer 2 port mirroring properties had been configured—the global port mirroring properties would be used at logical interface **ge-2/0/1.1** through firewall filter **pm_filter_2**.

NOTE: There is a limitation to a Layer 2 port mirroring firewall filter in which you implicitly reference Layer 2 port mirroring properties by including the **port-mirror** statement. If multiple named instances of Layer 2 port mirroring are bound to the underlying physical interface, then only the first binding in the stanza (or the only binding) is used at the logical interface. This is done mainly for backward compatibility.

In the example above, filter **pmff_bd_filter_2** uses the **port-mirror** statement, and so the filter action uses the mirroring properties of the first port mirroring instance applied to the router chassis at the **[edit chassis fpc 2 pic 0]** hierarchy level, which is the instance **pm_instance_1**.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Named Instances on page 72
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Named Instance of Layer 2 Port Mirroring on page 88
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97

Example: Layer 2 Port Mirroring at a Logical Interface

The following steps describe an example in which the global port-mirroring instance and a port-mirroring firewall filter are used to configure Layer 2 port mirroring for the input to a logical interface.

1. Configure the bridge domain **example-bd-with-analyzer**, which contains the external packet analyzer, and the bridge domain **example-bd-with-traffic**, which contains the source and destination of the Layer 2 traffic being mirrored:

```
[edit]
bridge-domains {
  example-bd-with-analyzer { # Contains an external traffic analyzer
    vlan-id 1000;
    interface ge-2/0/0.0; # External analyzer
  }
  example-bd-with-traffic { # Contains traffic input and output interfaces
    vlan-id 1000;
    interface ge-2/0/6.0; # Traffic input port
    interface ge-3/0/1.2; # Traffic output port
  }
}
```

   Assume that logical interface **ge-2/0/0.0** is associated with an external traffic analyzer that is to receive port-mirrored packets. Assume that logical interfaces **ge-2/0/6.0** and **ge-3/0/1.2** will be traffic input and output ports, respectively.

2. Configure Layer 2 port-mirroring for the global instance, with the port-mirroring destination being the bridge domain interface associated with the external analyzer (logical interface **ge-2/0/0.0** on bridge domain **example-bd-with-analyzer**). Be sure to enable the option that allows filters to be applied to this port-mirroring destination:

```
[edit]
forwarding-options {
  port-mirroring {
    input {
      rate 10;
      run-length 5;
    }
    family bridge {
      output {
        interface ge-2/0/0.0; # Mirror packets to the external analyzer
        no-filter-check; # Allow filters on the mirror destination interface
      }
    }
  }
}
```

   The **input** statement at the **[edit forwarding-options port-mirroring]** hierarchy level specifies that sampling begins every tenth packet and that each of the first five packets selected are to be mirrored.

The **output** statement at the **[edit forwarding-options port-mirroring family bridge]** hierarchy level specifies the output mirror interface for Layer 2 packets in a bridging environment:

- Logical interface **ge-2/0/0.0**, which is associated with the external packet analyzer, is configured as the port-mirroring destination.
- The optional **no-filter-check** statement allows filters to be configured on this destination interface.

3. Configure the Layer 2 port-mirroring firewall filter **example-bridge-pm-filter**:

```
[edit]
firewall {
  family bridge {
    filter example-bridge-pm-filter {
      term example-filter-terms {
        then {
          accept;
          port-mirror;
        }
      }
    }
  }
}
```

When this firewall filter is applied to the input or output of a logical interface for traffic in a bridging environment, Layer 2 port mirroring is performed according to the input packet-sampling properties and mirror destination properties configured for the Layer 2 port mirroring global instance. Because this firewall filter is configured with the single, default filter action **accept**, all packets selected by the **input** properties (**rate** = **10** and **run-length** = **5**) match this filter.

4. Configure the logical interfaces:

```
[edit]
interfaces {
  ge-2/0/0 { # Define the interface to the external analyzer
    encapsulation ethernet-bridge;
    unit 0 {
      family bridge;
    }
  }
  ge-2/0/6 { # Define the traffic input port
    flexible-vlan-tagging;
    encapsulation extended-vlan-bridge;
    unit 0 {
      vlan-id 100;
      family bridge {
        filter {
          input example-bridge-pm-filter; # Apply the port-mirroring firewall filter
        }
      }
    }
  }
  ge-3/0/1 { # Define the traffic output port
```

```
        flexible-vlan-tagging;
        encapsulation extended-vlan-bridge;
        unit 2 {
          vlan-tags outer 10 inner 20;
          family bridge;
        }
      }
    }
```

Packets received at logical interface **ge-2/0/6.0** on bridge domain **example-bd-with-traffic** are evaluated by the port-mirroring firewall filter **example-bridge-pm-filter**. The firewall filter acts on the input traffic according to the filter actions configured in the firewall filter itself plus the input packet-sampling properties and mirror destination properties configured in the global port-mirroring instance:

- All packets received at **ge-2/0/6.0** are forwarded to their (assumed) normal destination at logical interface **ge-3/0/1.2**.
- For every ten input packets, copies of the first five packets in that selection are forwarded to the external analyzer at logical interface **ge-0/0/0.0** in the other bridge domain, **example-bd-with-analyzer**.

If you configure the port-mirroring firewall filter **example-bridge-pm-filter** to take the **discard** action instead of the **accept** action, all original packets are discarded while copies of the packets selected using the global port-mirroring **input** properties are sent to the external analyzer.

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97

Example: Layer 2 Port Mirroring for a Layer 2 VPN

The following example is not a complete configuration, but shows all the steps needed to configure port mirroring on an L2VPN using **family ccc**.

1. Configure the bridge domain **port-mirror-bd**, which contains the external packet analyzer:

```
[edit]
bridge-domains {
  port-mirror-bd { # Contains an external traffic analyzer
    interface ge-2/2/9.0; # External analyzer
  }
}
```

2. Configure the Layer 2 VPN CCC to connect logical interface **ge-2/0/1.0** and logical interface **ge-2/0/1.1**:

```
[edit]
protocols {
```

```
    mpls {
      interface all;
    }
    connections {
      interface-switch if_switch {
        interface ge-2/0/1.0;
        interface ge-2/0/1.1;
      }
    }
}
```

3. Configure Layer 2 port mirroring for the global instance, with the port-mirroring destination being the bridge domain interface associated with the external analyzer (logical interface **ge-2/2/9.0** on bridge domain **example-bd-with-analyzer**):

```
[edit]
forwarding-options {
  port-mirroring {
    input {
      rate 1;
      maximum-packet-length 200;
    }
    family ccc {
      output {
        interface ge-2/2/9.0; # Mirror packets to the external analyzer
      }
    }
    instance {
      inst1 {
        input {
          rate 1;
          maximum-packet-length 300;
        }
        family ccc {
          output {
            interface ge-2/2/9.0;
          }
          {
        }
      }
    }
  }
}
```

4. Define the Layer 2 port-mirroring firewall filter **pm_filter_ccc** for **family ccc**:

```
[edit]
firewall {
  family ccc {
    filter pm_filter_ccc {
      term pm {
        then port-mirror;
      }
    }
  }
}
```

5. Apply the port mirror instance to the chassis:

```
[edit]
chassis {
  fpc 2 {
    port-mirror-instance inst1;
  }
}
```

6. Configure interface **ge-2/2/9** for the VLANs, and configure interface **ge-2/0/1** for port mirroring with the **pm_filter_ccc** firewall filter:

```
[edit]
interfaces {
  ge-2/2/9 {
    encapsulation ethernet-bridge;
    unit 0 {
      family bridge;
    }
  }
  ge-2/0/1 {
    vlan-tagging;
    encapsulation extended-vlan-ccc;
    unit 0 {
      vlan-id 10;
      family ccc {
        filter {
          input pm_filter_ccc;
        }
      }
    }
    unit 1 {
      vlan-id 20;
      family ccc {
        filter {
          output pm_filter_ccc;
        }
      }
    }
  }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97

Example: Layer 2 Port Mirroring for a Layer 2 VPN with LAG Links

The following example is not a complete configuration, but shows all the steps needed to configure port mirroring on an L2VPN using **family ccc** and aggregated Ethernet links.

1. Configure the bridge domain **port_mirror_bd**, which contains the external packet analyzer:

```
[edit]
bridge-domains {
  port_mirror_bd { # Contains an external traffic analyzer
    interface ge-2/2/8.0; # External analyzer
  }
}
```

2. Configure the Layer 2 VPN CCC to connect interface **ae0.0** and interface **ae0.1**:

```
[edit]
protocols {
  mpls {
    interface all;
  }
  connections {
    interface-switch if_switch {
      interface ae0.0;
      interface ae0.1;
    }
  }
}
```

3. Configure Layer 2 port mirroring for the global instance, with the port-mirroring destination being the bridge domain interface associated with the external analyzer (logical interface **ge-2/2/9.0** on bridge domain **example_bd_with_analyzer**):

```
[edit]
forwarding-options {
  port-mirroring {
    input {
      rate 1;
      maximum-packet-length 200;
    }
    family ccc {
      output {
        interface ge-2/2/8.0; # Mirror packets to the external analyzer
      }
    }
    instance {
      pm_instance_1 {
        input {
          rate 1;
          maximum-packet-length 300;
        }
        family ccc {
          output {
            interface ge-2/2/8.0;
          }
```

```
        {
      }
    }
  }
}
```

4. Configure the firewall filter **pm_ccc** for **family ccc**:

```
[edit]
firewall {
  family ccc {
    filter pm_ccc {
      term pm {
        then port-mirror;
      }
    }
  }
}
```

5. Apply the aggregated Ethernet interfaces and port mirror instance to the chassis:

```
[edit]
chassis {
  aggregated-devices {
    ethernet {
      device-count 10;
    }
  }
  fpc 2 {
    port-mirror-instance pm_instance_1;
  }
}
```

6. Configure interfaces **ae0** and **ge-2/0/2** (for aggregated Ethernet) and **ge-2/2/8** (for port mirroring) with the **pm_ccc** filter:

```
[edit]
interfaces {
  ae0 {
    vlan-tagging;
    encapsulation extended-vlan-ccc;
    unit 0 {
      vlan-id 10;
      family ccc {
        filter {
          input pm_ccc;
        }
      }
    }
    unit 1 {
      vlan-id 20;
      family ccc {
        filter {
          output pm_ccc;
        }
      }
    }
```

```
    }
    ge-2/0/2 {
      gigether-options {
        802.3ad ae0;
      }
    }
    ge-2/2/8 {
      encapsulation ethernet-bridge;
      unit 0 {
        family bridge;
      }
    }
  }
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring Firewall Filters on page 74
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97

Example: Layer 2 Port Mirroring to Multiple Destinations

On MX Series routers, you can mirror traffic to multiple destinations by configuring next-hop groups in Layer 2 port-mirroring firewall filters applied to tunnel interfaces.

1. Configure the chassis to support tunnel services at PIC 0 on FPC 2. This configuration includes two logical tunnel interfaces on FPC 2, PIC 0, port 10.

```
[edit]
chassis {
  fpc 2 {
    pic 0 {
      tunnel-services {
        bandwidth 1g;
      }
    }
  }
}
```

2. Configure the physical and logical interfaces for three bridge domains and one Layer 2 VPN CCC:

   - Bridge domain **bd** will span logical interfaces **ge-2/0/1.0** and **ge-2/0/1.1**.
   - Bridge domain **bd_next_hop_group** will span logical interfaces **ge-2/2/9.0** and **ge-2/0/2.0**.
   - Bridge domain **bd_port_mirror** will use the logical tunnel interface **lt-2/0/10.2**.
   - Layer 2 VPN CCC **if_switch** will connect logical interfaces **ge-2/0/1.2** and **lt-2/0/10.1**.

```
[edit]
interfaces {
  ge-2/0/1 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
```

```
    unit 0 { # An interface on bridge domain 'bd'.
      encapsulation vlan-bridge;
      vlan-id 200;
      family bridge {
        filter {
          input pm_bridge;
        }
      }
    }
    unit 1 { # An interface on bridge domain 'bd'.
      encapsulation vlan-bridge;
      vlan-id 201;
      family bridge {
        filter {
          input pm_bridge;
        }
      }
    }
    unit 2 {
      encapsulation vlan-ccc;
      vlan-id 1000;
    }
  }
  ge-2/0/2 { # For 'bd_next_hop_group'
    encapsulation ethernet-bridge;
    unit 0 {
      family bridge;
    }
  }
  lt-2/0/10 {
    unit 1 {
      encapsulation ethernet-ccc;
      peer-unit 2;
    }
    unit 2 {
      encapsulation ethernet-bridge;
      peer-unit 1;
      family bridge {
        filter {
          output redirect_to_nhg;
        }
      }
    }
  }
  ge-2/2/9 {
    encapsulation ethernet-bridge;
    unit 0 { # For 'bd_next_hop_group'
      family bridge;
    }
  }
}
```

3. Configure the three bridge domains and the Layer 2 VPN switching CCC:

   - Bridge domain **bd** spans logical interfaces **ge-2/0/1.0** and **ge-2/0/1.1**.
   - Bridge domain **bd_next_hop_group** spans logical interfaces **ge-2/2/9.0** and **ge-2/0/2.0**.
   - Bridge domain **bd_port_mirror** uses the logical tunnel interface **lt-2/0/10.2**.
   - Layer 2 VPN CCC **if_switch** connects interfaces **ge-2/0/1.2** and **lt-2/0/10.1**.

   ```
   [edit]
   bridge-domains {
     bd {
       interface ge-2/0/1.0;
       interface ge-2/0/1.1;
     }
     bd_next_hop_group {
       interface ge-2/2/9.0;
       interface ge-2/0/2.0;
     }
     bd_port_mirror {
       interface lt-2/0/10.2;
     }
   }
   protocols {
     mpls {
       interface all;
     }
     connections {
       interface-switch if_switch {
         interface ge-2/0/1.2;
         interface lt-2/0/10.1;
       }
     }
   }
   ```

   For detailed information about configuring the CCC connection for Layer 2 switching cross-connects, see the *Junos OS MPLS Applications Configuration Guide*.

4. Configure forwarding options:

   - Configure global port mirroring properties to mirror **family vpls** traffic to an interface on the bridge domain **bd_port_mirror**.
   - Configure the next-hop group **nhg_mirror_to_bd** to forward Layer 2 traffic to the bridge domain **bd_next_hop_group**.

   Both of these forwarding options will be referenced by the port-mirroring firewall filter:

   ```
   [edit]
   forwarding-options {
     port-mirroring { # Global port mirroring properties.
       input {
         rate 1;
       }
       family vpls {
         output {
   ```

```
            interface lt-2/0/10.2; # Interface on 'bd_port_mirror' bridge domain.
            no-filter-check;
          }
        }
      }
      next-hop-group nhg_mirror_to_bd { # Configure a next-hop group.
        group-type layer-2; # Specify 'layer-2' for Layer 2; default 'inet' is for Layer 3.
        interface ge-2/0/2.0; # Interface on 'bd_next_hop_group' bridge domain.
        interface ge-2/2/9.0; # Interface on 'bd_next_hop_group' bridge domain.
      }
    }
```

5. Configure two Layer 2 port-mirroring firewall filters for **family bridge** traffic:

   - **filter_pm_bridge**—Sends all **family bridge** traffic to the global port mirroring destination.
   - **filter_redirect_to_nhg**—Sends all **family bridge** traffic to the final next-hop group **nhg_mirror_to_bd**.

   Layer 2 port-mirroring firewall filters for **family bridge** traffic applies to traffic on a physical interface configured with encapsulation **ethernet-bridge**.

```
[edit]
firewall {
  family bridge {
    filter filter_pm_bridge {
      term term_port_mirror {
        then port-mirror;
      }
    }
    filter filter_redirect_to_nhg {
      term term_nhg {
        then next-hop-group nhg_mirror_to_bd;
      }
    }
  }
}
```

Related Documentation

- Layer 2 Port Mirroring Overview on page 69
- Layer 2 Port Mirroring to Multiple Destinations Using Next-Hop Groups on page 76
- Defining a Layer 2 Port-Mirroring Firewall Filter on page 97
- Defining a Next-Hop Group for Layer 2 Port Mirroring on page 108
- Displaying Next-Hop Group Settings and Status on page 109

PART 4

Layer 2 Bridging

CHAPTER 9

Layer 2 Bridging Overview

Layer 2 Bridge Domains Overview

You can configure one or more bridge domains on MX Series routers to perform Layer 2 bridging. The Layer 2 bridging functions of the MX Series routers include integrated routing and bridging (IRB) for support for Layer 2 bridging and Layer 3 IP routing on the same interface, and virtual switches that isolate a LAN segment with its spanning-tree protocol instance and separate its VLAN ID space.

A bridge domain is a set of logical ports that share the same flooding or broadcast characteristics. Like a virtual LAN (VLAN), a bridge domain spans one or more ports of multiple devices.

On Juniper Networks MX Series 3D Universal Edge Routers only, you can configure one or more bridge domains to perform Layer 2 bridging. Thus, MX Series routers can function as Layer 2 switches, each with multiple bridging, or broadcast, domains that participate in the same Layer 2 network. You can also configure Layer 3 routing support for a bridge domain. Integrated routing and bridging (IRB) provides support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route packets to another routed interface or to another bridge domain that has a Layer 3 protocol configured.

You can also group one or more bridge domains within a single instance, or virtual switch. The MX Series routers also support multiple virtual switches, each of which operates independently of other virtual switches on the router. Virtual switches isolate a LAN segment with its spanning-tree protocol instance and separate its VLAN ID space. Thus, each virtual switch can participate in a different Layer 2 network.

In Junos OS Release 9.2 and later, bridge domains provide support for a Layer 2 trunk port. A Layer 2 trunk interface enables you to configure a single logical interface to represent multiple VLANs on a physical interface. You can configure a set of bridge

domains and VLAN identifiers that are automatically associated with one or more Layer 2 trunk interfaces. Packets received on a trunk interface are forwarded within a bridge domain that has the same VLAN identifier. A Layer 2 trunk interface also supports IRB within a bridge domain. In addition, you can configure Layer 2 learning and forwarding properties that apply to the entire set of bridge domains.

In Junos OS Release 9.3 and later, you can configure VPLS ports in a virtual switch instead of a dedicated routing instance of type **vpls** so that the logical interfaces of the Layer 2 bridge domains in the virtual switch can handle VPLS routing instance traffic. Packets received on a Layer 2 trunk interface are forwarded within a bridge domain that has the same VLAN identifier.

Related Documentation

- Layer 2 Virtual Switches Overview on page 132
- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133
- Configuring a Bridge Domain on page 135

Layer 2 Virtual Switches Overview

On MX Series routers only, you can group one or more bridge domains to form a virtual switch to isolate a LAN segment with its spanning-tree protocol instance and separate its VLAN ID space. A bridge domain consists of a set of logical ports that share the same flooding or broadcast characteristics. Like a virtual LAN, a bridge domain spans one or more ports of multiple devices. You can configure multiple virtual switches, each of which operates independently of the other virtual switches on the routing platform. Thus, each virtual switch can participate in a different Layer 2 network.

You can configure a virtual switch to participate only in Layer 2 bridging and optionally to perform Layer 3 routing. In addition, you can configure one of three Layer 2 control protocols—Spanning-Tree Protocol, Rapid Spanning-Tree Protocol (RSTP), or Multiple Spanning-Tree Protocol (MSTP)—to prevent forwarding loops. For more information about how to configure Layer 2 logical ports on an interface, see the *Junos OS Network Interfaces Configuration Guide*.

In Junos OS Release 9.2 and later, you can associate one or more logical interfaces configured as trunk interfaces with a virtual switch. A trunk interface, or Layer 2 trunk port, enables you to configure a logical interface to represent multiple VLANs on the physical interface. Packets received on a trunk interface are forwarded within a bridge domain that has same VLAN identifier. For more information about how to configure trunk interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

You can also configure Layer 2 forwarding and learning properties for the virtual switch as well as any bridge domains that belong to a virtual switch. .

For more information about configuring a routing instance for Layer 2 VPN, see the *Junos OS VPNs Configuration Guide*. For a detailed Layer 2 VPN example configuration, see the *Junos OS Feature Guides*.

Related Documentation

- Configuring a Layer 2 Control Protocol Routing Instance on page 18
- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Protocol Tunneling Through a Network Overview on page 234

Layer 2 Learning and Forwarding for Bridge Domains Overview

When you configure a bridge domain, Layer 2 address learning is enabled by default. The bridge domain learns unicast media access control (MAC) addresses to avoid flooding the packets to all the ports in the bridge domain. Each bridge domain creates a source MAC entry in its source and destination MAC tables for each source MAC address learned from packets received on the ports that belong to the bridge domain.

NOTE: **Traffic is not flooded back onto the interface on which it was received. However, because this "split horizon" occurs at a late stage, the packet statistics displayed by commands such as show interfaces queue will include flood traffic.**

You can optionally disable MAC learning either for the entire router or for a specific bridge domain or logical interface. You can also configure the following Layer 2 learning and forwarding properties:

- Static MAC entries for logical interfaces only
- Limit to the number of MAC addresses learned from a specific logical interface or from all the logical interfaces in a bridge domain
- Size of the MAC address table for the bridge domain
- MAC accounting for a bridge domain

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179

Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports

Layer 2 learning is enabled by default. A set of bridge domains, configured to function as a switch with a Layer 2 trunk port, learns unicast media access control (MAC) addresses to avoid flooding packets to the trunk port.

NOTE: **Traffic is not flooded back onto the interface on which it was received. However, because this "split horizon" occurs at a late stage, the packet statistics displayed by commands such as show interfaces queue will include flood traffic.**

You can optionally disable Layer 2 learning for the entire set of bridge domains as well as modify the following Layer 2 learning and forwarding properties:

- Limit the number of MAC addresses learned from the Layer 2 trunk port associated with the set of bridge domains
- Modify the size of the MAC address table for the set of bridge domains
- Enable MAC accounting for the set of bridge domains

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179

Guidelines for Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances

For a bridge domain that is performing Layer 2 switching only, you do not have to specify a VLAN identifier.

For a bridge domain that is performing Layer 3 IP routing, you must specify either a VLAN identifier or dual VLAN identifier tags.

For a VPLS routing instance, you must specify either a VLAN identifier or dual VLAN identifier tags.

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179

CHAPTER 10

Configuring Layer 2 Bridging

Configuring Bridge Domains for Layer 2 Bridging and Layer 3 IP Routing

Configuring a Bridge Domain

A bridge domain must include a set of logical interfaces that participate in Layer 2 learning and forwarding. You can optionally configure a VLAN identifier and a routing interface for the bridge domain to also support Layer 3 IP routing.

To enable a bridge domain, include the following statements:

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge:
    interface interface-name;
    routing-interface routing-interface-name;
    vlan-id (none | all | number);
    vlan-id-list [ vlan-id-numbers ];
    vlan-tags outer number inner number);
  }
}
```

You cannot use the slash (/) character in bridge domain names. If you do, the configuration does not commit and an error is generated.

For the **vlan-id** statement, you can specify either a valid VLAN identifier or the **none** or **all** options. For information about VLAN identifiers and VLAN tags for a bridge domain, see "Guidelines for Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances" on page 134 and "Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances" on page 136.

To include one or more logical interfaces in the bridge domain, specify an ***interface-name*** for an Ethernet interface you configured at the **[edit interfaces]** hierarchy level.

NOTE: A maximum of 4000 active logical interfaces are supported on a bridge domain or on each mesh group in a virtual private LAN service (VPLS) instance configured for Layer 2 bridging.

By default, each bridge domain maintains a Layer 2 forwarding database that contains media access control (MAC) addresses learned from packets received on the ports that belong to the bridge domain. You can modify Layer 2 forwarding properties, including disabling MAC learning for the entire system or a bridge domain, adding static MAC addresses for specific logical interfaces, and limiting the number of MAC addresses learned by the entire system, the bridge domain, or a logical interface.

You can also configure spanning tree protocols to prevent forwarding loops. For more information, see "Spanning-Tree Protocols Supported on MX Series Routers" on page 189.

In Junos OS Release 8.5 and later, you can configure IGMP snooping for a bridge domain. For more information, see the *Junos OS Multicast Protocols Configuration Guide*.

Related Documentation

- Configuring Integrated Routing and Bridging for Bridge Domains on page 141
- Layer 2 Learning and Forwarding Overview on page 179
- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances

You can configure VLAN identifiers for a bridge domain or a VPLS routing instance in the following ways:

- By using the **input-vlan-map** and the **output-vlan-map** statements at the **[edit interfaces** ***interface-name***] or **[edit logical-systems** ***logical-system-name*** **interfaces** ***interface-name***] hierarchy level to configure VLAN mapping. For information about configuring input and output VLAN maps to stack and rewrite VLAN tags in incoming or outgoing frames, see the *Junos OS Network Interfaces Configuration Guide*.
- By using either the **vlan-id** statement or the **vlan-tags** statement to configure a normalizing VLAN identifier. This topic describes how normalizing VLAN identifiers are processed and translated in a bridge domain or a VPLS routing instance.

The **vlan-id** and **vlan-tags** statements are used to specify the normalizing VLAN identifier under the bridge domain or VPLS routing instance. The normalizing VLAN identifier is used to perform the following functions:

- Translate, or normalize, the VLAN tags of received packets received into a learn VLAN identifier.
- Create multiple learning domains that each contain a learn VLAN identifier. A learning domain is a MAC address database to which MAC addresses are added based on the learn VLAN identifier.

NOTE: You cannot configure VLAN mapping using the **input-vlan-map** and **output-vlan-map** statements if you configure a normalizing VLAN identifier for a bridge domain or VPLS routing instance using the **vlan-id** or **vlan-tags** statements.

To configure a VLAN identifier for a bridge domain, include either the **vlan-id** or the **vlan-tags** statement at the **[edit interfaces** ***interface-name*** **unit** ***logic-unit-number*** **family bridge]** or **[edit logical-systems** ***logical-system-name*** **interfaces** ***interface-name*** **unit** ***logic-unit-number*** **family bridge]** hierarchy level, and then include that logical interface in the bridge domain configuration. For more information about configuring a bridge domain, see "Configuring a Bridge Domain" on page 135.

For a VPLS routing instance, include either the **vlan-id** or **vlan-tags** statement at the **[edit interfaces** ***interface-name*** **unit** ***logic-unit-number*****]** or **[edit logical-systems** ***logical-system-name*** **interfaces** ***interface-name*** **unit** ***logic-unit-number*****]** hierarchy level, and then include that logical interface in the VPLS routing instance configuration. For more information about configuring a VPLS routing instance, see the *Junos OS VPNs Configuration Guide*.

NOTE: For a single bridge domain or VPLS routing instance, you can include either the **vlan-id** or the **vlan-tags** statement, but not both. If you do not configure a **vlan-id**, **vlan-tags**, or **vlan-id-list [** ***vlan-id-numbers*** **]** for the bridge domain or the VPLS routing instance, the Layer 2 packets received are forwarded to the outbound Layer 2 interface without having the VLAN tag modified unless an **output-vlan-map** is configured on the Layer 2 interface. This results in a frame being forwarded to a Layer 2 interface with a VLAN tag that is different from what is configured for the Layer 2 interface. Note that a frame received from the Layer 2 interface is still required to match the VLAN tag(s) specified in the interface configuration. The invalid configuration may cause a Layer 2 loop to occur.

The VLAN tags associated with the inbound logical interface are compared with the normalizing VLAN identifier. If the tags are different, they are rewritten as described in Table 8 on page 140. The source MAC address of a received packet is learned based on the normalizing VLAN identifier.

NOTE: You do not have to specify a VLAN identifier for a bridge domain that is performing Layer 2 switching only. To support Layer 3 IP routing, you must specify either a VLAN identifier or a pair of VLAN tags. However, you cannot specify the same VLAN identifier for more than one bridge domain within a routing instance. Each bridge domain must have a unique VLAN identifier.

If the VLAN tags associated with the outbound logical interface and the normalizing VLAN identifier are different, the normalizing VLAN identifier is rewritten to match the VLAN tags of the outbound logical interface, as described in Table 9 on page 141.

For the packets sent over the VPLS routing instance to be tagged by the normalizing VLAN identifier, include one of the following configuration statements:

- **vlan-id** *number* to tag all packets that are sent over the VPLS virtual tunnel (VT) interfaces with the VLAN identifier.
- **vlan-tags outer** *number* **inner** *number* to tag all packets sent over the VPLS VT interfaces with dual outer and inner VLAN tags.

Use the **vlan-id none** statement to have the VLAN tags removed from packets associated with an inbound logical interface when those packets are sent over VPLS VT interfaces. Note that those packets might still be sent with other customer VLAN tags.

The **vlan-id all** statement enables you to configure bridging for several VLANs with a minimum amount of configuration. Configuring this statement creates a learning domain for:

- Each inner VLAN, or learn VLAN, identifier of a logical interface configured with two VLAN tags
- Each VLAN, or learn VLAN, identifier of a logical interface configured with one VLAN tag

We recommend that you do not use customer VLAN IDs in a VPLS routing instance because customer VLAN IDs are used for learning only.

You should use the service VLAN ID in a VPLS routing instance, as in the following configuration:

```
[edit]
interface ge-1/1/1 {
   vlan-tagging;
   unit 1 {
      vlan-id s1; /* Service vlan */
      encapsulation vlan-vpls;
      input-vlan-map pop; /* Pop the service vlan on input */
      output-vlan-map push; /* Push the service vlan on output */
   }
}
interface ge-1/1/2 {
   encapsulation ethernet-vpls;
   unit 0;
```

```
}
routing-instance {
  V1 {
    instance-type vpls;
    vlan-id all;
    interface ge-1/1/1.1;
    interface ge-1/1/2.0;
  }
}
```

NOTE: If you configure the **vlan-id all** statement in a VPLS routing instance, we recommend using the **input-vlan-map pop** and **output-vlan-map push** statements on the logical interface to pop the service VLAN ID on input and push the service VLAN ID on output and in this way limit the impact of doubly-tagged frames on scaling. You cannot use the native **vlan- id** statement when the **vlan-id all** statement is included in the configuration.

The **vlan-id-list [** ***vlan-id-numbers*** **]** statement enables you to configure bridging for multiple VLANs on a trunk interface. Configuring this statement creates a learning domain for:

- Each VLAN listed: **vlan-id-list [100 200 300]**
- Each VLAN in a range: **vlan-id-list [100-200]**
- Each VLAN in a list and range combination: **vlan-id-list [50, 100-200, 300]**

The following steps outline the process for bridging a packet received over a Layer 2 logical interface when you specify a normalizing VLAN identifier using either the **vlan-id** ***number*** or **vlan-tags** statement for a bridge domain or a VPLS routing instance:

1. When a packet is received on a physical port, it is accepted only if the VLAN identifier of the packet matches the VLAN identifier of one of the logical interfaces configured on that port.
2. The VLAN tags of the received packet are then compared with the normalizing VLAN identifier. If the VLAN tags of the packet are different from the normalizing VLAN identifier, the VLAN tags are rewritten as described in Table 8 on page 140.
3. If the source MAC address of the received packet is not present in the source MAC table, it is learned based on the normalizing VLAN identifier.
4. The packet is then forwarded toward one or more outbound Layer 2 logical interfaces based on the destination MAC address. A packet with a known unicast destination MAC address is forwarded only to one outbound logical interface. For each outbound Layer 2 logical interface, the normalizing VLAN identifier configured for the bridge domain or VPLS routing instance is compared with the VLAN tags configured on that logical interface. If the VLAN tags associated with an outbound logical interface do not match the normalizing VLAN identifier configured for the bridge domain or VPLS routing instance, the VLAN tags are rewritten as described in Table 9 on page 141.

The tables below show how VLAN tags are applied for traffic sent to and from the bridge domain, depending on how the **vlan-id** and **vlan-tags** statements are configured for the

bridge domain and on how VLAN identifiers are configured for the logical interfaces in a bridge domain or VPLS routing instance. Depending on your configuration, the following rewrite operations are performed on VLAN tags:

- **pop**—Remove a VLAN tag from the top of the VLAN tag stack.
- **pop-pop**—Remove both the outer and inner VLAN tags of the frame.
- **pop-swap**—Remove the outer VLAN tag of the frame and replace the inner VLAN tag of the frame.
- **swap**—Replace the VLAN tag of the frame.
- **push**—Add a new VLAN tag to the top of the VLAN stack.
- **push-push**—Push two VLAN tags in front of the frame.
- **swap-push**—Replace the VLAN tag of the frame and add a new VLAN tag to the top of the VLAN stack.
- **swap-swap**—Replace both the outer and inner VLAN tags of the frame.

Table 8 on page 140 shows specific examples of how the VLAN tags for packets sent to the bridge domain are processed and translated, depending on your configuration. "–" means that the statement is not supported for the specified logical interface VLAN identifier. "No operation" means that the VLAN tags of the received packet are not translated for the specified input logical interface.

Table 8: Statement Usage and Input Rewrite Operations for VLAN Identifiers for a Bridge Domain

VLAN Identifier of Logical Interface	VLAN Configurations for Bridge Domain			
	vlan-id none	vlan-id 200	vlan-id all	vlan tags outer 100 inner 300
none	No operation	push 200	–	push 100, push 300
200	pop 200	No operation	No operation	swap 200 to 300, push 100
1000	pop 1000	swap 1000 to 200	No operation	swap 1000 to 300, push 100
vlan-tags outer 2000 inner 300	pop 2000, pop 300	pop 2000, swap 300 to 200	pop 2000	swap 2000 to 100
vlan-tags outer 100 inner 400	pop 100, pop 400	pop 100, swap 400 to 200	pop 100	swap 400 to 300
vlan-id-range 10-100	–	–	No operation	–
vlan-tags outer 200 inner-range 10-100	–	–	pop 200	–

Table 9 on page 141 shows specific examples of how the VLAN tags for packets sent from the bridge domain are processed and translated, depending on your configuration. "–" means that the statement is not supported for the specified logical interface VLAN identifier. "No operation" means that the VLAN tags of the outbound packet are not translated for the specified output logical interface.

Table 9: Statement Usage and Output Rewrite Operations for VLAN Identifiers for a Bridge Domain

VLAN Identifier of Logical Interface	VLAN Configurations for Bridge Domain			
	vlan-id none	vlan-id 200	vlan-id all	vlan tags outer 100 inner 300
none	no operation	pop 200	–	pop 100, pop 300
200	push 200	No operation	No operation	pop 100, swap 300 to 200
1000	push 1000	swap 200 to 1000	No operation	pop 100, swap 300 to 1000
vlan-tags outer 2000 inner 300	push 2000, push 300	swap 200 to 300, push 2000	push 2000	swap 100 to 2000
vlan-tags outer 100 inner 400	push 100, push 400	swap 200 to 400, push 100	push 100	swap 300 to 400
vlan-id-range 10-100	–	–	No operation	–
vlan-tags outer 200 inner-range 10-100	–	–	push 200	–

Related Documentation

- Configuring Integrated Routing and Bridging for Bridge Domains on page 141
- Layer 2 Learning and Forwarding Overview on page 179
- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

Configuring Integrated Routing and Bridging for Bridge Domains

Integrated routing and bridging (IRB) provides simultaneous support for Layer 2 bridging and Layer 3 routing on the same interface. IRB enables you to route packets to another routed interface or to another bridge domain that has an IRB interface configured. You configure a logical routing interface by including the **irb** statement at the **[edit interfaces]** hierarchy level and include that interface in the bridge domain. For more information about how to configure a routing interface, see the *Junos OS Network Interfaces Configuration Guide*.

NOTE: You can include only one routing interface in a bridge domain.

To configure a bridge domain with IRB support, include the following statements:

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    interface interface-name;
    routing-interface routing-interface-name;
    vlan-id (none | number);
    vlan-tags outer number inner number;
  }
}
```

For each bridge domain that you configure, specify a ***bridge-domain-name***. You must also specify the value **bridge** for the **domain-type** statement.

For the **vlan-id** statement, you can specify either a valid VLAN identifier or the **none** option.

NOTE: If you configure a routing interface to support IRB in a bridge domain, you cannot use the **all** option for the **vlan-id** statement.

The **vlan-tags** statement enables you to specify a pair of VLAN identifiers; an **outer** tag and an **inner** tag.

NOTE: For a single bridge domain, you can include either the **vlan-id** statement or the **vlan-tags** statement, but not both.

To include one or more logical interfaces in the bridge domain, specify the ***interface-name*** for each Ethernet interface to include that you configured at the **[edit interfaces]** hierarchy level.

NOTE: A maximum of 4000 active logical interfaces are supported on a bridge domain or on each mesh group in a VPLS routing instance configured for Layer 2 bridging.

To associate a routing interface with a bridge domain, include the **routing-interface *routing-interface-name*** statement and specify a ***routing-interface-name*** you configured at the **[edit interfaces irb]** hierarchy level. You can configure only one routing interface for each bridge domain. For more information about how to configure logical and routing interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

In Junos OS Release 9.0 and later, IRB interfaces are supported for multicast snooping. For more information about multicast snooping, see the *Junos OS Multicast Protocols Configuration Guide*.

In Junos 11.4 and later, IP multicast is supported on Layer 2 trunk ports through IRB interfaces using the Trio chipset.

In Junos OS Release 9.6 and later, in multihomed VPLS configurations, you can configure VPLS to keep a VPLS connection up if only an IRB interface is available by configuring the **irb** option for the **connectivity-type** statement at the **[edit routing-instances *routing-instance-name* protocols vpls]** hierarchy level. The **connectivity-type** statement has two options, **ce** and **irb**. The **ce** option is the default and specifies that a CE interface is required to maintain the VPLS connection. By default, if only an IRB interface is available, the VPLS connection is brought down. For more information about configuring VPNs, see the *Junos VPN Configuration Guide*.

NOTE: When you configure IRB interfaces in more than one logical system on a device, all of the of the IRB logical interfaces share the same MAC address.

Related Documentation

- Guidelines for Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 134
- Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 136

Configuring Bridge Domains as Switches for Layer 2 Trunk Ports

You can configure a set of bridge domains that are associated with a Layer 2 trunk port. The set of bridge domains function as a switch. Packets received on a trunk interface are forwarded within a bridge domain that has the same VLAN identifier. A trunk interface also provides support for IRB, which provides support for Layer 2 bridging and Layer 3 IP routing on the same interface.

To configure a Layer 2 trunk port and set of bridge domains, include the following statements:

```
[edit interfaces]
interface-name {
   unit number {
      family bridge {
         interface-mode access;
         vlan-id number;
      }
   }
}
interface-name {
   native-vlan-id number;
   unit number {
      family bridge {
         interface-mode trunk;
         vlan-id-list [ vlan-id-numbers ];
      }
   }
}
[edit bridge-domains]
```

```
bridge-domain-name {
  vlan-id number;
  vlan-id-list [ vlan-id-numbers ];
  ....
}
```

For **interface-mode trunk**, you can include the **vlan-id-list** statement.

You must configure a bridge domain and VLAN identifier for each VLAN associated with the trunk interface. You can configure one or more trunk or access interfaces at the **[edit interfaces]** hierarchy level. An access interface enables you to accept packets with no VLAN identifier. For more information about configuring trunk and access interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

Related Documentation

- Configuring a Bridge Domain on page 135

Configuring Layer 2 Virtual Switches

Configuring a Layer 2 Virtual Switch

A Layer 2 virtual switch, which isolates a LAN segment with its spanning-tree protocol instance and separates its VLAN ID space, filters and forwards traffic only at the data link layer. Layer 3 routing is not performed. Each bridge domain consists of a set of logical ports that participate in Layer 2 learning and forwarding. A virtual switch represents a Layer 2 network.

Two main types of interfaces are used in virtual switch hierarchies:

- Layer 2 logical interface—This type of interface uses the VLAN-ID as a virtual circuit identifier and the scope of the VLAN-ID is local to the interface port. This type of interface is often used in service-provider-centric applications.
- Access or trunk interface—This type of interface uses a VLAN-ID with global significance. The access or trunk interface is implicitly associated with bridge domains based on VLAN membership. Access or trunk interfaces are typically used in enterprise-centric applications.

NOTE: The difference between access interfaces and trunk interfaces is that access interfaces can be part of one VLAN only and the interface is normally attached to an end-user device (packets are implicitly associated with the configured VLAN). In contrast, trunk interfaces multiplex traffic from multiple VLANs and usually interconnect switches.

To configure a Layer 2 virtual switch, include the following statements:

```
[edit]
routing-instances {
  routing-instance-name (
    instance-type virtual-switch;
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        vlan-id (all | none | number); # Cannot be used with 'vlan-tags' statement
        vlan-id-list [ vlan-id-numbers ];
        vlan-tags outer number inner number; # Cannot be used with 'vlan-id' statement
      }
    }
    protocols {
      mstp {
        ...mstp-configuration ...
      }
    }
  }
}
```

To enable a virtual switch, you must specify **virtual-switch** as the **instance-type**.

For each bridge domain that you configure for the virtual switch, specify a ***bridge-domain-name***. You must also specify the value **bridge** for the **domain-type** statement.

For the **vlan-id** statement, you can specify either a valid VLAN identifier or the **none** or **all** options. If you specify a valid VLAN identifier, you cannot also use the **none** option. These statements are mutually exclusive.

The **all** option is not supported with IRB.

NOTE: You do not have to specify a VLAN identifier for a bridge domain. However, you cannot specify the same VLAN identifier for more than one bridge domain within a virtual switch. Each bridge domain within a virtual switch must have a unique VLAN identifier.

NOTE: For a single bridge domain, you can include either the **vlan-id** statement or the **vlan-tags** statement, but not both.

To specify one or more logical interfaces to include in the bridge domain, specify an ***interface-name*** for an Ethernet interface you configured at the **[edit interfaces]** hierarchy level. For more information, see the *Junos OS Network Interfaces Configuration Guide*.

For information about how to configure spanning tree protocols, see the *Junos OS Feature Guides*.

Related Documentation

- Guidelines for Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 134
- Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 136
- Configuring Integrated Routing and Bridging for a Bridge Domain in a Layer 2 Virtual Switch on page 148

Configuring a Layer 2 Virtual Switch with a Layer 2 Trunk Port

You can associate one or more Layer 2 trunk interfaces with a virtual switch. A Layer 2 trunk interface enables you to configure a logical interface to represent multiple VLANs on the physical interface. Within the virtual switch, you configure a bridge domain and VLAN identifier for each VLAN identifier configured on the trunk interfaces. Packets received on a trunk interface are forwarded within a bridge domain that has the same VLAN identifier. Each virtual switch you configure operates independently and can participate in a different Layer 2 network.

A virtual switch configured with a Layer 2 trunk port also supports IRB within a bridge domain. IRB provides simultaneous support for Layer 2 bridging and Layer 3 IP routing on the same interface. Only an interface configured with the **interface-mode (access | trunk)** statement can be associated with a virtual switch. An access interface enables you to accept packets with no VLAN identifier. For more information about configuring trunk and access interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

In addition, you can configure Layer 2 learning and forwarding properties for the virtual switch.

To configure a virtual switch with a Layer 2 trunk interface, include the following statements:

```
[edit]
routing-instances {
  routing-instance-name {
    instance-type virtual-switch;
    interface interface-name;
    bridge-domains {
      bridge-domain-name {
        vlan-id number;
      }
    }
  }
}
```

NOTE: You must configure a bridge domain and VLAN identifier for each VLAN identifier configured for the trunk interface.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

Configuring VPLS Ports in a Virtual Switch

In Junos OS Release 9.3 and later, you can configure VPLS ports in a virtual switch so that the logical interfaces of the Layer 2 bridge domains in the virtual switch can handle VPLS routing instance traffic. VPLS configuration no longer requires a dedicated routing instance of type **vpls**. Packets received on a Layer 2 trunk interface are forwarded within a bridge domain that has the same VLAN identifier.

A trunk interface is implicitly associated with bridge domains based on VLAN membership. Whereas access interfaces can be part of one VLAN only, trunk interfaces multiplex traffic from multiple VLANs and usually interconnect switches. A Layer 2 trunk port also supports IRB.

To configure VPLS ports in a virtual switch, perform the following tasks:

1. To configure the Layer 2 trunk ports that you will associate with the bridge domains in the virtual switch, include the following statements in the configuration:

```
[edit]
interfaces {
  interface-name {
    unit logical-unit-number { # Call this 'L2-trunk-port-A'
      family bridge {
        interface-mode trunk;
        vlan-id-list [ vlan-id-numbers ] ; # Trunk mode VLAN membership for this
          interface
      }
    }
  }
  .
  .
  .
  interface-name {
    unit logical-unit-number { # Call this 'L2-trunk-port-B'
      family bridge {
        interface-mode trunk;
        vlan-id-list [ vlan-id-numbers ] ; # Trunk mode VLAN membership for this
          interface
      }
    }
  }
}
```

   To configure a logical interface as a trunk port, include the **interface-mode** statement and the **trunk** option at the **[edit interfaces *interface-name* unit *logical-unit-number* family bridge]** hierarchy level.

   To configure all the VLAN identifiers to associate with a Layer 2 trunk port, include the **vlan-id-list [*vlan-id-numbers*]** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family bridge]** hierarchy level.

   Each of the logical interfaces "***L2-trunk-port-A***" and "***L2-trunk-port-B***" accepts packets tagged with any VLAN ID specified in the respective **vlan-id-list** statements.

2. To configure a virtual switch consisting of a set of bridge domains that are associated with one or more logical interfaces configured as a trunk ports, include the following statements in the configuration:

```
[edit]
routing-instance {
  routing-instance-name
    instance-type virtual-switch;
    interface L2-trunk-port-A; # Include one trunk port
    interface L2-trunk-port-B; # Include the other trunk port
    bridge-domains {
      bridge-domain-name-0 {
        domain-type bridge;
        vlan-id number;
      }
      bridge-domain-name-1 {
        domain-type bridge;
        vlan-id number;
      }
    }
    protocols {
      vpls {
        vpls-id number;
        ... vpls-configuration ...
      }
    }
  }
}
```

To begin configuring a virtual switch, include the **instance-type** statement and the **virtual-switch** option at the **[edit routing-instances *routing-instance-name*]** hierarchy level.

To configure a virtual switch consisting of a set of bridge domains that are associated with one or more logical interfaces configured as a trunk ports, you must identify each logical interface by including the **interface *interface-name*** statement at the **[edit routing-instances *routing-instance-name*]** hierarchy level.

For each VLAN configured for a trunk port, you must configure a bridge-domain that includes the trunk port logical interface and uses a VLAN identifier within the range carried by that trunk interface. To configure, include the **domain-type bridge**, **vlan-id *number***, and statements at the **[edit routing-instances *routing-instance-name* bridge-domain *bridge-domain-name*]** hierarchy level.

Related Documentation

- Configuring a Bridge Domain on page 135

Configuring Integrated Routing and Bridging for a Bridge Domain in a Layer 2 Virtual Switch

Integrated routing and bridging (IRB) provides simultaneous support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route local packets to another routed interface or to another bridge domain that has a Layer 3 protocol configured. You configure a logical routing interface by including the **irb** statement at **[edit interfaces]** hierarchy level and include that interface in the bridge domain. For more

information about how to configure a routing interface, see the *Junos OS Network Interfaces Configuration Guide*.

NOTE: You can include only one routing interface in a bridge domain.

To configure a virtual switch with IRB support, include the following statements:

```
[edit]
routing-instances {
  routing-instance-name {
    instance-type virtual-switch;
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        routing-interface routing-interface-name;
        vlan-id (none | number);
        vlan-tags outer number inner number;
      }
    }
  }
}
```

To enable a virtual switch, you must specify **virtual-switch** as the **instance-type**. The **instance-type virtual-switch** statement is not supported at the **[edit logical-systems *logical-system-name*]** hierarchy level.

For each bridge domain that you configure for the virtual switch, specify a ***bridge-domain-name***. You must also specify the value **bridge** for the **domain-type** statement.

For the **vlan-id** statement, you can specify either a valid VLAN identifier or the **none** option.

NOTE: For a single bridge domain, you can include either the **vlan-id** statement or the **vlan-tags** statement, but not both.

To include one or more logical interfaces in the bridge domain, specify the ***interface-name*** for each Ethernet interface to include that you configured at the **[edit interfaces irb]** hierarchy level.

To associate a routing interface with a bridge domain, include the **routing-interface *routing-interface-name*** statement and specify a ***routing-interface-name*** you configured at the **[edit interfaces irb]** hierarchy level. You can configure only one routing interface for each bridge domain. For more information about how to configure logical and routing interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

NOTE: If you configure a routing interface to support IRB in a bridge domain, you cannot use the **all** option for the **vlan-id** statement.

Related Documentation

- Guidelines for Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 134
- Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 136

Configuring Layer 2 Learning and Forwarding for Bridge Domains

Disabling MAC Learning for a Bridge Domain or Logical Interface

You can disable MAC learning for all logical interfaces in a specified bridge domain, or for a specific logical interface in a bridge domain. Disabling dynamic MAC learning prevents the specified interfaces from learning source MAC addresses.

To disable MAC learning for all logical interfaces in a bridge domain in a virtual switch, include the **no-mac-learning** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options]** hierarchy level:

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    interface interface-name;
    bridge-options {
      no-mac-learning;
    }
  }
}
```

To disable MAC learning for a specific logical interface in a bridge domain, include the **no-mac-learning** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*]** hierarchy level.

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    interface interface-name;
    bridge-options {
      interface interface-name {
        no-mac-learning;
      }
    }
  }
}
```

NOTE: When you disable MAC learning, source MAC addresses are not dynamically learned, and any packets sent to these source addresses are flooded into the bridge domain.

NOTE: When you gather interfaces into a bridge domain, the **no-mac-learn-enable** statement at the **[edit interfaces** *interface-name* **gigether-options ethernet-switch-profile]** hierarchy level is not supported. You must use the **no-mac-learning** statement at the **[edit bridge-domains** *bridge-domain-name* **bridge-options interface** *interface-name***]** hierarchy level to disable MAC learning on an interface in a bridge domain.

NOTE: When MAC learning is disabled for a VPLS routing instance, traffic is not load balanced and only one of the equal-cost next hops is used.

Related Documentation

- Configuring Static MAC Addresses for Logical Interfaces in a Bridge Domain on page 151
- Configuring the Size of the MAC Address Table on page 152
- Limiting MAC Addresses Learned from an Interface in a Bridge Domain on page 152
- Enabling MAC Accounting for a Bridge Domain on page 154

Configuring Static MAC Addresses for Logical Interfaces in a Bridge Domain

You can manually add static MAC entries for the logical interfaces in a bridge domain. You can specify one or more static MAC addresses for each logical interface.

To add a static MAC address for a logical interface in a bridge domain, include the **static-mac** *mac-address* statement at the **[edit bridge-domains** *bridge-domain-name* **bridge-options interface** *interface-name***]** hierarchy level.

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    bridge-options {
      interface interface-name {
        static-mac mac-address {
          <vlan-id number>;
        }
      }
    }
  }
}
```

You can optionally specify a VLAN identifier for the static MAC address by using the **vlan-id** statement. To specify a VLAN identifier for a static MAC address, you must use the **all** option when configuring a VLAN identifier for the bridge domain.

NOTE: If a static MAC address you configure for a logical interface appears on a different logical interface, packets sent to that interface are dropped.

Related Documentation

- Disabling MAC Learning for a Bridge Domain or Logical Interface on page 150
- Configuring the Size of the MAC Address Table on page 152
- Limiting MAC Addresses Learned from an Interface in a Bridge Domain on page 152
- Enabling MAC Accounting for a Bridge Domain on page 154

Configuring the Size of the MAC Address Table

You can modify the size of the MAC address table for each bridge domain. The default table size is 5120 addresses. The minimum you can configure is 16 addresses, and the maximum is 1,048,575 addresses.

If the MAC table limit is reached, new addresses can no longer be added to the table. Unused MAC addresses are removed from the MAC address table automatically. This frees space in the table, allowing new entries to be added.

To modify the size of the MAC table, include the **mac-table-size** *limit* statement at the **[edit bridge-domains** *bridge-domain-name* **bridge-options]** hierarchy level:

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    bridge-options {
      mac-table-size limit {
        packet-action drop;
      }
    }
  }
}
```

Related Documentation

- Disabling MAC Learning for a Bridge Domain or Logical Interface on page 150
- Configuring Static MAC Addresses for Logical Interfaces in a Bridge Domain on page 151
- Limiting MAC Addresses Learned from an Interface in a Bridge Domain on page 152
- Enabling MAC Accounting for a Bridge Domain on page 154

Limiting MAC Addresses Learned from an Interface in a Bridge Domain

You can configure a limit on the number of MAC addresses learned from a specific bridge domain or from a specific logical interface that belongs to a bridge domain.

To configure a limit for the number of MAC addresses learned from each logical interface in a bridge domain, include the **interface-mac-limit *limit*** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options]** hierarchy level:

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    interface interface-name;
    bridge-options {
      interface-mac-limit limit;
    }
  }
}
```

To limit the number of MAC addresses learned from a specific logical interface in a bridge domain or an entire bridge domain, include the **interface-mac-limit *limit*** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*]** or **[edit bridge-domains *bridge-domain-name* bridge-options]** hierarchy level:

```
[edit]
bridge-domains {
  bridge-domain-name {
    domain-type bridge;
    interface interface-name;
    bridge-options {
      interface-mac-limit limit{
        packet-action drop;
      }
      interface interface-name {
        interface-mac-limit limit{
          packet-action drop;
        }
      }
    }
  }
}
```

The value you configure for a specific logical interface overrides any value you specify for the entire bridge domain at the **[edit bridge-domains *bridge-domain-name* bridge-options]** hierarchy level.

The default limit to the number of MAC addresses that can be learned on a logical interface is 1024. The range that you can configure for a specific logical interface is 1 through 131,071.

After the MAC address limit is reached, the default is for any incoming packets with a new source MAC address to be forwarded. You can specify that the packets be dropped by including the **packet-action drop** statement. To specify that packets be dropped for the entire bridge domain, include the **packet-action drop** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*]** hierarchy level:

```
[edit bridge-domains bridge-domain-name bridge-options interface-mac-limit limit]
packet-action drop;
```

To specify that the packets be dropped for a specific logical interface in a bridge domain, include the **packet-action drop** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*]** hierarchy level:

```
[edit bridge-domains bridge-domain-name bridge-options interface interface-name
  interface-mac-limit limit]
packet-action drop;
```

You can also configure a limit to the number of MAC addresses learned for an MX Series router.

Related Documentation

- Disabling MAC Learning for a Bridge Domain or Logical Interface on page 150
- Configuring Static MAC Addresses for Logical Interfaces in a Bridge Domain on page 151
- Configuring the Size of the MAC Address Table on page 152
- Enabling MAC Accounting for a Bridge Domain on page 154

Enabling MAC Accounting for a Bridge Domain

By default, MAC accounting is disabled. You can enable packet counting for a bridge domain. When you enable packet accounting, the Junos OS maintains packet counters for each MAC address learned on the interfaces in the bridge domain.

To enable MAC accounting for a bridge domain, include the **mac-statistics** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options]** hierarchy level:

```
[edit bridge-domains bridge-domain-name bridge-options]
mac-statistics;
```

Related Documentation

- Disabling MAC Learning for a Bridge Domain or Logical Interface on page 150
- Configuring Static MAC Addresses for Logical Interfaces in a Bridge Domain on page 151
- Configuring the Size of the MAC Address Table on page 152
- Limiting MAC Addresses Learned from an Interface in a Bridge Domain on page 152

Configuring Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports

- Disabling MAC Learning for a Set of Bridge Domains on page 154
- Limiting the Number of MAC Addresses Learned from a Trunk Port on page 155
- Configuring the Size of the MAC Address Table for a Set of Bridge Domains on page 156
- Enabling MAC Accounting for a Set of Bridge Domains on page 156

Disabling MAC Learning for a Set of Bridge Domains

You can disable MAC learning for a set of bridge domains. Disabling dynamic MAC learning prevents the Layer 2 trunk port associated with the set of bridge domains from learning source and destination MAC addresses. When you disable MAC learning, source MAC addresses are not dynamically learned, and any packets sent to these source addresses are flooded into the switch.

To disable MAC learning for a set of bridge domains, include the **no-mac-learning** statement at the **[edit switch-options]** hierarchy level:

```
[edit switch-options]
no-mac-learning;
```

Related Documentation

- Limiting the Number of MAC Addresses Learned from a Trunk Port on page 155
- Configuring the Size of the MAC Address Table for a Set of Bridge Domains on page 156
- Enabling MAC Accounting for a Set of Bridge Domains on page 156

Limiting the Number of MAC Addresses Learned from a Trunk Port

You can configure a limit on the number of MAC addresses learned from a trunk port or from a specific trunk or access interface.

To limit the number of MAC addresses learned through a trunk port associated with a set of bridge domains, include the **interface-mac-limit *limit*** statement at the **[edit switch-options]** hierarchy level:

```
[edit]
switch-options {
  interface-mac-limit limit;
}
```

To limit the number of MAC addresses learned from a specific logical interface configured as an access interface or a trunk interface, include the **interface-mac-limit *limit*** statement at the **[edit switch-options interface *interface-name*]** hierarchy level:

```
[edit]
switch-options {
  interface interface-name {
    interface-mac-limit limit;
  }
}
```

The default value for the number MAC addresses that can be learned from a logical interface is 1024. You can specify a limit either for a set of bridge domains or for a specific logical interface in the range from 1 through 131,071. The value you configure for a specific logical interface overrides any value you specify for the set of bridge domains.

After the specified MAC address limit is reached, the default is for any incoming packets with a new source MAC address to be forwarded. You can specify that the packets be dropped for the entire virtual switch after the MAC address limit is reached by including the **packet-action drop** statement at the **[edit switch-options interface-mac-limit *limit*]** hierarchy level:

```
[edit switch-options interface interface-name interface-mac-limit limit]
packet-action drop;
```

To specify that the packets be dropped from a specific logical interface in a set of bridge domains with a trunk port after the MAC address limit is reached, include the **packet-action drop** statement at the **[edit routing-instances *routing-instance-name* interface *interface-name* interface-mac-limit *limit*]** hierarchy level:

```
[edit routing-instances routing-instance-name interface interface-name interface-mac-limit
    limit]
packet-action drop;
```

Related Documentation

- Disabling MAC Learning for a Set of Bridge Domains on page 154
- Configuring the Size of the MAC Address Table for a Set of Bridge Domains on page 156
- Enabling MAC Accounting for a Set of Bridge Domains on page 156

Configuring the Size of the MAC Address Table for a Set of Bridge Domains

You can modify the size of the MAC address table for a set of bridge domains. The minimum you can configure is 16 addresses, and the maximum is 1,048,575 addresses. The default table size is 5120 addresses.

If the MAC table limit is reached, new addresses can no longer be added to the table. Unused MAC addresses are removed from the MAC address table automatically. This frees space in the table, allowing new entries to be added to the table.

To modify the size of the MAC table for a set of bridge domains, include the **mac-table-size** statement at the **[edit switch-options]** hierarchy level:

```
[edit switch-options]
mac-table-size limit;
```

Related Documentation

- Disabling MAC Learning for a Set of Bridge Domains on page 154
- Limiting the Number of MAC Addresses Learned from a Trunk Port on page 155
- Enabling MAC Accounting for a Set of Bridge Domains on page 156

Enabling MAC Accounting for a Set of Bridge Domains

By default, MAC accounting is disabled. You can enable packet counting for a set of bridge domains. After you enable packet accounting, the Junos OS maintains packet counters for each MAC address learned on the trunk port associated with the set of bridge domains.

To enable MAC accounting for a set of bridge domains, include the **mac-statistics** statement at the **[edit switch-options]** hierarchy level:

```
[edit switch-options]
mac-statistics;
```

Related Documentation

- Disabling MAC Learning for a Set of Bridge Domains on page 154
- Limiting the Number of MAC Addresses Learned from a Trunk Port on page 155
- Configuring the Size of the MAC Address Table for a Set of Bridge Domains on page 156

Configuring Layer 3 Tunnel Services Interfaces on an MX Series Router with a DPC

The MX Series routers support Dense Port Concentrators (DPCs) with built-in Ethernet ports, which do not support Tunnel Services PICs. To create tunnel interfaces on an MX Series router with a DPC, you configure the DPC and the corresponding Packet Forwarding Engine to use for tunneling services at the **[edit chassis]** hierarchy level. You also configure the amount of bandwidth reserved for tunnel services. The Junos OS creates tunnel interfaces on the Packet Forwarding Engine.

To create tunnel interfaces on MX Series routers, include the following statements at the **[edit chassis]** hierarchy level:

```
[edit chassis]
fpc slot-number {
  pic number {
    tunnel-services {
      bandwidth (1g | 10g);
    }
  }
}
```

Include the **fpc *slot-number*** statement to specify the slot number of the DPC. If two SCBs are installed, the range is 0 through . If three SCBs are installed, the range is 0 through 5 and 7 through .

Include the **pic *number*** statement to specify the number of the Packet Forwarding Engine on the DPC. The range is 0 through 3.

You can also specify the amount of bandwidth to allocate for tunnel traffic on each Packet Forwarding Engine by including the **bandwidth** (**1g** | **10g**) statement at the **[edit chassis fpc *slot-number* pic *pic-number*]** hierarchy level:

- **1g** indicates that 1 Gbps of bandwidth is reserved for tunnel traffic. Configure this option only for a Packet Forwarding Engine on a Gigabit Ethernet 40-port DPC.
- **10g** indicates that 10 Gbps of bandwidth is reserved for tunnel traffic. Configure this option only for a Packet Forwarding Engine on a 10-Gigabit Ethernet 4-port DPC.

If you specify a bandwidth that is not compatible with the type of DPC and Packet Forwarding Engine, tunnel services are not activated. For example, you cannot specify a bandwidth of 1 Gbps for a Packet Forwarding Engine on a 10-Gigabit Ethernet 4-port DPC.

When you configure tunnel interfaces on the Packet Forwarding Engine of a 10-Gigabit Ethernet 4-port DPC, the Ethernet interfaces for that port are removed from service and are no longer visible in the command-line interface (CLI). The Packet Forwarding Engine of a 10-Gigabit Ethernet 4-port DPC supports either tunnel interfaces or Ethernet interfaces, but not both. Each port on the 10-Gigabit Ethernet 4-port DPC includes two LEDs, one for tunnel services and one for Ethernet services, to indicate which type of service is being used. On the Gigabit Ethernet 40-port DPC, you can configure both tunnel and Ethernet interfaces at the same time.

To verify that the tunnel interfaces have been created, issue the **show interfaces terse** operational mode command. For more information, see the *Junos OS Interfaces Command Reference*.

For additional information about tunnel services, see the "Tunnel Services" chapter in the *Junos OS Services Interfaces Configuration Guide*.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5

CHAPTER 11

Summary of Layer 2 Bridging Configuration Statements

The following sections explain each of the bridge domain configuration statements. The statements are organized alphabetically.

bandwidth

Syntax bandwidth (1g | 10g);

Hierarchy Level [edit chassis fpc *slot-number* pic *number* tunnel-services]

Release Information Statement introduced in Junos OS Release 8.2.

Description On MX Series routers only, specify the amount of bandwidth to reserve for tunnel services.

Options

1g—Specify a bandwidth of 1 Gbps on the Packet Forwarding Engine connected to a Gigabit Ethernet 40-port Dense Port Concentrator (DPC).

10g—Specify a bandwidth of 10 Gbps on the Packet Forwarding Engine connected to 10-Gigabit Ethernet 4-port DPC.

NOTE: If you specify a bandwidth that is not compatible with the type of DPC and Packet Forwarding Engine, tunnel services are not activated. For example, you cannot specify a bandwidth of 1 Gbps for a Packet Forwarding Engine on a 10-Gigabit Ethernet 4-port DPC.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Layer 3 Tunnel Services Interfaces on an MX Series Router with a DPC on page 157

bridge-domains

Syntax

```
bridge-domains {
  bridge-domain-name {
    bridge-options {
      ...bridge-options-configuration...
    }
    domain-type bridge;
    interface interface-name;
    no-irb-layer-2-copy;
    routing-interface routing-interface-name;
    vlan-id (all | none | number);
    vlan-id-list [ vlan-id-numbers ];
    vlan-tags outer number inner number;
    bridge-options {
      interface interface-name {
        static-mac mac-address;
      }
      interface-mac-limit limit;
      mac-statistics;
      mac-table-size limit;
      no-mac-learning;
    }
  }
}
```

Hierarchy Level

[edit],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*],
[edit routing-instances *routing-instance-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.
Support for the **no-irb-layer-2-copy** statement added in Junos OS Release 10.2.

Description

(MX Series routers only) Configure a domain that includes a set of logical ports that share the same flooding or broadcast characteristics in order to perform Layer 2 bridging.

Options

bridge-domain-name—Name of the bridge domain.

NOTE: You cannot use the slash (/) character as part of the bridge domain name. If you do, the configuration will not commit.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Bridge Domain on page 135
- Configuring a Layer 2 Virtual Switch on page 144

- Example: Configuring E-LINE and E-LAN Services for a PBB Network on MX Series Routers

bridge-options

Syntax

```
bridge-options {
  interface interface-name;
    static-mac static-mac-address;
  }
  interface-mac-limit limit;
    packet-action drop;
  }
  mac-statistics;
  mac-table-size limit;
  no-mac-learning;
}
```

Hierarchy Level

[edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description

(MX Series routers only) Configure Layer 2 learning and forwarding properties for a bridge domain or a virtual switch.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133

domain-type

Syntax domain-type bridge;

Hierarchy Level [edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Define the type of domain for a Layer 2 bridge domain.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring a Bridge Domain on page 135
- Configuring a Layer 2 Virtual Switch on page 144

interface

Syntax interface *interface-name*;

Hierarchy Level [edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit bridge-domains *bridge-domain-name*],

Release Information Statement introduced in Junos OS Release 8.4.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2.
In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Specify the logical interfaces to include in the bridge domain, VPLS instance, or virtual switch.

Options *interface-name*—Name of a logical interface. For more information about how to configure logical interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring a Bridge Domain on page 135
- Configuring a Layer 2 Virtual Switch on page 144

interface-mac-limit

Syntax

```
interface-mac-limit limit {
    packet-action drop;
}
```

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options],
[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface *interface-name*],
[edit logical-systems *logical-system-name* switch-options],
[edit logical-systems *logical-system-name* switch-options interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* switch-options],
[edit routing-instances *routing-instance-name* switch-options interface *interface-name*],
[edit switch-options],
[edit switch-options interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.

Description

(MX Series routers only) Configure a limit to the number of MAC addresses that can be learned from a bridge domain, virtual switch, or set of bridge domains.

Default

1024 MAC addresses for each logical interface.

Options

limit—Maximum number of MAC addresses learned from an interface.

Range: 1 through 131,071 MAC addresses per interface

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

mac-statistics

Syntax

mac-statistics;

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* switch-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* switch-options],
[edit switch-options]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.

Description

(MX Series routers only) Enable MAC accounting either for a specific bridge domain, or for a set of bridge domains associated with a Layer 2 trunk port.

Default

disabled

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

mac-table-size

Syntax

```
mac-table-size limit {
    packet-action drop;
}
```

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* switch-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* switch-options],
[edit switch-options]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.

Description

Modify the size of the MAC address table for the bridge domain, a set of bridge domains associated with a trunk port, or a virtual switch. The default is 5120 MAC addresses.

Options

limit—Specify the maximum number of addresses in the MAC address table.

Range: 16 through 1,048,575 MAC addresses

Default: 5120 MAC addresses

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

no-irb-layer-2-copy

Syntax no-irb-layer-2-copy;

Hierarchy Level [edit bridge-domains],
[edit logical-routers *logical-router-name* bridge-domains],
[edit routing-instances *routing-instance-name* bridge-domains]

Release Information Statement introduced in Junos OS Release 10.2.

Description If you include this statement when using port mirroring with Integrated Routing and Bridging (IRB), then the packet is mirrored as a Layer 3 packet. By default, the packet is mirrored as a Layer 2 packet. This statement is also supported if a routing instance is set to type VPLS.

Usage Guidelines See "Configuring a Bridge Domain" on page 135

Required Privilege Level view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- Configuring a Layer 2 Virtual Switch on page 144

no-mac-learning

Syntax no-mac-learning;

Hierarchy Level
[edit bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* switch-options],
[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* switch-options],
[edit switch-options]

Release Information
Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Disable MAC learning for a virtual switch, for a bridge domain, for a specific logical interface in a bridge domain, or for a set of bridge domains associated with a Layer 2 trunk port.

NOTE: When MAC learning is disabled for a VPLS routing instance, traffic is not load balanced and only one of the equal-cost next hops is used.

Default MAC learning is enabled. Use **no-mac-learning** to disable MAC learning.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133
- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

packet-action

Syntax packet-action drop;

Hierarchy Level
[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface *interface-name* interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* switch-options interface-mac-limit *limit*],
[edit protocols l2-learning global-mac-limit *limit*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit routing-instances *routing-instance-name* switch-options interface *interface-name* interface-mac-limit *limit*],
[edit routing-instances *routing-instance-name* switch-options interface-mac-limit *limit*],
[edit switch-options interface-mac-limit *limit*]

Release Information
Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Specify that packets for new source MAC addresses be dropped after the MAC address limit is reached. If this statement is not configured, then packets for new source MAC addresses are forwarded by default.

Default Disabled. The default is for packets for new source MAC addresses to be forwarded after the MAC address limit is reached.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133

- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

routing-interface

Syntax routing-interface *routing-interface-name*;

Hierarchy Level [edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Specify a routing interface to include in a bridge domain or a VPLS routing instance.

Options ***routing-interface-name***—Name of the routing interface to include in the bridge domain or the VPLS routing instance. The format of the routing interface name is **irb.*x***, where ***x*** is the unit number of the routing interface you configured at the **[edit interfaces irb]** hierarchy level. For more information about how to configure a routing interface, see the *Junos OS Network Interfaces Configuration Guide*.

NOTE: You can specify only one routing interface for each bridge domain or VPLS instance.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Bridge Domain on page 135
- Configuring a Layer 2 Virtual Switch on page 144

static-mac

Syntax

```
static-mac mac-address {
    vlan-id number;
}
```

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name*bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description

(MX Series routers only) Configure a static MAC address for a logical interface in a bridge domain.

Options

mac-address—MAC address

vlan-id *number*—(Optional) VLAN identifier to associate with static MAC address.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Overview on page 133

switch-options

Syntax

```
switch-options {
  interface interface-name {
    interface-mac-limit limit;
  }
  interface-mac-limit limit {
    packet-action drop;
  }
  mac-statistics;
  mac-table-size limit {
    packet-action drop;
  }
  no-mac-learning;
}
```

Hierarchy Level

[edit],
[edit logical-systems *logical-system-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*],
[edit routing-instances *routing-instance-name*]

Release Information

Statement introduced in Junos OS Release 9.2.
Support for logical systems added in Junos OS Release 9.6.

Description

Configure Layer 2 learning and forwarding properties for a set of bridge domains.

Options

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports on page 133

tunnel-services

Syntax

```
tunnel-services {
  bandwidth (1g | 10g);
}
```

Hierarchy Level [edit chassis fpc *slot-number* pic *number*]

Release Information Statement introduced in Junos OS Release 8.2.

Description For MX Series routers, configure the amount of bandwidth for tunnel services.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Layer 3 Tunnel Services Interfaces on an MX Series Router with a DPC on page 157

vlan-id (Bridge Domain)

Syntax vlan-id (all | none | *number*);

Hierarchy Level [edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* bridge-domainss *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for Layer 2 trunk ports added in Junos OS Release 9.2.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Specify a VLAN identifier (VID) to include in the packets sent to and from the bridge domain or a VPLS routing instance.

NOTE: When configuring a VLAN identifier for provider backbone bridge (PBB) routing instances, dual-tagged VIDs and the none option are not permitted.

Options *number*—A valid VLAN identifier. If you configure multiple bridge domains with a valid VLAN identifier, you must specify a unique VLAN identifier for each domain. However, you can use the same VLAN identifier for bridge domains that belong to different virtual switches. Use this option to send singly tagged frames with the specified VLAN identifier over VPLS VT interfaces.

NOTE: If you specify a VLAN identifier, you cannot also use the all option. They are mutually exclusive.

all—Specify that the bridge domain spans all the VLAN identifiers configured on the member logical interfaces.

NOTE: You cannot specify the all option if you include a routing interface in the bridge domain.

none—Specify to enable shared VLAN learning or to send untagged frames over VPLS VT interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Bridge Domain on page 135
- Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 136
- Configuring Bridge Domains as Switches for Layer 2 Trunk Ports on page 143
- Configuring a Layer 2 Virtual Switch on page 144
- Example: Configuring E-LINE and E-LAN Services for a PBB Network on MX Series Routers

vlan-id-list

Syntax vlan-id-list [*vlan-id-numbers*];

Hierarchy Level
[edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]

Release Information
Statement introduced in Junos OS Release 9.4.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Specify a VLAN identifier list to use for a bridge domain in trunk mode.

Options ***vlan-id-numbers***—Valid VLAN identifiers. You can combine individual numbers with range lists including a hyphen.

Range: 0 through 4095

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Bridge Domain on page 135
- Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 136

vlan-tags

Syntax vlan-tags outer *number* inner *number*;

Hierarchy Level [edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Specify dual VLAN identifier tags for a bridge domain or a VPLS routing instance.

Options outer *number*—A valid VLAN identifier.

inner *number*—A valid VLAN identifier.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Bridge Domain on page 135
- Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances on page 136
- Configuring a Layer 2 Virtual Switch on page 144.

PART 5

Layer 2 Address Learning and Forwarding

CHAPTER 12

Layer 2 Learning and Forwarding

Layer 2 Learning and Forwarding Overview

On MX Series routers only, you can configure Layer 2 MAC address and VLAN learning and forwarding properties in support of Layer 2 bridging. The router learns unicast media access control (MAC) addresses to avoid flooding the packets to all the ports in a bridge domain. The MX Series router creates a source MAC entry in its source and destination MAC tables for each MAC address learned from packets received on ports that belong to the bridge domain.

By default, Layer 2 address learning is enabled. You can disable MAC learning for the router or for a specific bridge domain or logical interfaces. You can also configure the following Layer 2 forwarding properties for an MX Series router:

- Timeout interval for MAC entries
- MAC accounting
- A limit to the number of MAC addresses learned from the logical interfaces

For more information about how to configure bridge domains and virtual switches, see "Configuring a Bridge Domain" on page 135 and "Configuring a Layer 2 Virtual Switch" on page 144.

Related Documentation

- Configuring the MAC Table Timeout Interval on page 180
- Enabling MAC Accounting on page 180
- Limiting the Number of MAC Addresses Learned from Each Logical Interface on page 181
- Disabling Layer 2 Learning and Forwarding on page 182

Configuring Layer 2 Learning and Forwarding

Configuring the MAC Table Timeout Interval

By default, the timeout interval for all entries in the MAC table is 300 seconds. You can modify the timeout interval for MAC table entries on an MX Series router. You cannot modify the timeout interval only for specific MAC table entries, such as for a bridge domain or a virtual switch.

NOTE: **The timeout interval applies only to dynamically learned MAC addresses. This value does not apply to configured static MAC addresses, which never time out.**

To modify the timeout interval for the MAC table for the entire routing platform, include the **global-mac-table-aging-time** ***seconds*** statement at the **[edit protocols l2-learning]** hierarchy level:

```
[edit protocols l2-learning]
global-mac-table-aging-time seconds;
```

The range for ***seconds*** is from 10 through 1,000,0000.

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179
- Enabling MAC Accounting on page 180
- Limiting the Number of MAC Addresses Learned from Each Logical Interface on page 181
- Disabling Layer 2 Learning and Forwarding on page 182

Enabling MAC Accounting

By default, MAC accounting is disabled. On MX Series routers, you can enable packet accounting either for the router as a whole or for a specific bridge domain. After you enable packet accounting, the Junos OS maintains packet counters for each MAC address learned.

To enable MAC accounting for an MX Series router, include the **global-mac-statistics** statement at the **[edit protocols l2-learning]** hierarchy level:

```
[edit protocols l2-learning]
global-mac-statistics;
```

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179
- Configuring the MAC Table Timeout Interval on page 180
- Limiting the Number of MAC Addresses Learned from Each Logical Interface on page 181

- Disabling Layer 2 Learning and Forwarding on page 182

Limiting the Number of MAC Addresses Learned from Each Logical Interface

You can configure a limit to the number of MAC addresses learned from the logical interfaces on an MX Series router.

To configure a limit to the total number of MAC addresses that can be learned from the logical interfaces, include the **global-mac-limit *limit*** statement at the **[edit protocols l2-learning]** hierarchy level:

```
[edit]
protocols {
  l2-learning {
    global-mac-limit limit;
  }
}
```

The default limit to the number of MAC addresses that can be learned the router as a whole is 393,215. The range that you can configure for the router as a whole is 20 through 1,048,575.

After the configured MAC address limit is reached, the default is for packets to be forwarded. You can specify that the packets be dropped by including the **packet-action drop** statement at the **[edit protocols l2-learning global-mac-limit]** hierarchy level:

```
[edit]
protocols {
  l2-learning {
    global-mac-limit limit {
      packet-action drop;
    }
  }
}
```

You can also configure a limit to the number of MAC address learned from all the interfaces in a bridge domain or from a specific logical interface only. For more information, see "Layer 2 Learning and Forwarding for Bridge Domains Overview" on page 133.

NOTE: On MX Series routers running Junos OS Release 8.4 and later, statistics for an aged destination MAC entry are not retained. In addition, source and destination statistics are reset during a MAC move. In previous releases, only source statistics were reset during a MAC move.

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179
- Configuring the MAC Table Timeout Interval on page 180
- Enabling MAC Accounting on page 180
- Disabling Layer 2 Learning and Forwarding on page 182

Disabling Layer 2 Learning and Forwarding

Disabling dynamic MAC learning on an MX Series router prevents all the logical interfaces on the router from learning source and destination MAC addresses.

To disable MAC learning for an MX Series router, include the **global-no-mac-learning** statement at the **[edit protocols l2-learning]** hierarchy level:

```
[edit protocols l2-learning]
global-no-mac-learning;
```

For information about how to configure a virtual switch, see "Configuring a Layer 2 Virtual Switch" on page 144.

Related Documentation

- Layer 2 Learning and Forwarding Overview on page 179
- Configuring the MAC Table Timeout Interval on page 180
- Enabling MAC Accounting on page 180
- Limiting the Number of MAC Addresses Learned from Each Logical Interface on page 181

CHAPTER 13

Summary of Layer 2 Address Learning and Forwarding Configuration Statements

The following sections explain each of the Layer 2 address learning and forwarding configuration statements. These statements are organized alphabetically.

global-mac-limit

Syntax

```
global-mac-limit limit {
  packet-action drop;
}
```

Hierarchy Level [edit protocols l2-learning]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Limit the number of media access control (MAC) addresses learned from the logical interfaces on the router.

Default 393,215 MAC addresses

Options ***limit***—Number of MAC addresses that can be learned systemwide.

Range: 20 through 1,048,575

The remaining statement is explained separately in the "Summary of Bridge Domain Configuration Statements" chapter.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Limiting the Number of MAC Addresses Learned from Each Logical Interface on page 181

global-mac-statistics

Syntax global-mac-statistics;

Hierarchy Level [edit protocols l2-learning]

Release Information Statement introduced in Junos OS Release 9.2.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Enable MAC accounting for the entire router,

Default disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Enabling MAC Accounting on page 180

global-mac-table-aging-time

Syntax global-mac-table-aging-time *seconds*;

Hierarchy Level [edit protocols l2-learning]

Release Information Statement introduced in Junos OS Release 9.2.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Configure the timeout interval for entries in the MAC table.

Default 300 seconds

Options ***seconds***—Time elapsed before MAC table entries are timed out and entries are deleted from the table.

Range: 10 through 1 million

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring the MAC Table Timeout Interval on page 180

global-no-mac-learning

Syntax global-no-mac-learning;

Hierarchy Level [edit protocols l2-learning]

Release Information Statement introduced in Junos OS Release 9.2.
Support for logical systems added in Junos OS Release 9.6.

Description (MX Series routers only) Disable MAC learning for the entire router.

Default MAC learning is enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Disabling Layer 2 Learning and Forwarding on page 182

l2-learning

Syntax
```
l2-learning {
  global-mac-limit limit;
  global-mac-statistics;
  global-mac-table-aging-time seconds;
  global-no-mac-learning;
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 8.4.

Description (MX Series routers only) Configure Layer 2 address learning and forwarding properties globally.

The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Layer 2 Learning and Forwarding Overview on page 179

PART 6

Spanning-Tree Protocols

CHAPTER 14

Spanning-Tree Protocols Overview

Spanning-Tree Protocols Supported on MX Series Routers

On MX Series routers in a Layer 2 environment, you can configure various spanning-tree protocol versions to create a loop-free topology in Layer 2 networks.

A spanning-tree protocol is a Layer 2 control protocol (L2CP) that calculates the best path through a switched network containing redundant paths. A spanning-tree protocol uses bridge protocol data unit (BPDU) data frames to exchange information with other switches. A spanning-tree protocol uses the information provided by the BPDUs to elect a root bridge, identify root ports for each switch, identify designated ports for each physical LAN segment, and prune specific redundant links to create a loop-free tree topology. The resulting tree topology provides a single active Layer 2 data path between any two end stations.

NOTE: In discussions of spanning-tree protocols, the terms *bridge* and *switch* are often used interchangeably.

The Juniper Networks MX Series 3D Universal Edge Routers support STP, RSTP, MSTP, and VSTP.

- The original Spanning-Tree Protocol (STP) is defined in the IEEE 802.1D 1998 specification. A newer version called Rapid Spanning-Tree Protocol (RSTP) was originally defined in the IEEE 802.1w draft specification and later incorporated into the IEEE 802.1D-2004 specification. A recent version called Multiple Spanning-Tree Protocol (MSTP) was originally defined in the IEEE 802.1s draft specification and later incorporated into the IEEE 802.1Q-2003 specification. The VLAN Spanning-Tree Protocol (VSTP) is compatible with the Per-VLAN Spanning Tree Plus (PVST+) and Rapid-PVST+ protocols supported on Cisco Systems routers and switches.
- RSTP provides faster reconvergence time than the original STP by identifying certain links as point to point and by using protocol handshake messages rather than fixed timeouts. When a point-to-point link fails, the alternate link can transition to the forwarding state without waiting for any protocol timers to expire.

- MSTP provides the capability to logically divide a Layer 2 network into regions. Every region has a unique identifier and can contain multiple instances of spanning trees. All regions are bound together using a Common Instance Spanning Tree (CIST), which is responsible for creating a loop-free topology *across* regions, whereas the Multiple Spanning-Tree Instance (MSTI) controls topology *within* regions. MSTP uses RSTP as a converging algorithm and is fully interoperable with earlier versions of STP.
- VSTP maintains a separate spanning-tree instance for each VLAN. Different VLANs can use different spanning-tree paths. When different VLANs use different spanning-tree paths, the CPU processing resources being consumed increase as more VLANs are configured. VSTP BPDU packets are tagged with the corresponding VLAN identifier and are transmitted to the multicast destination media access control (MAC) address **01-00-0c-cc-cc-cd** with a protocol type of **0x010b**. VSTP BPDUs are tunneled by pure IEEE 802.1q bridges.

NOTE: **All virtual switch routing instances configured on an MX Series router are supported using only one spanning-tree process. The Layer 2 control protocol process is named l2cpd.**

For more information about the various versions of spanning-tree protocols, see the appropriate IEEE specification.

Related Documentation

- Loop Protection for Spanning-Tree Instance Interfaces Overview on page 217
- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227

BPDU Overview

In a Layer 2 bridge environment, spanning-tree protocols use data frames called Bridge Protocol Data Units (BPDUs) to exchange information among bridges.

Spanning-tree protocols on peer systems exchange BPDUs, which contain information about port roles, bridge IDs, and root path costs. On each MX Series router, the spanning-tree protocol uses this information to elect a root bridge, identify root ports for each switch, identify designated ports for each physical LAN segment, and prune specific redundant links to create a loop-free tree topology. The resulting tree topology provides a single active Layer 2 data path between any two end stations.

NOTE: **In discussions of spanning-tree protocols, the terms *bridge* and *switch* are often used interchangeably.**

The transmission of BPDUs is controlled by the Layer 2 Control Protocol process (l2cpd) on MX Series 3D Universal Edge Routers.

The transmission of periodic packets on behalf of the l2cpd process is carried out by periodic packet management (PPM), which, by default, is configured to run on the Packet Forwarding Engine. The ppmd process on the Packet Forwarding Engine ensures that the BPDUs are transmitted even when the l2cpd process control plane is unavailable, and keeps the remote adjacencies alive during a unified in-service software upgrade (unified ISSU). However, if you want the distributed PPM (ppmd) process to run on the Routing Engine instead of the Packet Forwarding Engine, you can disable the ppmd process on the Packet Forwarding Engine. For more information, see the *Junos OS High Availability Configuration Guide*.

On MX Series routers with redundant Routing Engines (two Routing Engines that are installed in the same router), you can configure nonstop bridging. Nonstop bridging enables the router to switch from a primary Routing Engine to a backup Routing Engine without losing Layer 2 Control Protocol (L2CP) information. Nonstop bridging uses the same infrastructure as graceful Routing Engine switchover (GRES) to preserve interface and kernel information. However, nonstop bridging also saves L2CP information by running the l2cpd process on the backup Routing Engine.

NOTE: **To use nonstop bridging, you must first enable GRES.**

Nonstop bridging is supported for the following Layer 2 control protocols:

- Spanning-Tree Protocol (STP)
- Rapid Spanning-Tree Protocol (RSTP)
- Multiple Spanning-Tree Protocol (MSTP)

For more information about GRES and nonstop bridging, see the *Junos OS High Availability Configuration Guide*.

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Loop Protection for Spanning-Tree Instance Interfaces Overview on page 217
- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222

CHAPTER 15

Guidelines for Configuring Spanning-Tree Protocols

Spanning-Tree Protocols in Logical Systems

On MX Series routers only, you can configure spanning-tree protocols in logical systems for bridge domains and other virtual-switch routing instances.

When configuring spanning-tree protocols in logical systems for bridge domains and other virtual-switch routing instances, the following guidelines apply:

- You can only configure 16 logical systems.
- Logging is performed for the entire device and not per logical system.
- You cannot restart Layer 2 learning for an individual logical system.

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189

IEEE 802.1D STP Version Forced for RSTP or VSTP

The following topics describe guidelines for configuring Rapid Spanning-Tree Protocol (RSTP) or VLAN Spanning-Tree Protocol (VSTP) to run as the original IEEE 802.1D Spanning-Tree Protocol (STP) version for compatibility with older bridges that do not support RSTP or VSTP:

RSTP or VSTP Forced to Run as IEEE 802.1D STP

On MX Series routers in a Layer 2 environment, you can force the configured Rapid Spanning-Tree Protocol (RSTP) or VLAN Spanning-Tree Protocol (VSTP) to run as the original IEEE 802.1D Spanning-Tree Protocol (STP) version. Configure this option for compatibility with older bridges that do not support RSTP or VSTP.

Keep the following limitations in mind when RSTP or VSTP are run as the original STP version:

- If you configure an instance interface as an edge port, the configuration statement is ignored.
- If you configure point-to-point link mode for an instance interface, the configuration statement is ignored.

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring VLAN Spanning-Tree Protocol on page 210
- Reverting RSTP or VSTP Back From Forced IEEE 802.1D STP on page 194
- **force-version on page 253**

Reverting RSTP or VSTP Back From Forced IEEE 802.1D STP

On MX Series routers on which Rapid Spanning-Tree Protocol (RSTP) or VLAN Spanning-Tree Protocol (VSTP) has been forced to run as the original IEEE 802.1D Spanning-Tree Protocol (STP) version, you can revert back to RSTP or VSTP.

To revert from the forced instance of the original IEEE 802.1D STP version back to the configured RSTP or VSTP version:

1. Remove the **force-version** statement from the RSTP or VSTP configuration:

   user@host# **delete** force-version

   Include this statement under the RSTP or VSTP hierarchy level:

   - **[edit protocols** rstp**]**
   - **[edit protocols** vstp**]**
   - **[edit routing-instances** *routing-instance-name* **protocols** rstp**]**
   - **[edit routing-instances** *routing-instance-name* **protocols** vstp**]**

2. Revert the forced IEEE 802.1D STP to run as the configured RSTP or VSTP:

   user@host# **clear spanning-tree protocol-migration <interface** *interface-name***>**
   <routing-instance *routing-instance-name***>**

To revert the STP protocol for the specified interface only, specify the **interface** *interface-name* option.

To revert the STP protocol for a particular routing instance only, specify the **routing-instance** *routing-instance-name* option.

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- RSTP or VSTP Forced to Run as IEEE 802.1D STP on page 194
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring VLAN Spanning-Tree Protocol on page 210

Basic Configuration of Bridges in Spanning-Tree Instances

The following topics describe the basic features you can configure for spanning-tree protocol instances:

- Provider Bridge Participation in RSTP or MSTP Instances on page 195
- System Identifier for Bridges in STP or RSTP Instances on page 196
- Bridge Priority for Election of Root Bridge and Designated Bridge on page 196
- Maximum Age for Awaiting Arrival of Hello BPDUs on page 196
- Hello Time for Root Bridge to Transmit Hello BPDUs on page 196
- Forward Delay Before Ports Transition to Forwarding State on page 197

Provider Bridge Participation in RSTP or MSTP Instances

A provider network can bridge the customer STP BPDU packets between customer sites by default. At the same time, the provider network can prevent forwarding loops by running a spanning-tree protocol in the provider network. On an MX Series router running Rapid Spanning-Tree Protocol (RSTP) or Multiple Spanning-Tree Protocol (MSTP) in a provider network, you can enable provider bridge participation in the RSTP or MSTP instance.

The IEEE 802.1ad specification reserves the group MAC address value of **01:80:c2:00:00:08** to designate the *provider bridge group*. On an MX Series router for which you have enabled provider bridge participation in the RSTP or MSTP instance, the router exchanges BPDU packets with the provider bridge group as follows:

- Transmitted BPDU packets contain the destination MAC address **01:80:c2:00:00:08**.
- Received BPDU packets with the destination MAC address **01:80:c2:00:00:08** are accepted and passed to the Routing Engine.

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- **bpdu-destination-mac-address on page 246**

System Identifier for Bridges in STP or RSTP Instances

The extended system identifier is used to specify different bridge identifiers for different STP or RSTP routing instances.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- extended-system-id on page 253

Bridge Priority for Election of Root Bridge and Designated Bridge

Use the bridge priority to control which bridge is elected as the root bridge and also to control which bridge is elected the root bridge when the initial root bridge fails.

The root bridge for each spanning-tree protocol instance is determined by the bridge ID. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge. The bridge with the lowest bridge ID is elected as the root bridge. If the bridge priorities are equal or if the bridge priority is not configured, the bridge with the lowest MAC address is elected the root bridge.

The bridge priority can also be used to determine which bridge becomes the designated bridge for a LAN segment. If two bridges have the same path cost to the root bridge, the bridge with the lowest bridge ID becomes the designated bridge.

The bridge priority can be set only in increments of 4096.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- bridge-priority on page 248

Maximum Age for Awaiting Arrival of Hello BPDUs

The maximum age timer specifies the maximum expected arrival time of hello BPDUs. If the maximum age timer expires, the bridge detects that the link to the root bridge has failed and initiates a topology reconvergence. The maximum age timer should be longer than the configured hello timer.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- max-age on page 259

Hello Time for Root Bridge to Transmit Hello BPDUs

The hello timer specifies the time interval at which the root bridge transmits configuration BPDUs.

Related Documentation
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- **hello-time on page 255**

Forward Delay Before Ports Transition to Forwarding State

The forwarding delay timer specifies the length of time a spanning-tree protocol bridge port remains in the listening and learning states before transitioning to the forwarding state. Setting the interval too short could cause unnecessary spanning-tree reconvergence. Before changing this parameter, you should have a thorough understanding of spanning-tree protocols.

Related Documentation
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- **forward-delay on page 254**

Physical Interface Configuration for Spanning-Tree Protocol Instances

The following topics describe guidelines for configuring spanning-tree protocol instance interfaces:

- Spanning-Tree Instance Interface on page 197
- Spanning-Tree Instance Interface Priority on page 198
- Spanning-Tree Instance Interface Cost on page 198
- Spanning-Tree Instance Interface Point-to-Point Link Mode on page 199
- Spanning-Tree Instance Interface Configured as an Edge Port on page 199

Spanning-Tree Instance Interface

STP and RSTP are limited to a single instance on any physical interface. Use the **interface** statement to configure which interfaces participate in the STP or RSTP instance.

MSTP supports multiple instances on a single physical interface. Use the **interface** statement to configure which logical interfaces participate in MSTP.

For VSTP, interfaces can be configured at the global level or at the VLAN level. Interfaces configured at the global VSTP level will be enabled for all the configured VLANs. If an interface is configured at both the global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

Related Documentation
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204

- Configuring VLAN Spanning-Tree Protocol on page 210
- cost on page 250
- edge on page 252
- interface (Spanning Tree) on page 257
- mode on page 261
- priority on page 265

Spanning-Tree Instance Interface Priority

The root port is the interface on the nonroot bridge with the lowest path cost to the root bridge. When multiple interfaces have the same path cost to the root bridge, the interface with the lowest interface priority is selected as the root port.

If the interface priority is not configured and multiple interfaces have the same path cost to the root bridge, the interface with the lowest interface identifier is selected as the root port.

If the interface priority is configured under the MSTP protocol, this becomes the default value for all interfaces. If the interface priority is configured under the MSTI interface, the value overrides the default for that interface.

If the interface priority is configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- interface (Spanning Tree) on page 257
- priority on page 265

Spanning-Tree Instance Interface Cost

The path cost used to calculate the root path cost from any given LAN segment is determined by the total cost of each link in the path. By default, the link cost is determined by the speed of the link. The interface cost can be configured to override the default cost and control which bridge is the designated bridge and which port is the designated port. In MSTP the CIST external path cost is determined by the link speed and the number of hops.

If the interface cost is not configured, the cost is determined by the speed of the interface. For example, a 100-Mbps link has a default path cost of 19, a 1000-Mbps link has a default path cost of 4, and a 10-Gbps link has a default path cost of 2.

If the interface cost is configured under MSTP, this becomes the default value for all interfaces. If the interface cost is configured under the MSTI interface, the value overrides the default for that interface.

If the interface cost is configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

The interface cost should be set the same for all interfaces connected to the same LAN segment.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- **cost on page 250**
- **interface (Spanning Tree) on page 257**

Spanning-Tree Instance Interface Point-to-Point Link Mode

The interface mode allows RSTP, MSTP, and VSTP to converge faster than the original STP on point-to-point links. The protocol does not need to wait for timers on point-to-point links. Configure interfaces that have a point-to-point link to another Layer 2 bridge as **p2p**. This parameter is ignored if the STP is configured to run the original spanning-tree version.

If the interface mode is configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- **mode on page 261**
- **interface (Spanning Tree) on page 257**

Spanning-Tree Instance Interface Configured as an Edge Port

RSTP, MSTP, and VSTP instance interfaces configured as *edge ports* enable the protocol to converge faster than the original IEEE 802.1D STP version. Edge ports transition directly to the forwarding state, and so the protocol does not need to wait for BPDUs to be received on edge ports.

The Junos OS supports automatic detection of edge ports as described in the RSTP standard. Layer 2 bridges do not expect to receive BPDUs for edge ports. If a BPDU is received for an edge port, the port becomes a non-edge port.

Keep the following guidelines in mind when configuring spanning-tree instance interfaces as edge ports:

- Do not configure a spanning-tree instance interface as an edge port if it is connected to any Layer 2 bridge. An instance interface connected to Layer 2 bridges but configured as an edge port can cause physical loops.
- if the spanning-tree protocol is configured to run the original IEEE 802.1D spanning-tree version, the edge-port option (if configured) is ignored.
- If edge ports are configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- **edge on page 252**
- **interface (Spanning Tree) on page 257**

Spanning-Tree Protocol Trace Options

In order to trace spanning-tree protocol operations, you can set spanning-tree protocol-specific trace options in the spanning-tree protocol configuration.

For general information about tracing and global tracing options, see the statement summary for the global **traceoptions** statement in the *Junos OS Routing Protocols Configuration Guide*.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210
- Example: Tracing Spanning-Tree Protocol Operations on page 240
- **traceoptions (Spanning Tree) on page 272**

CHAPTER 16

Configuring Spanning-Tree Protocols

Configuring Rapid Spanning-Tree Protocol

You can configure Rapid Spanning-Tree Protocol (RSTP) under the following hierarchy levels:

- **[edit logical-systems** *logical-system-name* protocols**]**
- **[edit logical-systems** *logical-system-name* **routing-instances** *routing-instance-name* protocols**]**
- **[edit** protocols**]**
- **[edit routing-instances** *routing-instance-name* protocols**]**

The routing instance type can be either **virtual-switch** or **layer2-control**.

To configure the Rapid Spanning-Tree Protocol:

1. Enable RSTP as the version of spanning-tree protocol to be configured:

```
[edit]
user@host@ edit ... protocols rstp
```

2. (Optional) For compatibility with older bridges that do not support RSTP, you can run force RSTP to run as the original IEEE 802.1D Spanning-Tree Protocol (STP) version:

```
[edit ... protocols rstp]
user@host# set force-version stp
```

NOTE: If RSTP has been forced to run as the original STP version, you can revert back to RSTP by first removing the **force-version** statement from the configuration and then entering the **clear spanning-tree protocol-migration** configuration mode command.

3. (Optional) Enable provider bridge participation in the RSTP instance:

```
[edit ... protocols rstp]
user@host# set bpdu-destination-mac-address provider-bridge-group
```

4. (Optional) Specify the extended system identifier used in identifiers bridges that participate in RSTP:

```
[edit ... protocols rstp]
user@host# set extended-system-id identifier
```

5. Configure the interfaces that participate in the RSTP instance.

   a. Enable configuration of the interface:

```
[edit ... protocols rstp]
user@host# edit interface interface-name
```

   b. Configure the interface priority:

```
[edit ... protocols rstp interface interface-name]
user@host# set priority interface-priority
```

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

```
[edit ... protocols rstp interface interface-name]
user@host# set cost interface-link-cost
```

   d. Configure the interface link mode to identify point-to-point links:

```
[edit ... protocols rstp interface interface-name]
user@host# set mode (p2p | shared)
```

      Specify **p2p** if the link is point to point. Specify **shared** is the link is a shared media.

   e. (Optional) Configure the interface as an edge port:

```
[edit ... protocols rstp interface interface-name]
user@host# set edge
```

      Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

   You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see "Checking the Status of Spanning-Tree Instance Interfaces" on page 225.

6. Configure the bridge priority

```
[edit ... protocols rstp]
user@host# set bridge-priority bridge-priority
```

   For more information, see "Bridge Priority for Election of Root Bridge and Designated Bridge" on page 196.

7. Configure hello BPDU timers.

   a. Configure the maximum expected arrival time of hello BPDUs:

      ```
      [edit ... protocols rstp]
      user@host# set max-age seconds
      ```

   b. Configure the time interval at which the root bridge transmits configuration BPDUs:

      ```
      [edit ... protocols rstp]
      user@host# set hello-time seconds
      ```

8. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from **4** through **20** seconds instead:

   ```
   [edit ... protocols rstp]
   user@host# set forward-delay seconds
   ```

9. Verify the RSTP configuration:

   ```
   [edit]
   ... { # Optional logical system and/or routing instance
     protocols {
       rstp {
         force-version stp; # Optional.
         bpdu-destination-mac-address provider-bridge-group; # Optional
         extended-system-id identifier; # Optional.
         interface interface-name {
           priority interface-priority;
           cost interface-link-cost; # Optional.
           mode (p2p | shared);
           edge; # Optional.
         }
         bridge-priority bridge-priority;
         max-age seconds;
         hello-time seconds;
         forward-delay seconds; # Optional.
       }
     }
   }
   ```

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- RSTP or VSTP Forced to Run as IEEE 802.1D STP on page 194
- Reverting RSTP or VSTP Back From Forced IEEE 802.1D STP on page 194
- Provider Bridge Participation in RSTP or MSTP Instances on page 195
- System Identifier for Bridges in STP or RSTP Instances on page 196

Configuring Multiple Spanning-Tree Protocol

The following topics describe Multiple Spanning-Tree Protocol configuration and operation tasks on MX Series routers:

Configuring Multiple Spanning-Tree Protocol

You can configure the Multiple Spanning-Tree Protocol (MSTP) under the following hierarchy levels:

- **[edit logical-systems *logical-system-name* protocols]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]**
- **[edit protocols]**
- **[edit routing-instances *routing-instance-name* protocols]**

The routing instance type can be either **virtual-switch** or **layer2-control**.

To configure the Multiple Spanning-Tree Protocol:

1. Enable RSTP as the version of spanning-tree protocol to be configured:

```
[edit]
user@host@ edit ... protocols mstp
```

2. (Optional) Enable provider bridge participation in the MSTP instance:

```
[edit ... protocols mstp]
user@host# set bpdu-destination-mac-address provider-bridge-group
```

3. Configure the interfaces that participate in the MSTP instance.

   a. Enable configuration of the interface:

      ```
      [edit ... protocols mstp]
      user@host# edit interface interface-name
      ```

   b. Configure the interface priority:

      ```
      [edit ... protocols mstp interface interface-name]
      user@host# set priority interface-priority
      ```

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

      ```
      [edit ... protocols mstp interface interface-name]
      user@host# set cost interface-link-cost
      ```

   d. Configure the interface link mode to identify point-to-point links:

      ```
      [edit ... protocols mstp interface interface-name]
      user@host# set mode (p2p | shared)
      ```

      Specify **p2p** if the link is point to point. Specify **shared** is the link is a shared media.

   e. (Optional) Configure the interface as an edge port:

      ```
      [edit ... protocols mstp interface interface-name]
      user@host# set edge
      ```

      Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

   You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see "Checking the Status of Spanning-Tree Instance Interfaces" on page 225.

4. Configure the bridge priority

   ```
   [edit ... protocols mstp]
   user@host# set bridge-priority bridge-priority
   ```

   For more information, see "Bridge Priority for Election of Root Bridge and Designated Bridge" on page 196.

5. Configure hello BPDU timers.

   a. Configure the maximum expected arrival time of hello BPDUs:

      ```
      [edit ... protocols mstp]
      user@host# set max-age seconds
      ```

   b. Configure the time interval at which the root bridge transmits configuration BPDUs:

      ```
      [edit ... protocols mstp]
      user@host# set hello-time seconds
      ```

6. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from **4** through **20** seconds instead:

   ```
   [edit ... protocols mstp]
   user@host# set forward-delay seconds
   ```

7. Configure MSTP-specific options.

   a. Configure the MSTP region configuration name:

      ```
      [edit ... protocols mstp]
      user@host# set configuration-name configuration-name
      ```

   b. Configure the MSTP revision level:

      ```
      [edit ... protocols mstp]
      user@host# set revision-levelrevision-level revision-level
      ```

   c. Configure the maximum number of hops a BPDU can be forwarded in the MSTP region:

      ```
      [edit ... protocols mstp]
      user@host# set max-hops hops
      ```

8. Verify the MSTP configuration:

   ```
   [edit]
   ... { # Optional logical system and/or routing instance
     protocols {
       mstp {
         bpdu-destination-mac-address provider-bridge-group; # Optional
         interface interface-name {
           priority interface-priority;
           cost interface-link-cost; # Optional.
           mode (p2p | shared);
           edge; # Optional.
         }
         bridge-priority bridge-priority;
         max-age seconds;
         hello-time seconds;
         forward-delay seconds; # Optional.
         configuration-name configuration-name; # MST region configuration name.
         revision-level revision-level; # MST revision number.
         max-hops hops; # MST maximum hops.
       }
     }
   ```

```
}
```

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Configuring MST Instances on a Physical Interface on page 208
- Disabling MSTP on page 209

Configuring MST Instances on a Physical Interface

You can configure a Multiple Spanning-Tree Instance (MSTI) under the following hierarchy levels:

- **[edit logical-systems** *logical-system-name* protocols mstp**]**
- **[edit logical-systems** *logical-system-name* **routing-instances** *routing-instance-name* protocols mstp**]**
- **[edit** protocols mstp**]**
- **[edit routing-instances** *routing-instance-name* protocols mstp**]**

The routing instance type can be either **virtual-switch** or **layer2-control**.

Before you begin, configure Multiple Spanning-Tree Protocol. For configuration details, see "Configuring MSTP" on page 204.

1. Enable configuration of a MST instance:

   ```
   [edit]
   user@host# edit ... protocols mstp msti msti-id
   ```

   The *msti-id* value must be from **1** through **64**.

2. Configure the interfaces that participate in the MST instance.

   a. Enable configuration of the interface:

      ```
      [edit ... protocols mstp msti msti-id]
      user@host# edit interface interface-name
      ```

   b. Configure the interface priority:

      ```
      [edit ... protocols mstp msti msti-id interface interface-name]
      user@host# set priority interface-priority
      ```

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

      ```
      [edit ... protocols mstp msti msti-id interface interface-name]
      user@host# set cost interface-link-cost
      ```

   d. (Optional) Configure the interface as an edge port:

      ```
      [edit ... protocols mstp msti msti-id interface interface-name]
      user@host# set edge
      ```

      Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

3. Configure the bridge priority

   ```
   [edit ... protocols mstp msti msti-id]
   user@host# set bridge-priority bridge-priority
   ```

For more information, see "Bridge Priority for Election of Root Bridge and Designated Bridge" on page 196.

4. (Optional) An MSTI can map to a range of VLANs just as a logical port can map to a range of VLANs. The MSTP VLAN specifies the VLAN or VLAN range to which this MSTI is mapped. The vlan-id is configured under the logical interface. Configure the VLAN or VLAN range of the MSTI instance:

```
[edit]
user@host#  set vlan (vlan-id | vlan-id-range)
```

5. Verify the MST interface configuration.

```
[edit]
protocols {
  mstp {
    ...basic-mstp-configuration...
    msti msti-id { # Instance identifier 1 – 64.
      bridge-priority priority;
      vlan vlan-id; # Optional
      interface interface-name {
        cost cost;
        edge;
        priority interface-priority;
      }
    }
  }
}
```

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Configuring Multiple Spanning-Tree Protocol on page 204
- Disabling MSTP on page 209

Disabling MSTP

To disable the entire MSTP instance:

- Include the **disable** statement. You can include this statement at the following hierarchy levels:
  - **[edit logical-systems *logical-system-name* protocols mstp]**
  - **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp]**
  - **[edit protocols mstp]**
  - **[edit routing-instances *routing-instance-name* protocols mstp]**

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring MST Instances on a Physical Interface on page 208

Configuring VLAN Spanning-Tree Protocol

You can configure the VLAN Spanning-Tree Protocol (VSTP) under the following hierarchy levels:

- **[edit logical-systems *logical-system-name* protocols]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]**
- **[edit protocols]**
- **[edit routing-instances *routing-instance-name* protocols]**

The routing instance type can be either **virtual-switch** or **layer2-control**.

To configure the VLAN Spanning-Tree Protocol:

1. Enable VSTP as the version of spanning-tree protocol to be configured:

   ```
   [edit]
   user@host@ edit ... protocols vstp
   ```

2. (Optional) For compatibility with older bridges that do not support VSTP, you can run force VSTP to run as the original IEEE 802.1D Spanning-Tree Protocol (STP) version:

   ```
   [edit ... protocols vstp]
   user@host# set force-version stp
   ```

NOTE: If VSTP has been forced to run as the original STP version, you can revert back to VSTP by first removing the **force-version** statement from the configuration and then entering the **clear spanning-tree protocol-migration** configuration mode command.

3. Configure the interfaces that participate in the VSTP instance.

   a. Enable configuration of the interface:

      ```
      [edit ... protocols vstp]
      user@host# edit interface interface-name
      ```

   b. Configure the interface priority:

      ```
      [edit ... protocols vstp interface interface-name]
      user@host# set priority interface-priority
      ```

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

      ```
      [edit ... protocols vstp interface interface-name]
      user@host# set cost interface-link-cost
      ```

   d. Configure the interface link mode to identify point-to-point links:

      ```
      [edit ... protocols vstp interface interface-name]
      user@host# set mode (p2p | shared)
      ```

      Specify **p2p** if the link is point to point. Specify **shared** is the link is a shared media.

   e. (Optional) Configure the interface as an edge port:

      ```
      [edit ... protocols vstp interface interface-name]
      user@host# set edge
      ```

      Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

   You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see "Checking the Status of Spanning-Tree Instance Interfaces" on page 225.

4. Enable configuration of a VLAN instance:

   ```
   [edit ... protocols vstp]
   user@host# edit vlan vlan-id
   ```

5. Configure the bridge priority

   ```
   [edit ... protocols vstp vlan vlan-id]
   user@host# set bridge-priority bridge-priority
   ```

   For more information, see "Bridge Priority for Election of Root Bridge and Designated Bridge" on page 196.

6. Configure hello BPDU timers.

   a. Configure the maximum expected arrival time of hello BPDUs:

      ```
      [edit ... protocols vstp vlan vlan-id]
      user@host# set max-age seconds
      ```

   b. Configure the time interval at which the root bridge transmits configuration BPDUs:

      ```
      [edit ... protocols vstp vlan vlan-id]
      user@host# set hello-time seconds
      ```

7. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from **4** through **20** seconds instead:

   ```
   [edit ... protocols vstp vlan vlan-id]
   user@host# set forward-delay seconds
   ```

8. Configure the interfaces that participate in the VSTP instance.

   a. Enable configuration of the interface:

      ```
      [edit ... protocols vstp vlan vlan-id]
      user@host# edit interface interface-name
      ```

   b. Configure the interface priority:

      ```
      [edit ... protocols vstp vlan vlan-id interface interface-name]
      user@host# set priority interface-priority
      ```

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

      ```
      [edit ... protocols vstp vlan vlan-id interface interface-name]
      user@host# set cost interface-link-cost
      ```

   d. Configure the interface link mode to identify point-to-point links:

      ```
      [edit ... protocols vstp vlan vlan-id interface interface-name]
      user@host# set mode (p2p | shared)
      ```

      Specify **p2p** if the link is point to point. Specify **shared** is the link is a shared media.

   e. (Optional) Configure the interface as an edge port:

      ```
      [edit ... protocols vstp vlan vlan-id interface interface-name]
      user@host# set edge
      ```

      Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

   You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see "Checking the Status of Spanning-Tree Instance Interfaces" on page 225.

9. Verify the VSTP configuration:

   ```
   [edit]
   ... { # Optional logical system and/or routing instance
     protocols {
       vstp {
         force-version stp; # Optional.
         interface interface-name {
           priority interface-priority;
           cost interface-link-cost; # Optional.
           mode (p2p | shared);
           edge; # Optional.
         }
         vlan vlan-id {
           bridge-priority bridge-priority;
           max-age seconds;
           hello-time seconds;
           forward-delay seconds; # Optional.
   ```

```
            interface interface-name {
              priority interface-priority;
              cost interface-link-cost; # Optional.
              mode (p2p | shared);
              edge; # Optional.
            }
          }
        }
      }
    }
```

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- RSTP or VSTP Forced to Run as IEEE 802.1D STP on page 194
- Reverting RSTP or VSTP Back From Forced IEEE 802.1D STP on page 194
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227

Tracing Spanning-Tree Operations

You can enable global routing protocol tracing options at the **[edit routing-options] Hierarchy Level**. For general information about tracing and global tracing options, see the statement summary for the global traceoptions statement in the *Junos OS Routing Protocols Configuration Guide*.

In addition, you can enable STP-specific trace options at the following hierarchy levels:

- **[edit logical-systems** *logical-system-name* protocols (mstp | rstp | vstp)**]**
- **[edit logical-systems** *logical-system-name* **routing-instances** *routing-instance-name* protocols (mstp | rstp | vstp)**]**
- **[edit** protocols (mstp | rstp | vstp)**]**
- **[edit routing-instances** *routing-instance-name* protocols (mstp | rstp | vstp)**]**

The routing instance type can be either **virtual-switch** or **layer2-control**.

To enable tracing of spanning-tree protocol operations:

1. Enable configuration of the spanning-tree protocol whose operations are to be traced:

   ```
   [edit]
   user@host# edit ... protocols (mstp | rstp | vstp)
   ```

2. Enable configuration of spanning-tree protocol-specific trace options:

   ```
   [edit ... protocols (mstp | rstp | vstp)]
   user@host# edit traceoptions
   ```

3. Configure the files that contain trace logging information:

   ```
   [edit ... protocols (mstp | rstp | vstp)]
   ```

```
user@host# set file filename <files number> <size bytes>
<world-readable | no-world-readable>
```

4. Configure spanning-tree protocol-specific options.

   a. To enable a spanning-tree protocol-specific option, include the **flag** statement:

   ```
   [edit ... protocols (mstp | rstp | vstp)]
   user@host# set flag flag <flag-modifier> <disable>
   ```

   You can specify the following spanning-tree protocol-specific ***flag*** options:

   - **all**—Trace all operations.
   - **all-failures**—Trace all failure conditions.
   - **bpdu**—Trace BPDU reception and transmission.
   - **bridge-detection-state-machine**—Trace the bridge detection state machine.
   - **events**—Trace events of the protocol state machine.
   - **port-information-state-machine**—Trace the port information state machine.
   - **port-migration-state-machine**—Trace the port migration state machine.
   - **port-receive-state-machine**—Trace the port receive state machine.
   - **port-role-transit-state-machine**—Trace the port role transit state machine.
   - **port-role-select-state-machine**—Trace the port role selection state machine.
   - **port-transmit-state-machine**—Trace the port transmit state machine.
   - **port-state-transit-state-machine**—Trace the port state transit state machine.
   - **ppmd**—Trace the state and events for the ppmd process.
   - **state-machine-variables**—Trace when the state machine variables change.
   - **timers**—Trace protocol timers.
   - **topology-change-state-machine**—Trace the topology change state machine.

   NOTE: Use the trace flag all with caution. This flag may cause the CPU to become very busy.

   b. To disable an individual spanning-tree protocol-specific option, include the **disable** option with the **flag** statement.

5. Verify the spanning-tree protocol-specific trace options.

```
[edit]
...
  routing-options {
```

```
    traceoptions {
      ...global-trace-options-configuration...
    }
    }
  }
  protocols {
    (mstp | rstp | vstp) {
      traceoptions { # Spanning-tree protocol-specific.
        file filename <files number> <size bytes> <world-readable | no-world-readable>;
        flag flag <flag-modifier> <disable>;
      }
    }
  }
...
```

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Example: Tracing Spanning-Tree Protocol Operations on page 240

CHAPTER 17

Spanning-Tree Protocol Options

Loop Protection for Spanning-Tree Instance Interfaces

The following topics describe loop protection for spanning-tree instance interfaces:

Loop Protection for Spanning-Tree Instance Interfaces Overview

Spanning-tree protocol loop protection enhances the normal checks that spanning-tree protocols perform on interfaces. Loop protection performs a specified action when BPDUs are not received on a nondesignated port interface. You can choose to block the interface or issue an alarm when bridge protocol data units (BPDUs) are not received on the port.

The spanning-tree protocol family is responsible for breaking loops in a network of bridges with redundant links. However, hardware failures can create forwarding loops (STP loops) and cause major network outages. Spanning-tree protocols break loops by blocking ports (interfaces). However, errors occur when a blocked port transitions erroneously to a forwarding state.

Ideally, a spanning-tree protocol bridge port remains blocked as long as a superior alternate path to the root bridge exists for a connected LAN segment. This designated port is determined by receiving superior BPDUs from a peer on that port. When other ports no longer receive BPDUs, the spanning-tree protocol considers the topology to be loop free. However, if a blocked or alternate port moves into a forwarding state, this creates a loop.

By default (that is, without spanning-tree protocol loop protection configured), an interface that stops receiving BPDUs will assume the designated port role and possibly result in a spanning-tree protocol loop.

You can configure spanning-tree protocol loop protection to improve the stability of Layer 2 networks.

You configure spanning-tree protocol loop protection to prevent selected interfaces from interpreting the lack of received BPDUs as a “false positive” condition for making the interface the designated port.

Related Documentation

- Loop Protection for a Spanning-Tree Instance Interface on page 218
- Configuring Loop Protection for a Spanning-Tree Instance Interface on page 219
- Example: Enabling Loop Protection for Spanning-Tree Protocols on page 239

Loop Protection for a Spanning-Tree Instance Interface

By default, a spanning-tree protocol interface that stops receiving Bridge Protocol Data Unit (BPDU) data frames will transition to the designated port (forwarding) state, creating a potential loop. To prevent a spanning-tree instance interface from interpreting a lack of received BPDUs as a “false positive” condition for assuming the designated port role, you can configure one of the following loop protection options:

- Configure the router to raise an alarm condition if the spanning-tree instance interface has not received BPDUs during the timeout interval.
- Configure the router to block the spanning-tree instance interface if the interface has not received BPDUs during the timeout interval.

NOTE: Spanning-tree instance interface loop protection is enabled for all spanning-tree instances on the interface, but blocks or alarms only those instances that stop receiving BPDUs.

We recommend you configure loop protection only on non-designated interfaces such as the root or alternate interfaces. Otherwise, if you configure loop protection on both sides of a designated link, then certain STP configuration events (such as setting the root bridge priority to an inferior value in a topology with many loops) can cause both interfaces to transition to blocking mode.

Related Documentation

- Loop Protection for Spanning-Tree Instance Interfaces Overview on page 217
- Configuring Loop Protection for a Spanning-Tree Instance Interface on page 219
- Example: Enabling Loop Protection for Spanning-Tree Protocols on page 239
- **bpdu-timeout-action on page 247**
- **interface (Spanning Tree) on page 257**

Configuring Loop Protection for a Spanning-Tree Instance Interface

Before you begin, you must fully configure the spanning-tree protocol, including instance interfaces. You can configure RSTP, MSTP, or VSTP at the following hierarchy levels:

- **[edit protocols]**
- **[edit routing-instances *routing-instance-name* protocols]**

To configure enhanced loop protection:

1. Include the **bpdu-timeout-action** statement with either the **block** or **log** option for the spanning-tree protocol interface.

   - For the STP or RSTP instance on a physical interface:

     ```
     [edit]
     protocols {
       rstp {
         interface interface-name {
           bpdu-timeout-action (log | block);
         }
       }
     }
     ```

   - For all MSTP instances on a physical interface:

     ```
     [edit]
     protocols {
       mstp {
         interface interface-name {
           bpdu-timeout-action (log | block);
         }
       }
     }
     ```

   - For all VSTP instances on a physical interface configured at the global level or a the VLAN level:

     ```
     [edit]
     protocols {
       vstp {
         interface interface-name {
           bpdu-timeout-action (log | block);
         }
         vlan vlan-id {
           interface interface-name {
             bpdu-timeout-action (log | block);
           }
         }
       }
     }
     ```

2. To display the spanning-tree protocol loop protection characteristics on an interface, use the show spanning-tree interface operational command.

Related Documentation

- Loop Protection for Spanning-Tree Instance Interfaces Overview on page 217
- Loop Protection for a Spanning-Tree Instance Interface on page 218
- Example: Enabling Loop Protection for Spanning-Tree Protocols on page 239

Root Protect for Spanning-Tree Instance Interfaces

The following topics describe root protect for spanning-tree instance interfaces:

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- Root Protect for a Spanning-Tree Instance Interface on page 220
- Enabling Root Protect for a Spanning-Tree Instance Interface on page 221

Root Protection for Spanning-Tree Instance Interfaces Overview

Root protect helps to enforce the root bridge placement in a Layer 2 switched network. Enable root protect on interfaces that should not receive superior bridge protocol data units (BPDUs) from the root bridge. Typically, these ports are Spanning-Tree-Protocol-designated ports on an administrative boundary. Enabling root protect ensures the port remains a spanning-tree designated port.

If the bridge receives superior BPDUs on a port that has root protect enabled, that port transitions to a root-prevented STP state and the interface is blocked. This prevents a bridge that should not be the root bridge from being elected the root bridge.

After the bridge stops receiving superior BPDUs on the port with root protect enabled and the received BPDUs time out, that port transitions back to the STP-designated port state.

Related Documentation

- Root Protect for a Spanning-Tree Instance Interface on page 220
- Enabling Root Protect for a Spanning-Tree Instance Interface on page 221

Root Protect for a Spanning-Tree Instance Interface

When root protect is enabled on an interface, it is enabled for all spanning-tree protocol instances on that interface. The interface is blocked only for those instances that receive superior BPDUs.

By default, root protect is disabled.

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- Enabling Root Protect for a Spanning-Tree Instance Interface on page 221
- **interface (Spanning Tree) on page 257**
- **no-root-port on page 264**

Enabling Root Protect for a Spanning-Tree Instance Interface

To enable root protect for a spanning-tree instance interface:

1. Enable configuration of the spanning-tree protocol:

   ```
   [edit]
   user@host# edit protocols (mstp | rstp | vstp <vlan vlan-id>)
   ```

2. Enable configuration of the spanning-tree instance interface:

   ```
   [edit ... protocols (mstp | rstp | vstp <vlan vlan-id>)]
   user@host# edit interface interface-name
   ```

3. Enable root protection on the interface:

   ```
   [edit ... protocols (mstp | rstp | vstp <vlan vlan-id>) interface interface-name]
   user@host# set no-root-port
   ```

4. Verify the configuration of root protect for the spanning-tree instance interface:

   ```
   [edit ... protocols (mstp | rstp | vstp <vlan vlan-id>) interface interface-name]
   user@host# top
   user@host# show ... protocols

   ...
   (mstp | rstp | vstp <vlan vlan-id>) {
     interface interface-name {
       no-root-port;
     }
   }
   ```

NOTE: This is not a complete configuration.

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- Root Protect for a Spanning-Tree Instance Interface on page 220

BPDU Protection for Spanning-Tree Instance Interfaces

The following topics describe BPDU protection for spanning-tree instance interfaces:

- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222
- Configuring BPDU Protection on Individual Interfaces on page 223
- BPDU Protection on All Edge Ports of the Bridge on page 224
- Configuring BPDU Protection on All Edge Ports on page 225
- Checking the Status of Spanning-Tree Instance Interfaces on page 225
- Clearing the Blocked Status of a Spanning-Tree Instance Interface on page 226

BPDU Protection for Spanning-Tree Instance Interfaces Overview

By default, if a Bridge Protocol Data Unit (BPDU) data frame is received on a blocked interface, the system will disable the interface and stop forwarding frames out the interface until the interface is explicitly cleared.

The Spanning-Tree Protocol (STP) family is designed to break possible loops in a Layer 2 bridged network. Loop prevention avoids damaging broadcast storms that can potentially render the network useless. STP processes on bridges exchange BPDUs to determine the LAN topology, decide the root bridge, stop forwarding on some ports, and so on. However, a misbehaving user application or device can interfere with the operation of the STP protocols and cause network problems.

On the MX Series routers only, you can configure BPDU protection to ignore BPDUs received on interfaces where none should be expected (for example, a LAN interface on a network edge with no other bridges present). If a BPDU is received on a blocked interface, the interface is disabled and stops forwarding frames. By default, all BPDUs are accepted and processed on all interfaces.

You can configure BPDU protection on interfaces with the following encapsulation types:

- **ethernet-bridge**
- **ethernet-vpls**
- **extended-vlan-bridge**
- **vlan-vpls**
- **extended-vlan-vpls**

You can configure BPDU protection on individual interfaces or on all the edge ports of the bridge.

Related Documentation

- Configuring BPDU Protection on Individual Interfaces on page 223
- Configuring BPDU Protection on All Edge Ports on page 225
- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227

BPDU Protection for Individual Spanning-Tree Instance Interfaces

To configure BPDU protection on one or more spanning-tree instance interfaces, include the **bpdu-block** statement:

```
bpdu-block {
  interface interface-name;
  disable-timeout seconds;
}
```

NOTE: If you also include the optional **disable-timeout** *seconds* statement, *blocked interfaces* are automatically cleared after the specified time interval unless the interval is **0**.

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- Configuring BPDU Protection on Individual Interfaces on page 223

Configuring BPDU Protection on Individual Interfaces

On MX Series routers, you can configure BPDU protection to ignore BPDU received on interfaces where none should be expected. If a BPDU is received on a blocked interface, the interface is disabled and stops forwarding frames. By default, all BPDUs are accepted and processed on all interfaces.

To configure BPDU protection for individual spanning-tree instance interfaces:

1. Enable BPDU protection on a specific spanning-tree instance interface:

```
[edit]
user@host# edit protocols layer2-control bpdu-block
user@host# set interface interface (aex | (ge-fpc/pic/port | xe-fpc/pic/port)
```

   If a BPDU is received on the interface, the system will disable the interface and stop forwarding frames out the interface until the bridging process is restarted.

2. (Optional) Configure the amount of time the system waits before *automatically* unblocking this interface after it has received a BPDU.

```
[edit protocols layer2-contorl bpdu-block interface interface-name]
user@host# set disable-timeout seconds
```

   The range of the *seconds* option value is from 10 through 3600 seconds (one hour). A *seconds* option value of **0** is allowed, but this results in the default behavior (the interface is blocked until the interface is cleared).

3. Verify the configuration of BPDU blocking for individual interfaces:

```
[edit]
interfaces {
  ge-fpc/pic/port { # VLAN encapsulation on Gigabit Ethernet.
    encapsulation (ethernet-bridge | extended-vlan-bridge | extended-vlan-vpls |
      vlan-vpls);
  }
  xe-fpc/pic/port { # VLAN encapsulation on 10-Gigabit Ethernet.
    encapsulation (ethernet-bridge | extended-vlan-bridge | extended-vlan-vpls |
      vlan-vpls);
  }
  ae-X { # VLAN encapsulation
    encapsulation (ethernet-vpls vlan-vpls); # on Aggregated Ethernet.
    ...
  }
```

```
    ae-X { # Extended VLAN encapsulation
      vlan-tagging; # on Aggregated Ethernet.
      encapsulation extended-vlan-vpls;
      unit logical-unit-number {
        vlan-id number;
        ......
      }
      ......
    }
}
protocols
  layer2-control {
    bpdu-block
      interface interface-name;
      disable-timeout seconds;
    }
  }
```

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222

BPDU Protection on All Edge Ports of the Bridge

To configure edge port blocking for a particular STP family member, include the **bpdu-block-on-edge** statement for **mstp**, **rstp**, or **vstp**:

```
bpdu-block-on-edge;
interface interface-name;
```

NOTE: In contrast to BPDU protection configured on individual spanning-tree instance interfaces, BPDU protection configured on all edge ports of an entire spanning-tree protocol *disables designated edge ports* and does not enable them again.

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- Configuring BPDU Protection on All Edge Ports on page 225

Configuring BPDU Protection on All Edge Ports

On MX Series routers, you can configure BPDU protection to ignore BPDU received on interfaces where none should be expected. If a BPDU is received on a blocked interface, the interface is disabled and stops forwarding frames. By default, all BPDUs are accepted and processed on all interfaces.

To configure BPDU protection for all edge ports for a particular spanning-tree protocol::

1. Enable edge port blocking for a particular spanning-tree protocol:

```
[edit]
user@host# set protocols (mstp | rstp | vstp) bpdu-block-on-edge
```

2. Verify BPDU protection for edge ports.

```
[edit]
protocols {
  (mstp | rstp | vstp) {
    bpdu-block-on-edge;
  }
}
```

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection on All Edge Ports of the Bridge on page 224

Checking the Status of Spanning-Tree Instance Interfaces

On an MX Series router with a spanning-tree protocol enabled, the detection of a possible bridging loop from spanning-tree protocol operation can raise a bridge protocol data unit (BPDU) error condition on the affected spanning-tree instance interface.

To check whether a spanning-tree instance interface is blocked due to a BPDU error condition:

1. To check the status of spanning-tree instance interface, use the **show interfaces** command.

```
user@host> show interfaces interface-name
```

2. You can determine the status of the interface as follows:

   - If the **BPDU Error** field is **none**, the interface is enabled.
   - If the **BPDU Error** field is **Detected** and the link is **down**, the interface is blocked.

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222

- BPDU Protection on All Edge Ports of the Bridge on page 224
- Clearing the Blocked Status of a Spanning-Tree Instance Interface on page 226

Clearing the Blocked Status of a Spanning-Tree Instance Interface

To clear the blocked status of a spanning-tree instance interface:

- Use the **clear error bpdu** operational mode command.

  user@host> **clear error bpdu interface** ***interface-name***

NOTE: When you configure BPDU protection on individual interfaces (as opposed to on all the edge ports of the bridge), you can use the disable-timeout ***seconds*** option to specify that a blocked interface is automatically cleared after the specified time interval elapses (unless the interval is 0). For configuration details, see "Configuring BPDU Protection on Individual Interfaces" on page 223.

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222
- BPDU Protection on All Edge Ports of the Bridge on page 224
- Checking the Status of Spanning-Tree Instance Interfaces on page 225

VPLS Root Protection Topology Change Actions

The following topics describe VPLS root protection topology change actions:

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227
- VPLS Multihoming: Priority of the Backup Bridge on page 229
- VPLS Multihoming: Hold Time Before Switching to Primary Priority on page 229
- VPLS Multihoming: System Identifier for Bridges in the Ring on page 230
- VPLS Multihoming: Bridge Flush of MAC Cache on Topology Change on page 231
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233

VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview

Redundancy is built into many networks through the use of alternate links and paths, which often take the shape of rings.

In the case of multiple hosts attached to customer edge (CE) routers and provider edge (PE) routers to secure virtual private LAN service (VPLS), this practice is often called *multihoming*:

- Multiple hosts attach to CE routers, which are attached to each other as well as to the PE routers that access the VPLS network cloud. Any single link between the edge routers can fail without impacting the hosts' access to the VPLS services.
- This Layer 2 ring connects to the multiprotocol link switching (MPLS) infrastructure through two PE routers. Link breaks on the ring are protected by running a version of the spanning-tree protocol with the root-protect option enabled.

The virtual private network (VPN) protocols at Layer 3, however, are not aware of the blocking state that results from this root protection setup (rings or loops are not permitted at Layer 2 because the Layer 2 protocols will not function properly).

However, to keep the Layer 2 ring functioning in a multihomed environment with link failures, the spanning-tree protocol running on the MX Series routers requires the following additional configuration:

- The VPN protocols have to act on the blocking and unblocking of interfaces by the spanning-tree protocol. Specifically, media access control (MAC) flush messages need to be sent by the blocking PE router to LDP peers in order to flush the MAC addresses learned when other interface ports were blocked.
- Also, if an active PE router with VPLS root protection bridging enabled loses VPLS connectivity, root protection requires that the bridge switch to the other PE router to maintain connectivity. The spanning-tree protocol needs to be aware of the status of the VPLS connectivity on the PE router. If the MAC address cache is not flushed when the topology changes, frames could be sent to the wrong device.

You can control the actions taken by the MX Series router when the topology changes in a multihomed Layer 2 ring VPLS environment using *VPLS root protection*.

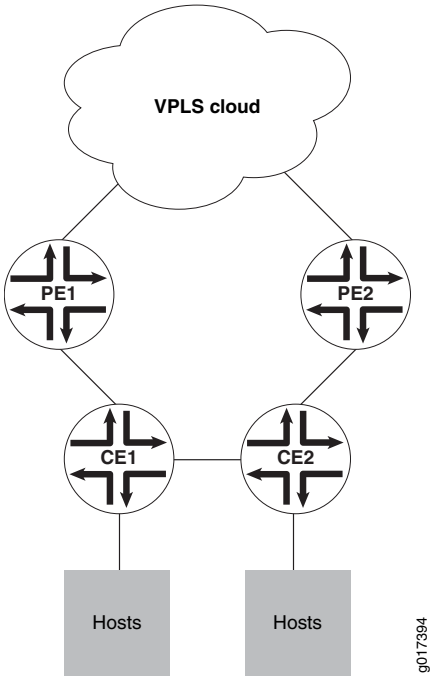
Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233
- Example: Configuring VPLS Root Topology Change Actions on page 240

VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology

Figure 3 on page 228 shows hosts connected to CE routers and to a VPLS network through two PE routers. The CE routers are also connected, forming a kind of ring structure.

Figure 3: VPLS Multihoming Configuration



The two PE routers have their own links to a VPLS network service, but are not directly connected to each other. All four edge routers run some type of spanning-tree protocol with root protection enabled, and only one PE interface will be in the forwarding state, the other being blocked.

Assume this forwarding interface is through PE1. If the link between CE1 and CE2 fails, then the blocking PE2 interface must detect a root protection switch and move to the forwarding state. All of the MAC addresses learned by CE2 that connect to the VPLS network service through PE1 need to be flushed. In the same way, when the link between CE1 and CE2 is restored, PE2 again detects the root protection switch and begins blocking again. Now all of the MAC addresses learned by CE2 that connect through PE2 need to be flushed. All of this is controlled by configuring VPLS root protection topology change actions on the CE routers.

Also, at a global level, each type of spanning-tree protocol will have a priority hold time associated with it. This is the number of seconds in the range from 1 through 255 seconds that the system waits to switch to the primary priority when the first core domain comes up. The default is 2 seconds. This allows the maximum number of core domains to come up, and some might be slower than others.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233
- Example: Configuring VPLS Root Topology Change Actions on page 240

VPLS Multihoming: Priority of the Backup Bridge

When an MX Series router in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the MX Series router when the topology changes. To do this, configure the VPLS root protection topology change actions.

The default value of the backup bridge is **32,768**. You can set the backup bridge priority to a value from **0** through **61440**, in increments of 4096.

To change the default value, you can use the following statement:

```
backup-bridge-priority vpls-ring-backup-bridge-priority
```

You can include the statement at the **[edit protocols (mstp | rstp | vstp)]** hierarchy level (to control global spanning-tree protocol behavior) or at the **[edit protocols vstp vlan *vlan-id*]** hierarchy level (to control a particular VLAN).

NOTE: **VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.**

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihoming: Hold Time Before Switching to Primary Priority on page 229
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Example: Configuring VPLS Root Topology Change Actions on page 240

VPLS Multihoming: Hold Time Before Switching to Primary Priority

When an MX Series router in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the MX Series router when the topology changes. To do this, configure the VPLS root protection topology change actions.

The default number of seconds to hold before switching to the primary priority when the first core domain comes up is 2 seconds.

To change the default value, you can use the following statement:

```
priority-hold-time seconds
```

You can include the statement at the **[edit protocols (mstp | rstp | vstp)]** hierarchy level (to control global spanning-tree protocol behavior) or at the **[edit protocols vstp vlan *vlan-id*]** hierarchy level (to control a particular VLAN).

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihoming: Priority of the Backup Bridge on page 229
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Example: Configuring VPLS Root Topology Change Actions on page 240

VPLS Multihoming: System Identifier for Bridges in the Ring

When an MX Series router in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the MX Series router when the topology changes. To do this, configure the VPLS root protection topology change actions.

The system identifier for bridges in the ring is not configured by default.

To configure a system identifier for bridges in the ring, you can use the following statement:

system-id ***system-id-value*** *bridge-host-ip-address(es)*

You can include the statement at the **[edit protocols (mstp | rstp | vstp)]** hierarchy level (to control global spanning-tree protocol behavior) or at the **[edit protocols vstp vlan *vlan-id*]** hierarchy level (to control a particular VLAN).

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihoming: Priority of the Backup Bridge on page 229
- VPLS Multihoming: Hold Time Before Switching to Primary Priority on page 229
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Example: Configuring VPLS Root Topology Change Actions on page 240

VPLS Multihoming: Bridge Flush of MAC Cache on Topology Change

When an MX Series router in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the MX Series router when the topology changes. To do this, configure the VPLS root protection topology change actions.

By default, if root protect is enabled and then the topology changes, the bridges do not flush the media access control (MAC) address cache of the MAC addresses learned when other interface ports were blocked.

To change the default behavior, you can use the following statement:

vpls-flush-on-topology-change

You can include the statement at the **[edit protocols (mstp | rstp | vstp)]** hierarchy level (to control global spanning-tree protocol behavior) or at the **[edit protocols vstp vlan *vlan-id*]** hierarchy level (to control a particular VLAN).

Specifically, MAC flush messages are sent from the blocked PE to LDP peers based on the mapping of system identifier to IP addresses as specified using the system-id statement.

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233
- Example: Configuring VPLS Root Topology Change Actions on page 240

Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior

To configure VPLS root protection topology change actions to control global spanning tree behavior:

1. Enable configuration of the spanning-tree protocol:

```
[edit]
user@host# edit protocols (mstp | rstp | vstp)
```

2. (Optional) Change the priority of the backup bridge in a VPLS multihomed Layer 2 ring with MPLS infrastructure:

```
[edit protocols (rstp | mstp | vstp)]
```

```
user@host# set backup-bridge-priority vpls-ring-backup-bridge-priority
```

3. (Optional) Change number of seconds to hold before switching to the primary priority when the first core domain comes up:

```
[edit protocols (rstp | mstp | vstp)]
user@host# set priority-hold-time seconds
```

4. Configure the system identifier for bridges in the ring:

```
[edit protocols (rstp | mstp | vstp)]
user@host# set system-id system-id-value bridge-host-ip-address(es)
```

The ***system-id-value*** is configured in the format ***nnnnnn*:*nnnnnn***, where ***n*** = any digit from **0** to **9**.

Each ***bridge-host-ip-address*** is a valid host IP address with a **/32** mask.

NOTE: There are no default values for the system identifier or host IP addresses.

5. Configure bridges to flush the MAC address cache (of the MAC addresses learned when other interfaces ports were blocked) when the spanning-tree topology changes:

```
[edit protocols (rstp | mstp | vstp)]
user@host# setvpls-flush-on-topology-change
```

6. Verify the configuration of VPLS root protection topology change actions to control global spanning tree behavior:

```
[edit]
protocols {
  (mstp | rstp | vstp) {
    backup-bridge-priority priority; # Default is 32,768.
    priority-hold-time seconds; # Default is 2 seconds.
    system-id system-id-value {
      ip-address;
    }
    vpls-flush-on-topology-change;
  }
}
```

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233
- Example: Configuring VPLS Root Topology Change Actions on page 240

Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior

To configure VPLS root protection topology change actions to control a particular VLAN:

1. Enable configuration of the spanning-tree protocol VLAN:

   ```
   [edit]
   user@host# edit protocols vstp vlan vlan-id
   ```

2. Optional) Change the priority of the backup bridge in a VPLS multihomed Layer 2 ring with MPLS infrastructure:

   ```
   [edit protocols vstp vlan vlan-id]
   user@host# set backup-bridge-priority vpls-ring-backup-bridge-priority
   ```

3. (Optional) Change the hold time before switching to the primary priority when the first core domain comes up:

   ```
   [edit protocols vstp vlan vlan-id]
   user@host# set priority-hold-time seconds
   ```

4. Configure the system identifier for bridges in the ring:

   ```
   [edit protocols vstp vlan vlan-id]
   user@host# set system-id system-id-value bridge-host-ip-address(es)
   ```

   The ***system-id-value*** is configured in the format ***nnnnnn:nnnnnn***, where ***n*** = any digit from **0** to **9**.

   Each ***bridge-host-ip-address*** is a valid host IP address with a **/32** mask.

   NOTE: There are no default values for the system identifier or host IP addresses.

5. Configure bridges to flush the MAC address cache (of the MAC addresses learned when other interfaces ports were blocked) when the spanning-tree topology changes:

   ```
   [edit protocols vstp vlan vlan-id]
   user@host# setvpls-flush-on-topology-change
   ```

6. Verify the configuration of VPLS root protection topology change actions to control a particular VLAN:

   ```
   [edit]
   protocols {
     vstp {
       vlan vlan-id {
         backup-bridge-priority priority; # Default is 32,768.
         priority-hold-time seconds; # Default is 2 seconds.
         system-id system-id-value {
           ip-address;
         }
         vpls-flush-on-topology-change;
       }
     }
   ```

}

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Example: Configuring VPLS Root Topology Change Actions on page 240

Layer 2 Protocol Tunneling Through a Network

The following topics describe Layer 2 protocol tunneling through a network:

Layer 2 Protocol Tunneling Through a Network Overview

Layer 2 protocol tunneling allows Layer 2 protocol data units (PDUs) to be tunneled through a network. This is useful to provide a single spanning-tree protocol domain for subscribers across a service provider network. It is also useful for tunneling Cisco Discovery Protocol (CDP) or VLAN Trunk Protocol (VTP) PDUs across a network.

When a control packet for STP, CDP, or VTP is received on a service provider edge port configured for Layer 2 protocol tunneling, the multicast destination MAC address is rewritten with the predefined multicast tunnel MAC address of **01:00:0c:cd:cd:d0**. The packet is transported across the provider network transparently to the other end of the tunnel and the original multicast destination MAC address is restored when the packet is transmitted.

If a packet is received on a tunnel interface that already has a destination multicast MAC address of **01:00:0c:cd:cd:d0**, the port enters an error state and is shut down. To clear the error condition, the administrator must enter the **clear error mac-rewrite interface** ***interface-name*** command.

Layer 2 protocol tunneling is supported on MX Series routers with enhanced queueing Dense Port Concentrators (DPCs).

NOTE: When an MX Series router sends a RADIUS access request, the Chargeable-User-Identity parameter is sent with an empty field. For more information about configuring RADIUS, see the *Junos Subscriber Access Configuration Guide*.

Related Documentation

- Configuring Layer 2 Protocol Tunneling on page 237
- Checking for a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface on page 238
- Clearing a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface on page 238

MAC Address Rewriting Enabled for Layer 2 Protocol Tunneling

To configure Layer 2 protocol tunneling, you must enable MAC address rewriting by installing the destination multicast tunnel MAC address of **01:00:0c:cd:cd:d0** in the MAC table.

To enable MAC address rewriting, include the mac-rewrite statement at the **[edit protocols layer2-control]** hierarchy level.

When enabling MAC address rewriting for Layer 2 protocol tunneling, the following guidelines apply:

- You can enable Layer 2 protocol tunneling for untagged interfaces.
- You can enable Layer 2 protocol tunneling for single-identifier tagged ports.
- You cannot enable Layer 2 protocol tunneling for double identifier tagged interfaces

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- Layer 2 Protocol Tunnel Interface on page 235
- Layer 2 Protocol to be Tunneled on page 236
- Configuring Layer 2 Protocol Tunneling on page 237

Layer 2 Protocol Tunnel Interface

To configure the interface where Layer 2 protocol tunneling is enabled, include the interface **ge-*fpc/pic/port*** statement at the **[edit protocols layer2-control]** hierarchy level.

Keep the following guidelines in mind when configuring Layer 2 protocol tunneling:

- Layer 2 protocol tunneling is supported on MX Series routers with enhanced queueing Dense Port Concentrators (DPCs).
- Layer 2 protocol tunneling must be configured on the interfaces at each end of the tunnel.

- You can enable Layer 2 protocol tunneling for untagged interfaces and single-identifier tagged interfaces only.
- For single-identifier tagged ports, configure a logical interface with the native VLAN identifier. This configuration associates the untagged control packets with a logical interface.
- You cannot enable Layer 2 protocol tunneling for double identifier tagged interfaces.

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- MAC Address Rewriting Enabled for Layer 2 Protocol Tunneling on page 235
- Layer 2 Protocol to be Tunneled on page 236
- Configuring Layer 2 Protocol Tunneling on page 237

Layer 2 Protocol to be Tunneled

To configure Layer 2 protocol tunneling, you must specify the protocol that is to be tunneled using the Layer 2 tunnel:

- **cdp**—Cisco Discovery Protocol.
- **stp**—All versions of the spanning-tree protocol.
- **vtp**—Tunnel the VLAN trunk protocol.

For each protocol specified, a static destination MAC address corresponding to the protocol being tunneled is installed in the MAC table.

To specify the protocol that will be tunneled by the Layer 2 protocol tunneling, you can include the protocol **(cdp | stp | vtp)** statement at the **[edit protocols** layer2-control mac-rewrite interface **ge-*fpc/pic/port*]** hierarchy level.

NOTE: When CDP, STP, or VTP is configured for tunneling on a customer-facing port in a provider bridge, the corresponding protocol should not be enabled for operation on that interface.

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- MAC Address Rewriting Enabled for Layer 2 Protocol Tunneling on page 235
- Layer 2 Protocol Tunnel Interface on page 235
- Configuring Layer 2 Protocol Tunneling on page 237

Configuring Layer 2 Protocol Tunneling

You can configure Layer 2 protocol tunneling under the following hierarchy levels:

- **[edit]**
- **[edit routing-instances *routing-instance-name*]**

To configure Layer 2 protocol tunneling:

1. Enable MAC address rewriting for Layer 2 protocol tunneling:

   ```
   [edit ... ]
   user@host# edit protocols layer2-control mac-rewrite
   ```

2. Configure the Layer 2 protocol tunnel interface:

   ```
   [edit ... protocols layer2-control mac-rewrite]
   user@host# edit interface ge-fpc/pic/port
   ```

3. Configure the Layer 2 protocol to be tunneled:

   ```
   [edit ... protocols layer2-control mac-rewrite interface ge-fpc/pic/port]
   user@host# set protocol (cdp | stp | vtp)
   ```

4. Verify the configuration:

   ```
   user@host> show ... protocols

   protocols {
     layer2-control {
       mac-rewrite {
         interface ge-fpc/pic/port {
           protocol (cdp | stp | vtp);
         }
       }
     }
   }
   ```

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- Checking for a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface on page 238
- Clearing a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface on page 238

Checking for a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface

To check whether a spanning-tree instance interface is blocked due to a MAC rewrite error condition:

1. Use the **show interfaces** operational mode command:

   user@host> **show interfaces** *interface-name*

2. You can determine the status of the interface as follows:

   - If the value in the **Physical interface** includes **Enabled, Physical link is Up** and the value of the **BPDU Error** field is **None**, the interface is enabled
   - If the value in the **Physical interface** field is **Enabled, Physical link is Down** and the value in the **BPDU Error** field is **Detected**, the interface is blocked.

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- Configuring Layer 2 Protocol Tunneling on page 237
- Clearing a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface on page 238

Clearing a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface

To clear the blocked status of a spanning-tree instance interface:

- Use the **clear error bpdu** operational mode command.

  user@host> **clear error bpdu interface** *interface-name*

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- Configuring Layer 2 Protocol Tunneling on page 237
- Checking for a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface on page 238

CHAPTER 18

Examples of Spanning-Tree Protocol Configurations

Example: Enabling Loop Protection for Spanning-Tree Protocols

This example blocks and logs the non-designated RSTP port **ge-1/2/0** after the BPDU timeout interval expires:

```
[edit]
protocols {
   rstp {
      interface ge-1/2/0 {
         bpdu-timeout-action block;
      }
   }
}
```

NOTE: This is not a complete configuration. You must also fully configure RSTP, including the ge-1/2/0 interface.

Example: Blocking BPDUs on Aggregated Ethernet for 600 Seconds

The following example, when used with a full bridge configuration with aggregated Ethernet, blocks BPDUs on aggregated interface **ae0** for ten minutes (600 seconds) before enabling the interface again:

```
[edit protocols layer2-control]
bpdu-block {
   interface ae0;
   disable-timeout 600;
}
```

Related Documentation

- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222
- BPDU Protection on All Edge Ports of the Bridge on page 224
- Checking the Status of Spanning-Tree Instance Interfaces on page 225
- Clearing the Blocked Status of a Spanning-Tree Instance Interface on page 226

Example: Configuring VPLS Root Topology Change Actions

This example configures a bridge priority of **36k**, a backup bridge priority of **44k**, a priority hold time value of **60** seconds, a system identifier of **000203:040506** for IP address **10.1.1.1/32**, and sets the bridge to flush the MAC cache on a topology change for MSTP only.

```
[edit]
protocols {
  mstp {
    bridge-priority 36k;
    backup-bridge-priority 44k;
    priority-hold-time 60;
    system-id 000203:040506 {
      10.1.1.1/32;
    }
    vpls-flush-on-topology-change;
  }
}
```

NOTE: This is not a complete configuration.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233

Example: Tracing Spanning-Tree Protocol Operations

Trace only unusual or abnormal operations to **/var/log/stp-log**:

```
[edit]
routing-options {
  traceoptions {
    file /var/log/routing-log;
    flag errors;
```

```
    }
  }
  protocols {
    rstp {
      traceoptions {
        file /var/log/stp-log;
      }
    }
  }
```

Related Documentation

- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- Tracing Spanning-Tree Operations on page 214

CHAPTER 19

Summary of Spanning-Tree Protocol Configuration Statements

The following sections explain each of the Rapid Spanning-Tree Protocol (RSTP) and Multiple Spanning-Tree Protocol (MSTP) configuration statements. The statements are organized alphabetically.

backup-bridge-priority

Syntax backup-bridge-priority *priority*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 10.0.

Description Determine the priority of the backup bridge in a VPLS multihomed Layer 2 ring with MPLS infrastructure.

Options *priority*—The backup bridge priority can be set only in increments of 4096.

Range: 0 through 61,440

Default: 32,768

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior on page 233
- Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior on page 231
- VPLS Multihoming: Priority of the Backup Bridge on page 229

bpdu-block

Syntax

```
bpdu-block {
  interface interface-name;
  disable-timeout seconds;
}
```

Hierarchy Level [edit protocols layer2-control]

Release Information Statement introduced in Junos OS Release 9.4.

Description Enable BPDU blocking on an interface.

The remaining statements are described separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222
- Configuring BPDU Protection on Individual Interfaces on page 223

bpdu-block-on-edge

Syntax bpdu-block-on-edge;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)],
[edit protocols (mstp | rstp | vstp)],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)]

Release Information Statement introduced in Junos OS Release 9.4.
Support for logical systems added in Junos OS Release 9.6.

Description Enable BPDU blocking on the edge ports of a virtual switch.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection on All Edge Ports of the Bridge on page 224
- Configuring BPDU Protection on All Edge Ports on page 225

bpdu-destination-mac-address (Spanning Tree)

Syntax bpdu-destination-mac-address provider-bridge-group;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)]

Release Information
Statement introduced in Junos OS Release 9.2.
Support for logical systems added in Junos OS Release 9.6.

Description Enable MX Series router to participate in the provider Rapid Spanning-Tree Protocol (RSTP) instance or a provider Multiple Spanning-Tree Protocol (MSTP) instance.

Default If the **bpdu-destination-mac-address** statement is not configured, the bridge participates in the customer RSTP instance, transmitting and receiving standard RSTP BPDU packets.

Options
provider-bridge-group—The destination MAC address of the BPDU packets transmitted is the provider bridge group address **01:80:c2:00:00:08**. Received BPDU packets with this destination MAC address are accepted and passed to the Routing Engine.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- BPDU Overview on page 190
- Provider Bridge Participation in RSTP or MSTP Instances on page 195
- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204

bpdu-timeout-action

Syntax bpdu-timeout-action (log | block);

Hierarchy Level
[edit ical-systems *ical-system-name* protocols (mstp | rstp | vstp)],
[edit ical-systems *ical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)],
[edit protocols (mstp | rstp | vstp)],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)]

Release Information
Statement introduced in Junos OS Release 9.4.
Support for ical systems added in Junos OS Release 9.6.

Description Provide STP loop protection for a given STP family protocol interface.

Default If the **bpdu-timeout-action** statement is not configured, an interface that stops receiving BPDUs will transition to the designated port (forwarding) state, creating a potential loop.

Options
log—The interface logs the fact that it has not received BPDUs during the timeout interval.

block—The interface is blocked and the fact that the interface has not received BPDUs during the timeout interval is logged.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Loop Protection for Spanning-Tree Instance Interfaces Overview on page 217
- Configuring Loop Protection for a Spanning-Tree Instance Interface on page 219
- Example: Enabling Loop Protection for Spanning-Tree Protocols on page 239

bridge-priority

Syntax bridge-priority *priority*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols mstp msti *msti-id*],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp msti *msti-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols mstp msti *msti-id*],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols mstp msti *msti-id*],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Determine which bridge is elected as the root bridge. If two bridges have the same path cost to the root bridge, the bridge priority determines which bridge becomes the designated bridge for a LAN segment.

Options *priority*—The bridge priority can be set only in increments of 4096.

Range: 0 through 61,440

Default: 32,768

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Bridge Priority for Election of Root Bridge and Designated Bridge on page 196

configuration-name

Syntax configuration-name *configuration-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mstp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp],
[edit protocols mstp],
[edit routing-instances *routing-instance-name* protocols mstp]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description The configuration name is the MSTP region name carried in the MSTP BPDUs.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- BPDU Overview on page 190
- Configuring Multiple Spanning-Tree Protocol on page 204

cost

Syntax cost *cost*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit protocols (mstp | rstp | vstp) interface *interface-name*],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols vstp vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Configure link cost to control which bridge is the designated bridge and which port is the designated port. By default, the link cost is determined by the link speed.

Options ***cost***—(Optional) Link cost associated with the port.

Range: 1 through 200,000,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Spanning-Tree Instance Interface on page 197
- Spanning-Tree Instance Interface Cost on page 198

disable

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mstp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp],
[edit protocols mstp],
[edit routing-instances *routing-instance-name* protocols mstp]

Release Information Statement introduced in Junos OS Release 9.1.
Support for logical systems added in Junos OS Release 9.6.

Description Disable the entire MSTP instance.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Multiple Spanning-Tree Protocol on page 204
- Disabling MSTP on page 209

disable-timeout

Syntax disable-timeout *seconds*;

Hierarchy Level [edit protocols layer2-control bpdu-block]

Release Information Statement introduced in Junos OS Release 9.4.

Description Configure the timeout value to periodically check to see if an interface is still disabled with BPDU blocking. If this option is not configured, the interface is not periodically checked and remains disabled.

Options *seconds*—Disable timeout value.

Range: 10 through 3600

Default: If this option is not configured, the interface is not periodically checked and remains disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222

edge

Syntax edge;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit protocols (mstp | rstp | vstp) interface *interface-name*],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols vstp vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Configure interfaces as edge ports. Edge ports do not expect to receive BPDUs. If a BPDU is received, the port becomes a nonedge port.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Spanning-Tree Instance Interface on page 197
- Spanning-Tree Instance Interface Configured as an Edge Port on page 199

extended-system-id

Syntax extended-system-id *identifier*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols rstp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rstp],
[edit protocols rstp],
[edit routing-instances *routing-instance-name* protocols rstp]

Release Information
Statement introduced in Junos OS Release 8.3.
Support for logical systems added in Junos OS Release 9.6.

Description The extended system ID is used to specify different bridge identifiers for different RSTP or STP routing instances.

Options *identifier*—Specify the system identifier to use for the RSTP or STP instance.

Range: 0 through 4095

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- System Identifier for Bridges in STP or RSTP Instances on page 196
- Configuring Rapid Spanning-Tree Protocol on page 201

force-version

Syntax force-version stp;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (rstp | vstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (rstp | vstp)],
[edit protocols (rstp | vstp)],
[edit routing-instances *routing-instance-name* protocols (rstp | vstp)]

Release Information
Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Force the spanning-tree version to be the original IEEE 803.1D STP.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Spanning-Tree Protocols Supported on MX Series Routers on page 189
- RSTP or VSTP Forced to Run as IEEE 802.1D STP on page 194
- Reverting RSTP or VSTP Back From Forced IEEE 802.1D STP on page 194

forward-delay

Syntax forward-delay *seconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Specify the length of time an STP bridge port remains in the listening and learning states before transitioning to the forwarding state.

Options ***seconds***—(Optional) Number of seconds the bridge port remains in the listening and learning states.

Range: 4 through 30

Default: 15 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Forward Delay Before Ports Transition to Forwarding State on page 197

hello-time

Syntax hello-time *seconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Specify the number of seconds between transmissions of configuration BPDUs by the root bridge.

Options ***seconds***—(Optional) Number of seconds between transmissions of configuration BPDUs.

Range: 1 through 10

Default: 2 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Hello Time for Root Bridge to Transmit Hello BPDUs on page 196

interface

See the following sections:

interface (BPDU Blocking)

Syntax interface *interface-name*;

Hierarchy Level [edit protocols layer2-control bpdu-block]

Release Information Statement introduced in Junos OS Release 9.4.

Description Configure the interface to participate in BPDU blocking.

Options ***interface-name***—Name of a Gigabit Ethernet or 10-Gigabit Ethernet interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- BPDU Protection for Spanning-Tree Instance Interfaces Overview on page 222
- BPDU Protection for Individual Spanning-Tree Instance Interfaces on page 222
- Configuring BPDU Protection on Individual Interfaces on page 223

interface (Layer 2 Protocol Tunneling)

Syntax

```
interface interface-name {
  protocol (cdp | stp | vtp);
}
```

Hierarchy Level [edit protocols layer2-control mac-rewrite]

Release Information Statement introduced in Junos OS Release 9.1.

Description Configure an interface for Layer 2 protocol tunneling.

The remaining statement is described separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234

interface (Spanning Tree)

Syntax

```
interface interface-name {
  bpdu-timeout-action {
    alarm;
    block;
  }
  cost cost;
  edge;
  mode (p2p | shared);
  no-root-port;
  priority interface-priority;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp | vstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description

Configure the interface to participate in the RSTP or MSTP instance.

Options

interface-name—Name of a Gigabit Ethernet or 10-Gigabit Ethernet interface.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Spanning-Tree Instance Interface on page 197

layer2-control

Syntax

```
layer2-control {
  bpdu-block {
    interface interface-name;
    disable-timeout seconds;
  }
  mac-rewrite {
    interface interface-name {
      protocol (cdp | stp | vtp);
    }
  }
  nonstop-bridging;
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 8.4.
bpdu-block statement added in Junos OS Release 9.4.

Description Configure Layer 2 control protocols to enable features such as Layer 2 protocol tunneling or nonstop bridging.

The remaining statements are described separately.

NOTE: For a detailed description of configuring the nonstop-bridging statement, see the *Junos OS High Availability Configuration Guide*. When this statement is configured on routing platforms with two Routing Engines, a master Routing Engine switches over gracefully to a backup Routing Engine and preserves Layer 2 Control Protocol (L2CP) information.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- Layer 2 Protocol Tunnel Interface on page 235
- Layer 2 Protocol to be Tunneled on page 236
- Configuring Layer 2 Protocol Tunneling on page 237
- instance-type

mac-rewrite

Syntax

```
mac-rewrite {
  interface interface-name {
    protocol (cdp | stp | vtp);
  }
}
```

Hierarchy Level [edit protocols layer2-control]

Release Information Statement introduced in Junos OS Release 9.1.

Description Enable rewriting of the MAC address for Layer 2 protocol tunneling.

The remaining statements are described separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Layer 2 Protocol Tunneling Through a Network Overview on page 234

max-age

Syntax max-age *seconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Specify the maximum expected arrival time of hello BPDUs.

Options ***seconds***—(Optional) Number of seconds expected between hello BPDUs.

Range: 6 through 40

Default: 20 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Maximum Age for Awaiting Arrival of Hello BPDUs on page 196

max-hops

Syntax max-hops *hops*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols mstp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp],
[edit protocols mstp],
[edit routing-instances *routing-instance-name* protocols mstp]

Release Information
Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Configure the maximum number of hops a BPDU can be forwarded in the MSTP region.

Options
hops—(Optional) Number of hops the BPDU can be forwarded.

Range: 1 through 255

Default: 19 hops

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Multiple Spanning-Tree Protocol on page 204

mode

Syntax mode (p2p | shared);

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit protocols (mstp | rstp | vstp) interface *interface-name*],
[edit protocols vstp vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Configure link mode to identify point-to-point links.

Default When the link is configured as full-duplex, the default link mode is **p2p**. When the link is configured half-duplex, the default link mode is **shared**.

Options **p2p**—The link is point to point.

shared—The link is shared media.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Spanning-Tree Instance Interface on page 197
- Spanning-Tree Instance Interface Point-to-Point Link Mode on page 199

msti

Syntax

```
msti msti-id {
  bridge-priority priority;
  vlan vlan-id;
  interface interface-name {
    cost cost;
    edge;
    priority interface-priority;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols mstp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp],
[edit protocols mstp],
[edit routing-instances *routing-instance-name* protocols mstp]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description

Configure the Multiple Spanning Tree Protocol (MSTI) instance identifier.

Options

msti-id—MSTI instance identifier.

Range: 1 through 64

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring MST Instances on a Physical Interface on page 208

mstp

Syntax

```
mstp {
  bpdu-block-on-edge;
  bridge-priority priority;
  configuration-name configuration-name;
  disable;
  forward-delay seconds;
  hello-time seconds;
  max-age seconds;
  max-hops hops;
  priority-hold-time seconds;
  revision-level revision-level;
  interface interface-name {
    bpdu-timeout-action {
      alarm;
      block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
  }
  msti msti-id {
    bridge-priority priority;
    interface interface-name {
      cost cost;
      edge;
      priority interface-priority;
    }
    vlan vlan-id;
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information

Statement introduced in Junos OS Release 8.4.
bpdu-block-on-edge statement added in Junos OS Release 9.4.
bpdu-timeout-action statement added in Junos OS Release 9.4.
Support for logical systems added in Junos OS Release 9.6.

Description

Configure MSTP parameters.

Options

The statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Multiple Spanning-Tree Protocol on page 204

no-root-port

Syntax
no-root-port;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit protocols (mstp | rstp | vstp) interface *interface-name*],
[edit protocols vstp vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*]

Release Information
Statement introduced in Junos OS Release 9.1.
Support for logical systems added in Junos OS Release 9.6.

Description
Ensure the port is the spanning-tree designated port. If the port receives superior bridge protocol data unit (BPDU) packets, root protect moves this port to a root-prevented spanning-tree state.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Root Protection for Spanning-Tree Instance Interfaces Overview on page 220
- Root Protect for a Spanning-Tree Instance Interface on page 220
- Enabling Root Protect for a Spanning-Tree Instance Interface on page 221

priority

Syntax priority *interface-priority*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*],
[edit protocols (mstp | rstp | vstp) interface *interface-name*],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols vstp *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp) interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols mstp msti *msti-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Use the interface priority to control which interface is elected as the root port. The interface priority must be set in increments of 16.

Options ***priority***—(Optional) Interface priority.

Range: 0 through 240

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Spanning-Tree Instance Interface on page 197
- Spanning-Tree Instance Interface Configured as an Edge Port on page 199
- Spanning-Tree Instance Interface Priority on page 198

priority-hold-time

Syntax priority-hold-time *seconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],

Release Information Statement introduced in Junos OS Release 10.0.

Description Specify the number of seconds to hold before switching to the primary priority when the first core domain comes up.

Options ***seconds***—Number of seconds to hold before switching to primary priority.

Range: 1 through 255

Default: 2 seconds

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- VPLS Multihoming: Hold Time Before Switching to Primary Priority on page 229

protocol

Syntax protocol (cdp | stp | vtp);

Hierarchy Level [edit protocols layer2-control mac-rewrite interface *interface-name*],

Release Information Statement introduced in Junos OS Release 9.1.

Description Configure the protocol to be tunneled on an interface for Layer 2 protocol tunneling. To tunnel multiple protocols, include multiple **protocol** statements.

Options

cdp—Tunnel the Cisco discovery protocol.

stp—Tunnel all versions of the spanning-tree protocol.

vtp—Tunnel the VLAN trunk protocol.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Layer 2 Protocol Tunneling Through a Network Overview on page 234
- Layer 2 Protocol Tunnel Interface on page 235
- Layer 2 Protocol to be Tunneled on page 236
- Configuring Layer 2 Protocol Tunneling on page 237

protocols

Syntax

```
protocols {
  mstp { ... }
  rstp { ... }
  vstp { ... }
}
```

Hierarchy Level

[edit],
[edit logical-systems *logical-system-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*],
[edit routing-instances *routing-instance-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description

Configure the Spanning Tree Protocol type as MSTP, RSTP, or VSTP.

Options

mstp—Configure the protocol as Multiple Spanning Tree.

rstp—Configure the protocol as Rapid Spanning Tree.

vstp—Configure the protocol as VLAN Spanning Tree.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201
- Configuring Multiple Spanning-Tree Protocol on page 204
- Configuring VLAN Spanning-Tree Protocol on page 210

revision-level

Syntax revision-level *revision-level*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mstp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp],
[edit protocols mstp],
[edit routing-instances *routing-instance-name* protocols mstp]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Set the revision number of the MSTP configuration.

Options ***revision-level***—Configure the revision number of the MSTP region configuration.

Range: 0 through 65,535

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Multiple Spanning-Tree Protocol on page 204

rstp

Syntax

```
rstp {
  bpdu-block-on-edge;
  bpdu-destination-mac-address provider-bridge-group;
  bridge-priority priority;
  extended-system-id;
  force-version stp;
  forward-delay seconds;
  hello-time seconds;
  max-age seconds;
  interface interface-name {
    bpdu-timeout-action {
      alarm;
      block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
  }
  priority-hold-time seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information

Statement introduced in Junos OS Release 8.4.
bpdu-block-on-edge statement added in Junos OS Release 9.4.
bpdu-timeout-action statement added in Junos OS Release 9.4.
Support for logic systems added in Junos OS Release 9.6.

Description

Configure RSTP parameters.

Options

The statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Rapid Spanning-Tree Protocol on page 201

system-id

Syntax

```
system-id system-id-value {
  ip-address(es);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information

Statement introduced in Junos OS Release 10.0.

Description

Determine the system identifier value for bridges in a VPLS multihomed Layer 2 ring with MPLS infrastructure.

Options

system-id-value—System identifier in the format ***nnnnnn*:*nnnnnn*** where ***n*** = any digit from 0 through 9.

Range: Any valid value

Default: None

ip-address(es)—Valid IP host addresses in the format ***ip-address*/32**.

Range: Any valid IP address

Default: None

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview on page 227
- VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology on page 227
- VPLS Multihoming: System Identifier for Bridges in the Ring on page 230

traceoptions (Spanning Tree)

Syntax

```
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (mstp | rstp | vstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)],
[edit protocols (mstp | rstp | vstp)],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp | vstp)]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description

Set STP protocol-level tracing options.

Default

The default STP protocol-level trace options are inherited from the global **traceoptions** statement.

Options

disable—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place STP tracing output in the file **/var/log/stp-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 1 trace file only

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. The following are the STP-specific tracing options:

- **all**—Trace all operations.
- **all-failures**—Trace all failure conditions.
- **bpdu**—Trace BPDU reception and transmission.
- **bridge-detection-state-machine**—Trace the bridge detection state machine.
- **events**—Trace events of the protocol state machine.

- **port-information-state-machine**—Trace the port information state machine.
- **port-migration-state-machine**—Trace the port migration state machine.
- **port-receive-state-machine**—Trace the port receive state machine.
- **port-role-transit-state-machine**—Trace the port role transit state machine.
- **port-role-select-state-machine**—Trace the port role selection state machine.
- **port-state-transit-state-machine**—Trace the port state transit state machine.
- **port-transmit-state-machine**—Trace the port transmit state machine.
- **ppmd**—Trace the state and events for the ppmd process.
- **state-machine-variables**—Trace when the state machine variables change.
- **timers**—Trace protocol timers.
- **topology-change-state-machine**—Trace the topology change state machine.

The following are the global tracing options:

- **all**—All tracing operations.
- **config-internal**—Trace configuration internals.
- **general**—Trace general events.
- **normal**—All normal events.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **parse**—Trace configuration parsing.
- **policy**—Trace policy operations and actions.
- **regex-parse**—Trace regular-expression parsing.
- **route**—Trace routing table changes.
- **state**—Trace state transitions.
- **task**—Trace protocol task processing.
- **timer**—Trace protocol task timer processing.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the files option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Spanning-Tree Protocol Trace Options on page 200
- Tracing Spanning-Tree Operations on page 214
- Example: Tracing Spanning-Tree Protocol Operations on page 240

vlan

See the following sections:

- vlan (MSTP) on page 275
- vlan (VSTP) on page 276

vlan (MSTP)

Syntax vlan *vlan-id*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mstp msti *msti-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp msti *msti-id*],
[edit protocols mstp msti *msti-id*],
[edit routing-instances *routing-instance-name* protocols mstp msti *msti-id*]

Release Information Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.

Description Configure the VLAN of an MSTI or VSTP instance or configure the VLAN range of an MSTI instance.

Options ***vlan-id***—The VLAN identifier associated with the MSTI.

vlan-id-range—Range of VLAN identifiers associated with the MSTI in the form ***minimum-vlan-id-maximum-vlan-id***. VLAN identifier ranges are not supported for VSTP.

Range: 1 through 4096

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Multiple Spanning-Tree Protocol on page 204

vlan (VSTP)

Syntax

```
vlan vlan-id {
  bridge-priority priority;
  forward-delay seconds;
  hello-time seconds;
  max-age seconds;
  interface interface-name {
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
  }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols vstp], [edit protocols vstp]

Release Information Statement introduced in Junos OS Release 9.0.
Support for logical systems added in Junos OS Release 9.6.

Description Configure VSTP VLAN parameters.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring VLAN Spanning-Tree Protocol on page 210

vpls-flush-on-topology-change

Syntax vpls-flush-on-topology-change;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* protocols vstp vlan *vlan-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan *vlan-id*],
[edit routing-instances *routing-instance-name* protocols (mstp | rstp)],
[edit routing-instances *routing-instance-name* protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 10.0.

Description Determine the action the bridge should take when the topology of a multihomed Layer 2 ring with MPLS infrastructure changes: flush the media access control (MAC) cache or not. By default, the bridge does not flush the cache when the topology changes.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- VPLS Multihoming: Bridge Flush of MAC Cache on Topology Change on page 231

vstp

Syntax

```
vstp {
  bpdu-block-on-edge;
  force-version stp;
  interface interface-name {
    bpdu-timeout-action {
      alarm;
      block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
  }
  priority-hold-time seconds;
  vlan vlan-id {
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    max-age seconds;
    interface interface-name {
      bpdu-timeout-action {
        alarm;
        block;
      }
      cost cost;
      edge;
      mode (p2p | shared);
      no-root-port;
      priority interface-priority;
    }
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information

Statement introduced in Junos OS Release 9.0.
bpdu-block-on-edge statement added in Junos OS Release 9.4.
bpdu-timeout-action statement added in Junos OS Release 9.4.
Support for logical systems added in Junos OS Release 9.6.

Description

Configure VSTP parameters.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring VLAN Spanning-Tree Protocol on page 210

PART 7

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