Junos® OS for EX Series Ethernet Switches

Class of Service for EX4300 Switches

Release
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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.

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About the Documentation

Documentation and 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/.

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Supported Platforms

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

- EX Series

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 *CLI User Guide*.

Documentation Conventions

Table 1 on page xiii 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.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xiii 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**

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

Convention	Description	Examples
`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 or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User 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; 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)	Encloses optional keywords or variables.	**stub <default-metric** ***metric*****>;**
| (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)	Encloses a variable for which you can substitute one or more values.	**community name members [** ***community-ids*** **]**

Indention and braces ({ })	Identifies 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.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.

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

Convention	Description	Examples
> (bold right angle bracket)	Separates levels in a hierarchy of menu 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 provide feedback by using either of the following methods:

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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 post-sales 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/.
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- Find CSC offerings: http://www.juniper.net/customers/support/
- Search for known bugs: http://www2.juniper.net/kb/
- 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: http://kb.juniper.net/InfoCenter/
- 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, see http://www.juniper.net/support/requesting-support.html.

PART 1

Overview

CHAPTER 1

CoS Overview

Junos OS CoS for EX Series Switches Overview

When a network experiences congestion and delay, some packets must be dropped. Junos operating system (Junos OS) class of service (CoS) divides traffic into classes to which you can apply different levels of throughput and packet loss when congestion occurs. This allows packet loss to happen according to rules that you configure.

For interfaces that carry IPv4, IPv6, and MPLS traffic, you can configure Junos OS CoS features to provide multiple classes of service for different applications. CoS also allows you to rewrite the Differentiated Services code point (DSCP), IP precedence, 802.1p, or EXP CoS bits of packets egressing out of an interface, thus allowing you to tailor packets for the remote peers' network requirements. See *Understanding Using CoS with MPLS Networks on EX Series Switches* for more information about CoS for MPLS networks.

CoS provides multiple classes of service for different applications. You can configure multiple forwarding classes for transmitting packets, define which packets are placed into each output queue, and schedule the transmission service level for each queue.

In designing CoS applications, you must give careful consideration to your service needs and thoroughly plan and design your CoS configuration to ensure consistency and interoperability across all platforms in a CoS domain.

Because Juniper Networks EX Series Ethernet Switches implement CoS in hardware rather than in software, you can experiment with and deploy CoS features without affecting packet-forwarding and switching performance.

NOTE: CoS policies can be enabled or disabled on each interface of an EX Series switch. Also, each physical and logical interface on the switch can have custom CoS rules associated with it. When CoS is used in an MPLS network, there are some additional restrictions. See *Understanding Using CoS with MPLS Networks on EX Series Switches*.

How Junos OS CoS Works

Junos OS CoS works by examining traffic entering at the edge of your network. The switches classify traffic into defined service groups to provide the special treatment of traffic across the network. For example, voice traffic can be sent across certain links, and data traffic can use other links. In addition, the data traffic streams can be serviced differently along the network path. As the traffic leaves the network at the far edge, you can rewrite the traffic to meet the policies of the targeted peer.

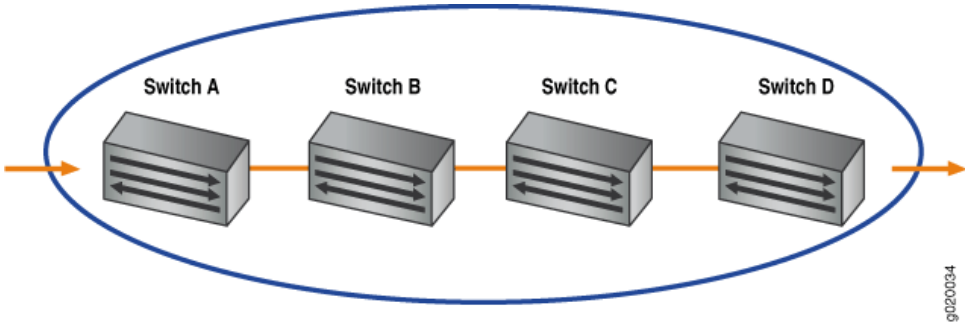
To support CoS, you must configure each switch in the network. Generally, each switch examines the packets that enter it to determine their CoS settings. These settings then dictate which packets are transmitted first to the next downstream switch. Switches at

the edges of the network might be required to alter the CoS settings of the packets that enter the network to classify the packets into the appropriate service groups.

Figure 1 on page 5 represents the network scenario of an enterprise. Switch A is receiving traffic from various network nodes such as desktop computers, servers, surveillance cameras, and VoIP telephones. As each packet enters, Switch A examines the packet's CoS settings and classifies the traffic into one of the groupings defined by the enterprise. This definition allows Switch A to prioritize resources for servicing the traffic streams it receives. Switch A might alter the CoS settings of the packets to better match the enterprise's traffic groups.

When Switch B receives the packets, it examines the CoS settings, determines the appropriate traffic groups, and processes the packets according to those settings. It then transmits the packets to Switch C, which performs the same actions. Switch D also examines the packets and determines the appropriate groups. Because Switch D sits at the far end of the network, it can rewrite the CoS bits of the packets before transmitting them.

Figure 1: Packet Flow Across the Network



Default CoS Behavior on EX Series Switches

If you do not configure any CoS settings on the switch, the software performs some CoS functions to ensure that user traffic and protocol packets are forwarded with minimum delay when the network is experiencing congestion. Some CoS settings, such as classifiers, are automatically applied to each logical interface that you configure. Other settings, such as rewrite rules, are applied only if you explicitly associate them with an interface.

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches on page 32
- Example: Configuring CoS on EX Series Switches on page 39
- *Example: Combining CoS with MPLS on EX Series Switches*

Understanding Junos OS CoS Components for EX Series Switches

This topic describes the Juniper Networks Junos operating system (Junos OS) class-of-service (CoS) components for Juniper Networks EX Series Ethernet Switches:

Code-Point Aliases

A code-point alias assigns a name to a pattern of code-point bits. You can use this name instead of the bit pattern when you configure other CoS components such as classifiers, drop-profile maps, and rewrite rules.

Policers

Policers limit traffic of a certain class to a specified bandwidth and *burst size*. Packets exceeding the policer limits can be discarded. You define policers with filters that can be associated with input interfaces.

For more information about policers, see *Understanding the Use of Policers in Firewall Filters*.

NOTE: **You can configure policers to discard packets that exceed the rate limits. If you want to configure CoS parameters such as loss-priority and forwarding-class, you must use firewall filters.**

Classifiers

Packet classification associates incoming packets with a particular CoS servicing level. In Juniper Networks Junos operating system (Junos OS), *classifiers* associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class. Junos OS supports two general types of classifiers:

- Behavior aggregate or CoS value traffic classifiers—Examines the CoS value in the packet header. The value in this single field determines the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the Differentiated Services code point (DSCP) value, IP precedence value, and IEEE 802.1p value.
- Multifield traffic classifiers—Examines multiple fields in the packet such as source and destination addresses and source and destination port numbers of the packet. With

multifield classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

Forwarding Classes

Forwarding classes group the packets for transmission. Based on forwarding classes, you assign packets to output queues. Forwarding classes affect the forwarding, scheduling, and marking policies applied to packets as they transit a switch. By default, four categories of forwarding classes are defined: best effort, assured forwarding, expedited forwarding, and network control. For EX Series switches, 16 forwarding classes are supported, providing granular classification capability.

Tail Drop Profiles

Drop profile is a mechanism that defines parameters that allow packets to be dropped from the network. Drop profiles define the meanings of the loss priorities. When you configure drop profiles you are essentially setting the value for queue fullness. The queue fullness represents a percentage of the queue used to store packets in relation to the total amount that has been allocated for that specific queue.

Loss priorities set the priority of dropping a packet. Loss priority affects the scheduling of a packet without affecting the packet's relative ordering. You can use the loss priority setting to identify packets that have experienced congestion. Typically you mark packets exceeding some service level with a high loss priority.

Schedulers

Each switch interface has multiple queues assigned to store packets. The switch determines which queue to service based on a particular method of scheduling. This process often involves determining which type of packet should be transmitted before another. You can define the priority, bandwidth, delay buffer size, and tail drop profiles to be applied to a particular queue for packet transmission.

A scheduler map associates a specified forwarding class with a scheduler configuration. You can associate up to four user-defined scheduler maps with the interfaces.

Rewrite Rules

A *rewrite rule* sets the appropriate CoS bits in the outgoing packet, thus allowing the next downstream device to classify the packet into the appropriate service group. Rewriting, or marking, outbound packets is useful when the switch is at the border of a network and must alter the CoS values to meet the policies of the targeted peer.

NOTE: **Egress firewall filters can also assign forwarding class and loss priority so that the packets are rewritten based on forwarding class and loss priority.**

Related Documentation

- Understanding CoS Code-Point Aliases on page 8
- *Understanding CoS Classifiers*
- *Understanding CoS Forwarding Classes*

- *Understanding CoS Tail Drop Profiles*
- Understanding CoS Schedulers on page 22
- Understanding CoS Two-Color Marking on page 29
- Understanding CoS Rewrite Rules on page 29
- Example: Configuring CoS on EX Series Switches on page 39

Understanding CoS Code-Point Aliases

A code-point alias assigns a name to a pattern of code-point bits. You can use this name instead of the bit pattern when you configure other CoS components such as classifiers, drop-profile maps, and rewrite rules.

Behavior aggregate classifiers use class-of-service (CoS) values such as Differentiated Services code points (DSCPs), IP precedence, and IEEE 802.1p bits to associate incoming packets with a particular CoS servicing level. On a switch, you can assign a meaningful name or alias to the CoS values and use this alias instead of bits when configuring CoS components. These aliases are not part of the specifications but are well known through usage. For example, the alias for DSCP 101110 is widely accepted as ef (expedited forwarding).

When you configure classes and define classifiers, you can refer to the markers by alias names. You can configure user-defined classifiers in terms of alias names. If the value of an alias changes, it alters the behavior of any classifier that references it.

This topic covers:

- Default Code-Point Aliases on page 8

Default Code-Point Aliases

Table 3 on page 8 shows the default mappings between the bit values and standard aliases.

Table 3: Default Code-Point Aliases

CoS Value Types	Mapping
DSCP CoS Values	
ef	101110
af11	001010
af12	001100
af13	001110
af21	010010

Table 3: Default Code-Point Aliases *(continued)*

CoS Value Types	Mapping
af22	010100
af23	010110
af31	011010
af32	011100
af33	011110
af41	100010
af42	100100
af43	100110
be	000000
cs1	001000
cs2	010000
cs3	011000
cs4	100000
cs5	101000
nc1/cs6	110000
nc2/cs7	111000
IEEE 802.1p CoS Values	
be	000
be1	001
ef	100
ef1	101
af11	010
af12	011
nc1/cs6	110

Table 3: Default Code-Point Aliases *(continued)*

CoS Value Types	Mapping
nc2/cs7	111
Legacy IP Precedence CoS Values	
be	000
be1	001
ef	010
ef1	011
af11	100
af12	101
nc1/cs6	110
nc2/cs7	111

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66
- Defining CoS Code-Point Aliases (J-Web Procedure) on page 67

Understanding CoS Classifiers

Packet classification associates incoming packets with a particular class-of-service (CoS) servicing level. Classifiers associate packets with a forwarding class and loss priority, and packets are associated to an output queue based on the forwarding class. You can define classifiers for IPv4 and IPv6 traffic to network interfaces, aggregated Ethernet interfaces (also known as link aggregation groups (LAGs)), integrated routing and bridging (IRB) interfaces (also known as routed VLAN interfaces (RVIs)), Layer 3 interfaces, and Layer 3 VLAN-tagged logical interfaces.

There are two general types of classifiers:

- Behavior aggregate (BA) classifiers
- Multifield (MF) classifiers

You can configure both a BA classifier and an MF classifier on an interface. If you do this, the BA classification is performed first and then the MF classification. If the two classification results conflict, the MF classification result overrides the BA classification result.

On Juniper Networks EX8200 Ethernet Switches, you can specify BA classifiers for bridged multidestination traffic and for IP multidestination traffic. A BA classifier for multicast packets is applied to all interfaces on the EX8200 switch.

NOTE: EX8200 switches implement the on-demand allocation of memory space for ternary content addressable memory (TCAM) so that when additional TCAM space is required for CoS classifiers, it is allocated from the free TCAM space or from the unused TCAM space. An error log message is generated when you configure CoS classifiers to use memory space that exceeds the available TCAM space that includes both the free and unused space.

This topic describes:

- Behavior Aggregate Classifiers on page 11
- Multifield Classifiers on page 13

Behavior Aggregate Classifiers

The behavior aggregate classifier maps packets to a forwarding class and a loss priority. The forwarding class determines the output queue for a packet. The loss priority is used by a scheduler to control packet discard during periods of congestion.

There are three types of BA classifiers:

- Differentiated Services Code Point (DSCP) for IP DiffServ
- IP precedence bits

- IEEE 802.1p CoS bits

BA classifiers are based on fixed-length fields, which makes them computationally more efficient than MF classifiers. Therefore core devices, which handle high traffic volumes, are normally configured to perform BA classification.

Default Behavior Aggregate Classification

Juniper Networks Junos operating system (Junos OS) automatically assigns implicit default BA classifiers to logical interfaces based on the type of interface. Table 4 on page 12 lists different types of interfaces and the corresponding implicit default BA classification.

Table 4: Default BA Classification

Type of Interface	Default BA Classification
Trunk and Circuit Cross-Connect (CCC) interfaces	**ieee8021p-default** NOTE: This BA classification for a CCC interface is applicable only for EX8200 switches.
Layer 3 interface (IPv4)	**dscp-default**
Layer 3 interface (IPv6)	**dscp-ipv6-default**
Access interface	Untrusted
Routed VLAN interface (RVI)	No default classification
MPLS	EXP NOTE: This BA classification is applicable only for EX8200 switches.

When you explicitly associate a BA classifier with a logical interface, you are overriding the implicit (default) BA classifier with an explicit BA classifier.

Table 5 on page 12 describes the BA classifier types you can configure on Layer 2 and Layer 3 interfaces.

Table 5: Allowed BA Classification

Type of Interface	Allowed BA Classification
Layer 2 interface	IEEE 802.1p, IP precedence, DSCP, DSCP IPv6
Layer 3 interface (IPv4)	IEEE 802.1p, IP precedence, DSCP
Layer 3 interface (IPv6)	IEEE 802.1p, IP precedence, DSCP IPv6

You can configure all the allowed classifier types on the same logical interface or on different logical interfaces. If you need to apply all classifier rules on the same logical

interface, configure the classifier rules allowed for both IPv4 and IPv6 on the logical interface.

If you have not explicitly configured a classifier on a logical interface, the default classifiers are assigned and classification works as follows:

- To a logical interface configured with an IPv4 address, a DSCP classifier is assigned by default, and IPv4 and IPv6 packets are classified using the DSCP classifier.
- To logical interface configured with an IPv6 address, a DSCP IPv6 classifier is assigned by default, and IPv4 and IPv6 packets are classified using the DSCP IPv6 classifier.

NOTE: On EX8200 switches, you can configure either one classifier of type DSCP or IEEE802.1p, or you can configure one classifier each of type DSCP and IEEE802.1p.

You can configure integrated routing and bridging (IRB) interfaces (also known as routed VLAN interfaces (RVIs)) to classify packets. After you do this, the User Priority (UP) bits in the incoming packets are rewritten according to the default IEEE 802.1p rewrite rule, except on EX8200 switches. On EX8200 switches, you must explicitly assign the default IEEE 802.1p rewrite rule to RVIs.

NOTE: By default, all BA classifiers classify traffic into either the best-effort forwarding class or the network-control forwarding class.

Multifield Classifiers

Multifield classifiers examine multiple fields in a packet such as source and destination addresses and source and destination port numbers of the packet. With MF classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

MF classification is normally performed at the network edge because of the general lack of support for DSCP or IP precedence classifiers in end-user applications. On an edge switch, an MF classifier provides the filtering functionality that scans through a variety of packet fields to determine the forwarding class for a packet. Typically, any classifier performs matching operations on the selected fields against a configured value.

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69
- Defining CoS Classifiers (J-Web Procedure) on page 71

Understanding CoS Forwarding Classes

Class-of-Service (CoS) forwarding classes can be thought of as output queues. In effect, the result of classifying packets is the identification of an output queue for a particular packet. For a classifier to assign an output queue to a packet, it must associate the packet with one of the following forwarding classes:

- best-effort (be)—Provides no service profile. Loss priority is typically not carried in a CoS value.
- expedited-forwarding (ef)—Provides a low loss, low latency, low jitter, assured bandwidth, end-to-end service.
- assured-forwarding (af)—Provides a group of values you can define and includes four subclasses: AF1, AF2, AF3, and AF4, each with two drop probabilities: low and high.
- network-control (nc)—Supports protocol control and thus is typically high priority.
- multicast best-effort (mcast-be)—Provides no service profile for multicast packets.
- multicast expedited forwarding (mcast-ef)—Supports high-priority multicast packets.
- multicast assured-forwarding (mcast-af)—Provides two drop profiles; high, and low, for multicast packets.

NOTE: **The forwarding classes multicast expedited-forwarding, multicast assured-forwarding, and multicast best-effort are applicable only to Juniper Networks EX8200 and Juniper Networks EX4300 Ethernet Switches.**

Juniper Networks EX Series Ethernet Switches support up to 16 forwarding classes, thus allowing granular packet classification. For example, you can configure multiple classes of expedited forwarding (EF) traffic such as EF, EF1, and EF2.

EX Series switches except EX4300 switches support up to eight output queues. Therefore, if you configure more than eight forwarding classes, you must map multiple forwarding classes to single output queues. EX4300 switches support up to 12 output queues. On EX8200 Virtual Chassis, you can configure only eight forwarding classes and you can assign only one forwarding class to each output queue.

NOTE: **On EX8200 Virtual Chassis, the queue number seven carries Virtual Chassis port (VCP) traffic and can also carry high-priority user traffic.**

This topic describes:

- Default Forwarding Classes on page 15

Default Forwarding Classes

Table 6 on page 15 shows the four default forwarding classes defined for unicast traffic, and Table 7 on page 15 shows the three default forwarding classes defined for multicast traffic.

NOTE: The default forwarding classes for multicast traffic are applicable only to EX8200 switches.

You can rename the forwarding classes associated with the queues supported on your switch. Assigning a new class name to an output queue does not alter the default classification or scheduling that is applicable to that queue. However, because CoS configurations can be quite complicated, we recommend that you avoid altering the default class names or queue number associations.

Table 6: Default Forwarding Classes for Unicast Traffic

Forwarding Class Name	Comments
best-effort (be)	The software does not apply any special CoS handling to packets with 000000 in the DiffServ field. This is a backward compatibility feature. These packets are usually dropped under congested network conditions.
expedited-forwarding (ef)	The software delivers assured bandwidth, low loss, low delay, and low delay variation (jitter) end-to-end for packets in this service class. The software accepts excess traffic in this class, but in contrast to the assured forwarding class, the out-of-profile expedited-forwarding class packets can be forwarded out of sequence or dropped.
assured-forwarding (af)	The software offers a high level of assurance that the packets are delivered as long as the packet flow from the customer stays within a certain service profile that you define. The software accepts excess traffic, but it applies a tail drop profile to determine that excess packets are dropped, and not forwarded. Two drop probabilities (low and high) are defined for this service class.
network-control (nc)	The software delivers packets in this service class with a high priority. (These packets are not delay-sensitive.) Typically, these packets represent routing protocol hello or keep alive messages. Because loss of these packets jeopardizes proper network operation, packet delay is preferable to packet discard for these packets.

Table 7: Default Forwarding Classes for Multicast Traffic

Forwarding Class Name	Comments
multicast best-effort (mcast-be)	The software does not apply any special CoS handling to multicast packets. These packets are usually dropped under congested network conditions.

Table 7: Default Forwarding Classes for Multicast Traffic *(continued)*

Forwarding Class Name	Comments
multicast expedited-forwarding (mcast-ef)	The software delivers assured bandwidth, low loss, low delay, and low delay variation (jitter) end-to-end for multicast packets in this service class. The software accepts excess traffic in this class, but in contrast to the multicast assured forwarding class, out-of-profile multicast expedited-forwarding class packets can be forwarded out of sequence or dropped.
multicast assured-forwarding (mcast-af)	The software offers a high level of assurance that the multicast packets are delivered as long as the packet flow from the customer stays within a certain service profile that you define. The software accepts excess traffic, but it applies a tail drop profile to determine if the excess packets are dropped and not forwarded. Two drop probabilities (low and high) are defined for this service class.
multicast network-control (mcast-nc)	The software delivers packets in this service class with a high priority. (These packets are not delay-sensitive.) Typically, these packets represent routing protocol hello or keep alive messages. Because loss of these packets jeopardizes proper network operation, packet delay is preferable to packet discard for these packets.

The following rules govern queue assignment:

- CoS configurations that specify more queues than the switch can support are not accepted. If you commit such a configuration, the commit fails and a message displays that states the number of queues available.
- All default CoS configurations are based on queue number. The name of the forwarding class that is displayed in the default configuration for a queue number is that of the forwarding class currently associated with that queue.

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Example: Configuring CoS on EX Series Switches on page 39
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Defining CoS Forwarding Classes (CLI Procedure) on page 73
- Defining CoS Forwarding Classes (J-Web Procedure) on page 73

Understanding CoS Congestion Management

A congestion in a network occurs because of various parameters and some packets must be dropped to avoid congestion and to facilitate easy flow of traffic in the network. On Juniper Networks EX Series Ethernet Switches, class of service (CoS) provides congestion management mechanisms for a switch to drop arriving packets based on certain parameters when a queue is full. Based on the EX Series switch that you are using, packets are dropped depending on the priority of a packet or on both priority and drop probability of a packet.

You can specify parameters at the **[edit class-of-service drop-profiles]** hierarchy level for dropping packets and reference the parameters in a scheduler configuration.

This topic describes:

Weighted Tail Drop Congestion Management

A weighted tail drop (WTD) is a congestion management mechanism for packets to be dropped from the tail of the queue when the queue reaches a certain buffer capacity (that is, the fill level), and hence the name weighted tail drop. The packets that are dropped are based on priority and are those marked with a packet loss priority (PLP) of *high*. You can configure a WTD profile (a WTD mechanism) usually on edge devices in a network.

NOTE: A WTD profile is supported only on the Juniper Networks EX2200, EX3200, EX3300, EX4200, EX4500, EX4550, and EX6200 Ethernet Switches.

When you configure a WTD profile, you are essentially setting the value for queue fullness. The queue fullness represents a percentage of the memory, known as delay-buffer bandwidth, that is used to store packets in relation to the total amount of memory that has been allocated for that specific queue. The delay-buffer bandwidth provides packet buffer space to absorb burst traffic up to the specified duration of delay. When the specified delay buffer becomes full, packets are dropped from the tail of the buffer.

By default, if you do not configure any drop profile, WTD profile is in effect and functions as the primary mechanism for managing congestion.

NOTE: The default WTD profile associated with the packets whose PLP is *low* cannot be modified. You can configure custom drop profile only for those packets whose PLP is *high*.

Weighted Random Early Detection Congestion Management

In a weighted random early detection (WRED) congestion management mechanism, random packets with a PLP of low or high are gradually dropped (based on drop probability) when the queue reaches a certain buffer capacity (that is, fill level).

NOTE: **The WRED mechanism is supported only on Juniper Networks EX4300 standalone switches, EX4300 Virtual Chassis, Juniper Networks EX8200 standalone switches, and EX8200 Virtual Chassis.**

Following are the different implementations of WRED:

- Segmented Drop Profile
- Interpolated Drop Profile

From a high level, segmented drop profile is a stair-step-like drop profile, whereas interpolated drop profile is a smother (curve) drop profile. Figure 2 on page 19 and Figure 3 on page 20 show a graphical representation of segmented and interpolated drop profiles. Regardless of the implementation, a drop profile represents a graph where the **x**-axis represents the percentage of fill level (l) and the **y**-axis represents the percentage of drop probability (p). The origin (0,0) represents the drop profile in which the drop probability is 0 percent when the queue fullness is 0 percent, and the point (100,100) represents that the drop probability is 100 percent when the queue fullness is 100 percent. Although the formation of graph lines in Figure 2 on page 19 and Figure 3 on page 20 is different, the application of the profile is the same. When a packet reaches the head of the queue, a random number between 0 and 100 is calculated. This random number is plotted against the drop profile graph using the current queue fullness of that particular queue. When the random number falls above the graph line, the packet is transmitted. When the number falls below the graph line, the packet is dropped from the network.

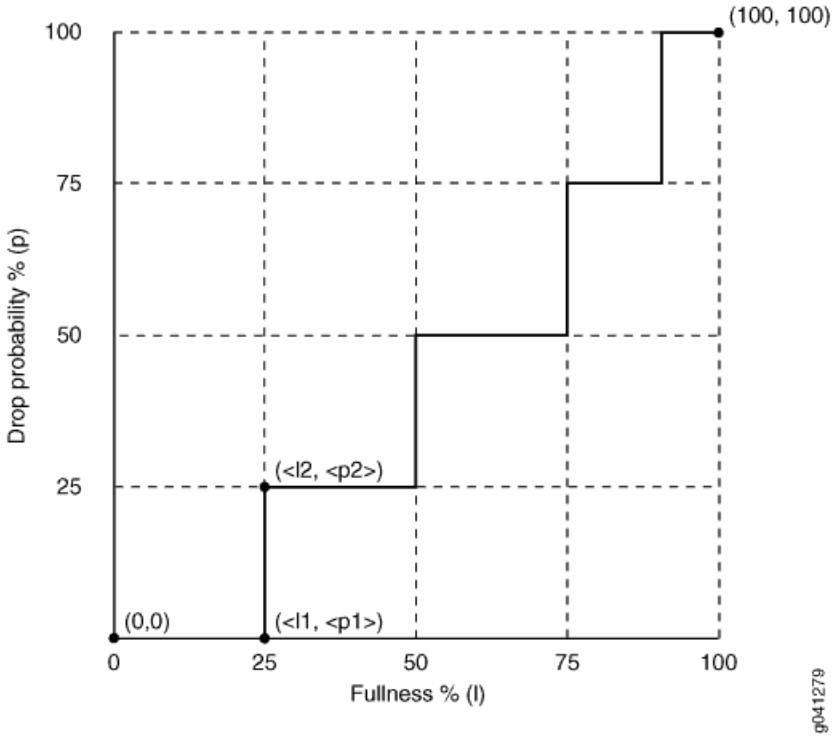
The following sections discuss the WRED drop profile implementations and parameters:

- Segmented Drop Profile on page 18
- Interpolated Drop Profile on page 19
- Drop Profile Parameters on page 21

Segmented Drop Profile

In a segmented drop profile configuration, you can define multiple data points for fill level and drop probability. Figure 2 on page 19 shows a graphical representation of a segmented drop profile.

Figure 2: Graphical Representation of a Segmented Drop Profile



To create the profile's graph line, the software begins at the bottom-left corner of the graph, representing a 0 percent fill level and a 0 percent drop probability (that is the point (0,0)). The configuration draws a line directly to the right until it reaches the first defined fill level (that is, 25 percent represented in the graph on the x-axis). The software then continues the line vertically until the first drop probability is reached (that is, 25 percent represented in the graph in the y-axis). This process is repeated for all of the defined fill levels and drop probabilities until the top-right corner of the graph is reached (that is point (100,100) in the graph).

Interpolated Drop Profile

An interpolated drop profile configuration forms a smoother graph line compared to the graph in a segmented drop profile configuration. In this method of congestion management also, a switch uses multiple drop profile values to drop incoming packets to reduce congestion in the output queue.

Following are interpolated drop profile configurations on EX Series switches:

- Interpolated Drop Profile Configuration on EX Series Switches Except EX4300 Switches on page 19
- Interpolated Drop Profile Configuration on EX4300 Switches on page 20

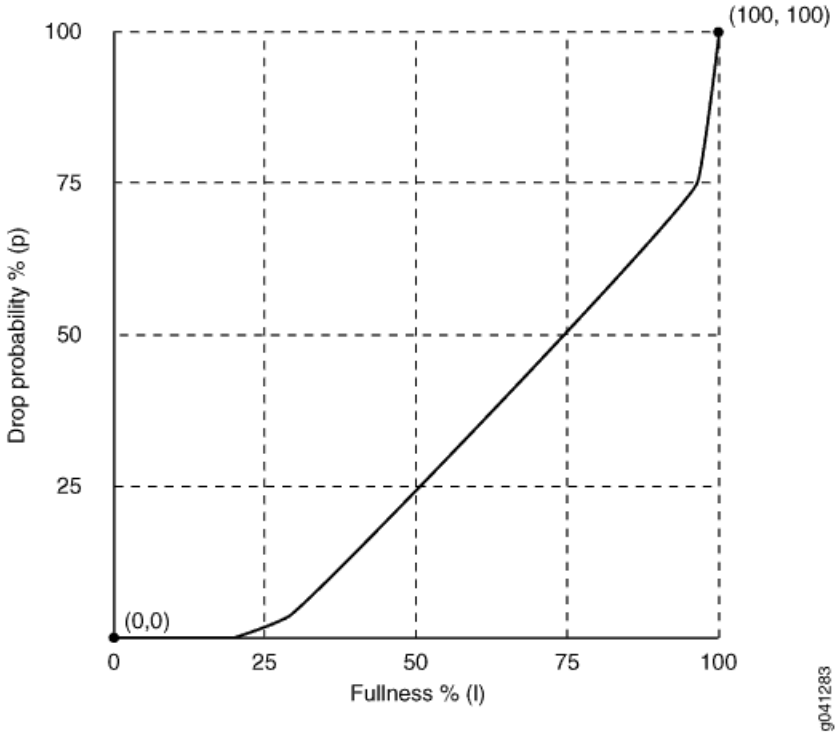
Interpolated Drop Profile Configuration on EX Series Switches Except EX4300 Switches

An interpolated drop profile on all EX Series switches except EX4300 switches automatically generates 64 pairs of data points on the graph beginning at (0, 0) and

ending at (100, 100). Along the way, the graph line intersects specific data points that you define for fullness and drop probability.

Figure 3 on page 20 shows a graphical representation of an interpolated drop profile.

Figure 3: Graphical Representation of an Interpolated Drop Profile on EX Series Switches Except EX4300 Switches



Interpolated Drop Profile Configuration on EX4300 Switches

On EX4300 switches, you can set two queue fill levels and two drop probabilities in each drop profile. The two fill levels and the two drop probabilities create two pairs of values. The first fill level and the first drop probability create one value pair and the second fill level and the second drop probability create the second value pair.

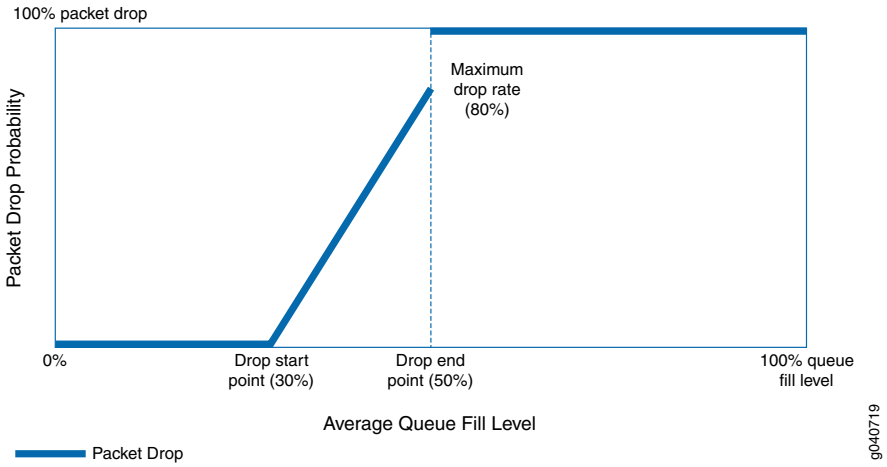
NOTE: You can configure a maximum of 64 drop profiles on EX4300 switches.

The first fill level value specifies the percentage of queue fullness at which packets begin to drop, known as the drop start point. Until the queue reaches this level of fullness, no packets are dropped. The second fill level value specifies the percentage of queue fullness at which all packets are dropped, known as the drop end point.

The first drop probability value is always **0** (zero). This pairs with the drop start point and specifies that until the queue fullness level reaches the first fill level, no packets drop. When the queue fullness exceeds the drop start point, packets begin to drop until the queue exceeds the second fill level, when all packets drop. The second drop probability value, known as the maximum drop rate, specifies the likelihood of dropping packets

when the queue fullness reaches the drop end point. As the queue fills from the drop start point to the drop end point, packets drop in a smooth, linear pattern (called an interpolated graph) as shown in Figure 4 on page 21. After the drop end point, all packets drop.

Figure 4: Tail-Drop Profile Packet Drop on EX4300 Switches



The thick line in Figure 4 on page 21 shows the packet drop characteristics for a sample tail drop profile. At the drop start point, the queue reaches a fill level of 30 percent. At the drop end point, the queue fill level reaches 50 percent, and the maximum drop rate is 80 percent.

No packets drop until the queue fill level reaches the drop start point of 30 percent. When the queue reaches the 30 percent fill level, packets begin to drop. As the queue fills, the percentage of packets dropped increases in a linear fashion. When the queue fills to the drop end point of 50 percent, the rate of packet drop has increased to the maximum drop rate of 80 percent. When the queue fill level exceeds the drop end point of 50 percent, all of the packets drop until the queue fill level drops below 50 percent.

Drop Profile Parameters

You can specify the following two values in drop profile configuration:

- Fill level—The queue fullness value, which represents a percentage of the memory used to store packets in relation to the total amount of memory allocated to the queue.
- Drop probability—The percentage value that corresponds to the likelihood that an individual packet is dropped.

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Example: Configuring CoS on EX Series Switches on page 39
- Configuring CoS Congestion Management (CLI Procedure) on page 82

Understanding CoS Schedulers

You use class-of-service (CoS) schedulers to define the properties of output queues on Juniper Networks EX Series Ethernet Switches. These properties include the amount of interface bandwidth assigned to the queue, the size of the memory buffer allocated for storing packets, the priority of the queue, and the drop profiles associated with the queue.

You associate the schedulers with forwarding classes by means of scheduler maps. You can then associate each scheduler map with an interface, thereby configuring the queues, packet schedulers, and tail drop processes that operate according to this mapping.

This topic describes:

Default Schedulers

Each forwarding class has an associated scheduler priority. On EX Series switches other than Juniper Networks EX8200 and Juniper Networks EX4300 Ethernet Switches, only two forwarding classes—best-effort (queue 0) and network-control (queue 7)—are used in the default configuration. On EX8200 switches three forwarding classes—best-effort (queue 0), multicast best-effort (queue 2), and network-control (queue 7)—are used in the default configuration.

On EX Series switches other than EX8200 and EX4300 switches, by default, the best-effort forwarding class (queue 0) receives 95 percent of the bandwidth and the buffer space for the output link, and the network-control forwarding class (queue 7) receives 5 percent. The default drop profile causes the buffer to fill completely and then to discard all incoming packets until it has free space. On EX8200 switches, by default, the best-effort forwarding class (queue 0) receives 75 percent of the bandwidth, the multicast best-effort forwarding class (queue 2) receives 20 percent, and the network-control forwarding class (queue 7) receives 5 percent of the bandwidth and buffer space for the output link.

On EX4300 switches, four forwarding classes—best-effort (queue 0), multicast best-effort (queue 8), network-control (queue 3), and multicast network-control (queue 11)—are used in the default configuration. By default, all the multicast traffic flows through the multicast best-effort queue. EX4300 switches support 12 queues (0–11), and the default scheduler transmission rates for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available bandwidth.

On EX Series switches other than EX4300 switches, the expedited-forwarding (queue 5) and assured-forwarding (queue 1) classes have no scheduler because no resources are assigned to queue 5 or queue 1, by default. However, you can manually configure resources to be assigned to the expedited-forwarding and assured-forwarding classes. On EX4300 switches, the expedited-forwarding (queue 1) and assured-forwarding (queue 2) classes have no scheduler because no resources are assigned to queue 1 or queue 2, by default. However, you can manually configure resources to be assigned to the expedited-forwarding and assured-forwarding classes.

Also by default, any queue can exceed the assigned bandwidth if additional bandwidth is available from other queues. When a forwarding class does not fully use the allocated transmission bandwidth, the remaining bandwidth can be used by other forwarding classes if they have a traffic load that exceeds their allocated bandwidth.

Excess Rate

Excess rate traffic determines the percentage of the excess bandwidth to share when a queue receives traffic in excess of its bandwidth allocation. By default, the excess bandwidth is shared in the ratio of the transmit rates. You can control this distribution by configuring the **excess-rate** statement at the **[edit class-of-service schedulers *scheduler-name*]** hierarchy. You can specify the excess rate sharing in percentage.

Transmission Rate

Transmission-rate control determines the actual traffic bandwidth for each forwarding class you configure. The transmission rate is specified in bits per second. Each queue is allocated some portion of the bandwidth of the interface. This bandwidth can be a fixed value, such as 1 megabit per second (Mbps), a percentage of the total available bandwidth, or the rest of the available bandwidth. In case of congestion, the configured transmission rate is guaranteed for the queue. Transmission-rate control allows you to ensure that each queue receives the bandwidth appropriate for its level of service.

Scheduler Buffer Size

To control congestion at the output stage, you can configure the delay-buffer bandwidth by using the buffer-size configuration statement. The delay-buffer bandwidth provides packet buffer space to absorb burst traffic up to the specified duration of delay. When the specified delay buffer becomes full, packets with 100 percent drop probability are dropped from the tail of the buffer.

On EX Series switches other than EX8200 and EX4300 switches, the default scheduler transmission rates for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent, respectively, of the total available bandwidth. The default buffer-size percentages for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent, respectively, of the total available buffer. On EX8200 switches, the default scheduler transmission rates for queues 0 through 7 are 75, 0, 20, 0, 0, 0, 0, and 5 percent, respectively, of the total available bandwidth, and the default buffer-size percentages for queues 0 through 7 are 75, 0, 20, 0, 0, 0, 0, and 5 percent, respectively, of the total available buffer. On EX4300 switches, the default scheduler transmission rates for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available buffer. On EX4300 switches,

the default buffer-size percentages for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available buffer.

For each scheduler on EX Series switches other than EX8200 switches, you can configure the buffer size as one of the following:

- The exact buffer size.
- A percentage of the total buffer.
- The remaining buffer available. The remainder is the buffer percentage that is not assigned to other queues. For example, if you assign 40 percent of the delay buffer to queue 0, allow queue 2 to keep the default allotment of 20 percent, allow queue 7 to keep the default allotment of 5 percent, and assign the remainder to queue 3, then queue 3 uses 35 percent of the delay buffer.

On EX8200 switches, you can configure the buffer size as a temporal value (in microseconds), percentage of the total buffer, or the remaining buffer available. You can configure the buffer size as a temporal value on Juniper Networks EX4200 and EX4300 Ethernet Switches also.

When you configure buffer size as a temporal value on EX4200 switches, if sufficient buffer size is not available in the shared pool, an error message is logged in the system log (syslog) file and the default profile is applied to the interface. After the temporal buffer space is allocated successfully, if the shared buffer size is less than the current value (which was set using the **set class-of-service shared-buffer percent *value*** command), the new reduced value must be greater than a sum of the existing reserved temporal buffer size and the required minimum buffer size. Otherwise, the modification to the shared-buffer configuration fails and an error message is logged in the system log.

Priority Scheduling

Priority scheduling determines the order in which an interface transmits traffic from queues, thus ensuring that queues containing important traffic are provided faster access.

Priority scheduling is accomplished through a procedure in which the scheduler examines the priority of the queue. Juniper Networks Junos operating system (Junos OS) supports two levels of transmission priority:

- Low—The scheduler determines whether the individual queue is within its defined bandwidth profile or not. This binary decision, which is re-evaluated on a regular time cycle, involves comparing the amount of data transmitted by the queue against the bandwidth allocated to it by the scheduler. If the transmitted amount is less than the allocated amount, the queue is considered to be in profile. A queue is out of profile when the amount of traffic that it transmits is larger than the queue's allocated limit. An out-of-profile queue is transmitted only if bandwidth is available. Otherwise, it is buffered.

  On EX Series switches other than EX4300 switches, a queue from a set of queues is selected based on the shaped deficit weighted round robin (SDWRR) algorithm, which operates within the set. On EX4300 switches, the weighted deficit round-robin (WDRR) algorithm is used to select a queue from a set of queues.

- Strict-high—A strict-high priority queue receives preferential treatment over a low-priority queue. Unlimited bandwidth is assigned to a strict-high priority queue. On EX Series switches other than EX4300 switches, queues are scheduled according to the queue number, starting with the highest queue, 7, with decreasing priority down through queue 0. Traffic in higher-numbered queues is always scheduled prior to traffic in lower-numbered queues. In other words, if there are two high-priority queues, the queue with the higher queue number is processed first. On EX4300 switches, you can configure multiple strict-high priority queues on an interface and an EX4300 switch processes these queues in a round-robin method.

Packets in low-priority queues are transmitted only when strict-high priority queues are empty.

Scheduler Drop-Profile Maps

Drop-profile maps associate drop profiles with a scheduler. A drop-profile map sets the drop profile for a specific packet loss priority (PLP) and protocol type. The inputs for a drop-profile map are the PLP and the protocol type. The output is the drop profile.

Scheduler Maps

A scheduler map associates a specified forwarding class with a scheduler configuration. After configuring a scheduler, you must include it in a scheduler map and then associate the scheduler map with an output interface.

On EX Series switches, if you configure more than the supported number of scheduler maps on a switch or for a port group in a line card, an error is logged in the system log. On any interface in a port group on a line card or on a switch, if you configure a scheduler map that causes the number of scheduler maps for that port group to exceed the maximum number supported, the default scheduler map is bound to that interface. We recommend that you check the system log for errors after the commit operation to verify that you have not configured more than the maximum permitted number of scheduler maps.

NOTE: **On EX Series switches, you cannot configure a scheduler map on an individual interface that is a member of a link aggregation group (LAG). Instead, you must configure the scheduler map on the LAG itself (that is, on the aggregated Ethernet (ae) interface).**

Table 8 on page 25 shows the number of scheduler maps supported for each port group in a switch or line card.

Table 8: Support for Scheduler Maps on Switches and Line Cards

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX2200-C-12T and EX2200-C-12P switches	1	Port 0–11 and 2 uplink ports form a port group.	6

Table 8: Support for Scheduler Maps on Switches and Line Cards *(continued)*

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX2200-24T and EX2200-24P switches	1	Ports 0–23 and 4 SFP uplink ports form a port group.	5
EX2200-48T and EX2200-48P switches	2	• Ports 0–23 and SFP uplink ports 0 and 1 form a port group. • Ports 24–47 and SFP uplink ports 2 and 3 form a port group.	5
EX3200-24T and EX3200-24P switches	1	• Ports 0–23 and the uplink ports form a port group. NOTE: Uplink ports include 2 SFP+ or XFP uplink ports, or 4 SFP uplink ports.	4
EX3200-24T and EX3200-24P switches	1	• Ports 0–23 and the uplink ports form a port group. NOTE: Uplink ports include 2 SFP+ or XFP uplink ports or 4 SFP uplink ports.	4
EX3200-48T and EX3200-48P switches	2	• Ports 0-23 and 1 SFP+ or XFP uplink port or 4 SFP uplink ports form a port group. • Ports 24–47 and 1 SFP+ or XFP uplink port form a port group.	4
EX4200-48T and EX4200-48P switches	3	• Ports 0–23 form a port group. • Ports 24–47 form a port group. • 2 SFP+ or XFP uplink ports or 4 SFP uplink ports form a port group.	4
EX4200-24T and EX4200-24P switches	2	• Ports 0–23 form a port group. • 2 SFP+ or XFP uplink ports or 4 SFP uplink ports form a port group.	4
EX4300-24Tand EX4300-24P switches	1	• Ports 0–23 ports, 4 uplink ports, and 4 ports on the real panel form a port group. NOTE: Uplink ports in the front panel contains SFP or SFP+ ports 0–3, and uplink ports in the rear panel contains QSFP+ ports 0–3.	64

Table 8: Support for Scheduler Maps on Switches and Line Cards *(continued)*

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX4300-48T and EX4300-48P switches	1	• Ports 0–47, 4 uplink ports, and 4 ports on the real panel form a port group. NOTE: Uplink ports in the front panel contains SFP or SFP+ ports 0–3, and uplink ports in the rear panel contains QSFP+ ports 0–3.	64
EX4500-40F switch	2	• SFP or SFP+ ports 0–19 and the first SFP or SFP+ port 0–4 form a port group. • SFP or SFP+ ports 20–39 and the second SFP or SFP+ uplink port 0–4 form a port group.	4
EX4550-32F switch	1	• SFP or SFP+ ports 0–31 and the uplink ports in the front and rear panels form a port group. NOTE: Uplink ports in the front panel contains SFP, SFP+, or RJ-45 ports 0–7, and uplink ports in the rear panel contains SFP, SFP+, or RJ-45 ports 0–7.	5
EX6200-48T (48-port RJ-45) and EX6200-48P (48-port PoE+) line cards	2	• Ports 0–23 form a port group. • Ports 24–47 form a port group.	5
EX6200-SRE64-4XS	1	SFP+ ports 0–3 form a port group.	4
EX8200-8XS (8-port SFP+) line card	4	• SFP+ ports 0 and 1 form a port group. • SFP+ ports 2 and 3 form a port group. • SFP+ ports 4 and 5 form a port group. • SFP+ ports 6 and 7 form a port group.	6

Table 8: Support for Scheduler Maps on Switches and Line Cards *(continued)*

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX8200-40XS (40-port SFP+) line card	8	• SFP+ ports 0–4 form a port group. • SFP+ ports 5–9 form a port group. • SFP+ ports 10–14 form a port group. • SFP+ ports 15–19 form a port group. • SFP+ ports 20–24 form a port group. • SFP+ ports 25–29 form a port group. • SFP+ ports 30–34 form a port group. • SFP+ ports 35–39 form a port group.	6
EX8200-48-F (48-port SFP) and EX8200-48T (48-port RJ-45) line cards	2	• SFP or RJ-45 ports 0–23 form a port group. • SFP or RJ-45 ports 24–47 form a port group.	6
EX8200-2XS-40P (40-port PoE+ with 4-port SFP and 2-port SFP+) line card	3	• Ports 0–19 and SFP ports 0 and 1 form a port group. • Ports 20–39 and SFP ports 2 and 3 form a port group.	5
		• 2 SFP+ ports form a port group.	6
EX8200-2XS-40T (40-port RJ-45 with 4-port SFP and 2-port SFP+) line card	3	• Ports 0–19, and SFP ports 0 and 1 form a port group. • Ports 20–39 and SFP ports 2 and 3 form a port group.	5
		• 2 SFP+ ports form a port group.	6
EX8200-48PL (48-port PoE+ 20 Gbps) and EX8200-48TL (48-port RJ-45 20 Gbps) line cards	2	• PoE+ or RJ-45 ports 0–23 form a port group. • PoE+ or RJ-45 ports 24–47 form a port group.	5

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75

- Defining CoS Schedulers (J-Web Procedure) on page 77

Understanding CoS Two-Color Marking

Networks police traffic by limiting the input or output transmission rate of a class of traffic on the basis of user-defined criteria. Policing traffic allows you to control the maximum rate of traffic sent or received on an interface and to partition a network into multiple priority levels or classes of service.

Policers require you to apply limits to the traffic flow and set a consequence for packets that exceed these limits—usually a higher loss priority, so that packets exceeding the policer limits are discarded first.

Juniper Networks EX Series Ethernet Switches support a single-rate two-color marking type of policer, which is a simplified version of Single-Rate-Three-Color marking, defined in RFC 2697, *A Single Rate Three Color Marker*. This type of policer meters traffic based on the configured committed information rate (CIR) and committed burst size (CBS).

The single-rate two-color marker meters traffic and marks incoming packets depending on whether they are smaller than the committed burst size (CBS)—marked green—or exceed it— marked red.

The single-rate two-color marking policer operates in color-blind mode. In this mode, the policer's actions are not affected by any previous marking or metering of the examined packets. In other words, the policer is “blind? to any previous coloring a packet might have had.

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- *Understanding the Use of Policers in Firewall Filters*
- *Configuring Policers to Control Traffic Rates (CLI Procedure)*

Understanding CoS Rewrite Rules

As packets enter or exit a network, edge switches might be required to alter the class-of-service (CoS) settings of the packets. This topic describes how to use rewrite rules to alter the CoS settings. It covers:

This topic covers:

- How Rewrite Rules Work on page 29
- Default Rewrite Rule on page 30

How Rewrite Rules Work

Rewrite rules set the value of the CoS bits within a packet’s header. Each rewrite rule reads the current forwarding class and loss priority associated with the packet, locates the chosen CoS value from a table, and writes this CoS value into the packet header. For rewrites to occur, rewrite rules must be explicitly assigned to an interface.

On EX Series switches, you can define rewrite rules for IPv4 and IPv6 traffic to network interfaces, aggregated Ethernet interfaces (also known as link aggregation groups (LAGs)), routed VLAN interfaces (RVIs), Layer 3 interfaces, and Layer 3 VLAN-tagged sub-interfaces. Multiple rewrite rules of different types can be assigned to a single interface.

On EX4300 switches, you cannot configure separate DSCPv4 and DSCPv6 rewrite rules on network interfaces, aggregated Ethernet interfaces, Layer 3 interfaces, and integrated routing and bridging (IRB) interfaces. If you configure a DSCPv4 rewrite rule on an interface to rewrite IPv4 traffic, then the same rewrite rule is applied to IPv6 traffic also on that interface, and vice versa. You can define only DSCPv4 rewrite rules on integrated routing and bridging (IRB) interfaces and Layer 3 VLAN-tagged logical interfaces.

In effect, the rewrite rule performs the reverse function of the behavior aggregate (BA) classifier, which is used when the packet enters the switch. As the packet leaves the switch, the final CoS action is generally the application of a rewrite rule.

You configure rewrite rules to alter CoS values in outgoing packets on the outbound interfaces of an edge switch to meet the policies of a targeted peer. This allows the downstream switch in a neighboring network to classify each packet into the appropriate service group.

NOTE: **When an IP precedence rewrite rule is active, bits 3, 4, and 5 of the type-of-service (ToS) byte are always reset to zero when code points are rewritten.**

Default Rewrite Rule

To define a rewrite rule on an interface, you can either create your own rewrite rule and enable it on the interface or enable a default rewrite rule. See "Defining CoS Rewrite Rules (CLI Procedure)" on page 86.

Table 9 on page 31 shows the default rewrite-rule mappings. These are based on the default bit definitions of Differentiated Services code point (DSCP), IEEE 802.1p, and IP precedence values and the default forwarding classes. You can configure multiple CoS rewrite rules for DSCP, IP precedence and IEEE 802.1p.

NOTE: **By default, rewrite rules are not assigned to an interface. You must explicitly assign a user-defined or system-defined rewrite rule to an interface for the rewrites to occur.**

When the CoS values of a packet match the forwarding class and packet-loss-priority (PLP) values, the switch rewrites markings on the packet based on the rewrite table.

Table 9: Default Packet Header Rewrite Mappings

Map from Forwarding Class	PLP Value	Map to DSCP/IEEE 802.1p/IP Precedence Value
expedited-forwarding	low	ef
expedited-forwarding	high	ef
assured-forwarding	low	af11
assured-forwarding	high	af12 (DSCP)
best-effort	low	be
best-effort	high	be
network-control	low	nc1/cs6
network-control	high	nc2/cs7

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Rewrite Rules (CLI Procedure) on page 86
- Defining CoS Rewrite Rules (J-Web Procedure) on page 87

Understanding Port Shaping and Queue Shaping for CoS on EX Series Switches

When the amount of traffic on a switch's network exceeds the maximum bandwidth, packets are lost because of congestion in the network. The excess traffic in the network must be handled carefully to ensure minimum or no data loss in the network. A class-of-service (CoS) configuration includes several parameters that classify traffic into different queues and also define packet loss priorities (PLPs) to ensure smooth transmission of data in the network. You can use these configuration parameters to control or shape traffic for a specific port on a switch or for a specific CoS queue. While port shaping defines the maximum bandwidth allocated to an interface, queue shaping defines a limit on excess-bandwidth usage for each queue.

This topic covers:

- Port Shaping on page 31
- Queue Shaping on page 32

Port Shaping

Port shaping enables you to shape the aggregate traffic through a port or channel to a rate that is less than the line rate. You can configure interfaces to shape traffic based on the rate-limited bandwidth of the total interface bandwidth. This allows you to shape

the output of the interface so that the interface transmits less traffic than it is capable of transmitting. For port shaping, you can specify shaping rate as the peak rate at which traffic can pass through the interface. You can specify rate as a value in bits per second (bps) either as a decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000) and the value can range from 1000 through 160,000,000,000 bps.

By default, shaping is not configured on an interface. If you do not configure a shaping rate on an interface, the default shaping rate is 100 percent, which is the equivalent to no shaping configured for that interface.

On EX Series switches except EX4300 switches, when you configure a shaping rate on an aggregated Ethernet (ae) interface, all members of the ae interface are shaped at the configured shaping rate. For example, consider an interface ae0 that consists of three interfaces: ge-0/0/0, ge-0/0/1, and ge-0/0/2. If a shaping rate of X Mpbs is configured on ae0, traffic at the rate of X Mpbs flows through each of the three interfaces. Therefore, the total traffic flowing through ae0 would be at the rate of 3X Mbps. On EX4300 switches, when you configure a shaping rate on an ae interface, the traffic is equally divided among the members of the ae interface.

Queue Shaping

Queue shaping throttles the rate at which queues transmit packets. For example, using queue shaping, you can rate-limit a strict-priority queue so that the strict-priority queue does not lock out (or starve) low-priority queues. Similarly, for any queue, you can configure queue shaping.

You can specify queue shaping as the maximum rate at which traffic can pass through the queue or as a percentage of the available bandwidth. On EX Series switches except EX4300 switches, you can specify the rate as a value between 3200 and 160,000,000,000 bps and the percentage as a value from 0 to 100 percent. On EX4300 switches, you can specify the rate as a value between 8000 and 160,000,000,000 bps and the percentage as a value from 0 to 100 percent.

Related Documentation

- Understanding CoS Schedulers on page 22
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75

Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches

Junos operating system (Junos OS) EZQoS on Juniper Networks EX Series Ethernet Switches eliminates the complexities involved in configuring class of service (CoS) across the network. EZQoS offers templates for key traffic classes.

Junos OS CoS allows you to divide traffic into classes and offer various levels of throughput and packet loss when congestion occurs. You can use CoS to ensure that different types of traffic (voice, video, and data) get the bandwidth and consideration they need to meet user expectations and business objectives.

Configuring CoS requires careful consideration of your service needs and thorough planning and design to ensure consistency across all switches in a CoS domain. To configure CoS

manually, you must define and fine-tune all CoS components such as classifiers, rewrite rules, forwarding classes, schedulers, and scheduler-maps and then apply these components to the interfaces. Therefore, configuring CoS can be a fairly complex and time-consuming task.

EZQoS works by automatically assigning preconfigured values to all CoS parameters based on the typical application requirements. These preconfigured values are stored in a template with a unique name. You can change the preconfigured values of these parameters to suit your particular application needs.

For using EZQoS, you must identify which switch ports are being used for a specific application (such as VoIP, video, and data) and manually apply the corresponding application-specific EZQoS template to these switch ports.

NOTE: Currently, we provide an EZQoS template for configuring CoS for VoIP.

NOTE: We recommend that you do not use the term EZQoS for defining a classifier.

Related Documentation

- Junos OS CoS for EX Series Switches Overview on page 4
- Configuring Junos OS EZQoS for CoS (CLI Procedure) on page 92

Understanding CoS Queues on EX8200 Line Cards That Include Oversubscribed Ports

Some line cards available for Juniper Networks EX8200 Ethernet Switches include oversubscribed ports that are combined in logical port groups that share bandwidth. These oversubscribed ports handle traffic differently than ports that provide continuous line-rate bandwidth. You might need to configure CoS queues differently for oversubscribed ports than for line-rate ports.

This topic describes:

- Oversubscribed Ports on Line Cards on page 33
- EX8200 Line Cards That Include Oversubscribed Ports on page 34
- Ingress Queueing on page 34
- Egress Queues on page 36

Oversubscribed Ports on Line Cards

Oversubscribed ports on a line card are grouped into logical port groups. A port group collectively supports a certain bandwidth.

An EX8200 switch supports different line cards that provide line-rate and oversubscribed ports. Based on your requirement, you can choose the appropriate line card for an EX8200 switch. Line cards are field-replaceable units (FRUs) that can be installed in the line card

slots in an EX8200 switch. In a line-rate EX8200 line card, each port in the line card supports the same amount of bandwidth and a single port can utilize that complete bandwidth. In an oversubscribed line card, a group of ports collectively support a certain total bandwidth and each port in that group can use either a portion or all of the available bandwidth. However, the total utilization of bandwidth by the ports in the group cannot exceed the bandwidth available for that group.

Because the port groups share bandwidth, class-of-service (CoS) ingress and egress queues are handled differently for these shared-bandwidth ports in logical port groups than they are for ports that individually support line-rate bandwidth. Some EX8200 line cards combine both port types, those that share bandwidth across port groups and those that individually support line-rate bandwidth.

EX8200 Line Cards That Include Oversubscribed Ports

Table 10 on page 34 lists EX8200 line cards that include oversubscribed ports in logical port groups.

Table 10: EX8200 Line Cards That Include Oversubscribed Ports

Line Card Model	Name	Number of Oversubscribed Ports/Port Connector
EX8200-40XS	40-port SFP+	40 oversubscribed 10-gigabit SFP+ ports
EX8200-2XS-40P	40-port PoE+ with 4-port SFP and 2-port SFP+	40 oversubscribed 10/100/1000 Gigabit Ethernet ports with RJ-45 connectors, four small form-factor pluggable (SFP) ports (in which you can install 1-gigabit SFP transceivers) and two SFP+ ports
EX8200-2XS-40T	40-port RJ-45 with 4-port SFP and 2-port SFP+	40 oversubscribed 10/100/1000 Gigabit Ethernet ports with RJ-45 connectors, four SFP ports (in which you can install 1-gigabit small form-factor pluggable (SFP) transceivers) and two SFP+ ports
EX8200-48PL	48-port PoE+ 20 Gbps	48 oversubscribed 10/100/1000 Gigabit Ethernet ports with RJ-45 connectors
EX8200-48TL	48-port RJ-45 20 Gbps	48 oversubscribed 10/100/1000 Gigabit Ethernet ports with RJ-45 connectors

Ingress Queueing

Classification of packets occurs in two phases for the oversubscribed ports in the port groups.

- Preclassification of Packets and Port Ingress Queuing on page 35
- Full Classification of Packets and Fabric Ingress Queuing on page 35

Preclassification of Packets and Port Ingress Queuing

Packets entering ports are forwarded to one of the ingress queues. The ingress queues schedule traffic from ports into the Packet Forwarding Engine.

The ingress queues are:

- Low-priority queue—Each interface in the line card has one low-priority queue. Traffic on these queues is scheduled using the shaped deficit weighted round-robin (SDWRR) algorithm, with each interface's queue having equal weight. On EX4300 switches, traffic is queued using the weighted deficit round-robin (WDRR) algorithm.
- High-priority queue—A set of interfaces in the line card shares a single high-priority queue. Traffic on this queue is scheduled by strict-high priority. The switch always sends critical network control packets on the high-priority queue.
- Line-rate priority queue—The packets entering line-rate ports are forwarded to this queue. Traffic on this queue is scheduled by strict priority and is always given higher priority than the traffic on the high-priority queue. This queue is used only in the following oversubscribed lines cards for an EX8200 switch:
  - EX8200-2XS-40P
  - EX8200-2XS-40T

For the purpose of port ingress queuing on oversubscribed ports, packets are classified only by behavior aggregate (BA) classification. To control the ingress queue (high priority or low priority) to which packets are sent, configure a BA classifier on the physical port and specify switch fabric priorities for the forwarding classes. On EX8200 switches, fabric priority determines the priority of packets ingressing the switch fabric. For the EX8200-40XS line card, fabric priority also determines the priority of packets ingressing the port group.

By default, the fabric priority for all forwarding classes is low. To direct packets belonging to a forwarding class to the high-priority ingress queue, set the fabric priority to high for that class.

Critical network-control packets and line-rate packets are handled differently from other packets. Instead of using the BA classifier to classify critical network-control packets, the switch always sends critical network packets to the high-priority queue. The line-rate packets are always sent to the line-rate priority queue. This difference in handling of network-control packets and line-rate packets ensures that these packets are not dropped because of congestion on the shared-bandwidth ports.

Full Classification of Packets and Fabric Ingress Queuing

When packets (apart from line-rate and critical network-control packets) from an oversubscribed port reach the Packet Forwarding Engine, it performs full packet classification, along with other actions, such as multifield (MF) classification, traffic policing, and storm control. It then schedules and queues the packets for ingressing the fabric. The fabric priority associated with the forwarding class determines whether packets are sent to the low priority or high-priority ingress queues.

Egress Queues

On EX Series switches except EX4300 switches, each interface supports eight egress CoS queues. You can map up to 16 forwarding classes to these queues. An EX4300 switch interface supports 12 egress CoS queues.

In the EX8200-40XS line card, all interfaces in a port group share a single set of eight egress queues at the Packet Forwarding Engine. Egress traffic is fanned out from the Packet Forwarding Engine queues to the corresponding queues for the individual ports. For this reason, the interfaces in a port group must share the same scheduler map configuration. If you configure different scheduler map configurations for the different interfaces in a port group, an error is logged in the system log and the default scheduler map is used for all ports in the port group.

Related Documentation

- Understanding Junos OS CoS Components for EX Series Switches on page 6
- Understanding CoS Schedulers on page 22
- *Understanding CoS Forwarding Classes*
- Example: Configuring CoS on EX Series Switches on page 39
- Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards (CLI Procedure) on page 93

PART 2

Configuration

CHAPTER 2

Configuration Examples

Example: Configuring CoS on EX Series Switches

Configure class of service (CoS) on your switch to manage traffic so that when the network experiences congestion and delay, critical applications are protected. Using CoS, you can divide traffic on your switch into classes and provide various levels of throughput and packet loss. This is especially important for traffic that is sensitive to jitter and delay, such as voice traffic.

This example shows how to configure CoS on a single EX Series switch in the network.

Requirements

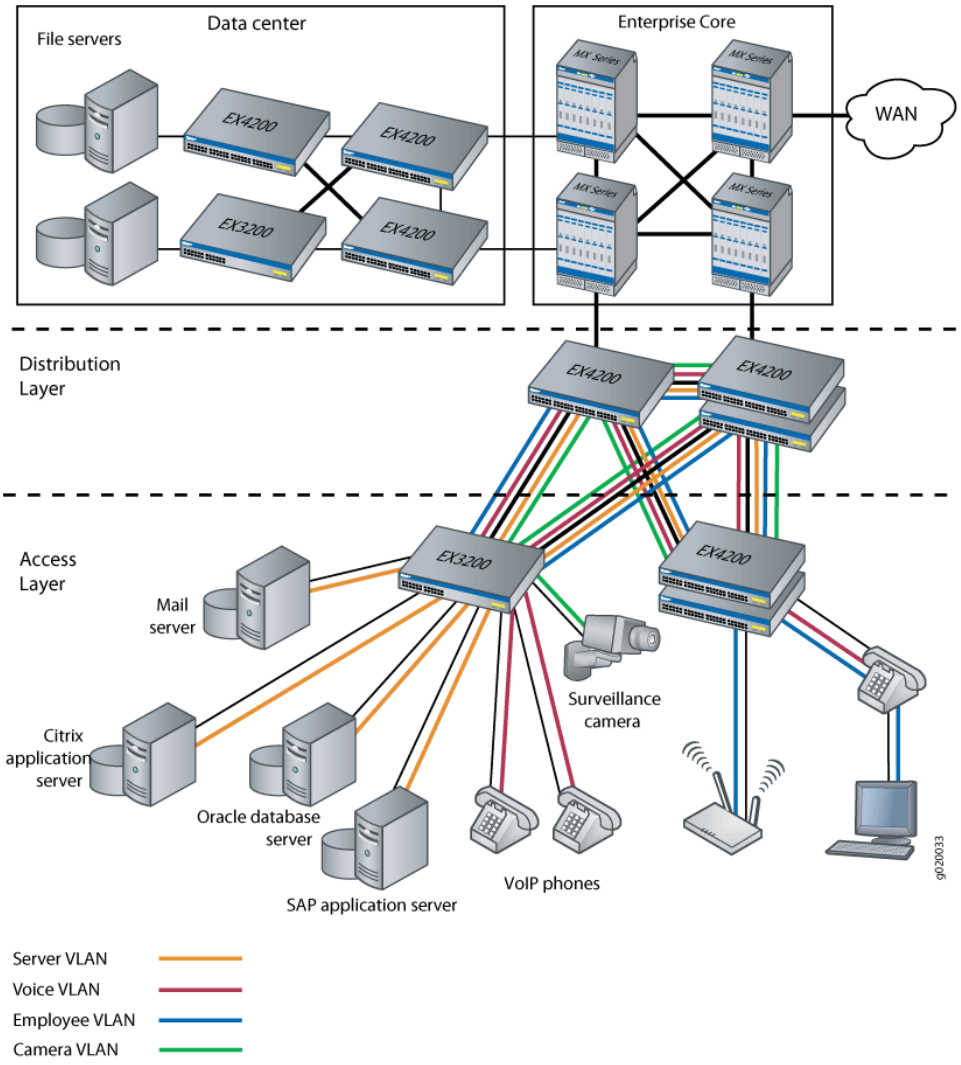
This example uses the following hardware and software components:

- EX3200 and EX4200 switches
- Junos OS Release 9.0 or later for EX Series switches

Overview and Topology

This example uses the topology shown in Figure 5 on page 40.

Figure 5: Topology for Configuring CoS



The topology for this configuration example consists of EX3200 and EX4200 switches at the access layer.

The EX Series access switch is configured to support VLAN membership. Interfaces **ge-0/0/0** and **ge-0/0/1** are assigned to the voice VLAN (**voice-vlan**) for two VoIP phones. Switch port **ge-0/0/2** is assigned to the camera VLAN (**camera-vlan**) for the surveillance camera. Switch ports **ge-0/0/3**, **ge-0/0/4**, **ge-0/0/5**, and **ge-0/0/6** are assigned to the server VLAN (**server-vlan**) for the servers hosting various applications such as those provided by Citrix, Microsoft, Oracle, and SAP.

Table 11 on page 41 shows the VLAN configuration components.

Table 11: Configuration Components: VLANs

VLAN Name	VLAN ID	VLAN Subnet and Available IP Addresses	VLAN Description
voice-vlan	10	**192.168.1.0/28** **192.168.1.1** through **192.168.1.14** **192.168.1.15** is the subnet's broadcast address.	Voice VLAN used for employee VoIP communication.
camera-vlan	20	**192.168.1.16/28** **192.168.1.17** through **192.168.1.30** **192.168.1.31** is the subnet's broadcast address.	VLAN for the surveillance cameras.
server-vlan	30	**192.168.1.32/28** **192.168.1.33** through **192.168.1.46** **192.168.1.47** is the subnet's broadcast address.	VLAN for the servers hosting enterprise applications.

PoE-capable ports on EX Series switches support Power over Ethernet (PoE) to provide both network connectivity and power for VoIP telephones connecting to the ports. Table 12 on page 41 shows the switch interfaces that are assigned to the VLANs and the IP addresses for devices connected to the switch ports on a 48-port switch, all ports of which are PoE-capable.

Table 12: Configuration Components: Switch Ports on a 48-Port All-PoE Switch

Interfaces	VLAN Membership	IP Addresses	Port Devices
ge-0/0/0, **ge-0/0/1**	**voice-vlan**	**192.168.1.1/28** through **192.168.1.2/28**	Two VoIP telephones.
ge-0/0/2	**camera-vlan**	**192.168.1.17/28**	Surveillance camera.
ge-0/0/3, **ge-0/0/4**, **ge-0/0/5**, **ge-0/0/6**	**server-vlan**	**192.168.1.33/28** through **192.168.1.36/28**	Four servers hosting applications such as those provided by Citrix, Microsoft, Oracle, and SAP.

NOTE: This example shows how to configure CoS on a standalone EX Series switch. This example does not consider across-the-network applications of CoS in which you might implement different configurations on ingress and egress switches to provide differentiated treatment to different classes across a set of nodes in a network.

Configuration

CLI Quick Configuration

To quickly configure CoS, copy the following commands and paste them into the switch terminal window:

```
[edit]
set class-of-service forwarding-classes class app queue-num 5
set class-of-service forwarding-classes class mail queue-num 1
set class-of-service forwarding-classes class db queue-num 2
set class-of-service forwarding-classes class erp queue-num 3
set class-of-service forwarding-classes class video queue-num 4
set class-of-service forwarding-classes class best-effort queue-num 0
set class-of-service forwarding-classes class voice queue-num 6
set class-of-service forwarding-classes class network-control queue-num 7
set firewall family ethernet-switching filter voip_class term voip from source-address 192.168.1.1/28
set firewall family ethernet-switching filter voip_class term voip from source-address 192.168.1.2/28
set firewall family ethernet-switching filter voip_class term voip from protocol udp
set firewall family ethernet-switching filter voip_class term voip from source-port 2698
set firewall family ethernet-switching filter voip_class term voip then forwarding-class voice
loss-priority low
set firewall family ethernet-switching filter voip_class term network_control from precedence
[net-control internet-control]
set firewall family ethernet-switching filter voip_class term network_control then forwarding-class
network-control loss-priority low
set firewall family ethernet-switching filter voip_class term best_effort_traffic then
forwarding-class best-effort loss-priority low
set interfaces ge-0/0/0 description phone1—voip-ingress-port
set interfaces ge-0/0/0 unit 0 family ethernet-switching filter input voip_class
set class-of-service interfaces ge-0/0/0 shaping-rate 100m
set interfaces ge-0/0/1 description phone2—voip-ingress-port
set interfaces ge-0/0/1 unit 0 family ethernet-switching filter input voip_class
set firewall family ethernet-switching filter video_class term video from source-address
192.168.1.17/28
set firewall family ethernet-switching filter video_class term video from protocol udp
set firewall family ethernet-switching filter video_class term video from source-port 2979
set firewall family ethernet-switching filter video_class term video then forwarding-class video
loss-priority low
set firewall family ethernet-switching filter video_class term network_control from precedence
[net-control internet-control]
set firewall family ethernet-switching filter video_class term network_control then forwarding-class
network-control loss-priority low
set firewall family ethernet-switching filter video_class term best_effort_traffic then
forwarding-class best-effort loss-priority low
set interfaces ge-0/0/2 description video-ingress-port
set interfaces ge-0/0/2 unit 0 family ethernet-switching filter input video_class
set firewall family ethernet-switching filter app_class term app from source-address
192.168.1.33/28
set firewall family ethernet-switching filter app_class term app from protocol tcp
set firewall family ethernet-switching filter app_class term app from source-port [1494 2512 2513
2598 2897]
set firewall family ethernet-switching filter app_class term app then forwarding-class app
loss-priority low
set firewall family ethernet-switching filter app_class term mail from source-address
192.168.1.34/28
set firewall family ethernet-switching filter app_class term mail from protocol tcp
set firewall family ethernet-switching filter app_class term mail from source-port [25 143 389
691 993 3268 3269]
set firewall family ethernet-switching filter app_class term mail then forwarding-class mail
loss-priority low
```

```
set firewall family ethernet-switching filter app_class term db from source-address 192.168.1.35/28
set firewall family ethernet-switching filter app_class term db from protocol tcp
set firewall family ethernet-switching filter app_class term db from source-port [1521 1525 1527
1571 1810 2481]
set firewall family ethernet-switching filter app_class term db then forwarding-class db loss-priority
low
set firewall family ethernet-switching filter app_class term erp from source-address 192.168.1.36/28
set firewall family ethernet-switching filter app_class term erp from protocol tcp
set firewall family ethernet-switching filter app_class term erp from source-port [3200 3300
3301 3600]
set firewall family ethernet-switching filter app_class term erp then forwarding-class erp
loss-priority low
set firewall family ethernet-switching filter app_class term network_control from precedence
[net-control internet-control]
set firewall family ethernet-switching filter app_class term network_control then forwarding-class
network-control loss-priority low
set firewall family ethernet-switching filter app_class term best_effort_traffic then forwarding-class
best-effort loss-priority low
set interfaces ge-0/0/3 unit 0 family ethernet-switching filter input app_class
set interfaces ge-0/0/4 unit 0 family ethernet-switching filter input app_class
set interfaces ge-0/0/5 unit 0 family ethernet-switching filter input app_class
set interfaces ge-0/0/6 unit 0 family ethernet-switching filter input app_class
set class-of-service schedulers voice-sched buffer-size percent 10
set class-of-service schedulers voice-sched priority strict-high
set class-of-service schedulers voice-sched transmit-rate percent 10
set class-of-service schedulers video-sched buffer-size percent 15
set class-of-service schedulers video-sched priority low
set class-of-service schedulers video-sched transmit-rate percent 15
set class-of-service schedulers app-sched buffer-size percent 10
set class-of-service schedulers app-sched priority low
set class-of-service schedulers app-sched transmit-rate percent 10
set class-of-service schedulers mail-sched buffer-size percent 5
set class-of-service schedulers mail-sched priority low
set class-of-service schedulers mail-sched transmit-rate percent 5
set class-of-service schedulers db-sched buffer-size percent 10
set class-of-service schedulers db-sched priority low
set class-of-service schedulers db-sched transmit-rate percent 10
set class-of-service schedulers erp-sched buffer-size percent 10
set class-of-service schedulers erp-sched priority low
set class-of-service schedulers erp-sched transmit-rate percent 10
set class-of-service schedulers nc-sched buffer-size percent 5
set class-of-service schedulers nc-sched priority strict-high
set class-of-service schedulers nc-sched transmit-rate percent 5
set class-of-service schedulers be-sched buffer-size percent 35
set class-of-service schedulers be-sched priority low
set class-of-service schedulers be-sched transmit-rate percent 35
set class-of-service scheduler-maps ethernet-cos-map forwarding-class voice scheduler
voice-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class video scheduler
video-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class app scheduler app-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class mail scheduler mail-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class db scheduler db-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class erp scheduler erp-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class network-control
scheduler nc-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class best-effort scheduler
be-sched
set class-of-service interfaces ge-0/0/20 scheduler-map ethernet-cos-map
set class-of-service schedulers voice-sched-queue-shap shaping-rate 30m
```

```
set class-of-service scheduler-maps sched-map-be forwarding-class best-effort scheduler
voice-sched-queue-shap
set class-of-service interfaces ge-0/0/2 scheduler-map sched-map-be
```

Step-by-Step Procedure

To configure and apply CoS:

1. Configure one-to-one mappings between eight forwarding classes and eight queues:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class app queue-num 5
   user@switch# set forwarding-classes class mail queue-num 1
   user@switch# set forwarding-classes class db queue-num 2
   user@switch# set forwarding-classes class erp queue-num 3
   user@switch# set forwarding-classes class video queue-num 4
   user@switch# set forwarding-classes class best-effort queue-num 0
   user@switch# set forwarding-classes class voice queue-num 6
   user@switch# set forwarding-classes class network-control queue-num 7
   ```

2. Define the firewall filter **voip_class** to classify the VoIP traffic:

   ```
   [edit firewall]
   user@switch# set family ethernet-switching filter voip_class
   ```

3. Define the term **voip**:

   ```
   [edit firewall]
   user@switch# set family ethernet-switching filter voip_class term voip from source-address
   192.168.1.1/28
   user@switch# set family ethernet-switching filter voip_class term voip from source-address
   192.168.1.2/28
   user@switch# set family ethernet-switching filter voip_class term voip protocol udp
   user@switch# set family ethernet-switching filter voip_class term voip source-port 2698
   user@switch# set family ethernet-switching filter voip_class term voip then forwarding-class
   voice loss-priority low
   ```

4. Define the term **network_control** (for the **voip_class** filter):

   ```
   [edit firewall]
   user@switch# set family ethernet-switching filter voip_class term network_control from
   precedence [net-control internet-control]
   user@switch# set family ethernet-switching filter voip_class term network_control then
   forwarding-class network-control loss-priority low
   ```

5. Define the term **best_effort_traffic** with no match conditions (for the **voip_class** filter):

   ```
   [edit firewall]
   user@switch# set family ethernet-switching filter voip_class term best_effort_traffic then
   forwarding-class best-effort loss-priority low
   ```

6. Apply the firewall filter **voip_class** as an input filter to the interfaces for the VoIP phones:

   ```
   [edit interfaces]
   user@switch# set ge-0/0/0 description phone1-voip-ingress-port
   user@switch# set ge-0/0/0 unit 0 family ethernet-switching filter input voip_class
   user@switch# set ge-0/0/1 description phone2-voip-ingress-port
   user@switch# set ge-0/0/1 unit 0 family ethernet-switching filter input voip_class
   ```

7. Apply port shaping on the interface ge-0/0/0:

   ```
   [edit]
   user@switch# set class-of-service interfaces ge-0/0/0 shaping-rate 100m
   ```

8. Define the firewall filter **video_class** to classify the video traffic:

   ```
   [edit firewall]
   user@switch# set family ethernet-switching filter video_class
   ```

9. Define the term **video**:

```
[edit firewall]
user@switch# set family ethernet-switching filter video_class term video from
source-address 192.168.1.17/28
user@switch# set family ethernet-switching filter video_class term video protocol udp
user@switch# set family ethernet-switching filter video_class term video source-port 2979
user@switch# set family ethernet-switching filter video_class term video then
forwarding-class video loss-priority low
```

10. Define the term **network_control** (for the **video_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter video_class term network_control from
precedence [net-control internet-control]
user@switch# set family ethernet-switching filter video_class term network_control then
forwarding-class network-control loss-priority low
```

11. Define the term **best_effort_traffic** with no match conditions (for the **video_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter video_class term best_effort_traffic then
forwarding-class best-effort loss-priority low
```

12. Apply the firewall filter **video_class** as an input filter to the interface for the surveillance camera:

```
[edit interfaces]
user@switch# set ge-0/0/2 description video-ingress-port
user@switch# set ge-0/0/2 unit 0 family ethernet-switching filter input video_class
```

13. Define the firewall filter **app_class** to classify the application server traffic:

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class
```

14. Define the term **app** (for the **app_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term app from source-address
192.168.1.33/28
user@switch# set family ethernet-switching filter app_class term app protocol tcp
user@switch# set family ethernet-switching filter app_class term app source-port [1494
2512 2513 2598 2897]
user@switch# set family ethernet-switching filter app_class term app then forwarding-class
app loss-priority low
```

15. Define the term **mail** (for the **app_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term mail from source-address
192.168.1.34/28
user@switch# set family ethernet-switching filter app_class term mail protocol tcp
user@switch# set family ethernet-switching filter app_class term mail source-port [25 143
389 691 993 3268 3269]
user@switch# set family ethernet-switching filter app_class term mail then forwarding-class
mail loss-priority low
```

16. Define the term **db** (for the **app_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term db from source-address
192.168.1.35/28
user@switch# set family ethernet-switching filter app_class term db protocol tcp
user@switch# set family ethernet-switching filter app_class term db source-port [1521
1525 1527 1571 1810 2481]
```

```
user@switch# set family ethernet-switching filter app_class term db then forwarding-class
db loss-priority low
```

17. Define the term **erp** (for the **app_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term erp from source-address
192.168.1.36/28
user@switch# set family ethernet-switching filter app_class term erp protocol tcp
user@switch# set family ethernet-switching filter app_class term erp source-port [3200
3300 3301 3600]
user@switch# set family ethernet-switching filter app_class term erp then forwarding-class
erp loss-priority low
```

18. Define the term **network_control** (for the **app_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term network_control from
precedence [net-control internet-control]
user@switch# set family ethernet-switching filter app_class term network_control then
forwarding-class network-control loss-priority low
```

19. Define the term **best_effort_traffic** (for the **app_class** filter):

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term best_effort_traffic then
forwarding-class best-effort loss-priority low
```

20. Apply the firewall filter **app_class** as an input filter to the interfaces for the servers hosting applications:

```
[edit interfaces]
user@switch# set ge-0/0/3 unit 0 family ethernet-switching filter input app_class
user@switch# set ge-0/0/4 unit 0 family ethernet-switching filter input app_class
user@switch# set ge-0/0/5 unit 0 family ethernet-switching filter input app_class
user@switch# set ge-0/0/6 unit 0 family ethernet-switching filter input app_class
```

21. Configure schedulers:

```
[edit class-of-service]
user@switch# set schedulers voice-sched buffer-size percent 10
user@switch# set schedulers voice-sched priority strict-high
user@switch# set schedulers voice-sched transmit-rate percent 10
user@switch# set schedulers video-sched buffer-size percent 15
user@switch# set schedulers video-sched priority low
user@switch# set schedulers video-sched transmit-rate percent 15
user@switch# set schedulers app-sched buffer-size percent 10
user@switch# set schedulers app-sched priority low
user@switch# set schedulers app-sched transmit-rate percent 10
user@switch# set schedulers mail-sched buffer-size percent 5
user@switch# set schedulers mail-sched priority low
user@switch# set schedulers mail-sched transmit-rate percent 5
user@switch# set schedulers db-sched buffer-size percent 10
user@switch# set schedulers db-sched priority low
user@switch# set schedulers db-sched transmit-rate percent 10
user@switch# set schedulers erp-sched buffer-size percent 10
user@switch# set schedulers erp-sched priority low
user@switch# set schedulers erp-sched transmit-rate percent 10
user@switch# set schedulers nc-sched buffer-size percent 5
user@switch# set schedulers nc-sched priority strict-high
user@switch# set schedulers nc-sched transmit-rate percent 5
user@switch# set schedulers be-sched buffer-size percent 35
user@switch# set schedulers be-sched priority low
user@switch# set schedulers be-sched transmit-rate percent 35
```

22. Assign the forwarding classes to schedulers with the scheduler map ethernet-cos-map:

```
[edit class-of-service]
user@switch# set scheduler-maps ethernet-cos-map forwarding-class voice scheduler
voice-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class video scheduler
video-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class app scheduler
app-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class mail scheduler
mail-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class db scheduler
db-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class erp scheduler
erp-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class network-control
scheduler nc-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class best-effort scheduler
be-sched
```

23. Associate the scheduler map with the outgoing interface:

```
[edit class-of-service interfaces]
user@switch# set ge-0/0/20 scheduler-map ethernet-cos-map
```

24. Apply queue shaping for the best-effort queue:

```
[edit]
user@switch# set class-of-service schedulers voice-sched-queue-shap shaping-rate 30m
user@switch# set class-of-service scheduler-maps sched-map-be forwarding-class
best-effort scheduler voice-sched-queue-shap
user@switch# set class-of-service interfaces ge-0/0/2 scheduler-map sched-map-be
```

Results Display the results of the configuration:

```
user@switch> show firewall

firewall family ethernet-switching {
  filter voip_class {
    term voip {
      from {
        source-address {
          192.168.1.1/28;
          192.168.1.2/28;
        }
        protocol udp;
        source-port 2698;
      }
      then {
        forwarding-class voice;
        loss-priority low;
      }
    }
    term network control {
      from {
        precedence [net-control internet-control];
      }
      then {
        forwarding-class network-control;
        loss-priority low;
```

```
        }
    }
    term best_effort_traffic {
        then {
            forwarding-class best-effort;
            loss-priority low;
        }
    }
}
filter video_class {
    term video {
        from {
            source-address {
                192.168.1.17/28;
            }
            protocol udp;
            source-port 2979;
        }
        then {
            forwarding-class video;
            loss-priority low;
        }
    }
    term network control {
        from {
            precedence [net-control internet-control];
        }
        then {
            forwarding-class network-control;
            loss-priority low;
        }
    }
    term best_effort_traffic {
        then {
            forwarding-class best-effort;
            loss-priority low;
        }
    }
}
filter app_class {
    term app {
        from {
            source-address {
                192.168.1.33/28;
            }
            protocol tcp;
            source-port [1491 2512 2513 2598 2897];
        }
        then {
            forwarding-class app;
            loss-priority low;
        }
    }
    term mail {
        from {
            source-address {
```

```
            192.168.1.34/28;
          }
          protocol tcp;
          source-port [25 143 389 691 993 3268 3269];
        }
        then {
          forwarding-class mail;
          loss-priority low;
        }
      }
      term db {
        from {
          source-address {
            192.168.1.35/28;
          }
          protocol tcp;
          source-port [1521 1525 1527 1571 1810 2481];
        }
        then {
          forwarding-class db;
          loss-priority low;
        }
      }
      term erp {
        from {
          source-address {
            192.168.1.36/28;
          }
          protocol tcp;
          source-port [3200 3300 3301 3600];
        }
        then {
          forwarding-class erp;
          loss-priority low;
        }
      }
      term network control {
        from {
          precedence [net-control internet-control];
        }
        then {
          forwarding-class network-control;
          loss-priority low;
        }
      }
      term best_effort_traffic {
        then {
          forwarding-class best-effort;
          loss-priority low;
        }
      }
    }
}

user@switch# show class-of-service

forwarding-classes {
```

```
    class app queue-num 5;
    class mail queue-num 1;
    class db queue-num 2;
    class erp queue-num 3;
    class video queue-num 4;
    class best-effort queue-num 0;
    class voice queue-num 6;
    class network-control queue-num 7;
}
interfaces {
    ge-0/0/0 {
        shaping-rate 100m;
    }
}
interfaces {
    ge-0/0/2 {
        scheduler-map sched-map-be;
    }
}
schedulers {
    voice-sched-queue-shap {
        shaping-rate 30m;
    }
    voice-sched {
        buffer-size percent 10;
        priority strict-high;
        transmit-rate percent 10;
    }
    video-sched {
        buffer-size percent 15;
        priority low;
        transmit-rate percent 15;
    }
    app-sched {
        buffer-size percent 10;
        priority low;
        transmit-rate percent 10;
    }
    mail-sched {
        buffer-size percent 5;
        priority low;
        transmit-rate percent 5;
    }
    db-sched {
        buffer-size percent 10;
        priority low;
        transmit-rate percent 10;
    }
    erp-sched {
        buffer-size percent 10;
        priority low;
        transmit-rate percent 10;
    }
    nc-sched {
        buffer-size percent 5;
        priority strict-high;
```



```
      transmit-rate percent 5;
    }
    be-sched {
      buffer-size percent 35;
      priority low;
      transmit-rate percent 35;
    }
  }
  scheduler-maps {
    ethernet-cos-map {
      forwarding-class voice scheduler voice-sched;
      forwarding-class video scheduler video-sched;
      forwarding-class app scheduler app-sched;
      forwarding-class mail scheduler mail-sched;
      forwarding-class db scheduler db-sched;
      forwarding-class erp scheduler erp-sched;
      forwarding-class network-control scheduler nc-sched;
      forwarding-class best-effort scheduler be-sched;
    }
    sched-map-be {
      forwarding-class best-effort scheduler voice-sched-queue-shap;
    }
  }
```

```
user@switch# show interfaces
```

```
ge-0/0/0 {
  unit 0 {
    family ethernet {
      filter {
        input voip_class;
      }
    }
  }
}
ge-0/0/1 {
  unit 0 {
    family ethernet {
      filter {
        input voip_class;
      }
    }
  }
}
ge-0/0/2 {
  unit 0 {
    family ethernet {
      filter {
        input video_class;
      }
    }
  }
}
ge-0/0/3 {
  unit 0 {
    family ethernet {
      filter {
```

```
            input app_class;
          }
        }
      }
    }
    ge-0/0/4 {
      unit 0 {
        family ethernet {
          filter {
            input app_class;
          }
        }
      }
    }
    ge-0/0/5 {
      unit 0 {
        family ethernet {
          filter {
            input app_class;
          }
        }
      }
    }
    ge-0/0/6 {
      unit 0 {
        family ethernet {
          filter {
            input app_class;
          }
        }
      }
    }
```

Verification

To confirm that the configuration is working properly, perform these tasks:

- Verifying That the Defined Forwarding Classes Exist and Are Mapped to Queues on page 52
- Verifying That the Forwarding Classes Have Been Assigned to Schedulers on page 53
- Verifying That the Scheduler Map Has Been Applied to the Interface on page 55
- Verifying That Port Shaping Has Been Applied on page 55
- Verifying That Queue Shaping Has Been Applied on page 59

Verifying That the Defined Forwarding Classes Exist and Are Mapped to Queues

Purpose Verify that the forwarding classes **app**, **best-effort**, **db**, **erp**, **mail**, **network-control**, **video**, and **voice** have been defined and mapped to queues.

Action

```
user@switch> show class-of-service forwarding-class
Forwarding class                          ID    Queue
  app                                      0        5
  db                                       1        2
  erp                                      2        3
  best-effort                              3        0
  mail                                     4        1
  voice                                    5        6
  video                                    6        4
  network-control                          7        7
```

Meaning This output shows that the forwarding classes have been defined and mapped to appropriate queues.

Verifying That the Forwarding Classes Have Been Assigned to Schedulers

Purpose Verify that the forwarding classes have been assigned to schedulers.

Action

```
user@switch> show class-of-service scheduler-map
Scheduler map: ethernet-cos-map, Index: 2
  Scheduler: voice-sched, Forwarding class: voice, Index: 22
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 15 percent,
    Priority: Strict-high
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: video-sched, Forwarding class: video, Index: 22
    Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: app-sched, Forwarding class: app, Index: 22
    Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: mail-sched, Forwarding class: mail, Index: 22
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: db-sched, Forwarding class: db, Index: 22
    Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: erp-sched, Forwarding class: erp, Index: 22
    Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: be-sched, Forwarding class: best-effort, Index: 20
    Transmit rate: 35 percent, Rate Limit: none, Buffer size: 35 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: nc-sched, Forwarding class: network-control, Index: 22
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,
```

```
    Priority: Strict-high
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>
```

Meaning This output shows that the forwarding classes have been assigned to schedulers.

Verifying That the Scheduler Map Has Been Applied to the Interface

Purpose Verify that the scheduler map has been applied to the interface.

Action

```
user@switch> show class-of-service interface
...
Physical interface: ge-0/0/20, Index: 149
Queues supported: 8, Queues in use: 8
  Scheduler map: ethernet-cos-map, Index: 43366
  Input scheduler map: <default>, Index: 3
...
```

Meaning This output shows that the scheduler map (**ethernet-cos-map**) has been applied to the interface (**ge-0/0/20**).

Verifying That Port Shaping Has Been Applied

Purpose Verify that the port shaping has been applied to an interface.

Action Following is the output before port shaping is applied to the interface **ge-0/0/0**, when there is egress traffic of 400 Mpbs exiting on that interface:

```
user@switch> show interfaces ge-0/0/0 extensive
Physical interface: ge-0/0/0, Enabled, Physical link is Up
  Interface index: 239, SNMP ifIndex: 548, Generation: 242
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error:
None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,
  Media type: Copper
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d
  Last flapped   : 2012-07-07 03:21:52 UTC (1d 18:02 ago)
  Statistics last cleared: 2012-07-07 23:54:34 UTC (21:29:59 ago)
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :           2299853696            345934816 bps
   Input  packets:                    0                    0 pps
   Output packets:             17967609               337827 pps
   IPv6 transit statistics:
    Input  bytes  :                    0
    Output bytes  :                    0
    Input  packets:                    0
```

```
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 8 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                   0             18302337                   0

    1 assured-forw                  0                    0                   0

    5 expedited-fo                  0                    0                   0

    7 network-cont                  0                    0                   0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   assured-forwarding
    5                   expedited-forwarding
    7                   network-control
  Active alarms  : None
  Active defects : None
  MAC statistics:                       Receive         Transmit
    Total octets                              0       2299853696
    Total packets                             0         17967609
    Unicast packets                           0         17967609
    Broadcast packets                         0                0
    Multicast packets                         0                0
    CRC/Align errors                          0                0
    FIFO errors                               0                0
    MAC control frames                        0                0
    MAC pause frames                          0                0
    Oversized frames                          0
    Jabber frames                             0
    Fragment frames                           0
    Code violations                           0
  Autonegotiation information:
    Negotiation status: Complete
    Link partner:
        Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
    Local resolution:
        Flow control: Symmetric, Remote fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 1
  CoS information:
    Direction : Output
    CoS transmit queue             Bandwidth              Buffer Priority   Limit

                             %            bps     %          usec
    0 best-effort           95      950000000    95            NA      low    none

    7 network-control        5       50000000     5            NA      low    none

  Interface transmit statistics: Disabled

  Logical interface ge-1/0/10.0 (Index 69) (SNMP ifIndex 638) (Generation 138)
```

```
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                   0 bps
     Output bytes  :                   0                   0 bps
     Input  packets:                   0                   0 pps
     Output packets:                   0                   0 pps
    Protocol eth-switch, Generation: 163, Route table: 0
      Flags: Trunk-Mode
```

The Traffic statistics: field in this output shows that egress traffic is ~400 Mpbs (345,934,816 bps). When a port shaping of 100 Mbps is applied to the ge-0/0/0 interface, you see the following outputs for the **show interfaces ge-0/0/0 statistics** and the **show class-of-service interface ge-0/0/0** commands:

```
user@switch> show interfaces ge-0/0/0 statistics
Physical interface: ge-0/0/0, Enabled, Physical link is Up
  Interface index: 239, SNMP ifIndex: 548, Generation: 242
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error:
None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,
  Media type: Copper
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d
  Last flapped   : 2012-07-07 03:21:52 UTC (1d 18:10 ago)
  Statistics last cleared: 2012-07-07 23:54:34 UTC (21:37:58 ago)
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :          15779512832           100223104 bps
   Input  packets:                   0                   0 pps
   Output packets:           123277444               97874 pps
   IPv6 transit statistics:
    Input  bytes  :                  0
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 8 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                   0           123350092             57012484
```

```
    1 assured-forw                  0                    0                    0

    5 expedited-fo                  0                    0                    0

    7 network-cont                  0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   assured-forwarding
    5                   expedited-forwarding
    7                   network-control
  Active alarms  : None
  Active defects : None
  MAC statistics:                       Receive         Transmit
    Total octets                              0      15779512832
    Total packets                             0        123277444
    Unicast packets                           0        123277444
    Broadcast packets                         0                0
    Multicast packets                         0                0
    CRC/Align errors                          0                0
    FIFO errors                               0                0
    MAC control frames                        0                0
    MAC pause frames                          0                0
    Oversized frames                          0
    Jabber frames                             0
    Fragment frames                           0
    Code violations                           0
  Autonegotiation information:
    Negotiation status: Complete
    Link partner:
        Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
    Local resolution:
        Flow control: Symmetric, Remote fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 1
  CoS information:
    Direction : Output
    CoS transmit queue              Bandwidth              Buffer Priority
Limit
                                %           bps     %           usec
    0 best-effort              95       95000000    95             NA      low
none
    7 network-control           5        5000000     5             NA      low
none
  Interface transmit statistics: Disabled

  Logical interface ge-1/0/10.0 (Index 69) (SNMP ifIndex 638) (Generation 138)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                    0 bps
```

```
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol eth-switch, Generation: 163, Route table: 0
      Flags: Trunk-Mode
```

```
user@switch> show class-of-service interface ge-0/0/0
Physical interface: ge-0/0/0, Index: 165
Queues supported: 8, Queues in use: 4
  Shaping rate: 100000000 bps
  ...
  ...
```

Meaning In the output for the **show interfaces ge-0/0/0 statistics** command, the Traffic statistics: field shows that egress traffic is ~100 Mbps (100,223,104 bps). The output for the **show class-of-service interface ge-0/0/0** command shows that the shaping rate is 100,000,000 bps, which indicates that a port shaping of 100 Mbps is applied to the ge-0/0/0 interface.

Verifying That Queue Shaping Has Been Applied

Purpose Verify that the queue shaping has been applied to the best-effort queue.

Action Following is the output before queue shaping is applied to the best-effort queue when there is egress traffic of 400 Mpbs exiting on that interface:

```
user@switch> show interfaces ge-0/0/2 extensive
Physical interface: ge-0/0/2, Enabled, Physical link is Up
  Interface index: 239, SNMP ifIndex: 548, Generation: 242
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error:
None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,
  Media type: Copper
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d
  Last flapped   : 2012-07-07 03:21:52 UTC (1d 18:02 ago)
  Statistics last cleared: 2012-07-07 23:54:34 UTC (21:29:59 ago)
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :           2299853696            345934816 bps
   Input  packets:                    0                    0 pps
   Output packets:             17967609               337827 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 8 supported, 4 in use
```

```
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                    0             18302337                    0

    1 assured-forw                   0                    0                    0

    5 expedited-fo                   0                    0                    0

    7 network-cont                   0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   assured-forwarding
    5                   expedited-forwarding
    7                   network-control
  Active alarms  : None
  Active defects : None
  MAC statistics:                      Receive         Transmit
    Total octets                             0       2299853696
    Total packets                            0         17967609
    Unicast packets                          0         17967609
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    Code violations                          0
  Autonegotiation information:
    Negotiation status: Complete
    Link partner:
        Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
    Local resolution:
        Flow control: Symmetric, Remote fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 1
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                                %           bps     %           usec
    0 best-effort              95     950000000    95             NA      low
none
    7 network-control           5      50000000     5             NA      low
none
  Interface transmit statistics: Disabled

  Logical interface ge-1/0/10.0 (Index 69) (SNMP ifIndex 638) (Generation 138)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
```

```
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol eth-switch, Generation: 163, Route table: 0
      Flags: Trunk-Mode
```

The Traffic statistics: field in this output shows that the egress traffic is ~400 Mpbs (345,934,816 bps). When a queue shaping of 30 Mbps is applied to the best-effort queue, you see the following output for the **show interfaces ge-0/0/2 statistics** and **show class-of-service scheduler-map sched-map-be** commands:

```
user@switch> show interfaces ge-0/0/2 statistics
Physical interface: ge-0/0/2, Enabled, Physical link is Up
  Interface index: 239, SNMP ifIndex: 548, Generation: 242
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error:
None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,
  Media type: Copper
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d
  Last flapped   : 2012-07-07 03:21:52 UTC (1d 18:29 ago)
  Statistics last cleared: 2012-07-08 21:46:22 UTC (00:04:56 ago)
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :           5376128896             30097712 bps
   Input  packets:                    0                    0 pps
   Output packets:             42001003                29392 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 8 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                   0             41986978             57813642

    1 assured-forw                  0                    0                    0

    5 expedited-fo                  0                    0                    0

    7 network-cont                  0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   assured-forwarding
```

```
    5                   expedited-forwarding
    7                   network-control
  Active alarms  : None
  Active defects : None
  MAC statistics:                       Receive         Transmit
    Total octets                              0       5376128896
    Total packets                             0         42001003
    Unicast packets                           0         42001003
    Broadcast packets                         0                0
    Multicast packets                         0                0
    CRC/Align errors                          0                0
    FIFO errors                               0                0
    MAC control frames                        0                0
    MAC pause frames                          0                0
    Oversized frames                          0
    Jabber frames                             0
    Fragment frames                           0
    Code violations                           0
  Autonegotiation information:
    Negotiation status: Complete
    Link partner:
        Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
    Local resolution:
        Flow control: Symmetric, Remote fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 1
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    0 best-effort             r              r     r             NA      low
none
  Interface transmit statistics: Disabled

  Logical interface ge-1/0/10.0 (Index 69) (SNMP ifIndex 638) (Generation 138)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                  0 bps
     Output bytes  :                   0                  0 bps
     Input  packets:                   0                  0 pps
     Output packets:                   0                  0 pps
    Protocol eth-switch, Generation: 163, Route table: 0
      Flags: Trunk-Mode


user@switch> show class-of-service scheduler-map sched-map-be

Scheduler map: sched-map-be, Index: 31271
```

```
Scheduler: voice-sched-queue-shap, Forwarding class: best-effort, Index: 64106

  Transmit rate: remainder, Rate Limit: none, Buffer size: remainder,
  Buffer Limit: none, Priority: low
  Excess Priority: unspecified
  Shaping rate: 30000000 bps
  Drop profiles:
    Loss priority   Protocol    Index    Name
    High            non-TCP         1    <default-drop-profile>
    High            TCP             1    <default-drop-profile>
```

Meaning In the output for the **show interfaces ge-0/0/2 statistics** command, the Traffic statistics: field shows that the egress traffic is ~30 Mbps (30,097,712 bps). The output for the **show class-of-service scheduler-map sched-map-be** command, shows that a shaping rate of 30,000,000 bps (that is 30 Mbps) is applied to the best-effort queue.

Related Documentation

- Defining CoS Code-Point Aliases (CLI Procedure) on page 66
- Defining CoS Classifiers (CLI Procedure) on page 69
- Defining CoS Forwarding Classes (CLI Procedure) on page 73
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75
- *Configuring CoS Tail Drop Profiles (CLI Procedure)*
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90
- *Configuring Firewall Filters (CLI Procedure)*

CHAPTER 3

Configuration Tasks

Configuring CoS (J-Web Procedure)

The Class of Service Configuration pages allow you to configure the Junos CoS components. You can configure forwarding classes for transmitting packets, define which packets are placed into each output queue, and schedule the transmission service level for each queue. After defining the CoS components you must assign classifiers to the required physical and logical interfaces.

Using the Class of Service Configuration pages, you can configure various CoS components individually or in combination to define particular CoS services.

To configure CoS components :

1. In the J-Web interface, select **Configure>Class of Service**.
2. On the Class of Service Configuration page, select one of the following options depending on the CoS component that you want to define. Enter information into the pages as described in the respective table:
   - To define or edit CoS value aliases, select **CoS Value Aliases** .
   - To define or edit forwarding classes and assign queues, select **Forwarding Classes**.
   - To define or edit classifiers, select **Classifiers** .
   - To define or edit rewrite rules, select **Rewrite Rules**.
   - To define or edit schedulers, select **Schedulers**.
   - To define or edit virtual channel groups, select **Interface Associations**.
3. Click **Apply** after completing configuration on any Configuration page.

Related Documentation

- Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- Defining CoS Schedulers (J-Web Procedure) on page 77
- Assigning CoS Components to Interfaces (J-Web Procedure) on page 90

Defining CoS Code-Point Aliases (CLI Procedure)

You can use code-point aliases to streamline the process of configuring CoS features on your EX Series switch. A code-point alias assigns a name to a pattern of code-point bits. You can use this name instead of the bit pattern when you configure other CoS components such as classifiers, drop-profile maps, and rewrite rules.

You can configure code-point aliases for the following CoS marker types:

- **dscp** and **dscp-ipv6**—Handles incoming IPv4 and IPv6 packets, respectively.
- **ieee-802.1**—Handles Layer 2 CoS.
- **inet-precedence**—Handles incoming IPv4 packets. IP precedence mapping requires only the higher order three bits of the DSCP field.

To configure a code-point alias for a specified CoS marker type (**dscp**), assign an alias (**my1**) to the code-point (**110001**):

```
[edit class-of-service code-point-aliases]
user@switch# set dscp my1 110001
```

The **my1** alias will be applicable for incoming IPv4 packets.

Related Documentation

- Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Example: Configuring CoS on EX Series Switches on page 39

- Monitoring CoS Value Aliases on page 134
- Understanding CoS Code-Point Aliases on page 8

Defining CoS Code-Point Aliases (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can use the J-Web interface to define CoS code-point aliases on an EX Series switch. By defining aliases you can assign meaningful names to a particular set of bit values and refer to them when configuring CoS components.

To define CoS code-point aliases:

1. Select **Configure** > **Class of Service** > **CoS Value Aliases**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:
   - **Add**—Adds a code-point alias. Enter information into the code point alias page as described in Table 13 on page 67.
   - **Edit**—Modifies an existing code-point alias. Enter information into the code point alias page as described in Table 13 on page 67.
   - **Delete**—Deletes an existing code-point alias.

Table 13 on page 67 describes the related fields.

Table 13: CoS Value Aliases Configuration Fields

Field	Function	Your Action
Code point name	Specifies the name for a code-point—for example, **af11** or **be**.	Enter a name.
Code point type	Specifies a code-point type. The code-point type can be DSCP or IP precedence.	Select a value.

Table 13: CoS Value Aliases Configuration Fields *(continued)*

Field	Function	Your Action
Code point value bits	Specifies the CoS value for which an alias is defined. Changing this value alters the behavior of all classifiers that refer to this alias.	To specify a CoS value, type it in the appropriate format: • For DSCP CoS values, use the format xxxxxx, where x is 1 or 0—for example, **101110**. • For IP precedence CoS values, use the format xxx, where x is 1 or 0—for example, **111**.

Related Documentation

- Defining CoS Code-Point Aliases (CLI Procedure) on page 66
- Monitoring CoS Value Aliases on page 134
- Example: Configuring CoS on EX Series Switches on page 39

Defining CoS Classifiers (CLI Procedure)

Packet classification associates incoming packets with a particular CoS servicing level. Classifiers associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class. Junos OS supports two general types of classifiers:

- Behavior aggregate (BA) classifier—Examine the CoS value in the packet header. The value in this single field determines the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the Differentiated Services code point (DSCP) value, IP precedence value, or IEEE 802.1p value. EX Series switches except EX4300 switches support two types of loss priorities: **high** and **low**. EX4300 switches support four types of loss priorities: **high**, **medium-high**, **low**, and **medium-low**.

  You can configure BA classifiers for the following CoS marker types:

  - **dscp** and **dscp-ipv6**—Handles incoming IPv4 and IPv6 packets, respectively.
  - **ieee-802.1**—Handles Layer 2 CoS.
  - **inet-precedence**—Handles incoming IPv4 packets. IP precedence mapping requires only the higher order three bits of the DSCP field.

- Multifield (MF) classifier—Examine multiple fields in the packet such as source and destination addresses and source and destination port numbers of the packet. With MF classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

NOTE: Juniper Networks EX8200 Ethernet Switches implement the on-demand ternary content addressable memory (TCAM) allocation of memory so that when additional TCAM space is required for CoS, the space is allocated from the free TCAM space or from the unused TCAM space. An error log message is generated when you configure CoS classifiers beyond the available TCAM space that includes both the free and unused space.

The following example describes how to configure a BA classifier (**ba-classifier**) as the default DSCP map for handling IPv4 traffic and to apply the BA classifier to either a specific Gigabit Ethernet interface or to all the Gigabit Ethernet interfaces on the switch. The BA classifier assigns loss priorities, as shown in Table 14 on page 69, to incoming packets in the four forwarding classes.

You can use the same procedure to set MF classifiers (except that you would use firewall filter rules).

Table 14: BA-classifier Loss Priority Assignments

Forwarding Class	For CoS Traffic Type	ba-classifier Assignment
be	Best-effort traffic	High-priority code point: **000001**

Table 14: BA-classifier Loss Priority Assignments *(continued)*

ef	Expedited-forwarding traffic	High-priority code point: **101110**
af	Assured-forwarding traffic	High-priority code point: **001100**
nc	Network-control traffic	High-priority code point: **110001**

To configure a DSCP BA classifier named **ba-classifier** as the default DSCP map:

- Associate code point **000001** with forwarding class **be** and loss priority **high:**

  ```
  [edit class-of-service classifiers]
  user@switch# set dscp ba-classifier import default forwarding-class be loss-priority high code-points 000001
  ```

- Associate code point **101110** with forwarding class **ef** and loss priority **high:**

  ```
  [edit class-of-service classifiers]
  user@switch# set dscp ba-classifier forwarding-class ef loss-priority high code-points 101110
  ```

- Associate code point **001100** with forwarding class **af** and loss priority **high:**

  ```
  [edit class-of-service classifiers]
  user@switch# set dscp ba-classifier forwarding-class af loss-priority high code-points 001100
  ```

- Associate code point **110001** with forwarding class **nc** and loss priority **high:**

  ```
  [edit class-of-service classifiers]
  user@switch# set dscp ba-classifier forwarding-class nc loss-priority high code-points 110001
  ```

- Apply the classifier to a specific interface or to all Gigabit Ethernet interfaces on the switch.

  - To apply the classifier to a specific interface:

    ```
    [edit class-of-service interfaces]
    user@switch# set ge-0/0/0 unit 0 classifiers dscp ba-classifier
    ```

  - To apply the classifier to all Gigabit Ethernet interfaces on the switch, use wildcards for the interface name and the logical-interface (unit) number:

    ```
    [edit class-of-service interfaces]
    user@switch# set ge-* unit * classifiers dscp ba-classifier
    ```

NOTE: On EX8200 switches, it can take a long time to install code-point classifiers on multiple interfaces (for example, approximately 25 minutes to install 64 code-point classifiers on multiple interfaces in the order of 280 or more).

Related Documentation

- Defining CoS Classifiers (J-Web Procedure) on page 71
- Example: Configuring CoS on EX Series Switches on page 39
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90
- Monitoring CoS Classifiers on page 127
- *Understanding CoS Classifiers*

- Troubleshooting a CoS Classifier Configuration for a TCAM Space Error on page 166

Defining CoS Classifiers (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can use the J-Web interface to define CoS classifiers on an EX Series switch. Classifiers examine the CoS value or alias of an incoming packet and assign the packet a level of service by setting its forwarding class and loss priority.

To define CoS classifiers:

1. Select **Configure** > **Class of Service** > **Classifiers**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:
   - **Add**—Adds a classifier. Enter information into the classifier page as described in Table 15 on page 71.
   - **Edit**—Modifies an existing classifier. Enter information into the classifier page as described in Table 15 on page 71.
   - **Delete**—Deletes an existing classifier.

Table 15: Classifiers Configuration Fields

Field	Function	Your Action
Classifier Name	Specifies the name for a classifier.	To name a classifier, type the name—for example, **ba-classifier**.
Classifier Type	Specifies the type of classifier: **dscp**, **ieee-802.1**, or **inet-precedence**.	Select a value from the list.

Table 15: Classifiers Configuration Fields *(continued)*

Field	Function	Your Action
Code Point Mapping	Sets the forwarding classes and the packet loss priorities (PLPs) for specific CoS values and aliases.	To add a code point mapping: 1. Click **Add**. 2. Select the code point. 3. Select a forwarding class from the following list: • **expedited-forwarding**—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service. Packets can be forwarded out of sequence or dropped. • **best-effort**—Provides no special CoS handling of packets. Typically, RED drop profile is aggressive and no loss priority is defined. • **assured-forwarding**—Provides high assurance for packets within the specified service profile. Excess packets are dropped. • **network-control**—Packets can be delayed but not dropped. 4. Select the loss priority. To assign a loss priority, select one: • **high**—Packet has a high loss priority. • **low**—Packet has a low loss priority.

Related Documentation

- Defining CoS Classifiers (CLI Procedure) on page 69
- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring CoS Classifiers on page 127
- *Understanding CoS Classifiers*

Defining CoS Forwarding Classes (CLI Procedure)

Forwarding classes allow you to group packets for transmission. Based on forwarding classes, you assign packets to output queues.

By default, four categories of forwarding classes are defined: best effort, assured forwarding, expedited forwarding, and network control. EX Series switches support up to 16 forwarding classes.

You can configure forwarding classes in one of the following ways:

- Using **class** statement—You can configure up to 16 forwarding classes and you can map multiple forwarding classes to single queue.
- Using **queue** statement—You can configure up to 8 forwarding classes and you can map one forwarding class to one queue.

  This example uses the **class** statement to configure forwarding classes.

To configure CoS forwarding classes, map the forwarding classes to queues:

```
[edit class-of-service forwarding-classes]
user@switch#  set class be queue—num 0
user@switch#  set class ef queue—num 1
user@switch#  set class af queue—num 2
user@switch#  set class nc queue—num 3
user@switch#  set class ef1 queue—num 4
user@switch#  set class ef2 queue—num 5
user@switch#  set class af1 queue—num 6
user@switch#  set class nc1 queue—num 7
```

Related Documentation

- Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- Example: Configuring CoS on EX Series Switches on page 39
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90
- Monitoring CoS Forwarding Classes on page 128
- *Understanding CoS Forwarding Classes*

Defining CoS Forwarding Classes (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can define CoS forwarding classes on an EX Series switch using the J-Web interface. Assigning a forwarding class to a queue number affects the scheduling and marking of a packet as it transits a switch.

To define forwarding classes:

1. Select **Configure** > **Class of Service** > **Forwarding Classes**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:

   - **Add**—Adds a forwarding class. Enter information into the forwarding class page as described in Table 16 on page 74.
   - **Edit**—Modifies an existing forwarding class. Enter information into the forwarding class page as described in Table 16 on page 74.
   - **Delete**—Deletes an existing forwarding class.

Table 16: Forwarding Classes Configuration Fields

Field	Function	Your Action
Forwarding Class Summary		
Queue #	Specifies the internal queue numbers to which forwarding classes are assigned. By default, if a packet is not classified, it is assigned to the class associated with queue 0. You can have more than one forwarding class to a queue number.	To specify an internal queue number, select an integer from 0 through 7, appropriate for your platform. NOTE: For EX4300 switches, to specify an internal queue number, select an integer from 0 through 11.
Forwarding Class Name	Specifies the forwarding class names assigned to specific internal queue numbers. By default, four forwarding classes are assigned to queue numbers 0 (best-effort), 1 (assured-forwarding), 5 (expedited-forwarding), and 7 (network-connect). NOTE: For EX4300 switches, by default the forwarding classes are assigned to queue numbers 0 (best-effort), 1(expedited -forwarding), 2 (assured-forwarding), 3 (network-connect), 8 (mcast-be), 9 (mcast-ef), 10 (mcast-af), and 11 (mcast-nc).	Type the name—for example, **be-class**.

Related Documentation

- Defining CoS Forwarding Classes (CLI Procedure) on page 73
- Example: Configuring CoS on EX Series Switches on page 39
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Monitoring CoS Forwarding Classes on page 128

- Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- *Understanding CoS Forwarding Classes*

Defining CoS Schedulers and Scheduler Maps (CLI Procedure)

You use schedulers to define the class-of-service (CoS) properties of output queues. These properties include the amount of interface bandwidth assigned to the queue, the size of the memory buffer allocated for storing packets, the priority of the queue, and the drop profiles associated with the queue.

You associate the schedulers with forwarding classes by means of scheduler maps. You can then associate each scheduler map with an interface, thereby configuring the queues and packet schedulers that operate according to this mapping.

NOTE: On EX Series switches, you cannot configure a scheduler map on an individual interface that is a member of a link aggregation group (LAG). Instead, you must configure the scheduler map on the LAG itself (that is, on the aggregated Ethernet (ae) interface).

You can associate up to four user-defined scheduler maps with an interface.

This topic describes:

- Configuring a Scheduler and a Scheduler Map on page 75
- Assigning a Scheduler Map to Interfaces on page 76
- Assigning Scheduler Maps to Interfaces on EX8200 Line Cards That Include Oversubscribed Ports on page 76

Configuring a Scheduler and a Scheduler Map

You can define the properties for an output queue by configuring a scheduler. You can then define a scheduler map to associate a forwarding class with a scheduler.

To configure a scheduler and a scheduler map:

1. Create a scheduler, and assign one or more output queue properties to it:

   [edit class-of-service]
   user@switch# set schedulers ***scheduler-name output-queue-properties***

   For various properties that you can define for an output queue, see the **schedulers** hierarchy.

2. Configure a scheduler map that associates the scheduler with the forwarding class:

   [edit class-of-service]
   user@switch# set scheduler-maps ***map-name*** forwarding-class ***class-name*** **scheduler** ***scheduler-name***

Assigning a Scheduler Map to Interfaces

After defining a scheduler map, you can assign the scheduler map to one or more interfaces. You can also assign the scheduler map to multiple interfaces by using a wildcard representation of the interface or Virtual Chassis Ports (VCPs).

Following are sample syntaxes and examples for assigning a scheduler map to a single or to multiple interfaces:

- To assign the scheduler map to one interface:

  [edit class-of-service interfaces]
  `user@switch#` **set *interface-name* scheduler-map *map-name***

- To assign the scheduler map to more than one interface, you can use a wildcard representation of the interface:

  [edit class-of-service interfaces]
  `user@switch#` **set *wild-card-representation-of-interface-name* scheduler-map *map-name***

  For example, following is the configuration to assign the **be-map** scheduler map to all Gigabit Ethernet interfaces (**ge-***):

  [edit class-of-service interfaces]
  `user@switch#` **set ge-* scheduler-map be-map**

- To assign the scheduler map to all VCPs:

  [edit class-of-service interfaces]
  `user@switch#` **set *wild-card-representation-of-vcp* scheduler-map *map-name***

  NOTE: You can assign a scheduler map to a VCP only on EX4200, EX4300 or EX4500 switches that are members of Virtual Chassis composed exclusively either of EX4200 switches, EX4300 switches or of EX4500 switches, or that are members of a mixed Virtual Chassis composed of EX4200, EX4300, and EX4500 switches.

  For example, following is the configuration to assign the **be-map** scheduler map to all VCPs:

  [edit class-of-service interfaces]
  `user@switch#` **set vcp-* scheduler-map be-map**

Assigning Scheduler Maps to Interfaces on EX8200 Line Cards That Include Oversubscribed Ports

Some line cards available for Juniper Networks EX8200 Ethernet Switches include oversubscribed ports that are combined in logical port groups that share bandwidth. These oversubscribed ports handle traffic differently than ports that provide continuous line-rate bandwidth. You might need to configure CoS queues differently for oversubscribed ports than for line-rate ports. For more information about EX8200 line cards that include oversubscribed ports, see "Understanding CoS Queues on EX8200 Line Cards That Include Oversubscribed Ports" on page 33.

For interfaces on oversubscribed EX8200 line cards, you use the same procedure to configure CoS schedulers as you do for other interfaces. However, you must assign the same scheduler map to all the interfaces in a port group. When you assign a scheduler map to one interface in a port group, you do not need to assign the scheduler map to the remaining interfaces in the port group. The switch automatically uses that scheduler map for all the interfaces in the port group when you bring the interfaces up. Therefore, you do not need to assign the scheduler map to the remaining interfaces in that port group.

If you assign different scheduler maps to different interfaces in a port group, you do not receive an error when you commit the configuration. Instead, an error is logged in the system log. When you bring an interface in the port group up, the default scheduler map is assigned to all interfaces in the port group. If you assign a scheduler map to an interface that is down and if that scheduler map is different from the scheduler map being used by the currently operating interfaces in the port group, then the default scheduler map is used by all interfaces in the port group, even the currently operating ones, when you bring the interface up.

To assign a scheduler map to a port group, assign a scheduler map to at least one interface in the port group:

[edit class-of-service interfaces]
`user@switch#` **set *interface-name* scheduler-map *map-name***

Considering that the xe-0/0/2 interface is part of a port group, following is the configuration to assign a scheduler map named **ef-map** to a port group that contains xe-0/0/2:

[edit class-of-service interfaces]
`user@switch#` **set xe-0/0/2 scheduler-map ef-map**

Related Documentation

- Defining CoS Schedulers (J-Web Procedure) on page 77
- Example: Configuring CoS on EX Series Switches on page 39
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90
- Monitoring CoS Scheduler Maps on page 132
- Understanding CoS Schedulers on page 22

Defining CoS Schedulers (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can use the J-Web interface to define CoS schedulers on an EX Series switch. Using schedulers, you can assign attributes to queues and thereby provide congestion control for a particular class of traffic. These attributes include the amount of interface bandwidth, memory buffer size, transmit rate, and schedule priority.

To configure schedulers:

1. Select **Configure** > **Class of Service** > **Schedulers**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:

   - **Add**—Adds a scheduler. Enter information into the Schedulers page as described in Table 17 on page 78.
   - **Edit**—Modifies an existing scheduler. Enter information into the Schedulers page as described in Table 17 on page 78.
   - **Delete**—Deletes an existing scheduler.

Table 17: Schedulers Configuration Page

Field	Function	Your Action
Scheduler name	Specifies the name for a scheduler.	To name a scheduler, type the name—for example, **be-scheduler**.
Scheduling priority	Sets the transmission priority of the scheduler, which determines the order in which an output interface transmits traffic from the queues. You can set the scheduling priority at different levels in the order of increasing priority from low to high. A high-priority queue with a high transmission rate might lock out lower-priority traffic.	To set a priority, select one: • **low**—Packets in this queue are transmitted last. • **strict-high**—Packets in this queue are transmitted first. • To specify no scheduling priority, select the blank check box.

Table 17: Schedulers Configuration Page *(continued)*

Field	Function	Your Action
Buffer size	Defines the size of the delay buffer. By default, queues 0 through 11 are allotted the following percentages of the total available buffer space: • Queue 0—75 percent • Queue 1—0 percent • Queue 2—0 percent • Queue 3—5 percent • Queue 4—0 percent • Queue 5—0 percent • Queue 6—0 percent • Queue 7—0 percent • Queue 8—15 percent • Queue 9—0 percent • Queue 10—0 percent • Queue 11—5 percent NOTE: A large buffer size value correlates with a greater possibility of packet delays. Such a value might not be practical for sensitive traffic such as voice or video.	To define a delay buffer size for a scheduler, select the appropriate option: • To specify no buffer size, select the blank check box. • To specify buffer size as a percentage of the total buffer, select **Percent** and type an integer from 1 through 100. • To specify buffer size as the remaining available buffer, select **Remainder**. NOTE: On EX8200 and EX4300 switches, you can specify the buffer size as a temporal value. The queuing algorithm will then drop packets after it has queued a computed number of bytes. This number is the product of the logical interface speed and the configured temporal value.
Shaping rate	Specifies the rate at which queues transmit packets.	• To specify shaping rate as a percentage, select **Percent** and type an integer from 1 through 100. • To specify shaping rate as a number, select **Rate** and enter a value. • To specify no shaping rate, select the blank check box.

Table 17: Schedulers Configuration Page *(continued)*

Field	Function	Your Action
Transmit rate	Defines the transmission rate of a scheduler. The transmit rate determines the traffic bandwidth from each forwarding class you configure. By default, queues 0 through 11 are allotted the following percentages of the transmission capacity: • Queue 0—75 percent • Queue 1—0 percent • Queue 2—0 percent • Queue 3—5 percent • Queue 4—0 percent • Queue 5—0 percent • Queue 6—0 percent • Queue 7—0 percent • Queue 8—15 percent • Queue 9—0 percent • Queue 10—0 percent • Queue 11—5 percent	To define a transmit rate, select the appropriate option: • To enforce the exact transmission rate, select **Rate** and enter a value. • To specify the remaining transmission capacity, select **Remainder Available**. • To specify a percentage of transmission capacity, select **Percent** and type an integer from 1 through 100. • To specify no transmit rate, select the blank check box.
Excess rate NOTE: This option is supported only on EX4300 switches.	Defines the excess rate of a scheduler.	To define the excess rate, select the appropriate option: • To specify a percentage of the excess rate, select **Percent** and type an integer from 1 through 100. • To specify no excess rate, select the blank check box.

Related Documentation

- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75
- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring CoS Scheduler Maps on page 132

Defining CoS Scheduler Maps (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can use the J-Web interface to configure CoS scheduler maps on an EX Series switch.

NOTE: On EX Series switches, you cannot configure a scheduler map on an individual interface that is a member of a link aggregation group (LAG). Instead, you must configure the scheduler map on the LAG itself (that is, on the aggregated Ethernet (ae) interface).

To configure scheduler maps:

1. Select **Configure** > **Class of Service** > **Scheduler Maps**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:

   - **Add**—Adds a scheduler map. Enter information into the scheduler map page as described in Table 18 on page 81.
   - **Edit**—Modifies an existing scheduler map. Enter information into the scheduler map page as described in Table 18 on page 81.
   - **Delete**—Deletes an existing scheduler map.

Table 18: Scheduler Maps Configuration Fields

Field	Function	Your Action
Scheduler Map Name	Specifies the name for a scheduler map.	To name a map, type the name—for example, **be-scheduler-map**.
Scheduler Mapping	Allows you to associate a preconfigured scheduler with a forwarding class. After scheduler maps have been applied to an interface, they affect the hardware queues and packet schedulers.	To associate a scheduler with a forwarding class, locate the forwarding class and select the scheduler in the box next to it. For example, for the **best-effort** forwarding class, select the configured scheduler from the list.

Related Documentation

- Defining CoS Schedulers (J-Web Procedure) on page 77
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75
- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring CoS Scheduler Maps on page 132

Configuring CoS Congestion Management (CLI Procedure)

An effective congestion management mechanism is imperative to ensure smooth flow of traffic in a network and also to ensure minimum packet drops in the network. Class of service (CoS) provides congestion management methods that allow you to define parameters based on which packets can be dropped when the output queue is full. These parameters vary depending on the EX Series switch that you are using in a network.

You can specify parameters for dropping packets at the **[edit class-of-service drop-profiles]** hierarchy level and reference them in a scheduler configuration. The parameters that you can specify are **fill-level** and **drop-probability**. The first parameter defines the delay-buffer bandwidth, which provides packet buffer space to absorb burst traffic up to the specified duration of delay. When the specified delay buffer becomes full, packets with 100 percent drop probability are dropped from the head of the buffer. The second parameter represents a percentage value that correlates to the likelihood that an individual packet is dropped from the network.

Depending on the switch on which you are configuring a drop profile, you can configure either a weighted tail drop (WTD) profile or a weighted random early detection (WRED) profile.

This topic describes:

Configuring a Weighted Tail Drop Profile

A weighted tail drop (WTD) is a congestion management mechanism in which packets are dropped from the tail of the queue when the queue reaches a certain buffer capacity (that is, the fill level), and hence the name weighted tail drop. When that level is reached on EX2200, EX3200, or EX4200 Switches, packets marked with a packet loss priority (PLP) of high are prevented from entering the queue (that is, they are discarded).

To configure a WTD profile, create a drop profile name and assign a fill level:

[edit class-of-service drop-profiles]
`user@switch#` **set *profile-name* fill-level *percentage***

Following is a sample WTD profile in which the fill level is set to 80 percent:

[edit class-of-service drop-profiles]
`user@switch#` **set wtd-profile fill-level 80**

Configuring a Weighted Random Early Detection Drop Profile

A WRED drop profile enables you to define multiple data points for fill level and drop probability so that packets are dropped at various levels of queue fullness, and for various drop probabilities. Unlike the WTD drop profile that can be defined only for packets with a PLP of high, WRED can be defined for packets with a PLP of high and also for packets with a PLP of low.

NOTE: The WRED drop profile is supported only on EX4300 standalone switches, EX4300 Virtual Chassis, EX8200 standalone switches and EX8200 Virtual Chassis.

WRED has two implementations: segmented and interpolated. From a high level, segmented is a stair-step-like drop profile, whereas interpolated is a smother (curve) drop profile. For a graphical representation of both these implementations, see "Understanding CoS Congestion Management" on page 17. Although the formation of graph lines is different for both these implementations, the application of the profile is the same. On EX Series switches except EX4300 switches, when a packet reaches the head of the queue, a random number between 0 and 100 is calculated. This random number is plotted against the drop profile using the current queue fullness of that particular queue. When the random number falls above the graph line, the packet is transmitted. When the number falls below the graph line, the packet is dropped from the network.

For information about congestion management on EX4300 switches, see "Understanding CoS Congestion Management" on page 17.

NOTE: On EX4300 switches, you cannot enable WRED on multidestination (multicast) queues. You can enable WRED only on unicast queues.

Following is the procedure to define a segmented and an interpolated drop profiles:

- To configure a segmented drop profile, specify multiple data points for fill level (**l**) and drop probability (**p**) as follows:

  [edit class-of-service drop-profiles]
  `user@switch#` **set *profile-name* fill-level *percentage-l1* drop-probability *percentage-p1***
  `user@switch#` **set *profile-name* fill-level *percentage-l2* drop-probability *percentage-p2***
  `user@switch#` **set *profile-name* fill-level *percentage-l3* drop-probability *percentage-p3***
  `user@switch#` **set *profile-name* fill-level *percentage-l4* drop-probability *percentage-p4***

  Following is a sample segmented drop profile:

  [edit class-of-service drop-profiles]
  `user@switch#` **set seg-prof fill-level 20 drop-probability 25**
  `user@switch#` **set seg-prof fill-level 40 drop-probability 50**
  `user@switch#` **set seg-prof fill-level 60 drop-probability 75**
  `user@switch#` **set seg-prof fill-level 80 drop-probability 100**

- To configure an interpolated drop profile on EX Series switches except EX4300 switches, specify multiple data points for fill level (**l**) and drop probability (**p**) using the **interpolate** statement as follows:

  [edit class-of-service drop-profiles]
  `user@switch#` **set *profile-name* interpolate fill-level *percentage-l1* drop-probability *percentage-l1***
  `user@switch#` **set *profile-name* interpolate fill-level *percentage-l2* drop-probability *percentage-l2***
  `user@switch#` **set *profile-name* interpolate fill-level *percentage-l3* drop-probability *percentage-p3***

```
user@switch#  set profile-name interpolate fill-level percentage-l4 drop-probability
percentage-p4
```

Following is a sample interpolated drop profile:

```
[edit class-of-service drop-profiles]
user@switch#  set inter-prof interpolate fill-level 20 drop-probability 25
user@switch#  set inter-prof interpolate fill-level 40 drop-probability 50
user@switch#  set inter-prof interpolate fill-level 60 drop-probability 75
user@switch#  set inter-prof interpolate fill-level 80 drop-probability 100
```

- To configure an interpolated drop profile EX4300 switches, specify two data points for fill level (**l**) and drop probability (**p**) by using the **interpolate** statement as follows:

```
[edit class-of-service drop-profiles ]
user@switch#  set profile-name interpolate fill-level percentage-l1 fill-level percentage-l2
drop-probability percentage-l1 percentage-l2
```

Following is a sample interpolated drop profile:

```
[edit class-of-service drop-profiles]
user@switch#  set inter-prof interpolate fill-level 20 fill-level 80 drop-probability 25
drop-probability 100
```

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Understanding CoS Congestion Management on page 17

Defining CoS Drop Profiles (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can use the J-Web interface to define CoS drop profiles on EX4500 and EX8200 switches.

To configure CoS drop profiles:

1. Select **Configure** > **Class of Service** > **Drop Profile**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:
   - **Add**—Adds a drop profile. Enter information into the drop profiles page as described in Table 19 on page 85.
   - **Edit**—Modifies an existing drop file. Enter information into the drop profiles page as described in Table 19 on page 85.
   - **Delete**—Deletes an existing drop profile.

Table 19: Drop Profiles Configuration parameters

Field	Function	Your Action
Drop Profile Name	Specifies the name for a drop profile.	Type the name.
Drop profile graph	Specifies the drop profile graph type	Select one: **Segmented** or **Interpolated**.
Drop profile values	Specifies values for the following two parameters of the drop profile: the queue fill level and the drop probability. The queue fill level represents a percentage of the memory used to store packets in relation to the total amount that has been allocated for that specific queue. The drop probability is a percentage value that correlates to the likelihood that an individual packet is dropped from the network.	To add new values: 1. Click **Add**. 2. Enter the fill level. 3. Enter the drop probability. 4. Click **OK**. To edit an existing value, click **Edit** and modify the fill level and drop probability. To delete a value, select it and click **Delete**.

Related Documentation

- Monitoring CoS Drop Profiles on page 134
- Example: Configuring CoS on EX Series Switches on page 39

Defining CoS Rewrite Rules (CLI Procedure)

You configure rewrite rules to alter CoS values in outgoing packets on the outbound interfaces of an EX Series switch to match the policies of a targeted peer. Policy matching allows the downstream routing platform or switch in a neighboring network to classify each packet into the appropriate service group.

To configure a CoS rewrite rule, create the rule by giving it a name and associating it with a forwarding class, loss priority, and a code point, thus creating a rewrite table, and you can enable the rewrite rule on an interface. On EX Series switches except EX4300 switches, you can also enable a rewrite rule on routed VLAN interfaces (RVIs). On EX4300 switches, you can also enable rewrite rules on integrated routing and bridging (IRB) interfaces. If you need to customize a rewrite rule, you can create a customized rewrite rule using a firewall filter configuration. You can configure CoS rewrite rules for DSCP, IP precedence and IEEE 802.1p.

You can configure rewrite rules for the following CoS marker types:

- **dscp** and **dscp-ipv6**—Handles incoming IPv4 and IPv6 packets, respectively. On EX4300 switches, you cannot configure DSCP IPv4 and DSCP IPv6 rewrite rules on the same interface. If you configure a DSCP IPv4 rewrite rule on an interface to rewrite IPv4 traffic, then the same rewrite rule is applied to IPv6 traffic also on that interface, and vice versa.
- **ieee-802.1**—Handles Layer 2 CoS.
- **inet-precedence**—Handles incoming IPv4 packets. IP precedence mapping requires only the higher order three bits of the DSCP field.

NOTE: To replace an existing rewrite rule on the interface with a new rewrite rule of the same type, first explicitly remove the rewrite rule and then apply the new rule.

To create IEEE 802.1p rewrite rules and enable them on Layer 2 interfaces:

- To create an IEEE 802.1p rewrite rule named customup-rw in the rewrite table for all Layer 2 interfaces:

```
[edit class-of-service rewrite-rules]
user@switch# set ieee-802.1 customup-rw forwarding-class be loss-priority low code-point
000
user@switch# set ieee-802.1 customup-rw forwarding-class be loss-priority high code-point
001
user@switch# set ieee-802.1 customup-rw forwarding-class af loss-priority low code-point
010
user@switch# set ieee-802.1 customup-rw forwarding-class af loss-priority high code-point
011
user@switch# set ieee-802.1 customup-rw forwarding-class ef loss-priority low code-point
100
user@switch# set ieee-802.1 customup-rw forwarding-class ef loss-priority high code-point
101
```

```
user@switch# set ieee-802.1 customup-rw forwarding-class nc loss-priority low code-point
110
user@switch# set ieee-802.1 customup-rw forwarding-class nc loss-priority high code-point
111
```

- To enable an IEEE 802.1p rewrite rule named customup-rw on a Layer 2 interface:

  ```
  [edit]
  user@switch# set class-of-service interfaces ge-0/0/0 unit 0 rewrite-rules ieee-802.1
  customup-rw
  ```

  (On EX4300 switches) To enable an IEEE 802.1p rewrite rule named customup-rw on a Layer 2 interface:

  ```
  [edit]
  user@switch# set class-of-service interfaces ge-0/0/0 rewrite-rules ieee-802.1 customup-rw
  ```

- To enable an IEEE 802.1p rewrite rule named customup-rw on all Gigabit Ethernet interfaces on the switch, use wildcards for the interface name and logical-interface (unit) number:

  ```
  [edit]
  user@switch# set class-of-service interfaces ge-* unit * rewrite-rules customup-rw
  ```

  (On EX4300 switches) To enable an IEEE 802.1p rewrite rule named customup-rw on all Gigabit Ethernet interfaces on the switch, use wildcards for the interface name:

  ```
  [edit]
  user@switch# set class-of-service interfaces ge-* rewrite-rules customup-rw
  ```

Related Documentation

- Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring CoS Rewrite Rules on page 131
- Understanding CoS Rewrite Rules on page 29

Defining CoS Rewrite Rules (J-Web Procedure)

NOTE: This topic applies only to the J-Web Application package.

You can use the J-Web interface to define CoS rewrite rules. Use the rewrite rules to alter the CoS values in outgoing packets to meet the requirements of the targeted peer. A rewrite rule examines the forwarding class and loss priority of a packet and sets its bits to a corresponding value specified in the rule.

To define rewrite rules:

1. Select **Configure** > **Class of Service** > **Rewrite Rules**.

NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. Click one of the following options:
   - **Add**—Adds a rewrite rule. Enter information into the rewrite rule page as described in Table 20 on page 88.
   - **Edit**—Modifies an existing rewrite rule. Enter information into the rewrite rule page as described in Table 20 on page 88.
   - **Delete**—Deletes an existing rewrite rule.

Table 20: Rewrite Rules Configuration Page Summary

Field	Function	Your Action
Rewrite Rule Name	Specifies the name for the rewrite rule.	To name a rule, type the name—for example, **rewrite-dscps**.
Rewrite rule type	Specifies the type of rewrite rule: **dscp**, **ieee-802.1**, or **inet-precedence**.	Select a value from the list.

Table 20: Rewrite Rules Configuration Page Summary *(continued)*

Field	Function	Your Action
Code Point Mapping	Rewrites outgoing CoS values of a packet based on the forwarding class and loss priority. Allows you to remove a code point mapping entry.	To configure a CoS value assignment, follow these steps: To add a code point mapping: 1. Click **Add**. 2. Select the code point. 3. Select a forwarding class from the following list: • **expedited-forwarding**—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service. Packets can be forwarded out of sequence or dropped. • **best-effort**—Provides no special CoS handling of packets. Typically, RED drop profile is aggressive and no loss priority is defined. • **assured-forwarding**—Provides high assurance for packets within the specified service profile. Excess packets are dropped. • **network-control**—Packets can be delayed but not dropped. 4. Select the loss priority. To assign a loss priority, select one: • **high**—Packet has a high loss priority. • **low**—Packet has a low loss priority. To edit an existing code point mapping, select it and click **Edit**. To remove a code point mapping entry, select it and click **Remove**.

Related Documentation

- Defining CoS Rewrite Rules (CLI Procedure) on page 86
- Understanding CoS Rewrite Rules on page 29
- Monitoring CoS Rewrite Rules on page 131
- Example: Configuring CoS on EX Series Switches on page 39

Assigning CoS Components to Interfaces (CLI Procedure)

After you have defined the following CoS components, you must assign them to logical or physical interfaces.

- Forwarding classes—Assign only to logical interfaces.
- Classifiers—Assign only to logical interfaces.
- Scheduler maps—Assign to either physical or logical interfaces.
- Rewrite rules—Assign to either physical or logical interfaces.

You can assign a CoS component to a single interface or to multiple interfaces using wild cards.

To assign CoS components to interfaces:

- To assign CoS components to a single interface, associate a CoS component (for example a scheduler map named **ethernet-cos-map**) with an interface:

```
[edit class-of-service interfaces]
user@switch# set ge-0/0/20 scheduler-map ethernet-cos-map
```

- To assign a CoS component to multiple interfaces, associate a CoS component (for example, a rewrite rule named **customup-rw**) to all Gigabit Ethernet interfaces on the switch, use wild characters for the interface name and logical-interface (unit) number:

```
[edit class-of-service interfaces]
user@switch# set ge-* unit * rewrite-rules ieee-802.1 customup-rw
```

Related Documentation

- Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring Interfaces That Have CoS Components on page 130
- Understanding Junos OS CoS Components for EX Series Switches on page 6

Assigning CoS Components to Interfaces (J-Web Procedure)

NOTE: **This topic applies only to the J-Web Application package.**

After you have defined CoS components on an EX Series switch, you must assign them to logical or physical interfaces. You can use the J-Web interface to assign scheduler maps to physical or logical interfaces and to assign forwarding classes or classifiers to logical interfaces.

To assign CoS components to interfaces:

1. Select **Configure** > **Class of Service** > **Assign to Interface**.

   NOTE: After you make changes to the configuration on this page, you must commit the changes immediately for them to take effect. To commit all changes to the active configuration, select **Commit Options** > **Commit**. See Using the Commit Options to Commit Configuration Changes for details about all commit options.

2. To configure interface association, select an interface from the list and click **Edit**. For an EX8200 Virtual Chassis configuration, select the member, the FPC, and the interface from the list, and click **Edit**.
3. Select one of the following:
   - **Associate system default scheduler map**—Associates the interface with the default scheduler map.
   - **Select the scheduler map**—Associates the interface with a configured scheduler map. Select the scheduler map from the list.

   NOTE: On the 40-port SFP+ line card for EX8200 switches, you cannot commit your changes using the J-Web interface unless you assign the same scheduler map or the default scheduler map to all interfaces in a port group.

4. Click **OK**.
5. To manage a CoS service assignment on a logical interface, Click one of the following options:
   - **Add**—Adds a CoS service to a logical interface on a specified physical interface. Enter information as described in Table 21 on page 91.
   - **Edit**—Modifies a CoS service assignment to a logical interface. Enter information as described in Table 21 on page 91.
   - **Delete**—Deletes the CoS service assignment to a logical interface.

Table 21: Assigning CoS Components to Logical Interfaces

Field	Function	Your Action
Unit	Specifies the name of a logical interface. Allows you to assign CoS components while configuring a logical interface on a physical interface at the same time.	Type the interface name. To assign CoS services to all logical interfaces configured on this physical interface, type the wildcard character (*).
Forwarding Class	Assigns a predefined forwarding class to incoming packets on a logical interface.	To assign a forwarding class to an interface, select the forwarding class.

Table 21: Assigning CoS Components to Logical Interfaces *(continued)*

Field	Function	Your Action
Classifiers	Allows you to apply classification maps to a logical interface. Classifiers assign a forwarding class and loss priority to an incoming packet based on its CoS value.	To assign a classification map to an interface, select an appropriate classifier for each CoS value type used on the interface.
Rewrite Rules	Allows you to alter the CoS values in outgoing packets to meet the requirements of the targeted peer. A rewrite rule examines the forwarding class and loss priority of a packet and sets its bits to a corresponding value specified in the rule. NOTE: In EX4300 switches, this option is available only when you click **Edit** button in the Configure Interface Association table.	To assign rewrite rules to the interface, select the appropriate rewrite rule for each CoS value type used on the interface.

Related Documentation

- Assigning CoS Components to Interfaces (CLI Procedure) on page 90
- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring Interfaces That Have CoS Components on page 130

Configuring Junos OS EZQoS for CoS (CLI Procedure)

You use Junos OS EZQoS on EX Series switches to eliminate the complexities involved in configuring class of service (CoS) across the network. EZQoS offers templates for key traffic classes.

When you configure EZQoS on EX Series switches, preconfigured values are assigned to all CoS parameters based on the typical application requirements. These preconfigured values are stored in a template with a unique name.

NOTE: Currently, we provide an EZQoS template for configuring CoS for VoIP applications. The EZQoS VoIP template is stored in **/etc/config/ezqos-voip.conf**.

To configure EZQoS using the CLI:

1. Load the EZQoS configuration file (**/etc/config/ezqos-voip.conf**):

   ```
   [edit]
   user@switch# load merge /etc/config/ezqos-voip.conf
   ```

2. Apply the EZQoS group (**ezqos-voip**):

   ```
   [edit]
   user@switch# set apply-groups ezqos-voip
   ```

3. Apply the DSCP classifier (**ezqos-dscp-classifier**) to a Gigabit Ethernet interface (**ge-0/0/0**):

   ```
   [edit class-of-service interfaces]
   ```

```
user@switch# set ge-0/0/0 unit 0 classifiers dscp ezqos-dscp-classifier
```

4. Apply the scheduler map (**ezqos-voip-sched-maps**) to a Gigabit Ethernet interface (**ge-0/0/1**):

```
[edit class-of-service interfaces]
user@switch# set ge-0/0/1 scheduler-map ezqos-voip-sched-maps
```

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches on page 32

Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards (CLI Procedure)

EX8200 switches provide certain line cards that include oversubscribed ports. These ports are logically grouped into a port group and each port group share a certain fixed bandwidth. Because oversubscribed ports handle traffic differently than ports that provide continuous line-rate bandwidth, configuring CoS queues is different for oversubscribed ports than for line-rate ports.

Packets arriving on an oversubscribed port in a line card are directed to a high-priority, low priority, or line-rate queue. These queues are used for scheduling traffic from the port into the Packet Forwarding Engine. The fabric priority associated with the packet's forwarding class determines which queue the packet is sent to. The forwarding class of the packet in turn is determined by the behavior aggregate (BA) classifier assigned to the port. By default, the fabric priority of all forwarding classes is low. Thus all packets, with the exception of critical network packets and line-rate packets, are sent to the low-priority ingress queue by default. The critical network packets and line-rate packets do not need a BA classifier as they are always sent on the high-priority and line-rate queues, respectively.

This procedure describes how you can direct traffic into the high-priority ingress queue and thus avoid congestion at the port group.

To direct traffic to the high-priority ingress queue for a port group:

1. Create the BA classifier for the forwarding class:

```
[edit class-of-service]
user@switch# set classifiers classifier-type classifier-name
forwarding-class class-name loss-priority level code-points code-point
```

2. Assign a queue number and fabric priority to the forwarding class:

```
[edit class-of-service]
user@switch# set forwarding-classes class class-name queue-num number
priority level
```

3. Assign the BA classifier to the physical interface:

```
[edit class-of-service]
user@switch# set interfaces interface-name unit 0
classifiers classifier-type classifier-name
```

For example, to direct voice traffic to the high-priority ingress queue for interface **xe-1/0/2**:

```
[edit class-of-service]
user@switch# set classifiers dscp dscp1 forwarding-class cos-voice
loss-priority low code-points ef

[edit class-of-service]
user@switch# set forwarding-classes class cos-voice queue-num 5 priority high

[edit class-of-service]
user@switch# set interfaces xe-1/0/2 unit 0 classifiers dscp dscp1
```

NOTE: You must use a BA classifier to classify traffic for ingress queuing. Multifield (MF) classification and port classification (that is, assigning a forwarding class to the interface) are not supported for classifying traffic for ingress queuing. The BA classifier must be assigned to a physical interface, not a Layer 3 tagged interface or a routed VLAN interface (RVI).

Related Documentation

- Understanding CoS Queues on EX8200 Line Cards That Include Oversubscribed Ports on page 33

CHAPTER 4

Configuration Statements

- transmit-rate (EX Series Switches) on page 122
- unit on page 123

[edit class-of-service] Configuration Statement Hierarchy on EX Series Switches

This topic lists supported and unsupported configuration statements in the **[edit class-of-service]** hierarchy level on EX Series switches.

- *Supported* statements are those that you can use to configure some aspect of a software feature on the switch.
- *Unsupported* statements are those that appear in the command-line interface (CLI) on the switch, but that have no effect on switch operation if you configure them.
- Not all features are supported on all switch platforms. For detailed information about feature support on specific EX Series switch platforms, see Feature Explorer.

This topic lists:

- Supported Statements in the [edit class-of-service] Hierarchy Level on page 96
- Unsupported Statements in the [edit class-of-service] Hierarchy Level on page 98

Supported Statements in the [edit class-of-service] Hierarchy Level

The following hierarchy shows the **[edit class-of-service]** configuration statements supported on EX Series switches:

```
class-of-service {
  classifiers {
    (dscp | dscp-ipv6 |ieee-802.1 | inet-precedence) classifier-name {
      forwarding-class class-name {
        loss-priority (high | low | medium-high | medium-low) {
          code-points [ aliases ] [ 6 bit-patterns ];
        }
      }
      import (classifier-name | default);
    }
  }
  code-point-aliases {
    (dscp | dscp-ipv6 | ieee-802.1 | inet-precedence) {
      alias-name bits;
    }
  }
  drop-profiles {
    profile-name {
      interpolate {
        drop-probability [values];
        fill-level [values]
      }
    }
  }
  forwarding-classes {
    class class-name
    queue queue-number;
```

```
}
interfaces interface-name {
  scheduler-map map-name;
  shaping-rate rate;
  unit (logical-unit-number | * ) {
    classifiers {
      (dscp | dscp-ipv6|ieee-802.1 | inet-precedence) (classifier-name | default);
    }
    forwarding-class class-name ;
    }
  }
  rewrite-rules {
    (dscp | dscp-ipv6 | ieee-802.1 | inet-precedence) (rewrite-rule-name | default);
  }
}
rewrite-rules {
  (dscp | dscp-ipv6 | ieee-802.1 | inet-precedence ) rewrite-name {
    import (default | rewrite-name);
    forwarding-class class-name {
      loss-priority (high | low | medium-high | medium-low) code-point (alias | bits);
    }
  }
}
scheduler-maps {
  map-name {
    forwarding-class class-name {
      scheduler scheduler-name;
    }
  }
}
schedulers {
  scheduler-name  {
    buffer-size (exact | percent percentage | remainder);
    drop-profile-map {
      loss-priority (any | high | medium-high | medium-low);
      protocol any;
      {
        drop-profile profile-name
      }
    }
    excess-rate {
      percent percentage;
    }
    priority (low | strict-high);
    shaping-rate (rate | percent percentage);
    transmit-rate (EX Series Switches) (rate | percent percentage | remainder) ;
  }
}
shared-buffer {
  percent;
}
traceoptions {
  file (file-name | files files | match match | no-world-readable | size size | world-readable);
  flag ( all | asynch | chassis-scheduler | cos-adjustment | dynamic | hardware-database
    | init | parse | performance-monitor | process | restart | route-socket | show | snmp |
    util);
```

```
        no-remote-trace;
    }
    tri-color;
}
```

Unsupported Statements in the [edit class-of-service] Hierarchy Level

All statements in the **[edit class-of-service]** hierarchy level that are displayed in the command-line interface (CLI) on the switch are supported on the switch and operate as documented.

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Forwarding Classes (CLI Procedure) on page 73 or Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- *Configuring CoS Tail Drop Profiles (CLI Procedure)*
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87

broadcast

Syntax broadcast *forwarding-class-name*;

Hierarchy Level [edit class-of-service multi-destination family ethernet]

Release Information Statement introduced in Junos OS Release 9.5 for EX Series switches.

Description Specify the forwarding class for the broadcast traffic belonging to the Ethernet family.

Options ***forwarding-class-name*** —Name of the forwarding class:

- **mcast-af**—Default forwarding class for assured forwarding of multicast traffic.
- **mcast-be**—Default best-effort forwarding class for multicast traffic.
- **mcast-ef**—Default forwarding class for expedited forwarding of multicast traffic.

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

Related Documentation

- Understanding CoS Schedulers on page 22
- *Understanding CoS Forwarding Classes*
- *Understanding CoS Classifiers*

buffer-size

Syntax buffer-size (exact | percent *percentage* | remainder | temporal);

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify buffer size in a scheduler configuration.

Default On EX Series switches except EX4300 switches, the default scheduler transmission rate and buffer size percentages for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent, respectively. On EX4300 switches, the default scheduler transmission rate and buffer size for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available buffer.

Options

exact—(Except on EX8200 standalone switches and EX8200 Virtual Chassis) Enforce the exact buffer size. When this option is configured, sharing is disabled on the queue, restricting the usage to guaranteed buffers only.

percent *percentage*—Buffer size as a percentage of the total buffer.

remainder—Remaining buffer available.

temporal—(EX4200 standalone switches, EX4200 Virtual Chassis, EX4300 standalong switches, EX4300 Virtual Chassis, EX8200 standalone switches, and EX8200 Virtual Chassis only) Buffer size as a temporal value.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Understanding CoS Schedulers on page 22

classifiers

Syntax

```
classifiers {
  (dscp | dscp-ipv6 | ieee-802.1 | inet-precedence) classifier-name {
    import (classifier-name | default);
    forwarding-class class-name {
      loss-priority level {
        code-points [aliases] [6–bit-patterns];
      }
    }
  }
}
```

Hierarchy Level

[edit class-of-service],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number*]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Expanded to include EXP classifiers in Junos OS Release 10.1 for EX Series switches.

Description

Apply a CoS aggregate behavior classifier to a logical interface. You can apply a default classifier or a custom classifier.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- *Example: Combining CoS with MPLS on EX Series Switches*
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- *Understanding CoS Classifiers*

code-point-aliases

Syntax

```
code-point-aliases {
  (dscp | dscp-ipv6 | ieee-802.1 | inet-precedence) |{
    alias-name  bits;
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Define an alias for a CoS marker.

The remaining statement is explained separately.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Understanding CoS Code-Point Aliases on page 8

code-points

Syntax code-points [*aliases*] [*6 bit-patterns*];

Hierarchy Level [edit class-of-service classifiers (dscp | ieee-802.1 | inet-precedence) forwarding-class *class-name* loss-priority *level*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify one or more DSCP code-point aliases or bit sets for association with a forwarding class.

Options ***aliases*** —Name of the DSCP alias.

6 bit-patterns —Value of the code-point bits, in decimal form.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- *Understanding CoS Classifiers*

drop-profile-map

Syntax drop-profile-map loss-priority *loss-priority* protocol *protocol* drop-profile *profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Define the loss priority value for the specified drop profile.

Options **drop-profile** ***profile-name*** —Name of the drop profile.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Understanding CoS Schedulers on page 22

dscp

Syntax

```
dscp classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ 6–bit-patterns ];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[editclass-of-service interfaces *interface-name* unit *logical-unit-number* classifiers],
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Define the Differentiated Services code point (DSCP) mapping that is applied to the packets.

Options

classifier-name—Name of the classifier.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- *Understanding CoS Classifiers*

dscp-ipv6

Syntax

```
dscp-ipv6 classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [aliases] [6–bit-patterns];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* classifiers]
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules]
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 10.2 for EX Series switches.

Description

Define the Differentiated Services code point (DSCP) mapping that is applied to the IPv6 packets.

Options

classifier-name—Name of the classifier.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- *Understanding CoS Classifiers*

ethernet (CoS for Multidestination Traffic)

Syntax

```
ethernet {
  broadcast forwarding-class-name;
}
```

Hierarchy Level [edit class-of-service multi-destination family]

Release Information Statement introduced in Junos OS Release 9.5 for EX Series switches.

Description Specify the Ethernet broadcast traffic family.

The remaining statement is explained separately.

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

Related Documentation

- Understanding CoS Schedulers on page 22
- *Understanding CoS Forwarding Classes*
- *Understanding CoS Classifiers*

excess-rate (Schedulers)

Syntax

```
excess-rate {
  percent percentage;
}
```

Hierarchy Level [edit class-of-service on page 96 schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.

Description (EX4300 switches only) Specify the percentage of excess bandwidth traffic to share.

Default Excess bandwidth is shared in proportion to the configured transmit rate of each queue.

Options

- **percent**—Percentage of the excess bandwidth to share.

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

Related Documentation

- Understanding CoS Schedulers on page 22
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Example: Configuring CoS on EX Series Switches on page 39

family

Syntax

```
family {
  ethernet {
    broadcast forwarding-class-name;
  }
  inet {
    classifiers{
      (dscp | ieee-802.1 | inet-precedence) classifier-name;
    }
  }
}
```

Hierarchy Level [edit class-of-service multi-destination]

Release Information Statement introduced in Junos OS Release 9.5 for EX Series switches.

Description Specify the multidestination traffic family.

The remaining 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

- Understanding CoS Schedulers on page 22
- *Understanding CoS Forwarding Classes*
- *Understanding CoS Classifiers*

forwarding-class

Syntax

```
forwarding-class class-name {
  loss-priority level {
    code-points [aliases] [6–bit-patterns];
  }
}
```

Hierarchy Level

[edit class-of-service classifiers (dscp | ieee-802.1 | inet-precedence) *classifier-name*],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number*],
[edit class-of-service rewrite-rules] (dscp | ieee-802.1 | inet-precedence) *rewrite-rule-name*],
[edit class-of-service scheduler-maps *map-name*],
[edit class-of-service host-outbound-traffic]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Define forwarding class name and option values.

Options

class-name —Name of the forwarding class.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Forwarding Classes (CLI Procedure) on page 73 or Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- *Understanding CoS Forwarding Classes*

forwarding-classes

Syntax

```
forwarding-classes {
    class class-name  queue-num queue-number priority (high | medium-high | low |
        medium-low);
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Associate the forwarding class with a queue name and number.

The statement is explained separately.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Forwarding Classes (CLI Procedure) on page 73 or Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- *Understanding CoS Forwarding Classes*

ieee-802.1

Syntax

```
ieee-802.1 classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ 6 bit-patterns ];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[editclass-of-service interfaces *interface-name* unit *logical-unit-number* classifiers],
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Apply an IEEE-802.1 rewrite rule.

Options

classifier-name —Name of the classifier.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- *Understanding CoS Classifiers*
- Understanding CoS Rewrite Rules on page 29

import

Syntax import (*classifier-name* | default);

Hierarchy Level [edit class-of-service classifiers (dscp | ieee-802.1 | inet-precedence) *classifier-name*],

[edit class-of-service rewrite-rules (dscp | ieee-802.1 | inet-precedence) *rewrite-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify a default or previously defined classifier.

Options ***classifier-name*** —Name of the classifier mapping configured at the **[edit class-of-service classifiers]** hierarchy level.

default—Default classifier mapping.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- *Understanding CoS Classifiers*
- Understanding CoS Rewrite Rules on page 29

inet-precedence

Syntax

```
inet-precedence classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ 6–bit-patterns ];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[editclass-of-service interfaces *interface-name* unit *logical-unit-number* classifiers],
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Apply an IPv4 precedence rewrite rule.

Options

classifier-name—Name of the classifier.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Code-Point Aliases (CLI Procedure) on page 66 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- *Understanding CoS Classifiers*
- Understanding CoS Rewrite Rules on page 29

interfaces

Syntax

```
interfaces {
  interface-name  {
    congestion-notification-profile profile-name {
      input {
        ieee-802.1 {
          code-point up-bits pfc;
          }
        }
      }
    }
    scheduler-map map-name;
    unit logical-unit-number {
      forwarding-class class-name;
      classifiers {
        (dscp | ieee-802.1 | inet-precedence) (classifier-name | default);
      }
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Configure interface-specific class-of-service (CoS) properties for incoming packets.

Options *interface-name*—Name of the interface.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Forwarding Classes (CLI Procedure) on page 73 or Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- *Configuring Priority-Based Flow Control for an EX Series Switch (CLI Procedure)*

loss-priority (Classifiers and Rewrite Rules)

Syntax

```
loss-priority level {
  code-points [aliases] [6–bit-patterns | 3–bit-patterns];
}
```

Hierarchy Level

```
[edit class-of-service classifiers (dscp | ieee-802.1 | inet-precedence | exp) classifier-name
  forwarding-class class-name],
[edit class-of-service rewrite-rules (dscp | ieee-802.1 | inet-precedence | exp)
  rewrite-rule-name forwarding-class class-name]
```

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement expanded to apply to EXP classifiers in Junos OS Release 10.1 for EX Series switches.

Description

Specify packet loss priority value for a specific set of code-point aliases and bit patterns.

Options

level —Can be one of the following:

- **high**—Packet has high loss priority.
- **medium-high**— (On EX3200, EX4200, EX4300, and EX4500 switches only) Code points to classify to loss priority medium-high.
- **low**—Packet has low loss priority.
- **medium-low** — (On EX3200, EX4200, EX4300, and EX4500 switches only) Code points to classify to loss priority medium-low.

The remaining statement is explained separately.

Required Privilege Level

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Classifiers (CLI Procedure) on page 69 or Defining CoS Classifiers (J-Web Procedure) on page 71
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- *Understanding CoS Classifiers*
- Understanding CoS Rewrite Rules on page 29

policing

Syntax policing (filter *filter-name* | no-automatic-policing);

Hierarchy Level [edit protocols mpls label-switched-path *lsp-name*]
[edit interfaces *interface-id* unit *number-of-logical-unit* family inet address *ip-address*]

Release Information Statement introduced in Junos OS Release 10.1 for EX Series switches.

Description Apply a rate-limiting policer as the specified policing filter:

- To the LSP for MPLS over CCC.
- To the customer-edge interface for IP over MPLS.

Options **filter *filter-name***—Specify the name of the policing filter.

no-automatic-policing—Disable automatic policing on this LSP.

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

Related Documentation

- *policer*
- *Configuring Policers to Control Traffic Rates (CLI Procedure)*
- *Configuring CoS on an MPLS Provider Edge Switch Using Circuit Cross-Connect (CLI Procedure)*
- *Configuring CoS on an MPLS Provider Edge Switch Using IP Over MPLS (CLI Procedure)*

priority (Schedulers)

Syntax priority *priority*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify packet-scheduling priority value.

Options ***priority*** —It can be one of the following:

- **low**—Scheduler has low priority.
- **strict-high**—Scheduler has strictly high priority.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Understanding CoS Schedulers on page 22

protocol (Drop Profiles)

Syntax protocol *protocol* drop-profile *profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify the protocol type for the specified drop profile.

Options **drop-profile** ***profile-name*** —Name of the drop profile.

protocol —Type of protocol. It can be:

- **any**—Accept any protocol type.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- *Configuring CoS Tail Drop Profiles (CLI Procedure)*
- *Understanding CoS Tail Drop Profiles*

rewrite-rules

Syntax

```
rewrite-rules {
  (dscp | dscp-ipv6 | exp |ieee-802.1 | inet-precedence ) rewrite-name {
    import ( default | rewrite-name);
    forwarding-class class-name {
      loss-priority level code-point (alias | bits);
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement expanded for use with global EXP classifiers in Junos OS Release 10.1 for EX Series switches.

Description Specify a rewrite-rules mapping for the traffic that passes through all queues on the interface.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Rewrite Rules (CLI Procedure) on page 86 or Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- Understanding CoS Rewrite Rules on page 29
- *Understanding Using CoS with MPLS Networks on EX Series Switches*

scheduler-map

Syntax scheduler-map *map-name*;

Hierarchy Level [edit class-of-service interfaces],
[edit class-of-service multi-destination]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Associate a scheduler map name with an interface or with a multidestination traffic configuration.

Options ***map-name*** —Name of the scheduler map.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- Understanding CoS Schedulers on page 22
- *Understanding CoS Classifiers*

scheduler-maps

Syntax

```
scheduler-maps {
  map-name {
    forwarding-class class-name scheduler scheduler-name;
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify a scheduler map name and associate it with the scheduler configuration and forwarding class.

Options *map-name* —Name of the scheduler map.

The remaining statement is explained separately.

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Forwarding Classes (CLI Procedure) on page 73 or Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- Understanding CoS Schedulers on page 22
- *Understanding CoS Forwarding Classes*

schedulers (CoS)

Syntax

```
schedulers {
  scheduler-name  {
    buffer-size (percent percentage | remainder);
    drop-profile-map loss-priority loss-priority protocol protocol drop-profile profile-name;
    excess-rate (percent percentage);
    priority priority;
    shaping-rate (rate | percent percentage);
    transmit-rate (EX Series Switches) (rate | percent percentage | remainder);
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify scheduler name and parameter values.

Options ***scheduler-name*** —Name of the scheduler.

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Understanding CoS Schedulers on page 22

shaping-rate

Syntax shaping-rate (percent *percentage* | rate);

Hierarchy Level [edit class-of-service schedulers (CoS) *scheduler-name*]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.

Description Configure shaping rate to throttle the rate at which queues transmit packets.

We recommend that you configure the shaping rate as an absolute maximum usage and not as additional usage beyond the configured transmit rate.

Default If you do not include this statement, the default shaping rate is 100 percent, which is the same as no shaping at all.

Options **percent*percentage*** —Shaping rate as a percentage of the available interface bandwidth.

Range: 0 through 100 percent

rate—Peak rate, in bits per second (bps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).

Range: 3200 through 32,000,000,000 bps

(EX4300 switches only) 8000 through 160,000,000,000 bps

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Understanding Junos OS CoS Components for EX Series Switches on page 6

transmit-rate (EX Series Switches)

Syntax transmit-rate (*rate* | percent *percentage* | remainder);

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify the transmit rate or percentage for a scheduler.

Default If you do not include this statement, the default scheduler transmission rate and buffer size percentages for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent.

Options

rate —Transmission rate, in bps. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).

Range: 3200 through 160,000,000,000 bps

(EX4300 switches only) 8000 through 160,000,000,000 bps

percent *percentage* —Percentage of transmission capacity. A percentage of zero drops all packets in the queue.

Range: 0 through 100 percent

remainder—Remaining rate available

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

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75 or Defining CoS Schedulers (J-Web Procedure) on page 77
- Understanding CoS Schedulers on page 22

unit

Syntax

```
unit logical-unit-number {
  forwarding-class class-name;
  classifiers {
    (dscp | ieee-802.1 | inet-precedence) (classifier-name | default);
  }
}
```

Hierarchy Level [edit class-of-service interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.

Options ***logical-unit-number*** —Number of the logical unit.

Range: 0 through 16,385

The remaining 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

- Example: Configuring CoS on EX Series Switches on page 39
- Assigning CoS Components to Interfaces (CLI Procedure) on page 90 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 90

PART 3

Administration

CHAPTER 5

Routine Monitoring

Monitoring CoS Classifiers

Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring functionality to display the mapping of incoming CoS values to forwarding class and loss priority for each classifier.

Action To monitor CoS classifiers in the J-Web interface, select **Monitor** > **Class of Service** > **Classifiers**.

To monitor CoS classifiers in the CLI, enter the following CLI command:

show class-of-service classifier

Meaning Table 22 on page 127 summarizes key output fields for CoS classifiers.

Table 22: Summary of Key CoS Classifier Output Fields

Field	Values	Additional Information
Classifier Name	Name of a classifier.	To display classifier assignments, click the plus sign (+).

Table 22: Summary of Key CoS Classifier Output Fields *(continued)*

Field	Values	Additional Information
CoS Value Type	The classifiers are displayed by type: • **dscp**—All classifiers of the DSCP type. • **ieee-802.1**—All classifiers of the IEEE 802.1 type. • **inet-precedence**—All classifiers of the IP precedence type.	
Index	Internal index of the classifier.	
Incoming CoS Value	CoS value of the incoming packets, in bits. These values are used for classification.	
Assign to Forwarding Class	Forwarding class that the classifier assigns to an incoming packet. This class affects the forwarding and scheduling policies that are applied to the packet as it transits the switch.	
Assign to Loss Priority	Loss priority value that the classifier assigns to the incoming packet based on its CoS value.	

Related Documentation

- Defining CoS Classifiers (CLI Procedure) on page 69
- Defining CoS Classifiers (J-Web Procedure) on page 71
- Example: Configuring CoS on EX Series Switches on page 39

Monitoring CoS Forwarding Classes

Purpose

NOTE: This topic applies only to the J-Web Application package.

View the current assignment of class-of-service (CoS) forwarding classes to queues on the switch.

Action

To monitor CoS forwarding classes in the J-Web interface, select **Monitor** > **Class of Service** > **Forwarding Classes**.

To monitor CoS forwarding classes in the CLI, enter the following CLI command:

show class-of-service forwarding-class

Meaning

Table 23 on page 129 summarizes key output fields for CoS forwarding classes.

Table 23: Summary of Key CoS Forwarding Class Output Fields

Field	Values
Forwarding Class	Names of forwarding classes assigned to queue numbers. The following are the default forwarding classes: • **best-effort**—Provides no special CoS handling of packets. Loss priority is typically not carried in a CoS value. • **expedited-forwarding**—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service. • **assured-forwarding**—Provides high assurance for packets within the specified service profile. Excess packets are dropped. • **network-control**—Packets can be delayed but not dropped. EX8200 switches have the following additional default forwarding classes: • **mcast-be**—Provides no special CoS handling of packets. • **mcast-ef**—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service. • **mcast-af**—Provides high assurance for packets within the specified service profile. Excess packets are dropped. EX4300 switches supports all the forwarding classes mentioned above and the one mentioned in this section: • **mcast-nc**—Provides multicast network-control traffic.
Queue	Queue number corresponding to the forwarding class name. The default forwarding classes are assigned as follows: • **best-effort**—0 • **expedited-forwarding**—5 • **assured-forwarding**—1 • **network-control**—7 • **mcast-be**—2 • **mcast-ef**—4 • **mcast-af**—6 EX4300 switches have the following queue numbers for the forwarding classes: • **best-effort**—0 • **expedited-forwarding**—1 • **assured-forwarding**—2 • **network-control**—3 • **mcast-be**—8 • **mcast-ef**—9 • **mcast-af**—10 • **mcast-nc**—11
Fabric Priority	(EX8200 switches only) Fabric priority for the forwarding class, either **high** or **low**. The fabric priority determines the priority of packets entering the switch fabric.

Related Documentation

- Defining CoS Forwarding Classes (CLI Procedure) on page 73
- Defining CoS Forwarding Classes (J-Web Procedure) on page 73
- Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards (CLI Procedure) on page 93
- Example: Configuring CoS on EX Series Switches on page 39

Monitoring Interfaces That Have CoS Components

Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring functionality to display details about the physical and logical interfaces and the CoS components assigned to them.

Action

To monitor interfaces that have CoS components in the J-Web interface, select **Monitor** > **Class of Service** > **Interface Association**.

To monitor interfaces that have CoS components in the CLI, enter the following command:

show class-of-service interface *interface*

Meaning

Table 24 on page 130 summarizes key output fields for CoS interfaces.

Table 24: Summary of Key CoS Interfaces Output Fields

Field	Values	Additional Information
Interface	Name of a physical interface to which CoS components are assigned.	To display names of logical interfaces configured on this physical interface, click the plus sign (+).
Scheduler Map	Name of the scheduler map associated with this interface.	
Queues Supported	Number of queues you can configure on the interface.	
Queues in Use	Number of queues currently configured.	
Logical Interface	Name of a logical interface on the physical interface to which CoS components are assigned.	
Object	Category of an object—for example, **classifier**, **scheduler-map**, or **rewrite**.	
Name	Name that you have given to an object—for example, **ba-classifier**.	

Table 24: Summary of Key CoS Interfaces Output Fields *(continued)*

Field	Values	Additional Information
Type	Type of an object—for example, **dscp** for a classifier.	
Index	Index of this interface or the internal index of a specific object.	

Related Documentation

- Assigning CoS Components to Interfaces (CLI Procedure) on page 90
- Assigning CoS Components to Interfaces (J-Web Procedure) on page 90
- Example: Configuring CoS on EX Series Switches on page 39

Monitoring CoS Rewrite Rules

Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring functionality to display information about CoS value rewrite rules, which are based on the forwarding class and loss priority.

Action

To monitor CoS rewrite rules in the J-Web interface, select **Monitor** > **Class of Service** > **Rewrite Rules**.

To monitor CoS rewrite rules in the CLI, enter the following command:

show class-of-service rewrite-rules

Meaning

Table 25 on page 131 summarizes key output fields for CoS rewrite rules.

Table 25: Summary of Key CoS Rewrite Rules Output Fields

Field	Values	Additional Information
Rewrite Rule Name	Names of rewrite rules.	
CoS Value Type	Rewrite rule type: • **dscp**—For IPv4 DiffServ traffic. • **exp**—For MPLS traffic. • **ieee-802.1**—For Layer 2 traffic. • **inet-precedence**—For IPv4 traffic.	To display forwarding classes, loss priorities, and rewritten CoS values, click the plus sign (+).
Index	Internal index for this particular rewrite rule.	

Table 25: Summary of Key CoS Rewrite Rules Output Fields *(continued)*

Field	Values	Additional Information
Forwarding Class	Forwarding class that is used to determine CoS values for rewriting in combination with loss priority.	Rewrite rules are applied to CoS values in outgoing packets based on forwarding class and loss priority setting.
Loss Priority	Loss priority that is used to determine CoS values for rewriting in combination with forwarding class.	
Rewrite CoS Value To	Value that the CoS value is rewritten to.	

Related Documentation

- Defining CoS Rewrite Rules (CLI Procedure) on page 86
- Defining CoS Rewrite Rules (J-Web Procedure) on page 87
- Example: Configuring CoS on EX Series Switches on page 39

Monitoring CoS Scheduler Maps

Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring functionality to display assignments of CoS forwarding classes to schedulers.

Action

To monitor CoS scheduler maps in the J-Web interface, select **Monitor** > **Class of Service** > **Scheduler Maps**.

To monitor CoS scheduler maps in the CLI, enter the following CLI command:

show class-of-service scheduler-map

Meaning

Table 26 on page 132 summarizes key output fields for CoS scheduler maps.

Table 26: Summary of Key CoS Scheduler Maps Output Fields

Field	Values	Additional Information
Scheduler Map	Name of a scheduler map.	For details, click the plus sign (+).
Index	Index of a specific object—scheduler maps, schedulers, or drop profiles.	
Scheduler Name	Name of a scheduler.	
Forwarding Class	Forwarding classes this scheduler is assigned to.	

Table 26: Summary of Key CoS Scheduler Maps Output Fields *(continued)*

Field	Values	Additional Information
Transmit Rate	Configured transmit rate of the scheduler in bits per second (bps). The rate value can be either of the following: • A percentage—The scheduler receives the specified percentage of the total interface bandwidth. • **remainder**— The scheduler receives the remaining bandwidth of the interface after bandwidth allocation to other schedulers.	
Buffer Size	Delay buffer size in the queue or the amount of transmit delay (in milliseconds). The buffer size can be either of the following: • A percentage—The buffer is a percentage of the total buffer allocation. • **remainder**—The buffer is sized according to what remains after other scheduler buffer allocations.	
Priority	Scheduling priority of a queue: • **strict-high**—Packets in this queue are transmitted first. • **low**—Packets in this queue are transmitted last.	
Excess rate	The percentage of excess bandwidth traffic to share.	
Drop Profiles	Name and index of a drop profile that is assigned to a specific loss priority and protocol pair.	
Loss Priority	Packet loss priority corresponding to a drop profile.	
Protocol	Transport protocol corresponding to a drop profile.	
Drop Profile Name	Name of the drop profile.	
Index	Index of a specific object—scheduler maps, schedulers, or drop profiles.	

Related Documentation

- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75
- Defining CoS Schedulers (J-Web Procedure) on page 77
- Example: Configuring CoS on EX Series Switches on page 39

Monitoring CoS Value Aliases

Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring functionality to display information about the CoS value aliases that the system is currently using to represent DSCP, IEEE 802.1p, and IPv4 precedence bits.

Action

To monitor CoS value aliases in the J-Web interface, select **Monitor** > **Class of Service** > **CoS Value Aliases**.

To monitor CoS value aliases in the CLI, enter the following command:

show class-of-service code-point-aliases

Meaning

Table 27 on page 134 summarizes key output fields for CoS value aliases.

Table 27: Summary of Key CoS Value Alias Output Fields

Field	Values	Additional Information
CoS Value Type	Type of the CoS value: • **dscp**—Examines Layer 3 packet headers for IP packet classification. • **ieee-802.1**—Examines Layer 2 packet headers for packet classification. • **inet-precedence**—Examines Layer 3 packet headers for IP packet classification.	To display aliases and bit patterns, click the plus sign (+).
CoS Value Alias	Name given to a set of bits—for example, **af11** is a name for **001010** bits.	
CoS Value	Set of bits associated with an alias.	

Related Documentation

- Defining CoS Code-Point Aliases (CLI Procedure) on page 66
- Defining CoS Code-Point Aliases (J-Web Procedure) on page 67
- Example: Configuring CoS on EX Series Switches on page 39

Monitoring CoS Drop Profiles

Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring functionality to view data point information for each CoS random early detection (RED) drop profile on the EX8200 switch.

Action To monitor CoS RED drop profiles in the J-Web interface, select **Monitor** > **Class of Service** > **RED Drop Profiles**.

To monitor CoS RED drop profiles in the CLI, enter the following CLI command:

```
show class-of-service drop-profile
```

Meaning Table 28 on page 135 summarizes the key output fields for CoS RED drop profiles.

Table 28: Summary of the Key Output Fields for CoS Red Drop Profiles

Field	Values	Additional Information
RED Drop Profile Name	Name of the RED drop profile. A drop profile consists of pairs of values between 0 and 100, one for queue buffer fill level and the other for drop probability, that determine the relationship between a buffer's fullness and the likelihood it will drop packets.	To display profile values, click the plus sign (+).
Graph RED Profile	Links to a graph of a RED curve that the system uses to determine the drop probability based on queue buffer fullness.	The x axis represents the queue buffer fill level, and the y axis represents the drop probability.
Type	Type of a specific drop profile: • **interpolated**—The two coordinates (x and y) of the graph are interpolated to produce a smooth profile. • **segmented**—The two coordinates (x and y) of the graph are represented by line fragments to produce a segmented profile.	
Index	Internal index of this drop profile.	
Fill Level	Percentage fullness of a buffer queue. This value is the x coordinate of the RED drop profile graph.	
Drop Probability	Drop probability of a packet corresponding to a specific queue buffer fill level. This value is the y coordinate of the RED drop profile graph.	

Related Documentation

- Defining CoS Drop Profiles (J-Web Procedure) on page 84
- Example: Configuring CoS on EX Series Switches on page 39

CHAPTER 6

Operational Commands

show class-of-service

Syntax **show class-of-service**

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
EXP classifiers added in Junos OS Release 10.1 for EX Series switches.

Description Display the class-of-service (CoS) information.

Required Privilege Level view

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- Monitoring CoS Value Aliases on page 134
- Monitoring CoS Classifiers on page 127
- Monitoring CoS Forwarding Classes on page 128
- Monitoring CoS Scheduler Maps on page 132
- Monitoring CoS Rewrite Rules on page 131

List of Sample Output show class-of- service on page 139
show class-of-service rewrite-rule on page 142

Output Fields Table 29 on page 138 lists the output fields for the **show class-of-service** command. Output fields are listed in the approximate order in which they appear.

Table 29: show class-of-service Output Fields

Field Name	Field Description	Level of Output
Forwarding class	The forwarding class configuration: • **Forwarding class**—Name of the forwarding class. • **ID**—Forwarding class ID. • **Queue**—Queue number. • **Fabric Priority**—(EX8200 switches only) Fabric priority: either **high** or **low**. The fabric priority determines which CoS ingress queues packets are sent to.	All levels
Code point type	The type of code-point alias: • **dscp**—Aliases for DiffServ code point (DSCP) values. • **ieee–802.1**—Aliases for IEEE 802.1p values. • **inet-precedence**—Aliases for IP precedence values. • **exp**—Aliases for experimental (EXP) values.	All levels
Alias	Names given to CoS values.	All levels
Bit pattern	Set of bits associated with an alias.	All levels
Classifier	Name of the classifier.	All levels

Table 29: show class-of-service Output Fields *(continued)*

Field Name	Field Description	Level of Output
Code point	Code-point values.	All levels
Loss priority	Loss priority assigned to specific CoS values and aliases of the classifier.	All levels
Rewrite rule	Name of the rewrite-rule.	All levels
Drop profile	Name of the drop profile.	All levels
Type	Type of drop profile. EX Series switches support only the **discrete** type of drop profile.	All levels
Fill level	Percentage of queue buffer fullness of *high* packets beyond which *high* packets are dropped.	All levels
Scheduler	Name of the scheduler.	All levels
Transmit rate	Transmission rate of the scheduler.	All levels
Excess rate	Percentage of excess bandwidth traffic to share.	All levels
Buffer size	Delay buffer size in the queue.	All levels
Drop profiles	Drop profiles configured for the specified scheduler.	All levels
Protocol	Transport protocol corresponding to the drop profile.	All levels
Name	Name of the drop profile.	All levels
Queues supported	Number of queues that can be configured on the interface.	All levels
Queues in use	Number of queues currently configured.	All levels
Physical interface	Name of the physical interface.	All levels
Scheduler map	Name of the scheduler map.	All levels
Index	Internal index of a specific object.	All levels

Sample Output

show class-of- service

```
user@switch> show class-of-service
Forwarding class                          ID      Queue
  best-effort                              0       0
  expedited-forwarding                     1       5
  assured-forwarding                       2       1
  network-control                          3       7
```

```
Code point type: dscp
  Alias              Bit pattern
  af11               001010
  af12               001100
  ...                ...

Code point type: ieee-802.1
  Alias              Bit pattern
  af11               010
  ...                ...

Code point type: inet-precedence
  Alias              Bit pattern
  af11               001
  ...                ...

Classifier: dscp-default, Code point type: dscp, Index: 7
  Code point         Forwarding class                   Loss priority
  000000             best-effort                        low
  000001             best-effort                        low
  ...                ...                                ...

Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11
  Code point         Forwarding class                   Loss priority
  000                best-effort                        low
  001                best-effort                        low
  010                best-effort                        low
  011                best-effort                        low
  100                best-effort                        low
  101                best-effort                        low
  110                network-control                    low
  111                network-control                    low

Classifier: ipprec-default, Code point type: inet-precedence, Index: 12
  Code point         Forwarding class                   Loss priority
  000                best-effort                        low
  001                best-effort                        low
  010                best-effort                        low
  011                best-effort                        low
  100                best-effort                        low
  101                best-effort                        low
  110                network-control                    low
  111                network-control                    low

Classifier: ieee8021p-untrust, Code point type: ieee-802.1, Index: 16
  Code point         Forwarding class                   Loss priority
  000                best-effort                        low
  001                best-effort                        low
  010                best-effort                        low
  011                best-effort                        low
  100                best-effort                        low
  101                best-effort                        low
  110                best-effort                        low
  111                best-effort                        low

Rewrite rule: dscp-default, Code point type: dscp, Index: 27
  Forwarding class                  Loss priority       Code point
  best-effort                       low                 000000
  best-effort                       high                000000
  expedited-forwarding              low                 101110
```

```
  expedited-forwarding               high               101110
  assured-forwarding                 low                001010
  assured-forwarding                 high               001100
  network-control                    low                110000
  network-control                    high               111000

Rewrite rule: ieee8021p-default, Code point type: ieee-802.1, Index: 30
  Forwarding class                   Loss priority      Code point
  best-effort                        low                000
  best-effort                        high               001
  expedited-forwarding               low                100
  expedited-forwarding               high               101
  assured-forwarding                 low                010
  assured-forwarding                 high               011
  network-control                    low                110
  network-control                    high               111

Rewrite rule: ipprec-default, Code point type: inet-precedence, Index: 31
  Forwarding class                   Loss priority      Code point
  best-effort                        low                000
  best-effort                        high               000
  expedited-forwarding               low                101
  expedited-forwarding               high               101
  assured-forwarding                 low                001
  assured-forwarding                 high               001
  network-control                    low                110
  network-control                    high               111

Drop profile:<default-drop-profile>, Type: discrete, Index: 1
  Fill level
         100

Scheduler map: <default>, Index: 2

  Scheduler: <default-be>, Forwarding class: best-effort, Index: 20
    Transmit rate: 95 percent, Rate Limit: none, Buffer size: 95 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

  Scheduler: <default-nc>, Forwarding class: network-control, Index: 22
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

Physical interface: ge-0/0/0, Index: 129
Queues supported: 8, Queues in use: 4
  Scheduler map: <default>, Index: 2

Physical interface: ge-0/0/1, Index: 130
Queues supported: 8, Queues in use: 4
  Scheduler map: <default>, Index: 2

...             ...              ...

Fabric priority: low
```

```
  Scheduler: <default-fabric>, Index: 23
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>

Fabric priority: high
  Scheduler: <default-fabric>, Index: 23
    Drop profiles:
      Loss priority   Protocol    Index    Name
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>
```

show class-of-service rewrite-rule

```
user@switch> show class-of-service rewrite-rule
Rewrite rule: dscp-default, Code point type: dscp, Index: 31
  Forwarding class                  Loss priority       Code point
  best-effort                       low                 000000
  best-effort                       high                000000
  expedited-forwarding              low                 101110
  expedited-forwarding              high                101110
  fw-class                          low                 001010
  fw-class                          high                001100
  network-control                   low                 110000
  network-control                   high                111000

Rewrite rule: exp-default, Code point type: exp, Index: 33
  Forwarding class                  Loss priority       Code point
  best-effort                       low                 000
  best-effort                       high                001
  expedited-forwarding              low                 010
  expedited-forwarding              high                011
  fw-class                          low                 100
  fw-class                          high                101
  network-control                   low                 110
  network-control                   high                111

Rewrite rule: ieee8021p-default, Code point type: ieee-802.1, Index: 34
  Forwarding class                  Loss priority       Code point
  best-effort                       low                 000
  best-effort                       high                001
  expedited-forwarding              low                 010
  expedited-forwarding              high                011
  fw-class                          low                 100
  fw-class                          high                101
  network-control                   low                 110
  network-control                   high                111

Rewrite rule: ipprec-default, Code point type: inet-precedence, Index: 35
  Forwarding class                  Loss priority       Code point
  best-effort                       low                 000
  best-effort                       high                000
  expedited-forwarding              low                 101
  expedited-forwarding              high                101
  fw-class                          low                 001
  fw-class                          high                001
  network-control                   low                 110
  network-control                   high                111
```

show class-of-service classifier

Syntax

show class-of-service classifier
<name *name*>
<type dscp | type dscp-ipv6 | type exp | type ieee-802.1 | type inet-precedence>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

For each class-of-service (CoS) classifier, display the mapping of code point value to forwarding class and loss priority.

Options

none—Display all classifiers.

name *name*—(Optional) Display named classifier.

type dscp—(Optional) Display all classifiers of the Differentiated Services code point (DSCP) type.

type dscp-ipv6—(Optional) Display all classifiers of the DSCP for IPv6 type.

type exp—(Optional) Display all classifiers of the MPLS experimental (EXP) type.

type ieee-802.1—(Optional) Display all classifiers of the ieee-802.1 type.

type inet-precedence—(Optional) Display all classifiers of the inet-precedence type.

Required Privilege Level

view

List of Sample Output

show class-of-service classifier type ieee-802.1 on page 144
show class-of-service classifier type ieee-802.1 (QFX Series) on page 144

Output Fields

Table 30 on page 143 describes the output fields for the **show class-of-service classifier** command. Output fields are listed in the approximate order in which they appear.

Table 30: show class-of-service classifier Output Fields

Field Name	Field Description
Classifier	Name of the classifier.
Code point type	Type of the classifier: **exp** (not on EX Series switch), **dscp**, **dscp-ipv6** (not on EX Series switch), **ieee-802.1**, or **inet-precedence**.
Index	Internal index of the classifier.
Code point	Code point value used for classification
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.

Table 30: show class-of-service classifier Output Fields *(continued)*

Field Name	Field Description
Loss priority	Loss priority value used for classification. For most platforms, the value is **high** or **low**. For some platforms, the value is **high**, **medium-high**, **medium-low**, or **low**.

Sample Output

show class-of-service classifier type ieee-802.1

```
user@host>  show class-of-service classifier type ieee-802.1
Classifier: ieee802.1-default, Code point type: ieee-802.1, Index: 3
Code Point         Forwarding Class                  Loss priority
  000              best-effort                         low
  001              best-effort                         high
  010              expedited-forwarding                low
  011              expedited-forwarding                high
  100              assured-forwarding                  low
  101              assured-forwarding                  medium-high
  110              network-control                     low
  111              network-control                     high

Classifier: users-ieee802.1, Code point type: ieee-802.1
  Code point         Forwarding class                    Loss priority
  100                expedited-forwarding                low
```

show class-of-service classifier type ieee-802.1 (QFX Series)

```
user@switch>  show class-of-service classifier type ieee-802.1
Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11
  Code point         Forwarding class                    Loss priority
  000                best-effort                         low
  001                best-effort                         low
  010                best-effort                         low
  011                fcoe                                low
  100                no-loss                             low
  101                best-effort                         low
  110                network-control                     low
  111                network-control                     low

Classifier: ieee-mcast, Code point type: ieee-802.1, Index: 46
  Code point         Forwarding class                    Loss priority
  000                mcast                               low
  001                mcast                               low
  010                mcast                               low
  011                mcast                               low
  100                mcast                               low
  101                mcast                               low
  110                mcast                               low
  111                mcast                               low
```

show class-of-service code-point-aliases

Syntax show class-of-service code-point-aliases
<dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the mapping of class-of-service (CoS) code point aliases to corresponding bit patterns.

Options **none**—Display code point aliases of all code point types.

dscp—(Optional) Display Differentiated Services code point (DSCP) aliases.

dscp-ipv6—(Optional) Display IPv6 DSCP aliases.

exp—(Optional) Display MPLS EXP code point aliases.

ieee-802.1—(Optional) Display IEEE-802.1 code point aliases.

inet-precedence—(Optional) Display IPv4 precedence code point aliases.

Required Privilege Level view

List of Sample Output show class-of-service code-point-aliases exp on page 146

Output Fields Table 31 on page 145 describes the output fields for the **show class-of-service code-point-aliases** command. Output fields are listed in the approximate order in which they appear.

Table 31: show class-of-service code-point-aliases Output Fields

Field Name	Field Description
Code point type	Type of the code points displayed: **dscp**, **dscp-ipv6** (not on EX Series switch), **exp** (not on EX Series switch or the QFX Series), **ieee-802.1**, or **inet-precedence** (not on the QFX Series).
Alias	Alias for a bit pattern.
Bit pattern	Bit pattern for which the alias is displayed.

Sample Output

show class-of-service code-point-aliases exp

```
user@host> show class-of-service code-point-aliases exp
Code point type: exp
  Alias              Bit pattern
  af11               100
  af12               101
  be                 000
  be1                001
  cs6                110
  cs7                111
  ef                 010
  ef1                011
  nc1                110
  nc2                111
```

show class-of-service drop-profile

Syntax
show class-of-service drop-profile
<profile-name *profile-name*>

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description
Display data points for each class-of-service (CoS) random early detection (RED) drop profile.

Options
none—Display all drop profiles.

profile-name *profile-name*—(Optional) Display the specified profile only.

Required Privilege Level
view

List of Sample Output
show class-of-service drop-profile on page 148
show class-of-service drop-profile (EX4200 Switch) on page 148
show class-of-service drop-profile (EX8200 Switch) on page 148

Output Fields
Table 32 on page 147 describes the output fields for the **show class-of-service drop-profile** command. Output fields are listed in the approximate order in which they appear.

Table 32: show class-of-service drop-profile Output Fields

Field Name	Field Description
Drop profile	Name of a drop profile.
Type	Type of drop profile: • **discrete** (default) • **interpolated** (EX8200 switches only)
Index	Internal index of this drop profile.
Fill Level	Percentage fullness of a queue.
Drop probability	Drop probability at this fill level.

Sample Output

show class-of-service drop-profile

```
user@host> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: user-drop-profile, Type: interpolated, Index: 2989
  Fill level    Drop probability
           0                   0
           1                   1
           2                   2
           4                   4
           5                   5
           6                   6
           8                   8
          10                  10
          12                  15
          14                  20
          15                  23
        ... 64 entries total
          90                  96
          92                  96
          94                  97
          95                  98
          96                  98
          98                  99
          99                  99
         100                 100
```

show class-of-service drop-profile (EX4200 Switch)

```
user@switch> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level
         100
Drop profile: dp1, Type: discrete, Index: 40496
  Fill level
          10
```

show class-of-service drop-profile (EX8200 Switch)

```
user@switch> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: dp1, Type: interpolated, Index: 40496
  Fill level    Drop probability
           0                   0
           1                  80
           2                  90
           4                  90
           5                  90
           6                  90
           8                  90
          10                  90
          12                  91
          14                  91
          15                  91
          16                  91
```

```
                18                  91
                20                  91
                22                  92
                24                  92
                25                  92
                26                  92
                28                  92
                30                  92
                32                  93
                34                  93
                35                  93
                36                  93
                38                  93
                40                  93
                42                  94
                44                  94
                45                  94
                46                  94
                48                  94
                49                  94
                51                  95
                52                  95
                54                  95
                55                  95
                56                  95
                58                  95
                60                  95
                62                  96
                64                  96
                65                  96
                66                  96
                68                  96
                70                  96
                72                  97
                74                  97
                75                  97
                76                  97
                78                  97
                80                  97
                82                  98
                84                  98
                85                  98
                86                  98
                88                  98
                90                  98
                92                  99
                94                  99
                95                  99
                96                  99
                98                  99
                99                  99
               100                 100
Drop profile: dp2, Type: discrete, Index: 40499
  Fill level    Drop probability
                10                   5
                50                  50
```

show class-of-service forwarding-class

Syntax show class-of-service forwarding-class

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about forwarding classes, including the mapping of forwarding classes to queue numbers.

Required Privilege Level view

Related Documentation

- Example: Configuring CoS on EX Series Switches on page 39
- *Example: Configuring Forwarding Classes*
- *Example: Configuring CoS Hierarchical Port Scheduling (ETS)*
- Monitoring CoS Forwarding Classes on page 128
- Defining CoS Forwarding Classes (CLI Procedure) on page 73
- *Defining CoS Forwarding Class Sets*
- Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards (CLI Procedure) on page 93

List of Sample Output
show class-of-service forwarding-class on page 151
show class-of-service forwarding-class (EX8200 Switch) on page 151
show class-of-service forwarding-class (QFX Series) on page 151

Output Fields Table 33 on page 150 describes the output fields for the **show class-of-service forwarding-class** command. Output fields are listed in the approximate order in which they appear.

Table 33: show class-of-service forwarding-class Output Fields

Field Name	Field Description
Forwarding class	Name of the forwarding class.
ID	Forwarding class identifier.
Queue	CoS queue mapped to the forwarding class.
Policing priority	Not supported on EX Series switches or the QFX Series and can be ignored.
Fabric priority	(EX8200 switches only) Fabric priority for the forwarding class, either **high** or **low**. Determines the priority of packets entering the switch fabric.

Table 33: show class-of-service forwarding-class Output Fields *(continued)*

Field Name	Field Description
No-Loss	(QFX Series only) Packet loss attribute to differentiate lossless forwarding classes from lossy forwarding classes: • Disabled—Lossless transport is not configured on the forwarding class (packet drop attribute is **drop**). • Enabled—Lossless transport is configured on the forwarding class (packet drop attribute is **no-loss**).

Sample Output

show class-of-service forwarding-class

```
user@switch> show class-of-service forwarding-class
Forwarding class                ID                      Queue  Policing priority
  best-effort                   0                           0           normal
  expedited-forwarding          1                           5           normal
  assured-forwarding            2                           1           normal
  network-control               3                           7           normal
```

Sample Output

show class-of-service forwarding-class (EX8200 Switch)

```
user@switch> show class-of-service forwarding-class
Forwarding class                 ID      Queue  Fabric priority
  best-effort                    0       0      low
  expedited-forwarding           1       5      low
  assured-forwarding             2       1      low
  network-control                3       7      low
  mcast-be                       4       2      low
  mcast-ef                       5       4      low
  mcast-af                       6       6      low
```

Sample Output

show class-of-service forwarding-class (QFX Series)

```
user@switch> show class-of-service forwarding-class
Forwarding class                 ID      Queue  Policing priority  No-Loss

  best-effort                    0       0         normal          Disabled

  fcoe                           1       3         normal          Enabled

  no-loss                        2       4         normal          Enabled

  network-control                3       7         normal          Disabled

  mcast                          8       8         normal          Disabled
```

show pfe statistics traffic cpu

Syntax show pfe statistics traffic cpu <fpc *fpc-slot*>

Release Information Command introduced in Junos OS Release 9.5 for EX Series switches.

Description (On EX8200 switches only) Display count of multidestination packets ingressing from the physical interface to the CPU.

NOTE: Multidestination packets include unknown unicast, broadcast, and multicast packets.

Options **none**—Displays the count of packets ingressing from all the physical interfaces (line cards) to the CPU.

fpc *fpc-slot*—(Optional) Displays the count of packets ingressing from the physical interface, referred to by the slot number, to the CPU.

On an EX8200 switch, the FPC slot number is the slot number for the line card. Possible values are **0** through **7** on the EX8208 switch and **0** through **15** on the EX8216 switch.

Required Privilege Level view

Related Documentation

- show pfe statistics traffic multicast on page 158
- show pfe statistics traffic egress-queues on page 156
- *show interfaces queue*
- *Monitoring Interface Status and Traffic*
- Understanding Junos OS CoS Components for EX Series Switches on page 6

List of Sample Output show pfe statistics traffic cpu (EX8208 Switch) on page 153

Output Fields Table 34 on page 152 lists the output fields for the **show pfe statistics traffic cpu** command. Output fields are listed in the approximate order in which they appear.

Table 34: show pfe statistics traffic cpu Output Fields

Field Name	Field Description
Queue	CoS queue number.
Forwarding classes	Forwarding class name.
Queued Packets	Number of packets queued to this queue.

Table 34: show pfe statistics traffic cpu Output Fields *(continued)*

Field Name	Field Description
Queued Bytes	Number of bytes queued to this queue.
Packets	Number of packets transmitted by this queue.
Bytes	Number of bytes transmitted by this queue.
Tail-dropped packets	Count of packets dropped at the tail end of the queue because of lack of buffer space.
RED-dropped packets	Number of packets dropped because of Random Early Discard (RED): • **Low**—Number of low-loss priority packets dropped because of RED. • **High**—Number of high-loss priority packets dropped because of RED.
RED-dropped bytes	Number of bytes dropped because of Random Early Discard (RED): • **Low**—Number of low-loss priority bytes dropped because of RED. • **High**—Number of high-loss priority bytes dropped because of RED.

Sample Output

show pfe statistics traffic cpu (EX8208 Switch)

```
user@switch> show pfe statistics traffic cpu

Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                     0                    0 pps
    Bytes                :                     0                    0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes    :                     0                    0 bps
     Low                 :                     0                    0 bps
     High                :                     0                    0 bps
    RED-dropped packets  :                     0                    0 pps
     Low                 :                     0                    0 pps
     High                :                     0                    0 pps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                     0                    0 pps
    Bytes                :                     0                    0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes    :                     0                    0 bps
     Low                 :                     0                    0 bps
     High                :                     0                    0 bps
    RED-dropped packets  :                     0                    0 pps
     Low                 :                     0                    0 pps
     High                :                     0                    0 pps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
```

```
    Bytes               : Not Available
    Packets             :                      0                      0 pps
    Bytes               :                      0                      0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes   :                      0                      0 bps
     Low                :                      0                      0 bps
     High               :                      0                      0 bps
    RED-dropped packets :                      0                      0 pps
     Low                :                      0                      0 pps
     High               :                      0                      0 pps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets             : Not Available
    Bytes               : Not Available
    Packets             :                      0                      0 pps
    Bytes               :                      0                      0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes   :                      0                      0 bps
     Low                :                      0                      0 bps
     High               :                      0                      0 bps
    RED-dropped packets :                      0                      0 pps
     Low                :                      0                      0 pps
     High               :                      0                      0 pps
Queue: 4
    Packets             : Not Available
    Bytes               : Not Available
    Packets             :                      0                      0 pps
    Bytes               :                      0                      0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes   :                      0                      0 bps
     Low                :                      0                      0 bps
     High               :                      0                      0 bps
    RED-dropped packets :                      0                      0 pps
     Low                :                      0                      0 pps
     High               :                      0                      0 pps
Queue: 5
    Packets             : Not Available
    Bytes               : Not Available
    Packets             :                      0                      0 pps
    Bytes               :                      0                      0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes   :                      0                      0 bps
     Low                :                      0                      0 bps
     High               :                      0                      0 bps
    RED-dropped packets :                      0                      0 pps
     Low                :                      0                      0 pps
     High               :                      0                      0 pps
Queue: 6
    Packets             : Not Available
    Bytes               : Not Available
    Packets             :                      0                      0 pps
    Bytes               :                      0                      0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes   :                      0                      0 bps
     Low                :                      0                      0 bps
     High               :                      0                      0 bps
    RED-dropped packets :                      0                      0 pps
     Low                :                      0                      0 pps
     High               :                      0                      0 pps
Queue: 7
    Packets             : Not Available
```

```
Bytes               : Not Available
Packets             :                  0                  0 pps
Bytes               :                  0                  0 bps
Tail-dropped packets :                 0
RED-dropped bytes   :                  0                  0 bps
 Low                :                  0                  0 bps
 High               :                  0                  0 bps
RED-dropped packets :                  0                  0 pps
 Low                :                  0                  0 pps
 High               :                  0                  0 pps
```

show pfe statistics traffic egress-queues

Syntax show pfe statistics traffic egress-queues <fpc *fpc-slot*>

Release Information Command introduced in Junos OS Release 9.5 for EX Series switches.

Description (On EX8200 switches only) Display count of multidestination packets dropped on egress ports when the egress queues are oversubscribed due to multidestination traffic.

NOTE: Multidestination packets include unknown unicast, broadcast, and multicast packets.

Options **none**—Displays count of packets dropped on egress ports of all physical interfaces (line cards) when egress queues are oversubscribed due to multidestination traffic.

fpc *fpc-slot*—(Optional) Displays count of packets dropped on egress ports of the physical interface (line card) referred to by the slot number.

NOTE: On an EX8200 switch, the FPC slot number is the slot number for the line card. Possible values are 0 through 7 on the EX8208 switch and 0 through 15 on the EX8216 switch.

Required Privilege Level view

Related Documentation

- show pfe statistics traffic cpu on page 152
- show pfe statistics traffic multicast on page 158
- *show interfaces queue*
- *Monitoring Interface Status and Traffic*
- Understanding Junos OS CoS Components for EX Series Switches on page 6

List of Sample Output show pfe statistics traffic egress-queues fpc 4 (EX8208 Switch) on page 157

Output Fields Table 35 on page 156 lists the output fields for the **show pfe statistics traffic egress-queues** command. Output fields are listed in the approximate order in which they appear.

Table 35: show pfe statistics traffic egress-queues Output Fields

Field Name	Field Description
Tail-dropped packets	Number of arriving packets dropped because the output queue buffers are full.

Sample Output

show pfe statistics traffic egress-queues fpc 4 (EX8208 Switch)

```
user@switch> show pfe statistics traffic egress-queues fpc 4
Tail-dropped packets :                    0
```

show pfe statistics traffic multicast

Syntax show pfe statistics traffic multicast <fpc *fpc-slot dev-number*>

Release Information Command introduced in Junos OS Release 9.5 for EX Series switches.

Description (On EX8200 switches only) Display class-of-service (CoS) queue information for multidestination traffic on a physical interface (line card).

NOTE: Multidestination packets include unknown unicast, broadcast, and multicast packets.

NOTE: To view statistical information for unicast traffic, use the **show interfaces queue** command.

Options fpc *fpc-slot dev-number*—(Optional) Displays class-of-service (CoS) queue information for multidestination traffic on the physical interface (line card) referred to by the slot number and device number.

NOTE: On an EX8200 switch, the FPC slot number is the slot number for the line card. Possible values for the FPC slot number are 0 through 7 on the EX8208 switch and 0 through 15 on the EX8216 switch. The value for the device number ranges from 0–5, where 0–4 values correspond to the statistics only from that specific device and the value 5 corresponds to the combined statistics from all the devices in the FPC.

Required Privilege Level view

Related Documentation

- show pfe statistics traffic cpu on page 152
- show pfe statistics traffic egress-queues on page 156
- *show interfaces queue*
- *Monitoring Interface Status and Traffic*
- Understanding Junos OS CoS Components for EX Series Switches on page 6

List of Sample Output show pfe statistics traffic multicast fpc 0 2(EX8208 Switch) on page 159

Output Fields Table 36 on page 159 lists the output fields for the **show pfe statistics traffic multicast** command. Output fields are listed in the approximate order in which they appear.

Table 36: show pfe statistics traffic multicast Output Fields

Field Name	Field Description
Queue	CoS queue number.
Forwarding classes	Forwarding class name.
Queued Packets	Number of packets queued to this queue.
Queued Bytes	Number of bytes queued to this queue.
Packets	Number of packets transmitted by this queue.
Bytes	Number of bytes transmitted by this queue.
Tail-dropped packets	Count of packets dropped at the tail end of the queue because of lack of buffer space.
RED-dropped packets	Number of packets dropped because of Random Early Discard (RED): • **Low**—Number of low-loss priority packets dropped because of RED. • **High**—Number of high-loss priority packets dropped because of RED.
RED-dropped bytes	Number of bytes dropped because of Random Early Discard (RED): • **Low**—Number of low-loss priority bytes dropped because of RED. • **High**—Number of high-loss priority bytes dropped because of RED.

Sample Output

show pfe statistics traffic multicast fpc 0 2(EX8208 Switch)

```
user@switch> show pfe statistics traffic multicast fpc 0 2

Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     High                :                     0                     0 bps
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     High                :                     0                     0 pps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
```

```
     High                :                      0                      0 bps
    RED-dropped packets  :                      0                      0 pps
     Low                 :                      0                      0 pps
     High                :                      0                      0 pps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                      0                      0 pps
    Bytes                :                      0                      0 bps
    Tail-dropped packets :                      0
    RED-dropped bytes    :                      0                      0 bps
     Low                 :                      0                      0 bps
     High                :                      0                      0 bps
    RED-dropped packets  :                      0                      0 pps
     Low                 :                      0                      0 pps
     High                :                      0                      0 pps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                      0                      0 pps
    Bytes                :                      0                      0 bps
    Tail-dropped packets :                      0
    RED-dropped bytes    :                      0                      0 bps
     Low                 :                      0                      0 bps
     High                :                      0                      0 bps
    RED-dropped packets  :                      0                      0 pps
     Low                 :                      0                      0 pps
     High                :                      0                      0 pps
Queue: 4
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                      0                      0 pps
    Bytes                :                      0                      0 bps
    Tail-dropped packets :                      0
    RED-dropped bytes    :                      0                      0 bps
     Low                 :                      0                      0 bps
     High                :                      0                      0 bps
    RED-dropped packets  :                      0                      0 pps
     Low                 :                      0                      0 pps
     High                :                      0                      0 pps
Queue: 5
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                      0                      0 pps
    Bytes                :                      0                      0 bps
    Tail-dropped packets :                      0
    RED-dropped bytes    :                      0                      0 bps
     Low                 :                      0                      0 bps
     High                :                      0                      0 bps
    RED-dropped packets  :                      0                      0 pps
     Low                 :                      0                      0 pps
     High                :                      0                      0 pps
Queue: 6
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                      0                      0 pps
    Bytes                :                      0                      0 bps
    Tail-dropped packets :                      0
    RED-dropped bytes    :                      0                      0 bps
```

```
     Low                 :                     0                     0 bps
     High                :                     0                     0 bps
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     High                :                     0                     0 pps
Queue: 7
    Packets              : Not Available
    Bytes                : Not Available
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     High                :                     0                     0 bps
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     High                :                     0                     0 pps
```

PART 4

Troubleshooting

CHAPTER 7

Troubleshooting Procedures

Troubleshooting CoS Schedulers on a 40-port SFP+ Line Card in an EX8200 Switch

Problem **Description:** After you configure a scheduler map on an interface on the 40-port SFP+ line card, you notice one or both of the following:

- All packets are being dropped on a class-of-service queue configured on the interface.
- A message in the system log states that the interface is using the default scheduler map, not the scheduler map you configured. For example:

```
Sep 19 21:26:50  hostname cosd[907]: COSD_SCHED_MAP_GROUP_CONFLICT:
Interface xe-5/0/15 cannot be bound to scheduler-map m1. It will be bound to
default scheduler-map
```

Cause The ports in a 40-port SFP+ line card are divided into eight groups, each group comprising five ports. The ports in a port group share 10 gigabits of bandwidth. Because the port groups share bandwidth, only one scheduler map can be active at a time in a port group. If you configure different scheduler maps for different interfaces in a port group, you do not receive an error when you commit the configuration. Instead, default scheduler map becomes the active scheduler map for all interfaces in the port group, and messages in the system log report that the default scheduler map is in use for the affected interfaces. If the default scheduler map does not define a queue, all traffic is dropped on that queue.

Solution Check your CoS configuration for the interfaces in the port group. If you have different scheduler maps assigned to different interfaces in the port group:

1. Delete the scheduler map configuration for all interfaces in the port group.
2. Determine the scheduler map that you want all interfaces in the port group to use.
3. Assign that scheduler map to at least one interface in the port group. The remaining interfaces in the port group will adopt this scheduler map.

BEST PRACTICE: To prevent confusion and future configuration conflicts, explicitly assign the scheduler map to each interface in the port group.

4. After you commit the configuration, verify that the scheduler map is the active scheduler map for the interfaces in the port group by using the **show class-of-service forwarding-table scheduler-map** command.

Related Documentation

- *40-port SFP+ Line Card in an EX8200 Switch*
- Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 75
- Understanding CoS Queues on EX8200 Line Cards That Include Oversubscribed Ports on page 33

Troubleshooting a CoS Classifier Configuration for a TCAM Space Error

Problem

Description: When a CoS classifier configuration exceeds the amount of available ternary content addressable memory (TCAM) space, the switch returns the following system log message:

```
<number_of_rules_being_added> rules for <filter_name> class <filter_class> will
not be installed, key: <bind_point>. no space in tcam db(<shared_pool_information>)
```

The switch returns this message during the commit operation if the number of classifiers defined in the CoS configuration or the number of bind points (interfaces) to which classifiers are bound causes the CoS configuration to exceed the amount of available TCAM space. However, the commit operation for the CoS configuration is completed in the CLI module.

Solution

When a CoS configuration exceeds the amount of available TCAM table space, you must either define fewer classifiers or bind them to fewer interfaces, or both, so that the space requirements for the CoS configuration do not exceed the available space in TCAM.

To delete classifier definitions and bind points in a CoS configuration, and to apply a new CoS classifier definition to fewer bind points:

1. Delete either the CoS classifier definition or the bind points:
   - To delete the CoS classifier definition:
     - For behavioral classifiers:

       ```
       [edit class-of-service]
       user@switch# delete classifier dscp d1
       ```

     - For multifield classifiers:

       ```
       [edit]
       user@switch# delete interfaces ge-3/0/2 unit 0 family ethernet-switching filter input ipacl
       ```

       This command deletes a multifield classifier defined for a port. Similarly, you can delete a multifield classifier defined for a VLAN or router.

       You can also delete terms defined in a single multifield classifier:

       ```
       [edit]
       user@switch# delete firewall family inet filter f1 term t1
       ```

     In both these examples (for behavioral and multifield classifiers), the assumption is that too many classifier definitions resulted in the error message.

   - To delete the bind points:

     ```
     [edit class-of-service]
     user@switch# delete class-of-service interfaces ge-0/0/0
     user@switch# delete class-of-service interfaces ge-0/0/1
     user@switch# delete class-of-service interfaces ge-0/0/2
     user@switch# delete class-of-service interfaces ge-0/0/3
     user@switch# delete class-of-service interfaces ge-0/0/4
     user@switch# delete class-of-service interfaces ge-0/0/5
     user@switch# delete class-of-service interfaces ge-0/0/6
     user@switch# delete class-of-service interfaces ge-0/0/7
     user@switch# delete class-of-service interfaces ge-0/0/8
     ```

     Here the assumption is that too many bind points (nine) in the configuration resulted in the error message.

2. Commit the operation:

   ```
   [edit]
   user@switch# commit
   ```

3. Define fewer classifiers in the CoS configuration or bind classifiers to fewer interfaces, or both, so that the CoS classifier configuration does not exceed the amount of available TCAM space on the switch:
   - To define CoS classifiers:
     - For behavioral classifiers:

       ```
       [edit]
       user@switch# set class-of-service classifiers dscp d2 forwarding-class fc1 loss-priority low code-points 000001
       user@switch# set class-of-service classifiers dscp d2 forwarding-class fc2 loss-priority low code-points 000010
       user@switch# set class-of-service classifiers dscp d2 forwarding-class fc3 loss-priority low code-points 000011
       ```

```
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc4 loss-priority
low code-points 000100
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc5 loss-priority
low code-points 000101
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc6 loss-priority
low code-points 000110
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc7 loss-priority
low code-points 000111
```

- For multifield Classifiers:

```
[edit]
user@switch# set firewall family inet filter f1 term t1 from protocol tcp
user@switch# set firewall family inet filter f1 term t1 then loss-priority high
user@switch# set firewall family inet filter f1 term t1 then forwarding-class best-effort
user@switch# set firewall family inet filter f1 term t2 from protocol udp
user@switch# set firewall family inet filter f1 term t2 then loss-priority high
user@switch# set firewall family inet filter f1 term t2 then forwarding-class
assured-forwarding
user@switch# set firewall family inet filter f1 term t3 from source-port ssh
user@switch# set firewall family inet filter f1 term t3 then loss-priority low
user@switch# set firewall family inet filter f1 term t3 then forwarding-class fc8
user@switch#set class-of-service forwarding-classes best-effort, assured-forwarding,
fc8
```

- To bind classifiers to fewer interfaces:

```
[edit]
user@switch# set class-of-service interfaces ge-0/0/0 unit 0 classifiers dscp d2
user@switch# set class-of-service interfaces ge-0/0/1 unit 0 classifiers dscp d2
user@switch# set class-of-service interfaces ge-0/0/2 unit 0 forwarding-class best-effort
user@switch# set class-of-service interfaces ge-0/0/3 unit 0 forwarding-class
assured-forwarding
user@switch# set class-of-service interfaces ge-0/0/4 unit 0 forwarding-class fc8
```

4. Commit the operation:

```
[edit]
user@switch# commit
```

5. Check system log for an error message. If an error message is not logged, then your classifier configuration has not exceeded the TCAM space limit.

   If an error message is logged, then repeat this procedure by defining fewer classifiers or binding classifiers to fewer bind points.

Related Documentation

- *Understanding CoS Classifiers*
- Defining CoS Classifiers (CLI Procedure) on page 69