



JUNOS® Software for EX Series Ethernet Switches, Release 10.0: Class of Service

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Class of Service

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How to Use This Guide

Complete documentation for the EX Series product family is provided on webpages at http://www.juniper.net/techpubs/en_US/release-independent/information-products/pathway-pages/ex-series/product/index.html. We have selected content from these webpages and created a number of EX Series guides that collect related topics into a book-like format so that the information is easy to print and easy to download to your local computer.

The release notes are at http://www.juniper.net/techpubs/en_US/junos10.0/information-products/topic-collections/release-notes/10.0/junos-release-notes-10.0.pdf.

List of EX Series Guides for JUNOS Release 10.0





Title	Description
<i>Complete Hardware Guide for EX3200 and EX4200 Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance information for EX3200 and EX4200 switches
<i>Complete Hardware Guide for EX8208 Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance information for EX8208 switches
<i>Complete Hardware Guide for EX8216 Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance information for EX8216 switches
<i>Complete Software Guide for JUNOS® Software for EX Series Switches, Release 10.0</i>	Software feature descriptions, configuration examples, and tasks for JUNOS Software for EX Series switches

Title	Description
Software Topic Collections	Software feature descriptions, configuration examples and tasks, and reference pages for configuration statements and operational commands (This information also appears in the <i>Complete Software Guide</i> .)
<i>JUNOS® Software for EX Series Switches, Release 10.0: Access Control</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Alarms and System Log Messages</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Configuration and File Management</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Class of Service</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Device Security</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Ethernet Switching</i>	
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<i>JUNOS® Software for EX Series Switches, Release 10.0: MPLS</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Multicast</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Network Management and Monitoring</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Port Security</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Routing Policy and Packet Filtering</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Spanning-Tree Protocols</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: System Setup</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: User and Access Management</i>	
<i>JUNOS® Software for EX Series Switches, Release 10.0: Virtual Systems</i>	

Downloading Software

You can download JUNOS Software for EX Series switches from the Download Software area at <http://www.juniper.net/customers/support/>. To download the software, you must have a Juniper Networks user account. For information about obtaining an account, see <http://www.juniper.net/entitlement/setupAccountInfo.do>.

Documentation Symbols Key

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.

Text and Syntax Conventions		
Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the <code>configure</code> command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> ■ Introduces important new terms. ■ Identifies book names. ■ Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> ■ A policy <i>term</i> is a named structure that defines match conditions and actions. ■ <i>JUNOS System Basics Configuration Guide</i> ■ RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	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 <i>domain-name</i>
Plain text like this	Represents names of configuration statements, commands, files, and directories; IP addresses; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> ■ To configure a stub area, include the <code>stub</code> statement at the [edit protocols ospf area area-id] hierarchy level. ■ The console port is labeled CONSOLE.

Text and Syntax Conventions		
Convention	Description	Examples
< > (angle brackets)	Enclose optional keywords or variables.	stub <default-metric <i>metric</i> >;
(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 (<i>string1</i> <i>string2</i> <i>string3</i>)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Enclose a variable for which you can substitute one or more values.	community name members [<i>community-ids</i>]
Indentation and braces ({ })	Identify a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
J-Web GUI Conventions		
Bold text like this	Represents J-Web graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> ■ In the Logical Interfaces box, select All Interfaces. ■ To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of J-Web selections.	In the configuration editor hierarchy, select Protocols > Ospf .

Documentation Feedback

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- Document URL or title
- Page number if applicable
- Software version
- Your name and company

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/customers/support/downloads/710059.pdf> .
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/> .
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

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- Find product documentation: <http://www.juniper.net/techpubs/>
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- Download the latest versions of software and review release notes: <http://www.juniper.net/customers/csc/software/>
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- 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/>

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

Part 1

Class of Service

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Chapter 1

Class of Service

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Class of Service (CoS)—Overview

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JUNOS CoS for EX Series Switches Overview

When a network experiences congestion and delay, some packets must be dropped. JUNOS 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. CoS also allows you to rewrite the Differentiated Service Code Point (DSCP), IP precedence, or 802.1p CoS bits of packets egressing out of a specific interface, thus allowing you to tailor packets for the remote peers' network requirements.

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 you must 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.

- How JUNOS CoS Works on page 4
- Default CoS Behavior on EX Series Switches on page 5

How JUNOS CoS Works

JUNOS CoS works by examining traffic entering at the edge of your network. The access 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 to ensure that higher-paying customers receive better service. As the traffic leaves the network at the far edge, you can rewrite the traffic to meet the policies of the targeted peer.

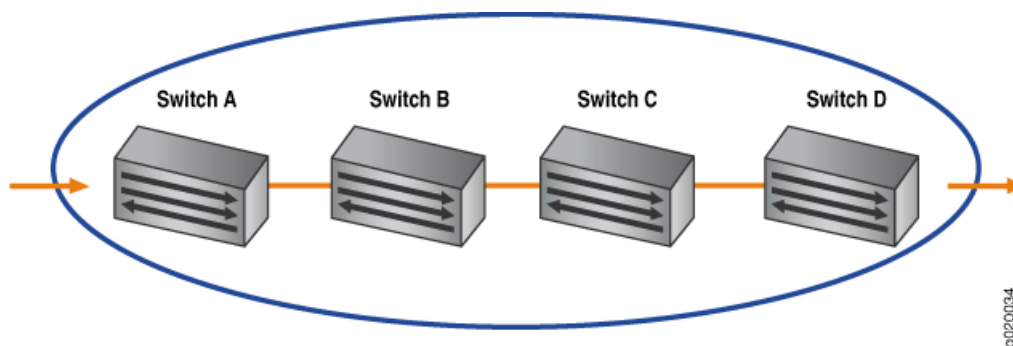
To support CoS, you must configure each switch in the network. Generally, each switch examines the packets that enter it to determine their CoS settings. These settings then dictate which packets are transmitted first to the next downstream switch. Switches at the edges of the network might be required 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 your 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 Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Understanding JUNOS EZQoS for CoS Configurations on EX Series Switches on page 22
 - Example: Combining CoS with MPLS on EX Series Switches on page 22

Understanding JUNOS CoS Components for EX Series Switches

This topic describes the JUNOS CoS components for Juniper Networks EX Series Ethernet Switches:

- Code-Point Aliases on page 6
- Policers on page 6
- Classifiers on page 6
- Forwarding Classes on page 6

- Tail Drop Profiles on page 7
- Schedulers on page 7
- Rewrite Rules on page 7

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 Software, *classifiers* associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class. JUNOS Software 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: Rewrite rules are applied when the packets are routed. Rewrite rules are not applied when the packets are forwarded.

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

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- Related Topics**
- Understanding CoS Code-Point Aliases on page 8
 - Understanding CoS Classifiers on page 10
 - Understanding CoS Forwarding Classes on page 13
 - Understanding CoS Tail Drop Profiles on page 15
 - Understanding CoS Schedulers on page 16
 - Understanding CoS Two-Color Marking on page 19
 - Understanding CoS Rewrite Rules on page 20
 - Example: Combining CoS with MPLS on EX Series Switches on page 22

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 802.1 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.

You can configure code-point aliases for the following type of CoS markers :

- dscp—Handles incoming IPv4 packets.
- ieee-802.1—Handles Layer 2 CoS.
- inet-precedence—Handles incoming IPv4 packets. IP precedence mapping requires only the upper three bits of the DSCP field.

This topic covers:

- Default Code-Point Aliases on page 8

Default Code-Point Aliases

Table 1 on page 8 shows the default mappings between the bit values and standard aliases.

Table 1: Default Code-Point Aliases

CoS Value Types	Mapping
DSCP CoS Values	
ef	101110
af11	001010
af12	001100
af13	001110
af21	010010
af22	010100

Table 1: Default Code-Point Aliases (continued)

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

Table 1: Default Code-Point Aliases (continued)

CoS Value Types	Mapping
ef	010
ef1	011
af11	100
af12	101
nc1/cs6	110
nc2/cs7	111

- Related Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Defining CoS Code-Point Aliases (CLI Procedure) on page 42
 - Defining CoS Code-Point Aliases (J-Web Procedure) on page 41

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 assign packets to output queues based on the associated forwarding class. There are two general types of classifiers:

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

For a specified interface, you can configure both an MF classifier and a BA classifier without conflicts. In such cases, BA classification is performed first, followed by MF classification. If the two classification results conflict, the MF classification result overrides the BA classification result.



NOTE: When a source MAC address is learned, the frame that contains the source MAC address is always sent out on queue 0 while egressing from the network interface, irrespective of the classifier applied to the ingress interface.

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

- Behavior Aggregate Classifiers on page 11
- Multifield Classifiers on page 12

Behavior Aggregate Classifiers

The behavior aggregate classifier maps a class-of-service (CoS) value to a forwarding class and loss priority. The forwarding class determines the output queue. 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 Software automatically assigns implicit default classifiers to all logical interfaces based on the type of interface. Table 2 on page 11 lists different types of interfaces and the corresponding implicit default classifiers.

Table 2: Default BA Classification

Type of Interface	Default BA Classification
Trunk interface	ieee8021p-default
Layer 3 interface	dscp-default
Access interface	Untrusted
Routed VLAN interface (RVI)	No default classification

When you explicitly associate a classifier with a logical interface, you are in effect overriding the implicit default classifier with an explicit classifier.

You can configure routed VLAN interfaces (RVIs) to classify packets. After you do so the User Priority (UP) bits in the incoming packets are rewritten according to the default IEEE 802.1p rewrite rule.



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



NOTE: On EX8200 switches, only one classifier of a single type DSCP or IEEE 802.1p can be applied to an interface.

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 DiffServ code point (DSCP) or IP precedence support 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, a classifier performs matching operations on the selected fields against a configured value.

- Related Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Defining CoS Classifiers (CLI Procedure) on page 43
 - Defining CoS Classifiers (J-Web Procedure) on page 44

Understanding CoS Forwarding Classes

It is helpful to think of forwarding classes as output queues. In effect, the end result of classification is the identification of an output queue for a particular packet. For a classifier to assign an output queue to each packet, it must associate the packet with one of the following forwarding classes:

- 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.
- best-effort (be)—Provides no service profile. Loss priority is typically not carried in a class-of-service (CoS) value.
- network-control (nc)—Supports protocol control and thus is typically high priority.
- multicast best-effort (mcast-be)—Used for high-priority multicast packets.
- multicast assured-forwarding (mcast-af)—Provides two drop profiles, high and low, for multicast packets.
- multicast best-effort (mcast-be)—Provides no service profile for multicast packets.



NOTE: The forwarding classes multicast expedited-forwarding, multicast assured-forwarding, and multicast best-effort are applicable only to Juniper Networks EX8200 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 EF traffic such as EF, EF1, and EF2.

EX Series 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.

- Default Forwarding Classes on page 13

Default Forwarding Classes

Table 3 on page 14 shows the four default forwarding classes defined for unicast traffic, and Table 4 on page 14 shows the three default forwarding classes defined for multicast traffic.



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

If desired, 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. CoS configurations can be quite complicated, so unless it is required by your scenario, we recommend that you not alter the default class names or queue number associations.

Table 3: Default Forwarding Classes for Unicast Packets

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)	<p>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.</p> <p>The software accepts excess traffic, but it applies a tail drop profile to determine if the excess packets are dropped and not forwarded.</p> <p>Up to two drop probabilities (low and high) are defined for this service class.</p>
network-control (nc)	<p>The software delivers packets in this service class with a high priority. (These packets are not delay-sensitive.)</p> <p>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.</p>

Table 4: Default Forwarding Classes for Multicast Packets

Forwarding Class Name	Comments
multicast best-effort (mcast-be)	The software does not apply any special CoS handling to the multicast packets. These packets are usually dropped under congested network conditions.
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)	<p>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.</p> <p>The software accepts excess traffic, but it applies a tail drop profile to determine if the excess packets are dropped and not forwarded.</p> <p>Up to two drop probabilities (low and high) are defined for this service class.</p>

The following rules govern queue assignment:

- CoS configurations that specify more queues than the switch can support are not accepted. The commit fails with a detailed message that states the total number of queues available.
- All default CoS configurations are based on queue number. The name of the forwarding class that shows up when the default configuration is displayed is the forwarding class currently associated with that queue.

- Related Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Defining CoS Forwarding Classes (CLI Procedure) on page 47
 - Defining CoS Forwarding Classes (J-Web Procedure) on page 47

Understanding CoS Tail Drop Profiles

Tail drop profile is a congestion management mechanism that allows switch to drop arriving packets when queue buffers become full or begin to overflow.

Tail drop profiles define the meanings of the loss priorities. When you configure tail drop profiles you are essentially setting the value for queue fullness. The queue fullness 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 queue fullness defines the delay-buffer bandwidth, which provides packet buffer space to absorb burst traffic up to the specified duration of delay. Once the specified delay buffer becomes full, packets with 100 percent drop probability are dropped from the tail of the buffer.

On Juniper Networks EX Series Ethernet Switches, drop probability is implicitly set to 100 percent and it cannot be modified.

You specify drop probabilities in the drop profile section of the CoS configuration hierarchy and reference them in each scheduler configuration.

By default, if you do not configure any drop profile, tail drop profile is in effect and functions as the primary mechanism for managing congestion. In the default tail drop profile, when the fill level is 0 percent, the drop probability is 0 percent. When the fill level is 100 percent, the drop probability is 100 percent.



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

- Related Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Configuring CoS Tail Drop Profiles (CLI Procedure) on page 52

Understanding CoS Schedulers

You use schedulers to define the 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, packet schedulers, and tail drop processes that operate according to this mapping.

- Default Schedulers on page 16
- Transmission Rate on page 17
- Scheduler Buffer Size on page 17
- Priority Scheduling on page 17
- Scheduler Drop-Profile Maps on page 18
- Scheduler Maps on page 18

Default Schedulers

Each forwarding class has an associated scheduler priority. Only two forwarding classes, best-effort (queue0) and network-control (queue7) are used in the default configuration.



NOTE: On Juniper Networks EX8200 Ethernet Switches three forwarding classes—best-effort (queue0), multicast best-effort (queue2), and network-control (queue7)—are used in the default configuration.

By default, the best-effort forwarding class (queue 0) receives 95 percent of the bandwidth and 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.



NOTE: 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 of the bandwidth and buffer space for the output link, and the network-control forwarding class (queue 7) receives 5 percent.

The expedited-forwarding and assured-forwarding classes have no scheduler because no resources are assigned to queue 5 and queue 1, by default. However, you can manually configure resources for the expedited-forwarding and assured-forwarding classes.

Also by default, each 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 receive a larger amount of offered load than their allocated bandwidth allows.

Transmission Rate

The transmission-rate control determines the actual traffic bandwidth from each forwarding class you configure. The rate is specified in bits per second. Each queue is allocated some portion of the bandwidth of the outgoing interface.

This bandwidth amount 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. You can allow transmission bandwidth to exceed the configured rate if additional bandwidth is available from other queues. In case of congestion, configured amount of transmission rate is guaranteed for the queue. This property allows you to ensure that each queue receives the amount of bandwidth appropriate to its level of service.

Scheduler Buffer Size

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

The default scheduler transmission rate for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent 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 of the total available buffer.



NOTE: On EX8200 switches, the default scheduler transmission rates for queues 0 through 7 are 75, 0, 20, 0, 0, 0, 0, and 5 percent of the total available bandwidth. The default buffer-size percentages for queues 0 through 7 are 75, 0, 20, 0, 0, 0, 0, and 5 percent of the total available buffer.

For each scheduler, you can configure the buffer size as one of the following:

- 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 approximately 35 percent of the delay buffer.

Priority Scheduling

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

Priority scheduling is accomplished through a procedure in which the scheduler examines the priority of the queue. Juniper Networks JUNOS Software supports two levels of transmission priority:

- **Low**—The scheduler determines if the individual queue is within its defined bandwidth profile. This binary decision, which is reevaluated on a regular time cycle, compares the amount of data transmitted by the queue against the amount of bandwidth allocated to it by the scheduler. When the transmitted amount is less than the allocated amount, the queue is considered to be in profile. A queue is out of profile when its transmitted amount is larger than its allocated amount. Out of profile queue will be transmitted only if bandwidth is available. Otherwise, it will be buffered.

A queue from the set is selected based on the shaped deficit weighted round robin (SDWRR) algorithm, which operates within the set.

- **Strict-high**—Strict-high priority queue receives preferential treatment over low priority queue. Unlimited bandwidth is assigned to strict-high priority queue. Queues are scheduled according to the queue number, starting with the highest queue 7, with decreasing priority down through queue 0. Traffic in higher queue numbers is always scheduled prior to traffic in lower queue numbers. In other words, in case of two high priority queues, the queue with higher queue number is processed first.

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. Drop-profile map sets the drop profile for a specific packet loss priority (PLP) and protocol type. The inputs for the 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.

Juniper Networks EX Series Ethernet Switches allow you to associate up to four user-defined scheduler maps with interfaces.

- Related Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Defining CoS Schedulers (CLI Procedure) on page 49
 - Defining CoS Schedulers (J-Web Procedure) on page 49

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 Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - 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. Rewrite rules set the value of the CoS bits within the 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. Rewrite rules must be assigned to an interface for rewrites to be activated. Only tagged Layer 3 interfaces and tagged routed VLAN interfaces (RVIs) rewrite packets by using the default IEEE 802.1p rewrite rule. Multiple rewrite rules of different types can be applied to a single interface.



NOTE: On the Juniper Networks EX8200 Ethernet Switches, rewrite rules can be bound to only Layer 3 interfaces and RVIs. Rewrites on these interfaces are not a default behavior, and only one rewrite rule of each type can be bound to any interface in the system

In effect, the rewrite rule performs the opposite function of the behavior aggregate (BA) classifier 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 ToS byte are always reset to zero when code points are rewritten.

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- [Default Rewrite Rule on page 20](#)

Default Rewrite Rule

If you want to enable a rewrite rule on an interface, you can either create your own rule and enable it on the interface or enable a default rewrite rule. See “Defining CoS Rewrite Rules (CLI Procedure)” on page 53.

Table 5 on page 21 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.

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 5: 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 Topics**
- Understanding JUNOS CoS Components for EX Series Switches on page 5
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Defining CoS Rewrite Rules (CLI Procedure) on page 53
 - Defining CoS Rewrite Rules (J-Web Procedure) on page 54

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

If the amount of traffic on a switch's network interface is more than the maximum bandwidth allowed on the interface, it leads to congestion. Port shaping and queue shaping can be used to manage the excess traffic and avoid congestion. Port shaping defines the maximum bandwidth allocated to a port, while queue shaping defines a limit on excess-bandwidth usage per queue.

This topic covers:

- Port Shaping on page 21
- Queue Shaping on page 21

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 or port rate.

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.

- Related Topics**
- Understanding CoS Schedulers on page 16

- Defining CoS Schedulers (CLI Procedure) on page 49

Understanding JUNOS EZQoS for CoS Configurations on EX Series Switches

JUNOS 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 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 Topics**
- JUNOS CoS for EX Series Switches Overview on page 4
 - Configuring JUNOS EZQoS for CoS (CLI Procedure) on page 58

Examples: CoS Configuration

- Example: Configuring CoS on EX Series Switches on page 22

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 on page 23
- Overview and Topology on page 23
- Configuration on page 26
- Verification on page 37

Requirements

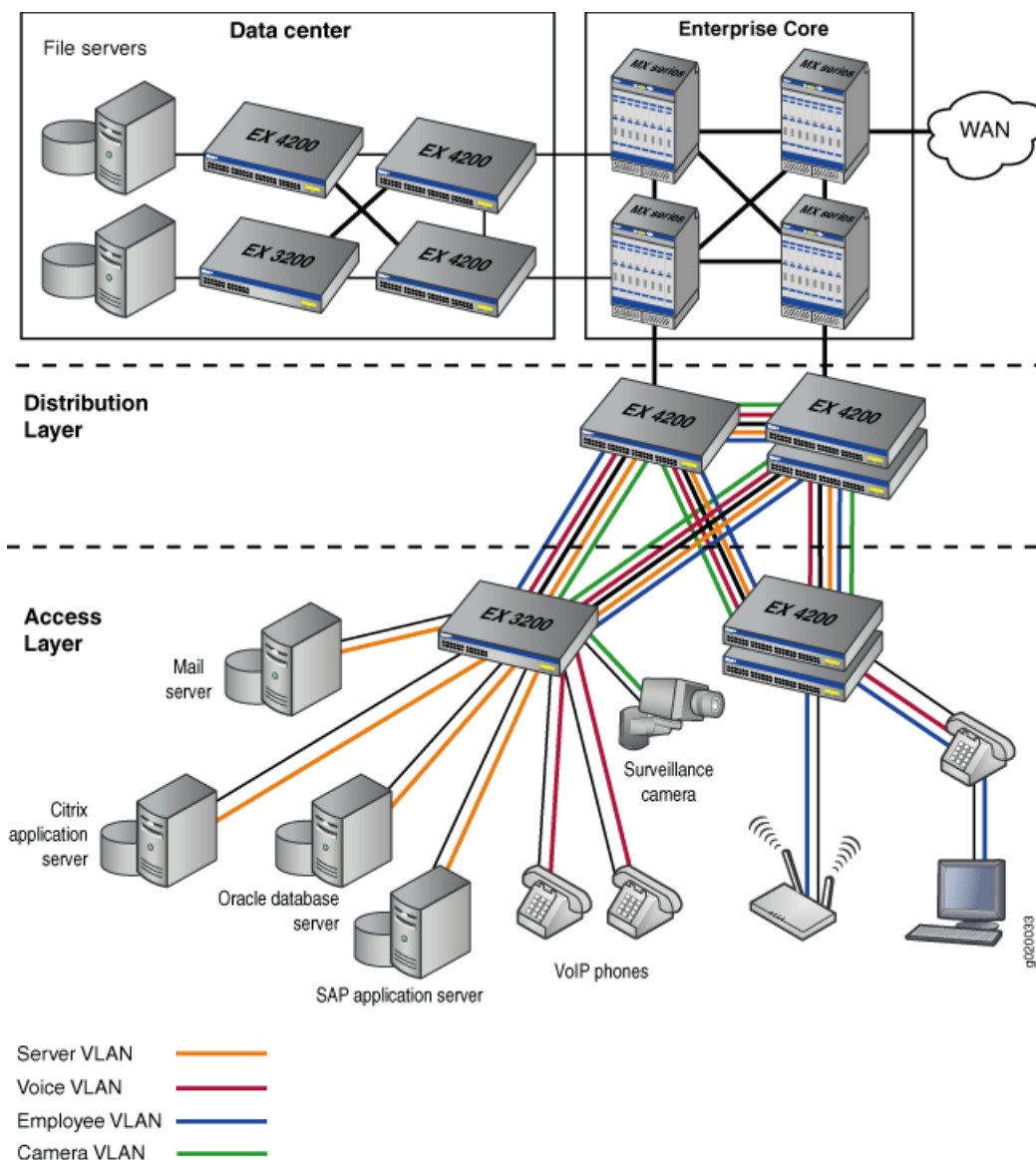
This example uses the following hardware and software components:

- JUNOS Release 9.0 or later for EX Series switches
- One Juniper Networks EX3200 switch

Overview and Topology

This example uses the topology shown in Figure 2 on page 24.

Figure 2: Topology for Configuring CoS



The topology for this configuration example consists of one EX Series switch at the access layer.

The EX Series access switch is configured to support VLAN membership. Switch ports `ge-0/0/0` and `ge-0/0/1` are assigned to the `voice-vlan` for two VoIP phones. Switch port `ge-0/0/2` is assigned to the `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` for the servers hosting various applications such as those provided by Citrix, Microsoft, Oracle, and SAP.

Table 6 on page 25 shows the VLAN configuration components.

Table 6: Configuration Components: VLANs

VLAN Name	VLAN ID	VLAN Subnet and Available IP Addresses	VLAN Description
voice-vlan	10	192.168.1.0/32 192.168.1.1 through 192.168.1.11 192.168.1.12 is the subnet's broadcast address.	Voice VLAN used for employee VoIP communication.
camera-vlan	20	192.168.1.13/32 192.168.1.14 through 192.168.1.20 192.168.1.21 is the subnet's broadcast address.	VLAN for the surveillance cameras.
server-vlan	30	192.168.1.22/32 192.168.1.23 through 192.168.1.35 192.168.1.36 is the subnet's broadcast address.	VLAN for the servers hosting enterprise applications.

Ports on the EX Series switches support Power over Ethernet (PoE) to provide both network connectivity and power for VoIP telephones connecting to the ports. Table 7 on page 25 shows the switch interfaces that are assigned to the VLANs and the IP addresses for devices connected to the switch ports:

Table 7: 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 through 192.168.1.2	Two VoIP telephones.
ge-0/0/2	camera-vlan	192.168.1.14	Surveillance camera.
ge-0/0/3, ge-0/0/4, ge-0/0/5, ge-0/0/6	server-vlan	192.168.1.23 through 192.168.1.26	Four servers hosting applications such as those provided by Citrix, Microsoft, Oracle, and SAP.



NOTE: This example shows how to configure CoS on a single 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 192.168.1.1/32
set firewall family ethernet-switching filter voip_class term voip from
source-address 192.168.1.2/32
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 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 192.168.1.14/32
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 192.168.1.23/32
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 192.168.1.24/32
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
192.168.1.25/32
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 192.168.1.26/32
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

```

Step-by-Step Procedure To configure and apply CoS:

1. Configure one-to-one mapping 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 192.168.1.1/32
user@switch# set family ethernet-switching filter voip_class term voip
from source-address 192.168.1.2/32
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:

```
[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:

```
[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. Define the firewall filter `video_class` to classify the video traffic:

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

8. Define the term `video`:

```
[edit firewall]
user@switch# set family ethernet-switching filter video_class term video
from source-address 192.168.1.14/32
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
```

9. 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
```

10. Define the term `best_effort_traffic` (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
```

11. 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
```

12. Define the firewall filter `app_class` to classify the application server traffic:

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

13. Define the term `app`:

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term app from
source-address 192.168.1.23/32
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
```

14. Define the term `mail`:

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term mail from
source-address 192.168.1.24/32
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
```

15. Define the term `db`:

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term db from
source-address 192.168.1.25/32
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
```

16. Define the term `erp`:

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term erp from
source-address 192.168.1.26/32
```

```

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

```

17. 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

```

18. 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

```

19. 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

```

20. 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

```

21. 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

```

22. 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

```

Results Display the results of the configuration:

```

user@switch# show firewall

firewall family ethernet-switching {
  filter voip_class {
    term voip {
      from {
        source-address {
          192.168.1.1/32;
          192.168.1.2/32;
        }
        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 {
                192.168.1.14/32;
            }
            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 {
                192.168.1.23/32;
            }
            protocol tcp;
            source-port [1491 2512 2513 2598 2897];
        }
        then {
            forwarding-class app;
            loss-priority low;
        }
    }
}

```

```

    }
  }
  term mail {
    from {
      source-address {
        192.168.1.24/32;
      }
      protocol tcp;
      source-port [25 143 389 691 993 3268 3269];
    }
    then {
      forwarding-class mail;
      loss-priority low;
    }
  }
  term db {
    from {
      source-address {
        192.168.1.25/32;
      }
      protocol tcp;
      source-port [1521 1525 1527 1571 1810 2481];
    }
    then {
      forwarding-class db;
      loss-priority low;
    }
  }
  term erp {
    from {
      source-address {
        192.168.1.26/32;
      }
      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;
}
schedulers {
  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;
  }
}

```

```
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 37
- Verifying That the Forwarding Classes Have Been Assigned to Schedulers on page 38
- Verifying That the Scheduler Map Has Been Applied to the Interface on page 39

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

Purpose Verify that the following forwarding classes app, db, erp, mail, 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).

- Related Topics**
- Defining CoS Code-Point Aliases (CLI Procedure) on page 42
 - Defining CoS Classifiers (CLI Procedure) on page 43
 - Defining CoS Forwarding Classes (CLI Procedure) on page 47
 - Defining CoS Schedulers (CLI Procedure) on page 49
 - Configuring CoS Tail Drop Profiles (CLI Procedure) on page 52
 - Assigning CoS Components to Interfaces (CLI Procedure) on page 56
 - Configuring Firewall Filters (CLI Procedure)

Configuring CoS

- Configuring CoS (J-Web Procedure) on page 40
- Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
- Defining CoS Code-Point Aliases (CLI Procedure) on page 42
- Defining CoS Classifiers (CLI Procedure) on page 43
- Defining CoS Classifiers (J-Web Procedure) on page 44
- Defining CoS Forwarding Classes (CLI Procedure) on page 47
- Defining CoS Forwarding Classes (J-Web Procedure) on page 47

- Defining CoS Schedulers (CLI Procedure) on page 49
- Defining CoS Schedulers (J-Web Procedure) on page 49
- Configuring CoS Tail Drop Profiles (CLI Procedure) on page 52
- Defining CoS Rewrite Rules (CLI Procedure) on page 53
- Defining CoS Rewrite Rules (J-Web Procedure) on page 54
- Assigning CoS Components to Interfaces (CLI Procedure) on page 56
- Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
- Configuring JUNOS EZQoS for CoS (CLI Procedure) on page 58

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 Topics

- Defining CoS Classifiers (J-Web Procedure) on page 44
- Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
- Defining CoS Forwarding Classes (J-Web Procedure) on page 47
- Defining CoS Rewrite Rules (J-Web Procedure) on page 54
- Defining CoS Schedulers (J-Web Procedure) on page 49
- Assigning CoS Components to Interfaces (J-Web Procedure) on page 56

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

To define CoS Value Aliases, select **Configure > Class of Service > CoS Value Aliases** in the J-Web interface.

Table 8 on page 41 describes the related fields. By defining aliases you can assign meaningful names to a particular set of bit values and refer to them when configuring CoS components.

Table 8: CoS Value Aliases Configuration Pages Summary

Field	Function	Your Action
CoS Value Alias Summary		
DSCP	Allows you to define aliases for DiffServ code point (DSCP) IPv4 values. You can refer to these aliases when you configure classes and define classifiers.	Click DSCP .
IPv4 Precedence	Allows you to define aliases for IPv4 precedence values. Precedence values are modified in the IPv4 type-of-service (TOS) field and mapped to values that correspond to levels of service.	Click IPv4 Precedence .
Alias Name	Displays names given to CoS values—for example, af11 or be .	None.
Default Value	Displays the default values mapped to standard aliases. For example, ef (expedited forwarding) is a standard alias for DSCP bits 101110 . You cannot delete default values. The check box next to these values is unavailable.	None.
Configured Value	Displays the CoS values that you have assigned to specific aliases. You can delete a configured alias.	None.
Add	Opens a page that allows you to define CoS value aliases.	Click Add .
Delete	Allows you to delete a configured CoS value alias. You cannot delete a default alias.	Select the check box next to the CoS value alias and click Delete .
Add a CoS Value Alias		
CoS Value Alias	Assigns a name to a CoS value. A CoS value can be of different types—DSCP or IP precedence.	To define an alias for a CoS value, type a name—for example, my1 .

Table 8: CoS Value Aliases Configuration Pages Summary (continued)

Field	Function	Your Action
CoS Value Alias 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 an appropriate format: <ul style="list-style-type: none"> ■ 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 Topics**
- Defining CoS Code-Point Aliases (CLI Procedure) on page 42
 - Monitoring CoS Value Aliases on page 64
 - Example: Combining CoS with MPLS on EX Series Switches on page 22

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—Handles incoming IPv4 packets.
- IEEE 802.1p—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
```

- Related Topics**
- Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring CoS Value Aliases on page 64
 - Understanding CoS Code-Point Aliases on page 8

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 Software 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, or 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.

The following example describes how to configure a BA classifier **ba-classifier** as the default DSCP map and apply it 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 9 on page 43, to incoming packets in the four forwarding classes.

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

Table 9: BA-classifier Loss Priority Assignments

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

- Related Topics**
- Defining CoS Classifiers (J-Web Procedure) on page 44
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Assigning CoS Components to Interfaces (CLI Procedure) on page 56
 - Monitoring CoS Classifiers on page 59
 - Understanding CoS Classifiers on page 10

Defining CoS Classifiers (J-Web Procedure)

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 classifiers, select **Configure > Class of Service > Classifiers** in the J-Web interface. Table 10 on page 44 describes the related fields.

Table 10: Classifiers Configuration Page Summary

Field	Function	Your Action
Classifier Summary		
DSCP	Defines classifiers for DSCP code point values.	Click DSCP .
IPv4 Precedence	Defines classifiers for IPv4 precedence values.	Click IPv4 Precedence .

Table 10: Classifiers Configuration Page Summary (continued)

Field	Function	Your Action
Classifier Name	Displays the names of classifiers. Allows you to edit a specific classifier.	To edit a classifier, click its name.
Incoming Code Point (Alias)	Displays CoS values and aliases to which forwarding class and loss priority are mapped.	None.
Classify to Forwarding Class	Displays forwarding classes that are assigned to specific CoS values and aliases of a classifier.	None.
Classify to Loss Priority	Displays loss priorities that are assigned to specific CoS values and aliases of a classifier.	None.
Add	Opens a page that allows you to define classifiers.	To add a classifier, click Add .
Delete	Deletes a specified classifier.	To delete a classifier, locate the classifier, select the check box next to it, and click Delete .
Add a Classifier/Edit Classifier		
Classifier Name	Specifies the name for a classifier.	To name a classifier, type the name—for example, ba-classifier .
Classifier Code Point Mapping	Sets the forwarding classes and the packet loss priorities (PLPs) for specific CoS values and aliases.	None.
Incoming Code Point	Specifies the CoS value in bits and the alias of a classifier for incoming packets.	To specify a CoS value and alias, either select preconfigured ones from the list or type new ones. For information about forwarding classes and aliases assigned to well-known DSCPs, see the <i>JUNOS Class of Service Configuration Guide</i> .
Forwarding Class	Assigns the forwarding class to the specified CoS value and alias.	To assign a forwarding class, select either one of the following default forwarding classes or one that you have configured: <ul style="list-style-type: none"> ■ 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.

Table 10: Classifiers Configuration Page Summary (continued)

Field	Function	Your Action
Loss Priority	Assigns a loss priority to the specified CoS value and alias.	To assign a loss priority, select one: <ul style="list-style-type: none"> ■ high—Packet has a high loss priority. ■ low—Packet has a low loss priority.
Add	Assigns a forwarding class and loss priority to the specified CoS value and alias. A classifier examines the incoming packet's header for the specified CoS value and alias and assigns it the forwarding class and loss priority that you have defined.	To assign a forwarding class and loss priority to a specific CoS value and alias, click Add .
Delete	Removes the forwarding class and loss priority assignment from the classifier.	To remove the forwarding class and loss priority assignment, select it and click Delete .

- Related Topics**
- Defining CoS Classifiers (CLI Procedure) on page 43
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring CoS Classifiers on page 59
 - Understanding CoS Classifiers on page 10

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 Topics**
- Defining CoS Forwarding Classes (J-Web Procedure) on page 47
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Assigning CoS Components to Interfaces (CLI Procedure) on page 56
 - Monitoring CoS Forwarding Classes on page 60
 - Understanding CoS Forwarding Classes on page 13

Defining CoS Forwarding Classes (J-Web Procedure)

To define forwarding classes, select **Configure > Class of Service > Forwarding Classes** in the J-Web interface. Table 11 on page 47 describes the related fields. By assigning a forwarding class to a queue number, you affect the scheduling and marking of a packet as it transits an EX Series switch.

Table 11: Forwarding Classes Configuration Pages Summary

Field	Function	Your Action
Forwarding Class Summary		

Table 11: Forwarding Classes Configuration Pages Summary (continued)

Field	Function	Your Action
Queue #	<p>Displays internal queue numbers to which forwarding classes are assigned.</p> <p>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.</p> <p>Allows you to edit an assigned forwarding class.</p>	To edit an assigned forwarding class, click the queue number to which the class is assigned.
Forwarding Class Name	<p>Displays the forwarding class names assigned to specific internal queue numbers.</p> <p>By default, four forwarding classes are assigned to queue numbers 0 (best-effort), 1 (assured-forwarding), 5 (expedited-forwarding), and 7 (network-connect).</p>	None.
Add	Opens a page that allows you to assign forwarding classes to internal queue numbers.	To add a forwarding class, click Add .
Add a Forwarding Class/Edit Forwarding Class Queue #		
Queue #	Specifies the internal queue number to which a forwarding class is assigned.	To specify an internal queue number, type an integer from 0 through 7, as supported by your platform.
Forwarding Class Name	Specifies the forwarding class name assigned to the internal queue number.	To assign a forwarding class name to a queue, type the name—for example, be-class .

- Related Topics**
- Defining CoS Forwarding Classes (CLI Procedure) on page 47
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring CoS Forwarding Classes on page 60
 - Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
 - Understanding CoS Forwarding Classes on page 13

Defining CoS Schedulers (CLI Procedure)

You use schedulers to define the 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 tail 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.

You can associate up to four user-defined scheduler maps with the interfaces.

To configure CoS schedulers using the CLI:

1. Create a scheduler (**be-sched**) with low priority:

```
[edit class-of-service schedulers]
user@switch# set be-sched priority low
```

2. Configure a scheduler map (**be-map**) that associates the scheduler (**be-sched**) with the forwarding class (**best-effort**):

```
[edit class-of-service scheduler-maps]
user@switch# set be-map forwarding-class best-effort scheduler be-sched
```

3. Assign the scheduler map (**be-map**) to a Gigabit Ethernet interface (**ge-0/0/1**):

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

4. Alternatively to assign the scheduler map (**be-map**) to all the Gigabit Ethernet interfaces using wild cards (**ge-***):

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

- Related Topics**
- Defining CoS Schedulers (J-Web Procedure) on page 49
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Assigning CoS Components to Interfaces (CLI Procedure) on page 56
 - Monitoring CoS Scheduler Maps on page 62
 - Understanding CoS Schedulers on page 16

Defining CoS Schedulers (J-Web Procedure)

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 using the Configuration pages:

1. Create a scheduler and specify attributes for it. For a description of scheduler-related fields, see Table 12 on page 50.
2. Associate the scheduler to a forwarding class. Because the forwarding class is assigned to a queue number, the queue inherits this scheduler's attributes. For a description of scheduler map-related fields, see Table 12 on page 50.

Table 12: Schedulers Configuration Page Summary

Field	Function	Your Action
Scheduler Summary		
Scheduler Name	Displays the names of defined schedulers. Allows you to edit a specific scheduler.	To edit a scheduler, click its name.
Scheduler Information	Displays a summary of defined settings for a scheduler, such as bandwidth, delay buffer size, and transmit rates.	None.
Add	Opens a page that allows you to add a scheduler.	Click Add .
Delete	Removes a scheduler.	Click Delete .
Add a Scheduler/Edit Scheduler		
Scheduler Name	Specifies the name for a scheduler.	To name a scheduler, type the name—for example, be-scheduler .
Buffer Size	Defines the size of the delay buffer. By default, queues 0 through 7 have the following percentage of the total available buffer space: <ul style="list-style-type: none"> ■ Queue 0—95 percent ■ Queue 1—0 percent ■ Queue 2—0 percent ■ Queue 3—0 percent ■ Queue 4—0 percent ■ Queue 5—0 percent ■ Queue 6—0 percent ■ Queue 7—5 percent <p>NOTE: A large buffer size value correlates with a greater possibility of packet delays. This might not be practical for sensitive traffic such as voice or video.</p>	To define a delay buffer size for a scheduler, select the appropriate option: <ul style="list-style-type: none"> ■ To specify no buffer size, select Unconfigured. ■ 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.

Table 12: Schedulers Configuration Page Summary (continued)

Field	Function	Your Action
Scheduling Priority	<p>Sets the transmission priority of the scheduler, which determines the order in which an output interface transmits traffic from the queues.</p> <p>You can set scheduling priority at different levels in an order of increasing priority from low to high.</p> <p>A high-priority queue with a high transmission rate might lock out lower-priority traffic.</p>	<p>To specify a priority, select one:</p> <ul style="list-style-type: none"> ■ low—Packets in this queue are transmitted last. ■ strict—high—Packets in this queue are transmitted first.
Transmit Rate	<p>Defines the transmission rate of a scheduler.</p> <p>The transmit rate determines the traffic bandwidth from each forwarding class you configure.</p> <p>By default, queues 0 through 7 have the following percentage of transmission capacity:</p> <ul style="list-style-type: none"> ■ Queue 0—95 percent ■ Queue 1—0 percent ■ Queue 2—0 percent ■ Queue 3—5 percent ■ Queue 4—0 percent ■ Queue 6—0 percent ■ Queue 7—5 percent 	<p>To define a transmit rate, select the appropriate option:</p> <ul style="list-style-type: none"> ■ To not specify transmit rate, select Unconfigured. ■ 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. <p>To enforce the exact transmission rate or percentage you configured, select the Exact Transmit Rate check box.</p>

Table 13: Scheduler Maps Configuration Page Summary

Field	Function	Your Action
Scheduler Maps Summary		
Scheduler Map Name	<p>Displays the names of defined scheduler maps. Scheduler maps link schedulers to forwarding classes.</p> <p>Allows you to edit a scheduler map.</p>	To edit a scheduler map, click its name.
Scheduler Map Information	For each map, displays the schedulers and the forwarding classes that they are assigned to.	None.
Add	Opens a page that allows you to add a scheduler map.	Click Add .
Delete	Removes a scheduler map.	Select it and click Delete .
Add a Scheduler Map/Edit Scheduler Map		
Scheduler Map Name	Specifies the name for a scheduler map.	To name a map, type the name—for example, be-scheduler-map.

Table 13: Scheduler Maps Configuration Page Summary (continued)

Field	Function	Your Action
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, packet schedulers.	To associate a scheduler with a forwarding class, locate the forwarding class and select the scheduler in the box next to it.

- Related Topics**
- Defining CoS Schedulers (CLI Procedure) on page 49
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring CoS Scheduler Maps on page 62

Configuring CoS Tail Drop Profiles (CLI Procedure)

Tail drop is a simple and effective traffic congestion avoidance mechanism. When you apply this mechanism to manage congestion, packets are dropped when the output queue is full.

To configure CoS tail-drop profiles, create a drop profile name (**be-dp**) and assign a fill level (25):

```
[edit class-of-service drop-profiles]
user@switch# set be-dp fill-level 25
```

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Understanding CoS Tail Drop Profiles on page 15

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. After the rewrite rule is created, enable it on an interface. You can also apply an existing rewrite rule on an interface.



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.



NOTE: Custom rewrite-rule bindings are implemented through filters. And custom rewrite rules cannot be bound to routed VLAN interfaces (RVIs).

To create rewrite rules and enable them on interfaces:

- To create an 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 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
```

- To enable an 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
```

- Related Topics**
- Defining CoS Rewrite Rules (J-Web Procedure) on page 54
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring CoS Rewrite Rules on page 61
 - Understanding CoS Rewrite Rules on page 20

Defining CoS Rewrite Rules (J-Web Procedure)

To define rewrite rules, select **Configure > Class of Service > Rewrite Rules** in the J-Web interface. Table 14 on page 54 describes the related fields. 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.

Table 14: Rewrite Rules Configuration Page Summary

Field	Function	Your Action
Rewrite Rules Summary		
DSCP	Redefines DSCP code point values of outgoing packets.	Click DSCP .
IPv4 Precedence	Redefines IPv4 precedence code point values.	Click IPv4 Precedence .
Rewrite Rule Name	Displays names of defined rewrite rules. Allows you to edit a specific rule.	To edit a rule, click its name.
Forwarding Class	Displays forwarding classes associated with a specific rewrite rule.	None.
Loss Priority	Displays loss priority values associated with a specific rewrite rule.	None.
Rewrite Outgoing Code Point To	Displays the CoS values and aliases that a specific rewrite rule has set for a specific forwarding class and loss priority.	None.
Add	Opens a page that allows you to define a new rewrite rule.	To add a rewrite rule, click Add .
Delete	Removes specified rewrite rules.	To remove a rule, select the check box next to it and click Delete .
Add a Rewrite Rule/Edit Rewrite Rule		
Rewrite Rule Name	Specifies a rewrite rule name.	To name a rule, type the name—for example, rewrite-dscps .

Table 14: Rewrite Rules Configuration Page Summary (continued)

Field	Function	Your Action
Code Point Mapping	<p>Rewrites outgoing CoS values of a packet based on the forwarding class and loss priority.</p> <p>Allows you to remove a code point mapping entry.</p>	<p>To configure the CoS value assignment, follow these steps:</p> <ol style="list-style-type: none"> 1. From the Forwarding Class list, select a class. 2. Select a priority from the following: <ul style="list-style-type: none"> ■ low—Rewrite rule applies to packets with a low loss priority. ■ high—Rewrite rule applies to packets with a high loss priority. 3. For Rewritten Code Point, either select a predefined CoS value and alias or type a new CoS value and alias. <p>For information about predefined CoS values and aliases, see the <i>JUNOS Class of Service Configuration Guide</i>.</p> <ol style="list-style-type: none"> 4. Click Add. <p>To remove a code point mapping entry, select it and click Delete.</p>

-
- Related Topics**
- Defining CoS Rewrite Rules (CLI Procedure) on page 53
 - Understanding CoS Rewrite Rules on page 20
 - Monitoring CoS Rewrite Rules on page 61
 - Example: Combining CoS with MPLS on EX Series Switches on page 22

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 Topics**
- Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring Interfaces That Have CoS Components on page 60
 - Understanding JUNOS CoS Components for EX Series Switches on page 5

Assigning CoS Components to Interfaces (J-Web Procedure)

After you have defined CoS components, you must assign them to logical or physical interfaces. The CoS Configuration pages allow you 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. In the J-Web interface, select **Configure>Class of Service>Interface Association**.
2. Enter information into these pages, as described in Table 15 on page 57.
3. Click one:

- Click OK to apply changes to the configuration.
- Click Cancel to cancel without saving changes.

Table 15: Assigning CoS Components to Interfaces

Field	Function	Your Action
Add CoS Service to a Physical Interface/Edit CoS Physical Interface		
Physical Interface Name	Specifies the name of a physical interface. Allows you to assign CoS components to a set of interfaces at the same time.	To specify an interface for CoS assignment, type its name in the Physical Interface Name box. To specify a set of interfaces for CoS assignment, use the wildcard character (*)—for example, <i>ge-0/*/0</i> .
Scheduler Map	Specifies a predefined scheduler map for the physical interface. A scheduler map enables the physical interface to have more than one set of output queues.	To specify a map for an interface, select it from the Scheduler Map list.
Add	Allows you to add a CoS service to a logical interface on a specified physical interface.	To add a CoS Service to a logical interface, click Add .
Add CoS Service to a Logical Interface Unit/Edit CoS Logical Interface Unit		
Logical Interface Unit Name	Specifies the name of a logical interface. Allows you to assign CoS components to a logical interface configured on a physical interface at the same time.	To specify an interface for CoS assignment, type the interface name in the Logical Interface Unit Name box. 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 the interface, select the forwarding class.
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 the 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.	To assign rewrite rules to the interface, select the appropriate rewrite rule for each CoS value type used on the interface.

- Related Topics**
- Assigning CoS Components to Interfaces (CLI Procedure) on page 56
 - Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Monitoring Interfaces That Have CoS Components on page 60

Configuring JUNOS EZQoS for CoS (CLI Procedure)

You use JUNOS 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 Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
 - Understanding JUNOS EZQoS for CoS Configurations on EX Series Switches on page 22

Verifying CoS Configuration

- Monitoring CoS Classifiers on page 59
- Monitoring CoS Forwarding Classes on page 60
- Monitoring Interfaces That Have CoS Components on page 60

- Monitoring CoS Rewrite Rules on page 61
- Monitoring CoS Scheduler Maps on page 62
- Monitoring CoS Value Aliases on page 64

Monitoring CoS Classifiers

Purpose 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 16 on page 59 summarizes key output fields for CoS classifiers.

Table 16: 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 (+).
CoS Value Type	The classifiers are displayed by type: <ul style="list-style-type: none"> ■ <code>dscp</code>—All classifiers of the DSCP type. ■ <code>ieee-802.1</code>—All classifiers of the IEEE 802.1 type. ■ <code>inet-precedence</code>—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 Topics**
- Defining CoS Classifiers (CLI Procedure) on page 43
 - Defining CoS Classifiers (J-Web Procedure) on page 44
 - Example: Combining CoS with MPLS on EX Series Switches on page 22

Monitoring CoS Forwarding Classes

- Purpose** Use the monitoring functionality to view the current assignment of CoS forwarding classes to queue numbers on the system.
- 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 17 on page 60 summarizes key output fields for CoS forwarding classes.

**Table 17: Summary of Key CoS Forwarding Class Output Fields**

| Field            | Values                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Additional Information                                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Forwarding Class | Names of forwarding classes assigned to queue numbers. By default, the following forwarding classes are assigned to queues 0, 1, 5, or 7: <ul style="list-style-type: none"> <li>■ <b>best-effort</b>—Provides no special CoS handling of packets. Loss priority is typically not carried in a CoS value.</li> <li>■ <b>expedited-forwarding</b>—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service.</li> <li>■ <b>assured-forwarding</b>—Provides high assurance for packets within specified service profile. Excess packets are dropped.</li> <li>■ <b>network-control</b>—Packets can be delayed but not dropped.</li> </ul> |                                                                            |
| Queue            | Queue number corresponding to the forwarding class name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | By default, four queues, 0, 1, 5 or 7, are assigned to forwarding classes. |

- Related Topics**
- Defining CoS Forwarding Classes (CLI Procedure) on page 47
  - Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Example: Combining CoS with MPLS on EX Series Switches on page 22

## Monitoring Interfaces That Have CoS Components

- Purpose** 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 18 on page 61 summarizes key output fields for CoS interfaces.

**Table 18: 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.                           |                                                                                                        |
| 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 Topics**
- Assigning CoS Components to Interfaces (CLI Procedure) on page 56
  - Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
  - Example: Combining CoS with MPLS on EX Series Switches on page 22

## Monitoring CoS Rewrite Rules

**Purpose** 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 19 on page 62 summarizes key output fields for CoS rewrite rules.

**Table 19: 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: <ul style="list-style-type: none"> <li>■ dscp—For IPv4 DiffServ traffic.</li> <li>■ ieee-802.1—For Layer 2 traffic.</li> <li>■ inet-precedence—For IPv4 traffic.</li> </ul> | To display forwarding classes, loss priorities, and rewritten CoS values, click the plus sign (+).               |
| Index                | Internal index for this particular rewrite rule.                                                                                                                                               |                                                                                                                  |
| 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 Topics**
- Defining CoS Rewrite Rules (CLI Procedure) on page 53
  - Defining CoS Rewrite Rules (J-Web Procedure) on page 54
  - Example: Combining CoS with MPLS on EX Series Switches on page 22

## Monitoring CoS Scheduler Maps

**Purpose** 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 20 on page 63 summarizes key output fields for CoS scheduler maps.

**Table 20: 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.                                                                                                                                                                                                                                                                                                                                                                         |                                       |
| Transmit Rate     | <p>Configured transmit rate of the scheduler in bits per second (bps). The rate value can be either of the following:</p> <ul style="list-style-type: none"> <li>■ A percentage—The scheduler receives the specified percentage of the total interface bandwidth.</li> <li>■ <b>remainder</b>— The scheduler receives the remaining bandwidth of the interface after bandwidth allocation to other schedulers.</li> </ul> |                                       |
| Buffer Size       | <p>Delay buffer size in the queue or the amount of transmit delay (in milliseconds). The buffer size can be either of the following:</p> <ul style="list-style-type: none"> <li>■ A percentage—The buffer is a percentage of the total buffer allocation.</li> <li>■ <b>remainder</b>—The buffer is sized according to what remains after other scheduler buffer allocations.</li> </ul>                                  |                                       |
| Priority          | <p>Scheduling priority of a queue:</p> <ul style="list-style-type: none"> <li>■ <b>strict-high</b>—Packets in this queue are transmitted first.</li> <li>■ <b>low</b>—Packets in this queue are transmitted last.</li> </ul>                                                                                                                                                                                              |                                       |
| 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 Topics**
- Defining CoS Schedulers (CLI Procedure) on page 49
  - Defining CoS Schedulers (J-Web Procedure) on page 49
  - Example: Combining CoS with MPLS on EX Series Switches on page 22

### Monitoring CoS Value Aliases

**Purpose** 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 21 on page 64 summarizes key output fields for CoS value aliases.

**Table 21: Summary of Key CoS Value Alias Output Fields**

| Field           | Values                                                                                                                                                                                                                                                                                                                                                         | Additional Information                                        |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| CoS Value Type  | Type of the CoS value: <ul style="list-style-type: none"> <li>■ <code>dscp</code>—Examines Layer 3 packet headers for IP packet classification.</li> <li>■ <code>ieee-802.1</code>—Examines Layer 2 packet headers for packet classification.</li> <li>■ <code>inet-precedence</code>—Examines Layer 3 packet headers for IP packet classification.</li> </ul> | To display aliases and bit patterns, click the plus sign (+). |
| CoS Value Alias | Name given to a set of bits—for example, <code>af11</code> is a name for <code>001010</code> bits.                                                                                                                                                                                                                                                             |                                                               |
| CoS Value       | Set of bits associated with an alias.                                                                                                                                                                                                                                                                                                                          |                                                               |

- Related Topics**
- Defining CoS Code-Point Aliases (CLI Procedure) on page 42
  - Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
  - Example: Combining CoS with MPLS on EX Series Switches on page 22

### Configuration Statements for CoS

- [edit class-of-service] Configuration Statement Hierarchy on page 65

**[edit class-of-service] Configuration Statement Hierarchy**

```

class-of-service {
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) classifier-name {
 import (classifier-name | default);
 forwarding-class class-name {
 loss-priority loss-priority {
 code-points [aliases] [6 bit-patterns];
 }
 }
 }
 }
}
code-point-aliases {
 (dscp | ieee-802.1 | inet-precedence) {
 alias-name bits;
 }
}
forwarding-classes {
 class class-name queue-num queue-number;
}
interfaces {
 interface-name {
 scheduler-map map-name;
 unit logical-unit-number {
 forwarding-class class-name;
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) (classifier-name | default);
 }
 }
 }
}
multi-destination {
 family {
 ethernet {
 broadcast forwarding-class-name;
 }
 inet {
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) classifier-name;
 }
 }
 }
 scheduler-map map-name;
}
rewrite-rules {
 (dscp | ieee-802.1 | inet-precedence) rewrite-name {
 import (rewrite-name | default);
 forwarding-class class-name {
 loss-priority loss-priority code-point (alias | bits);
 }
 }
}
scheduler-maps {

```

```

 map-name {
 forwarding-class class-name scheduler scheduler-name;
 }
}
schedulers {
 scheduler-name {
 buffer-size (percent percentage | remainder);
 drop-profile-map loss-priority loss-priority protocol protocol drop-profile
 profile-name;
 priority priority;
 shaping-rate (rate | percent percentage);
 transmit-rate (rate | percent percentage | remainder);
 }
}
}

```

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Code-Point Aliases (CLI Procedure) on page 42 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
  - Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
  - Defining CoS Forwarding Classes (CLI Procedure) on page 47 or Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Configuring CoS Tail Drop Profiles (CLI Procedure) on page 52
  - Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49
  - Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54
  - Assigning CoS Components to Interfaces (CLI Procedure) on page 56 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
  - Understanding CoS Classifiers on page 10

## **broadcast**

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>broadcast forwarding-class-name;</code>                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit class-of-service multi-destination family ethernet]                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.5 for EX Series switches.                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Specify the forwarding class for the broadcast traffic belonging to the Ethernet family.                                                                                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | <i>forwarding-class-name</i> —Name of the forwarding class: <ul style="list-style-type: none"><li>■ <code>mcast-af</code>—Default forwarding class for assured forwarding of multicast traffic.</li><li>■ <code>mcast-be</code>—Default best-effort forwarding class for multicast traffic.</li><li>■ <code>mcast-ef</code>—Default forwarding class for expedited forwarding of multicast traffic.</li></ul> |
| <b>Required Privilege Level</b> | <code>routing</code> —To view this statement in the configuration.<br><code>routing-control</code> —To add this statement to the configuration.                                                                                                                                                                                                                                                               |
| <b>Related Topics</b>           | <ul style="list-style-type: none"><li>■ Understanding CoS Schedulers on page 16</li><li>■ Understanding CoS Forwarding Classes on page 13</li><li>■ Understanding CoS Classifiers on page 10</li></ul>                                                                                                                                                                                                        |

## buffer-size

---

|                                 |                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | buffer-size (percent <i>percentage</i>   remainder);                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit class-of-service schedulers <i>scheduler-name</i> ]                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                          |
| <b>Description</b>              | Specify buffer size.                                                                                                                                                                                                                                                                       |
| <b>Default</b>                  | 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.                                                                                                                  |
| <b>Options</b>                  | <i>percent percentage</i> —Buffer size as a percentage of total buffer.<br><i>remainder</i> —Remaining buffer available.                                                                                                                                                                   |
| <b>Required Privilege Level</b> | <i>routing</i> —To view this statement in the configuration.<br><i>routing-control</i> —To add this statement to the configuration.                                                                                                                                                        |
| <b>Related Topics</b>           | <ul style="list-style-type: none"><li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li><li>■ Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49</li><li>■ Understanding CoS Schedulers on page 16</li></ul> |

## class

---

**Syntax** `class class-name queue-num queue-number;`

**Hierarchy Level** [edit class-of-service forwarding-classes]

**Release Information** Statement introduced in JUNOS Release 9.0 for EX Series switches.

**Description** Configure up to 16 forwarding classes with multiple forwarding classes mapped to single queues. If you want to configure up to eight forwarding classes with one-to-one mapping to output queues, use the **queue** statement instead of the **class** statement at the [edit class-of-service forwarding-classes] hierarchy level.

**Options** *class-name* —Name of forwarding class..

*queue-num* *queue-number* —Output queue number.

**Range:** 0 through 15.

**Required Privilege Level** routing—To view this statement in the configuration.

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

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Forwarding Classes (CLI Procedure) on page 47 or Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Understanding CoS Forwarding Classes on page 13

## class-of-service

---

```

Syntax class-of-service {
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) classifier-name {
 import (classifier-name | default);
 forwarding-class class-name {
 loss-priority level {
 code-points [aliases] [6 bit-patterns];
 }
 }
 }
 }
 code-point-aliases {
 (dscp | ieee-802.1 | inet-precedence) {
 alias-name bits;
 }
 }
 forwarding-classes {
 class class-name queue-num queue-number;
 }
 interfaces {
 interface-name {
 scheduler-map map-name;
 unit logical-unit-number {
 forwarding-class class-name;
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) (classifier-name | default);
 }
 }
 }
 }
 multi-destination {
 family {
 ethernet {
 broadcast forwarding-class-name;
 }
 inet {
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) classifier-name;
 }
 }
 }
 scheduler-map map-name;
 }
 rewrite-rules {
 (dscp | ieee-802.1 | inet-precedence) rewrite-name {
 import (rewrite-name | default);
 forwarding-class class-name {
 loss-priority priority code-point (alias | bits);
 }
 }
 }
}

```

```

scheduler-maps {
 map-name {
 forwarding-class class-name scheduler scheduler-name;
 }
}
schedulers {
 scheduler-name {
 buffer-size (percent percentage | remainder);
 drop-profile-map loss-priority loss-priority protocol protocol drop-profile profile-name;
 priority priority;
 shaping-rate (rate | percent percentage);
 transmit-rate (rate | percent percentage | remainder);
 }
}
}

```

**Hierarchy Level** [edit]

**Release Information** Statement introduced in JUNOS Release 9.0 for EX Series switches.  
Option **multi-destination** introduced in JUNOS Release 9.5 for EX Series switches.

**Description** Configure class-of-service parameters on EX Series switches.

The remaining statements are explained separately.

**Default** If you do not configure any CoS features, the default CoS settings are used.

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

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Code-Point Aliases (CLI Procedure) on page 42 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
  - Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
  - Defining CoS Forwarding Classes (CLI Procedure) on page 47 or Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Configuring CoS Tail Drop Profiles (CLI Procedure) on page 52
  - Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49
  - Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54
  - Assigning CoS Components to Interfaces (CLI Procedure) on page 56 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
  - Understanding CoS Classifiers on page 10

## classifiers

---

```

Syntax classifiers {
 (dscp | 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 Release 9.0 for EX Series switches.

**Description** Apply a CoS aggregate behavior classifier to a logical interface. You can apply a default classifier or one that has been previously defined.

The statements are explained separately.

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

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
  - Assigning CoS Components to Interfaces (CLI Procedure) on page 56 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 56
  - Understanding CoS Classifiers on page 10

## code-point-aliases

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|                                 |                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | code-point-aliases {<br>(dscp   ieee-802.1   inet-precedence) {<br>alias-name bits;<br>}<br>}                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit class-of-service]                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Define an alias for a CoS marker.<br><br>The statements are explained separately.                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                   |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Defining CoS Code-Point Aliases (CLI Procedure) on page 42 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 41</li> <li>■ Understanding CoS Code-Point Aliases on page 8</li> </ul> |

## code-points

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|                                 |                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | code-points [ <i>aliases</i> ] [ <i>6 bit-patterns</i> ];                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit class-of-service classifiers (dscp   ieee-802.1   inet-precedence) forwarding-class class-name loss-priority level]                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                 |
| <b>Description</b>              | Specify one or more DSCP code-point aliases or bit sets for association with a forwarding class.                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><i>aliases</i> —Name of the DSCP alias.</p> <p><i>6 bit-patterns</i> —Value of the code-point bits, in decimal form.</p>                                                                                                                                                                       |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                               |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44</li> <li>■ Understanding CoS Classifiers on page 10</li> </ul> |

## drop-profile-map

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|                                 |                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | drop-profile-map loss-priority <i>loss-priority</i> protocol <i>protocol</i> drop-profile <i>profile-name</i> ;                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit class-of-service schedulers <i>scheduler-name</i> ]                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                          |
| <b>Description</b>              | Define the loss priority value for the specified drop profile.                                                                                                                                                                                                                             |
| <b>Options</b>                  | drop-profile <i>profile-name</i> —Name of the drop profile.<br><br>The remaining statements are explained separately.                                                                                                                                                                      |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                        |
| <b>Related Topics</b>           | <ul style="list-style-type: none"><li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li><li>■ Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49</li><li>■ Understanding CoS Schedulers on page 16</li></ul> |

**dscp**

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>dscp classifier-name {   import (classifier-name   default);   forwarding-class class-name {     loss-priority level {       code-points [ aliases ] [ 6-bit-patterns ];     }   } }</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit class-of-service classifiers],<br>[edit class-of-service code-point-aliases],<br>[edit class-of-service interfaces <i>interface-name</i> unit <i>logical-unit-number</i> classifiers],<br>[edit class-of-service rewrite-rules]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | Define the Differentiated Services code point (DSCP) mapping that is applied to the packets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <i>classifier-name</i> —Name of the classifier.<br><br>The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Defining CoS Code-Point Aliases (CLI Procedure) on page 42 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 41</li> <li>■ Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44</li> <li>■ Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54</li> <li>■ Assigning CoS Components to Interfaces (CLI Procedure) on page 56 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 56</li> <li>■ Understanding CoS Classifiers on page 10</li> </ul> |

## ethernet

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|                                 |                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ethernet {<br>broadcast <i>forwarding-class-name</i> ;<br>}                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit class-of-service multi-destination family]                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.5 for EX Series switches.                                                                                                                                          |
| <b>Description</b>              | Specify the Ethernet broadcast traffic family.<br><br>The remaining statement is explained separately.                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                        |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Understanding CoS Schedulers on page 16</li> <li>■ Understanding CoS Forwarding Classes on page 13</li> <li>■ Understanding CoS Classifiers on page 10</li> </ul> |

## family

---

|                                 |                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | family {<br>ethernet {<br>broadcast <i>forwarding-class-name</i> ;<br>}<br>inet {<br>classifiers{<br>(dscp   ieee-802.1   inet-precedence) <i>classifier-name</i> ;<br>}<br>}<br>}                         |
| <b>Hierarchy Level</b>          | [edit class-of-service multi-destination]                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.5 for EX Series switches.                                                                                                                                          |
| <b>Description</b>              | Specify the multidestination traffic family.<br><br>The remaining statements are explained separately.                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                        |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Understanding CoS Schedulers on page 16</li> <li>■ Understanding CoS Forwarding Classes on page 13</li> <li>■ Understanding CoS Classifiers on page 10</li> </ul> |

## 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-name*],  
 [edit class-of-service scheduler-maps *map-name*]

**Release Information** Statement introduced in JUNOS 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** routing—To view this statement in the configuration.  
 routing-control—To add this statement to the configuration.

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Forwarding Classes (CLI Procedure) on page 47 or Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Understanding CoS Forwarding Classes on page 13

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

**Release Information** Statement introduced in JUNOS 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** routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
  - Defining CoS Code-Point Aliases (CLI Procedure) on page 42 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
  - Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54
  - Understanding CoS Classifiers on page 10
  - Understanding CoS Rewrite Rules on page 20

## import

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | import ( <i>classifier-name</i>   default);                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit class-of-service classifiers (dscp   ieee-802.1   inet-precedence) <i>classifier-name</i> ],<br>[edit class-of-service rewrite-rules (dscp   ieee-802.1   inet-precedence) <i>rewrite-name</i> ]                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | Specify a default or previously defined classifier.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <i>classifier-name</i> —Name of the classifier mapping configured at the [edit class-of-service classifiers] hierarchy level.<br><br>default—Default classifier mapping.                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44</li> <li>■ Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54</li> <li>■ Understanding CoS Classifiers on page 10</li> <li>■ Understanding CoS Rewrite Rules on page 20</li> </ul> |

## inet

---

**Syntax**

```
inet {
 classifiers {
 (dscp | ieee-802.1 | inet-precedence) classifier-name ;
 }
}
```

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

**Release Information** Option inet introduced in JUNOS Release 9.5 for EX Series switches. The remaining statements are explained separately.

**Description** Specify the IP multicast family.

The remaining statements are explained separately.

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

- Related Topics**
- Understanding CoS Schedulers on page 16
  - Understanding CoS Forwarding Classes on page 13
  - Understanding CoS Classifiers on page 10

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

**Release Information** Statement introduced in JUNOS 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** routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
  - Defining CoS Code-Point Aliases (CLI Procedure) on page 42 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 41
  - Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54
  - Understanding CoS Classifiers on page 10
  - Understanding CoS Rewrite Rules on page 20

## interfaces

---

**Syntax**

```

interfaces {
 interface-name {
 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 Release 9.0 for EX Series switches.

**Description** Configure interface-specific CoS properties for incoming packets.

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

The statements are explained separately.

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

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
  - Defining CoS Forwarding Classes (CLI Procedure) on page 47 or Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49
  - EX Series Switches Interfaces Overview

## loss-priority

---

**Syntax** `loss-priority level {  
code-points [ aliases ] [ 6-bit-patterns ];  
}`

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

**Release Information** Statement introduced in JUNOS Release 9.0 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.
- **low**—Packet has low loss priority.

The remaining statement is explained separately.

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

**Related Topics**

- Example: Combining CoS with MPLS on EX Series Switches on page 22
- Defining CoS Classifiers (CLI Procedure) on page 43 or Defining CoS Classifiers (J-Web Procedure) on page 44
- Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54
- Understanding CoS Classifiers on page 10
- Understanding CoS Rewrite Rules on page 20

## multi-destination

---

**Syntax**

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

**Hierarchy Level** [edit class-of-service]

**Release Information** Statement introduced in JUNOS Release 9.5 for EX Series switches.

**Description** Define the CoS configuration for multidestination traffic.

The remaining statements are explained separately.

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

- Related Topics**
- Understanding CoS Schedulers on page 16
  - Understanding CoS Forwarding Classes on page 13
  - Understanding CoS Classifiers on page 10

## priority

---

|                                 |                                                                                                                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>priority <i>priority</i>;</code>                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit class-of-service schedulers <i>scheduler-name</i> ]                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                              |
| <b>Description</b>              | Specify packet-scheduling priority value.                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | <p><i>priority</i> —It can be one of the following:</p> <ul style="list-style-type: none"> <li>■ <i>low</i>—Scheduler has low priority.</li> <li>■ <i>strict-high</i>—Scheduler has strictly high priority.</li> </ul>                                                                         |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                 |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49</li> <li>■ Understanding CoS Schedulers on page 16</li> </ul> |

## protocol

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|                                 |                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>protocol <i>protocol</i> drop-profile <i>profile-name</i>;</code>                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit class-of-service schedulers <i>scheduler-name</i> ]                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                         |
| <b>Description</b>              | Specify the protocol type for the specified drop profile.                                                                                                                                                                                                 |
| <b>Options</b>                  | <p><code>drop-profile <i>profile-name</i></code> —Name of the drop profile.</p> <p><i>protocol</i> —Type of protocol. It can be:</p> <ul style="list-style-type: none"> <li>■ <i>any</i>—Accept any protocol type.</li> </ul>                             |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                            |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Configuring CoS Tail Drop Profiles (CLI Procedure) on page 52</li> <li>■ Understanding CoS Tail Drop Profiles on page 15</li> </ul> |

## rewrite-rules

---

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

**Hierarchy Level** [edit class-of-service]

**Release Information** Statement introduced in JUNOS Release 9.0 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** routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Rewrite Rules (CLI Procedure) on page 53 or Defining CoS Rewrite Rules (J-Web Procedure) on page 54
  - Understanding CoS Rewrite Rules on page 20

## **scheduler-map**

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>scheduler-map <i>map-name</i>;</code>                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit class-of-service interfaces],<br>[edit class-of-service multi-destination]                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Associate a scheduler map name with an interface or with a multidestination traffic configuration.                                                                                                                                                                                                                                                                          |
| <b>Options</b>                  | <i>map-name</i> —Name of the scheduler map.                                                                                                                                                                                                                                                                                                                                 |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                         |
| <b>Related Topics</b>           | <ul style="list-style-type: none"><li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li><li>■ Assigning CoS Components to Interfaces (CLI Procedure) on page 56 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 56</li><li>■ Understanding CoS Schedulers on page 16</li><li>■ Understanding CoS Classifiers on page 10</li></ul> |

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

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Forwarding Classes (CLI Procedure) on page 47 or Defining CoS Forwarding Classes (J-Web Procedure) on page 47
  - Understanding CoS Schedulers on page 16
  - Understanding CoS Forwarding Classes on page 13

## schedulers

---

**Syntax** schedulers {  
     *scheduler-name* {  
         buffer-size (percent *percentage* | remainder);  
         drop-profile-map loss-priority *loss-priority* protocol *protocol* drop-profile *profile-name*;  
         priority *priority*;  
         shaping-rate (*rate* | percent *percentage*);  
         transmit-rate (*rate* | percent *percentage* | remainder);  
     }  
 }

**Hierarchy Level** [edit class-of-service]

**Release Information** Statement introduced in JUNOS 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** routing—To view this statement in the configuration.  
 routing-control—To add this statement to the configuration.

- Related Topics**
- Example: Combining CoS with MPLS on EX Series Switches on page 22
  - Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49
  - Understanding CoS Schedulers on page 16

## shaping-rate

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | shaping-rate (percent <i>percentage</i>   rate);                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit class-of-service schedulers <i>scheduler-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.3 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | <p>Configure shaping rate to throttle the rate at which queues transmit packets.</p> <p>We recommend that you configure the shaping rate as an absolute maximum usage and not as additional usage beyond the configured transmit rate.</p>                                                                                                                                                                                                |
| <b>Default</b>                  | If you do not include this statement, the default shaping rate is 100 percent, which is the same as no shaping at all.                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                  | <p><i>percentpercentage</i> —Shaping rate as a percentage of the available interface bandwidth.<br/> <b>Range:</b> 0 through 100 percent</p> <p><i>rate</i>—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).<br/> <b>Range:</b> 3200 through 32,000,000,000 bps</p> |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                            |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Understanding JUNOS CoS Components for EX Series Switches on page 5</li> </ul>                                                                                                                                                                                                                                      |

## transmit-rate

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | transmit-rate ( <i>rate</i>   percent <i>percentage</i>   remainder);                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit class-of-service schedulers <i>scheduler-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | Specify the transmit rate or percentage for a scheduler.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Default</b>                  | 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.                                                                                                                                                                                                                                                                                                                           |
| <b>Options</b>                  | <p><i>rate</i> —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).<br/> <b>Range:</b> 3200 through 160,000,000,000 bps</p> <p>percent <i>percentage</i> —Percentage of transmission capacity. A percentage of zero drops all packets in the queue.<br/> <b>Range:</b> 0 through 100 percent</p> <p>remainder—Remaining rate available</p> |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Defining CoS Schedulers (CLI Procedure) on page 49 or Defining CoS Schedulers (J-Web Procedure) on page 49</li> <li>■ Understanding CoS Schedulers on page 16</li> </ul>                                                                                                                                                                                                      |

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

**Related Topics**

- Example: Combining CoS with MPLS on EX Series Switches on page 22
- Assigning CoS Components to Interfaces (CLI Procedure) on page 56 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 56

## Operational Mode Commands for CoS

---

## show class-of-service

|                                 |                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show class-of-service                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Command introduced in JUNOS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Display the class of service (CoS) information.                                                                                                                                                                                                                                                                                                                                          |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Topics</b>           | <ul style="list-style-type: none"> <li>■ Example: Combining CoS with MPLS on EX Series Switches on page 22</li> <li>■ Monitoring CoS Value Aliases on page 64</li> <li>■ Monitoring CoS Classifiers on page 59</li> <li>■ Monitoring CoS Forwarding Classes on page 60</li> <li>■ Monitoring CoS Scheduler Maps on page 62</li> <li>■ Monitoring CoS Rewrite Rules on page 61</li> </ul> |
| <b>List of Sample Output</b>    | show class-of- service on page 94                                                                                                                                                                                                                                                                                                                                                        |
| <b>Output Fields</b>            | Table 22 on page 93 lists the output fields for the show class-of-service command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                               |

**Table 22: show class-of-service Output Fields**

| Field Name       | Field Description                                                                                                                                                                                                                                        | Level of Output |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Forwarding class | The forwarding class configuration: <ul style="list-style-type: none"> <li>■ Forwarding class—Name of the forwarding class.</li> <li>■ ID—Forwarding class ID.</li> <li>■ Queue—Queue number.</li> </ul>                                                 | All levels      |
| Code point type  | The type of code-point alias: <ul style="list-style-type: none"> <li>■ dscp—Aliases for DiffServ code point (DSCP) values.</li> <li>■ ieee-802.1—Aliases for IEEE 802.1p values.</li> <li>■ inet-precedence—Aliases for IP precedence values.</li> </ul> | 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      |
| Code point       | Code-point values.                                                                                                                                                                                                                                       | All levels      |
| Loss priority    | Loss priority assigned to specific CoS values and aliases of the classifier.                                                                                                                                                                             | All levels      |

**Table 22: show class-of-service Output Fields** (continued)

| Field Name         | Field Description                                                                         | Level of Output |
|--------------------|-------------------------------------------------------------------------------------------|-----------------|
| 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 after which high packets are dropped. | All levels      |
| Scheduler          | Name of the scheduler.                                                                    | All levels      |
| Transmit rate      | Transmission rate of the scheduler.                                                       | 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      |

```

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 pfe statistics traffic

---

|                                 |                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show pfe statistics traffic                                                                                                                                      |
| <b>Release Information</b>      | Command introduced in JUNOS Release 9.5 for EX Series switches.                                                                                                  |
| <b>Description</b>              | Display the packet forwarding engine traffic statistics.                                                                                                         |
| <b>Options</b>                  | none—Display statistics about all the traffic handled by the packet forwarding engine.                                                                           |
| <b>Required Privilege Level</b> | admin                                                                                                                                                            |
| <b>List of Sample Output</b>    | show pfe statistics traffic on page 98                                                                                                                           |
| <b>Output Fields</b>            | Table 23 on page 97 lists the output fields for the show pfe statistics traffic command. Output fields are listed in the approximate order in which they appear. |

**Table 23: show pfe statistics traffic Output Fields**

| Field Name                                        | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Packet Forwarding Engine Traffic statistics       | Information about Packet Forwarding Engine traffic: <ul style="list-style-type: none"> <li>■ Input Packets—Number and rate of input packets.</li> <li>■ Output Packets—Number and rate of output packets.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                          |
| Packet Forwarding Engine Local Traffic statistics | Information about Packet Forwarding Engine local traffic: <ul style="list-style-type: none"> <li>■ Local packets input—Number of local input packets.</li> <li>■ Local packets output—Number of local output packets.</li> <li>■ Software input high drops—Number of software input high-priority drops.</li> <li>■ Software input medium drops—Number of software input medium-priority drops.</li> <li>■ Software input low drops—Number of software input low-priority drops.</li> <li>■ Software output drops—Number of software output drops.</li> <li>■ Hardware input drops—Number of hardware input drops.</li> </ul> |

**Table 23: show pfe statistics traffic Output Fields (continued)**

| Field Name                                           | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Packet Forwarding Engine Local Protocol statistics   | <p>Information about the Packet Forwarding Engine Local Protocol:</p> <ul style="list-style-type: none"> <li>■ HDLC keepalives—Number of HDLC keepalive packets.</li> <li>■ ATM OAM—Number of Asynchronous Transfer Mode (ATM) Operation, Administration, and Maintenance (OAM) packets.</li> <li>■ Frame Relay LMI—Number of Frame Relay Local Management Interface (LMI) packets.</li> <li>■ PPP LCP/NCP—Number of Point-to-Point Protocol (PPP) Link Control Protocol (LCP) or Network Control Protocol (NCP) packets.</li> <li>■ OSPF hello—Number of Open Shortest Path First (OSPF) hello packets.</li> <li>■ OSPF3 hello—Number of Open Shortest Path First version 3 (OSPFv3) hello packets.</li> <li>■ RSVP hello—Number of Reservation Setup Protocol (RSVP) hello packets.</li> <li>■ LDP hello—Number of Label Distribution Protocol (LDP) hello packets.</li> <li>■ BFD—Number of Bidirectional Forwarding Detection Protocol (BFD) hello packets.</li> <li>■ IS-IS IIH—Number of Intermediate System-to-Intermediate System Hello (IIH) packets.</li> <li>■ LACP—Number of Link Aggregation Control Protocol (LACP) packets.</li> <li>■ ARP—Number of Address Resolution Protocol (ARP) packets.</li> <li>■ ETHER OAM—Number of Ethernet Operations, Administration, and Management (OAM) packets.</li> <li>■ Unknown—Number of unknown packets not matching any of the packet types listed above.</li> </ul> |
| Packet Forwarding Engine Hardware Discard statistics | <p>Information about Packet Forwarding Engine hardware discards:</p> <ul style="list-style-type: none"> <li>■ Timeout—Number of packets discarded because of timeouts.</li> <li>■ Truncated key—Number of packets discarded because of truncated keys.</li> <li>■ Bits to test—Number of bits to test.</li> <li>■ Data error—Number of packets discarded because of data errors.</li> <li>■ Stack underflow—Number of packets discarded because of stack underflows.</li> <li>■ Stack overflow—Number of packets discarded because of stack overflows.</li> <li>■ Normal discard—Number of packets discarded because of discard routes.</li> <li>■ Extended discard—Number of packets discarded because of illegal next hops.</li> <li>■ Invalid interface—Number of packets discarded because of invalid incoming interfaces.</li> <li>■ Info cell drops—Number of information cell drops.</li> <li>■ Fabric drops—Number of fabric drops.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

```

show pfe statistics traffic user@host> show pfe statistics traffic
Packet Forwarding Engine traffic statistics:
 Input packets: 102682 5 pps
 Output packets: 58033 4 pps
Packet Forwarding Engine local traffic statistics:
 Local packets input : 44628
 Local packets output : 46146
 Software input control plane drops : 0
 Software input high drops : 0
 Software input medium drops : 0
 Software input low drops : 0
 Software output drops : 0
 Hardware input drops : 0
Packet Forwarding Engine local protocol statistics:

```

```

HDLC keepalives : 0
ATM OAM : 0
Frame Relay LMI : 0
PPP LCP/NCP : 5597
OSPF hello : 3195
OSPF3 hello : 0
RSVP hello : 0
LDP hello : 7478
BFD : 0
IS-IS IIH : 0
LACP : 0
ARP : 0
ETHER OAM : 0
Unknown : 8
Packet Forwarding Engine hardware discard statistics:
Timeout : 0
Truncated key : 0
Bits to test : 0
Data error : 0
Stack underflow : 0
Stack overflow : 0
Normal discard : 0
Extended discard : 0
Invalid interface : 0
Info cell drops : 0
Fabric drops : 0
Packet Forwarding Engine Input IPv4 Header Checksum Error and Output MTU Error
statistics:
Input Checksum : 0
Output MTU : 0

```

## show pfe statistics traffic cpu

**Syntax** show pfe statistics traffic cpu <fpc fpc-slot>

**Release Information** Command introduced in JUNOS Release 9.5 for EX Series switches.

**Description** 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 Topics**
- show pfe statistics traffic multicast
  - show pfe statistics traffic egress-queues
  - show interfaces queue
  - Monitoring Interface Status and Traffic
  - Understanding JUNOS CoS Components for EX Series Switches on page 5

**List of Sample Output** show pfe statistics traffic cpu (EX8208 Switch) on page 101

**Output Fields** Table 24 on page 100 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 24: 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. |
| Queued Bytes       | Number of bytes queued to this queue.   |

**Table 24: show pfe statistics traffic cpu Output Fields (continued)**

| Field Name           | Field Description                                                                                                                                                                                                                                                 |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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): <ul style="list-style-type: none"> <li>■ Low—Number of low-loss priority packets dropped because of RED.</li> <li>■ High—Number of high-loss priority packets dropped because of RED.</li> </ul> |
| RED-dropped bytes    | Number of bytes dropped because of Random Early Discard (RED): <ul style="list-style-type: none"> <li>■ Low—Number of low-loss priority bytes dropped because of RED.</li> <li>■ High—Number of high-loss priority bytes dropped because of RED.</li> </ul>       |

**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 Release 9.5 for EX Series switches.

**Description** 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 Topics**
- show pfe statistics traffic cpu
  - show pfe statistics traffic multicast
  - show interfaces queue
  - Monitoring Interface Status and Traffic
  - Understanding JUNOS CoS Components for EX Series Switches on page 5

**List of Sample Output** show pfe statistics traffic egress-queues fpc 4 (EX 8208 Switch) on page 105

**Output Fields** Table 25 on page 104 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 25: 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. |

```
show pfe statistics user@switch> show pfe statistics traffic egress-queues fpc 4
traffic egress-queues fpc Tail-dropped packets : 0
4 (EX 8208 Switch)
```

## show pfe statistics traffic multicast

---

**Syntax** show pfe statistics traffic multicast <fpc fpc-slot>

**Release Information** Command introduced in JUNOS Release 9.5 for EX Series switches.

**Description** Display class-of-service (CoS) queue information for multdestination 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* —(Optional) Displays class-of-service (CoS) queue information for multdestination traffic on 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 Topics**
- show pfe statistics traffic cpu
  - show pfe statistics traffic egress-queues
  - show interfaces queue
  - Monitoring Interface Status and Traffic
  - Understanding JUNOS CoS Components for EX Series Switches on page 5

**List of Sample Output** show pfe statistics traffic multicast fpc 0 (EX8208 Switch) on page 107

**Output Fields** Table 26 on page 106 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 26: show pfe statistics traffic multicast Output Fields**

| Field Name | Field Description |
|------------|-------------------|
| Queue      | CoS queue number. |

---

**Table 26: show pfe statistics traffic multicast Output Fields (continued)**

| Field Name                                   | Field Description                                                                                                                                                                                                                                                 |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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): <ul style="list-style-type: none"> <li>■ Low—Number of low-loss priority packets dropped because of RED.</li> <li>■ High—Number of high-loss priority packets dropped because of RED.</li> </ul> |
| RED-dropped bytes                            | Number of bytes dropped because of Random Early Discard (RED): <ul style="list-style-type: none"> <li>■ Low—Number of low-loss priority bytes dropped because of RED.</li> <li>■ High—Number of high-loss priority bytes dropped because of RED.</li> </ul>       |
| Multicast Replication Engine-dropped packets | Egress packets dropped by the PFE because none of the ports on the physical interface are needed to forward the packet.                                                                                                                                           |

**show pfe statistics  
traffic multicast fpc 0  
(EX8208 Switch)**

```
user@switch> show pfe statistics traffic multicast fpc 0
```

```
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
Multicast Replication Engine-dropped packets : 0 pps

```

