



Class of Service Feature Guide for EX2300, EX3400, and EX4300 Switches



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Class of Service Feature Guide for EX2300, EX3400, and EX4300 Switches
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About the Documentation

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- Supported Platforms on page xi
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- Documentation Conventions on page xiii
- Documentation Feedback on page xv
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Documentation and Release Notes

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

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

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Supported Platforms

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

- EX4300
- EX3400
- EX2300

Using the Examples in This Manual

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

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

```
commit {
```

```
file ex-script-snippet.xml; }
```

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

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

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

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

For more information about the **load** command, see [CLI Explorer](#).

Documentation Conventions

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

Table 1: Notice Icons







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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> Introduces or emphasizes important new terms. Identifies guide 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 OS CLI User 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>
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. The console port is labeled CONSOLE.
< > (angle brackets)	Encloses optional keywords or variables.	stub <default-metric <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)	Encloses a variable for which you can substitute one or more values.	community name members [community-ids]
Indentation and braces ({ })	Identifies 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.	

GUI Conventions

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

Convention	Description	Examples
Bold text like this	Represents 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 menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback rating system—On any page of the Juniper Networks TechLibrary site at <http://www.juniper.net/techpubs/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <http://www.juniper.net/techpubs/feedback/>.
- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

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

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

Self-Help Online Tools and Resources

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

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

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

Opening a Case with JTAC

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

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

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

PART 1

Overview

- [Understanding Class of Service on page 3](#)

CHAPTER 1

Understanding Class of Service

- [Junos OS CoS for EX Series Switches Overview on page 4](#)
- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)

Junos OS CoS for EX Series Switches Overview

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

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

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

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

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



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

- [How Junos OS CoS Works on page 4](#)
- [Default CoS Behavior on EX Series Switches on page 5](#)

How Junos OS CoS Works

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

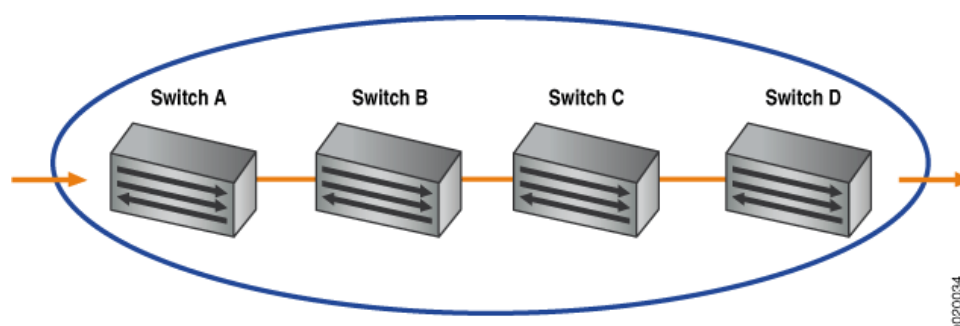
To support CoS, you must configure each switch in the network. Generally, each switch examines the packets that enter it to determine their CoS settings. These settings then dictate which packets are transmitted first to the next downstream switch. Switches at

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

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

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

Figure 1: Packet Flow Across the Network



Default CoS Behavior on EX Series Switches

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

Related Documentation

- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
- [Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches on page 11](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Example: Combining CoS with MPLS on EX Series Switches](#)

Understanding Junos OS CoS Components for EX Series Switches

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

- [Code-Point Aliases on page 6](#)
- [Policers on page 6](#)
- [Classifiers on page 6](#)
- [Forwarding Classes on page 7](#)
- [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 operating system (Junos OS), *classifiers* associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class. Junos OS supports two general types of classifiers:

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

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

Forwarding Classes

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

Tail Drop Profiles

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

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

Schedulers

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

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

Rewrite Rules

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



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

Related Documentation

- [Understanding CoS Code-Point Aliases on page 16](#)
- [Understanding CoS Classifiers](#)

- *Understanding CoS Forwarding Classes*
- *Understanding CoS Tail Drop Profiles*
- [Understanding CoS Schedulers on page 37](#)
- [Understanding CoS Two-Color Marking on page 85](#)
- [Understanding CoS Rewrite Rules on page 51](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)

PART 2

Configuring Class of Service

- [Using Junos OS EZQoS or J-Web to Quickly Configure CoS on page 11](#)
- [Classifying and Assigning Traffic to Output Queues for Different Service Levels on page 15](#)
- [Defining Output Queue Properties Using Schedulers on page 37](#)
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- [Controlling Congestion Using Drop Profiles, ECN, Traffic Shaping, and Two-Color Marking on page 59](#)
- [Assigning CoS Components to Interfaces on page 87](#)
- [Example of CoS Configuration on page 91](#)

CHAPTER 2

Using Junos OS EZQoS or J-Web to Quickly Configure CoS

- Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches on page 11
- Configuring Junos OS EZQoS for CoS (CLI Procedure) on page 12
- Configuring CoS (J-Web Procedure) on page 13

Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches

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

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

Configuring CoS requires careful consideration of your service needs and thorough planning and design to ensure consistency across all switches in a CoS domain. To configure CoS manually, you must define and fine-tune all CoS components such as classifiers, rewrite rules, forwarding classes, schedulers, and scheduler-maps and then apply these components to the interfaces. Therefore, configuring CoS can be a fairly complex and time-consuming task.

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

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



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



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

**Related
Documentation**

- [Junos OS CoS for EX Series Switches Overview on page 4](#)
- [Configuring Junos OS EZQoS for CoS \(CLI Procedure\) on page 12](#)

Configuring Junos OS EZQoS for CoS (CLI Procedure)

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

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



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

To configure EZQoS using the CLI:

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

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

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

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

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

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

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

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

**Related
Documentation**

- [Example: Configuring CoS on EX Series Switches on page 91](#)

- [Understanding Junos OS EZQoS for CoS Configurations on EX Series Switches on page 11](#)

Configuring CoS (J-Web Procedure)

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

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

To configure CoS components :

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

Related Documentation

- [Defining CoS Classifiers \(J-Web Procedure\) on page 26](#)
- [Defining CoS Code-Point Aliases \(J-Web Procedure\) on page 19](#)
- [Defining CoS Forwarding Classes \(J-Web Procedure\) on page 33](#)
- [Defining CoS Rewrite Rules \(J-Web Procedure\) on page 55](#)
- [Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)
- [Assigning CoS Components to Interfaces \(J-Web Procedure\) on page 88](#)

CHAPTER 3

Classifying and Assigning Traffic to Output Queues for Different Service Levels

- [Understanding CoS Code-Point Aliases on page 16](#)
- [Defining CoS Code-Point Aliases \(CLI Procedure\) on page 19](#)
- [Defining CoS Code-Point Aliases \(J-Web Procedure\) on page 19](#)
- [Understanding CoS Classifiers on page 21](#)
- [Defining CoS Classifiers \(CLI Procedure\) on page 24](#)
- [Defining CoS Classifiers \(J-Web Procedure\) on page 26](#)
- [Defining CoS BA Classifiers \(DSCP, DSCP IPv6, IEEE 802.1p\) on page 28](#)
- [Understanding CoS Forwarding Classes on page 30](#)
- [Defining CoS Forwarding Classes \(CLI Procedure\) on page 33](#)
- [Defining CoS Forwarding Classes \(J-Web Procedure\) on page 33](#)

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.



NOTE: This topic applies to all EX Series switches except the EX4600. Because the EX4600 uses a different chipset than other EX Series switches, the code-point aliases on EX4600 match those on QFX Series switches. For EX4600 code-point aliases, see *Understanding CoS Code-Point Aliases*.

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

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

This topic covers:

- [Default Code-Point Aliases on page 16](#)

Default Code-Point Aliases

[Table 3 on page 16](#) shows the default mappings between the bit values and standard aliases.

Table 3: Default Code-Point Aliases

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

Table 3: 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	100
ef1	101
af11	010
af12	011
nc1/cs6	110
nc2/cs7	111

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

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

**Related
Documentation**

- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Defining CoS Code-Point Aliases \(CLI Procedure\) on page 19](#)
- [Defining CoS Code-Point Aliases \(J-Web Procedure\) on page 19](#)

Defining CoS Code-Point Aliases (CLI Procedure)

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

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

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

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

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

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

Related Documentation

- [Defining CoS Code-Point Aliases \(J-Web Procedure\) on page 19](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Monitoring CoS Value Aliases on page 130](#)
- [Understanding CoS Code-Point Aliases on page 16](#)

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



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

To define CoS code-point aliases:

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



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

2. Click one of the following options:

- **Add**—Adds a code-point alias. Enter information into the code point alias page as described in [Table 4 on page 20](#).
- **Edit**—Modifies an existing code-point alias. Enter information into the code point alias page as described in [Table 4 on page 20](#).
- **Delete**—Deletes an existing code-point alias.

[Table 4 on page 20](#) describes the related fields.

Table 4: CoS Value Aliases Configuration Fields

Field	Function	Your Action
Code point name	Specifies the name for a code-point—for example, af11 or be .	Enter a name.
Code point type	Specifies a code-point type. The code-point type can be DSCP or IP precedence.	Select a value.
Code point value bits	Specifies the CoS value for which an alias is defined. Changing this value alters the behavior of all classifiers that refer to this alias.	To specify a CoS value, type it in the appropriate format: <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 Documentation

- [Defining CoS Code-Point Aliases \(CLI Procedure\) on page 19](#)
- [Monitoring CoS Value Aliases on page 130](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)

Understanding CoS Classifiers

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

There are two general types of classifiers:

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

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

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



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

This topic describes:

- [Behavior Aggregate Classifiers on page 21](#)
- [Multifield Classifiers on page 23](#)

Behavior Aggregate Classifiers

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

There are three types of BA classifiers:

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

- IEEE 802.1p CoS bits

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

Default Behavior Aggregate Classification

Juniper Networks Junos operating system (Junos OS) automatically assigns implicit default BA classifiers to logical interfaces based on the type of interface.

[Table 5 on page 22](#) lists different types of interfaces and the corresponding implicit default BA classification.

Table 5: Default BA Classification

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

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

[Table 6 on page 22](#) describes the BA classifier types you can configure on Layer 2 and Layer 3 interfaces.

Table 6: Allowed BA Classification

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

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

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

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

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



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

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



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

Multifield Classifiers

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

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

Related Documentation

- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Defining CoS Classifiers \(CLI Procedure\) on page 24](#)
- [Defining CoS Classifiers \(J-Web Procedure\) on page 26](#)

Defining CoS Classifiers (CLI Procedure)

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

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

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

- **dscp** and **dscp-ipv6**—Handles incoming IPv4 and IPv6 packets, respectively.
- **ieee-802.1**—Handles Layer 2 CoS.
- **inet-precedence**—Handles incoming IPv4 packets. IP precedence mapping requires only the higher order three bits of the DSCP field.
- Multifield (MF) classifier—Examine multiple fields in the packet such as source and destination addresses and source and destination port numbers of the packet. With MF classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.



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

The following example describes how to configure a BA classifier (**ba-classifier**) as the default DSCP map for handling IPv4 traffic and to apply the BA classifier to either a specific Gigabit Ethernet interface or to all the Gigabit Ethernet interfaces on the switch. The BA classifier assigns loss priorities, as shown in [Table 7 on page 24](#), to incoming packets in the four forwarding classes.

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

Table 7: BA-classifier Loss Priority Assignments

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

Table 7: BA-classifier Loss Priority Assignments (*continued*)

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

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

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

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

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

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

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

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

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

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

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

- To apply the classifier to a specific interface:

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

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

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



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

- Related Documentation**
- [Defining CoS Classifiers \(J-Web Procedure\) on page 26](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)
 - [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
 - [Monitoring CoS Classifiers on page 123](#)
 - [Understanding CoS Classifiers](#)
 - [Troubleshooting a CoS Classifier Configuration for a TCAM Space Error on page 133](#)

Defining CoS Classifiers (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service on EX4600 switches.

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

To define CoS classifiers:

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



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

2. Click one of the following options:
 - **Add**—Adds a classifier. Enter information into the classifier page as described in [Table 8 on page 26](#).
 - **Edit**—Modifies an existing classifier. Enter information into the classifier page as described in [Table 8 on page 26](#).
 - **Delete**—Deletes an existing classifier.

Table 8: Classifiers Configuration Fields

Field	Function	Your Action
Classifier Name	Specifies the name for a classifier.	To name a classifier, type the name—for example, ba-classifier .

Table 8: Classifiers Configuration Fields (*continued*)

Field	Function	Your Action
Classifier Type	Specifies the type of classifier: dscp , ieee-802.1 , or inet-precedence .	Select a value from the list.
Code Point Mapping	Sets the forwarding classes and the packet loss priorities (PLPs) for specific CoS values and aliases.	<p>To add a code point mapping:</p> <ol style="list-style-type: none"> 1. Click Add. 2. Select the code point. 3. Select a forwarding class from the following list: <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. 4. Select the loss priority. <p>To assign a loss priority, select one:</p> <ul style="list-style-type: none"> • high—Packet has a high loss priority. • low—Packet has a low loss priority.

- Related Documentation**
- [Defining CoS Classifiers \(CLI Procedure\) on page 24](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)
 - [Monitoring CoS Classifiers on page 123](#)
 - [Understanding CoS Classifiers](#)

Defining CoS BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p)

Packet classification associates incoming packets with a particular CoS servicing level. Behavior aggregate (BA) classifiers examine the Differentiated Services code point (DSCP or DSCP IPv6) value, the IEEE 802.1p CoS value, or the MPLS EXP value in the packet header to determine the CoS settings applied to the packet. (See *Configuring a Global MPLS EXP Classifier* to learn how to define EXP classifiers for MPLS traffic.) BA classifiers allow you to set the forwarding class and loss priority of a packet based on the incoming CoS value.



NOTE: OCX Series switches do not support MPLS EXP classifiers.

On switches except QFX10000 and NFX Series devices, unicast traffic must use different classifiers than multdestination (multicast, broadcast, and destination lookup fail) traffic. You use the **multi-destination** statement at the **[edit class-of-service]** hierarchy level to configure a multdestination BA classifier.

On QFX10000 switches and NFX Series devices, unicast and multdestination traffic use the same classifiers and forwarding classes.

Multdestination classifiers apply to all of the switch interfaces and handle multicast, broadcast, and destination lookup fail (DLF) traffic. You cannot apply a multdestination classifier to a single interface or to a range of interfaces.

To configure a DSCP, DSCP IPv6, or IEEE 802.1p BA classifier using the CLI:

1. Create a BA classifier:

- To create a DSCP, DSCP IPv6, or IEEE 802.1p BA classifier based on the default classifier, import the default DSCP, DSCP IPv6, or IEEE 802.1p classifier and associate it with a forwarding class, a loss priority, and a code point:

```
[edit class-of-service classifiers]
user@switch# set (dscp | dscp-ipv6 | ieee-802.1) classifier-name import default
forwarding-class forwarding-class-name loss-priority level code-points [aliases]
[bit-patterns]
```

- To create a BA classifier that is not based on the default classifier, create a DSCP, DSCP IPv6, or IEEE 802.1p classifier and associate it with a forwarding class, a loss priority, and a code point:

```
[edit class-of-service classifiers]
user@switch# set (dscp | dscp-ipv6 | ieee-802.1) classifier-name forwarding-class
forwarding-class-name loss-priority level code-points [aliases] [bit-patterns]
```

2. For multdestination traffic, except on QFX10000 switches or NFX Series devices, configure the classifier as a multdestination classifier:

```
[edit class-of-service]
user@switch# set multi-destination classifiers (dscp | dscp-ipv6 | ieee-802.1 | inet-precedence)
classifier-name
```

3. Apply the classifier to a specific Ethernet interface or to all Ethernet interfaces, or to all Fibre Channel interfaces on the device.

- To apply the classifier to a specific interface:

```
[edit class-of-service interfaces]
user@switch# set interface-name unit unit classifiers (dscp | dscp-ipv6 | ieee-802.1)
classifier-name
```

- To apply the classifier to all 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 xe-* unit * classifiers (dscp | dscp-ipv6 | ieee-802.1) classifier-name
```

**Related
Documentation**

- *Example: Configuring CoS Hierarchical Port Scheduling (ETS)*
- *Example: Configuring Unicast Classifiers*
- *Configuring a Global MPLS EXP Classifier*
- *Configuring Rewrite Rules for MPLS EXP Classifiers*
- *Monitoring CoS Classifiers*
- *Understanding CoS Classifiers*
- *Understanding CoS Classifiers*
- *Understanding CoS MPLS EXP Classifiers and Rewrite Rules*
- *Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces*
- *Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces*

Understanding CoS Forwarding Classes

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

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



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

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

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



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

This topic describes:

- [Default Forwarding Classes on page 31](#)

Default Forwarding Classes

Table 9 on page 31 shows the four default forwarding classes defined for unicast traffic, and Table 10 on page 31 shows the three default forwarding classes defined for multicast traffic.



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

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

Table 9: Default Forwarding Classes for Unicast Traffic

Forwarding Class Name	Comments
best-effort (be)	The software does not apply any special CoS handling to packets with 000000 in the DiffServ field. This is a backward compatibility feature. These packets are usually dropped under congested network conditions.
expedited-forwarding (ef)	The software delivers assured bandwidth, low loss, low delay, and low delay variation (jitter) end-to-end for packets in this service class. The software accepts excess traffic in this class, but in contrast to the assured forwarding class, the out-of-profile expedited-forwarding class packets can be forwarded out of sequence or dropped.
assured-forwarding (af)	<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 that excess packets are dropped, and not forwarded.</p> <p>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 for these packets.</p>

Table 10: Default Forwarding Classes for Multicast Traffic

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

Table 10: Default Forwarding Classes for Multicast Traffic (*continued*)

Forwarding Class Name	Comments
multicast expedited-forwarding (mcast-ef)	The software delivers assured bandwidth, low loss, low delay, and low delay variation (jitter) end-to-end for multicast packets in this service class. The software accepts excess traffic in this class, but in contrast to the multicast assured forwarding class, out-of-profile multicast expedited-forwarding class packets can be forwarded out of sequence or dropped.
multicast assured-forwarding (mcast-af)	<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>Two drop probabilities (low and high) are defined for this service class.</p>
multicast network-control (mcast-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 for these packets.</p>

The following rules govern queue assignment:

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

Related Documentation

- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic](#)
- [Defining CoS Forwarding Classes \(CLI Procedure\) on page 33](#)
- [Defining CoS Forwarding Classes \(J-Web Procedure\) on page 33](#)

Defining CoS Forwarding Classes (CLI Procedure)

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

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

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

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

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

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

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

Related Documentation

- [Defining CoS Forwarding Classes \(J-Web Procedure\) on page 33](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic](#)
- [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
- [Monitoring CoS Forwarding Classes on page 124](#)
- [Understanding CoS Forwarding Classes](#)

Defining CoS Forwarding Classes (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

To define forwarding classes:

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



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

2. Select one of the following options:

- **Add**—Adds a forwarding class. Enter information into the forwarding class page as described in [Table 11 on page 34](#).
- **Edit**—Modifies an existing forwarding class. Enter information into the forwarding class page as described in [Table 11 on page 34](#).
- **Delete**—Deletes an existing forwarding class.

Table 11: Forwarding Classes Configuration Fields

Field	Function	Your Action
Forwarding Class Summary		
Queue #	<p>Specifies the 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>To specify an internal queue number, select an integer from 0 through 11, appropriate for your platform as follows:</p> <p>NOTE: For EX3400 and EX4300 switches, to specify an internal queue number, select an integer from 0 through 11.</p> <p>NOTE: For EX2300 and EX2300-C switches, a maximum of eight egress queues are supported per port. To specify an internal queue number select an integer from 0 through 7.</p>

Table 11: Forwarding Classes Configuration Fields (*continued*)

Field	Function	Your Action
Forwarding Class Name	<p>Specifies 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> <p>NOTE: For EX4300 switches, by default the forwarding classes are assigned to queue numbers 0 (best-effort), 1 (expedited-forwarding), 2 (assured-forwarding), 3 (network-connect), 8 (mcast-be), 9 (mcast-ef), 10 (mcast-af), and 11 (mcast-nc).</p>	Type the name—for example, be-class .

Release History Table

Release	Description
14.1X53-A2	J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

Related Documentation

- [Defining CoS Forwarding Classes \(CLI Procedure\) on page 33](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic](#)
- [Monitoring CoS Forwarding Classes on page 124](#)
- [Assigning CoS Components to Interfaces \(J-Web Procedure\) on page 88](#)
- [Understanding CoS Forwarding Classes](#)

CHAPTER 4

Defining Output Queue Properties Using Schedulers

- [Understanding CoS Schedulers on page 37](#)
- [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)
- [Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)
- [Defining CoS Scheduler Maps \(J-Web Procedure\) on page 49](#)

Understanding CoS Schedulers

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

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

This topic describes:

- [Default Schedulers on page 37](#)
- [Excess Rate on page 38](#)
- [Transmission Rate on page 38](#)
- [Scheduler Buffer Size on page 39](#)
- [Priority Scheduling on page 40](#)
- [Scheduler Drop-Profile Maps on page 40](#)
- [Scheduler Maps on page 40](#)

Default Schedulers

Each forwarding class has an associated scheduler priority. On EX Series switches other than Juniper Networks EX8200, EX4300, and EX3400 Ethernet Switches, only two forwarding classes—best-effort (queue 0) and network-control (queue 7)—are used in the default configuration. By default on these switches, the best-effort forwarding class (queue 0) receives 95 percent of the bandwidth and the buffer space for the output link,

and the network-control forwarding class (queue 7) receives 5 percent. The default drop profile causes the buffer to fill completely and then to discard all incoming packets until it has free space.

On EX8200 switches three forwarding classes—best-effort (queue 0), multicast best-effort (queue 2), and network-control (queue 7)—are used in the default configuration. By default, the best-effort forwarding class (queue 0) receives 75 percent of the bandwidth, the multicast best-effort forwarding class (queue 2) receives 20 percent, and the network-control forwarding class (queue 7) receives 5 percent of the bandwidth and buffer space for the output link.

On EX4300 and EX 3400 switches, four forwarding classes—best-effort (queue 0), multicast best-effort (queue 8), network-control (queue 3), and multicast network-control (queue 11)—are used in the default configuration. By default, all the multicast traffic flows through the multicast best-effort queue. EX4300 and EX3400 switches support 12 queues (0–11), and the default scheduler transmission rates for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available bandwidth.

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

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

Excess Rate

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

Transmission Rate

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

Scheduler Buffer Size

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

On EX Series switches other than EX8200, EX4300, and EX3400 switches, the default scheduler transmission rates for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent, respectively, of the total available bandwidth. The default buffer-size percentages for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent, respectively, of the total available buffer.

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

On EX4300 and EX3400 switches, the default scheduler transmission rates for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available buffer. The default buffer-size percentages for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available buffer.

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

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

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

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

Priority Scheduling

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

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

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

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

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

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

Scheduler Drop-Profile Maps

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

Scheduler Maps

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

On EX Series switches, if you configure more than the supported number of scheduler maps on a switch or for a port group in a line card, an error is logged in the system log. On any interface in a port group on a line card or on a switch, if you configure a scheduler map that causes the number of scheduler maps for that port group to exceed the

maximum number supported, the default scheduler map is bound to that interface. We recommend that you check the system log for errors after the commit operation to verify that you have not configured more than the maximum permitted number of scheduler maps.



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

Table 12 on page 41 shows the number of scheduler maps supported for each port group in a switch or line card.

Table 12: Support for Scheduler Maps on Switches and Line Cards

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX2200-C-12T and EX2200-C-12P switches	1	Port 0–11 and 2 uplink ports form a port group.	6
EX2200-24T and EX2200-24P switches	1	Ports 0–23 and 4 SFP uplink ports form a port group.	5
EX2200-48T and EX2200-48P switches	2	<ul style="list-style-type: none"> Ports 0–23 and SFP uplink ports 0 and 1 form a port group. Ports 24–47 and SFP uplink ports 2 and 3 form a port group. 	5
EX3200-24T and EX3200-24P switches	1	<ul style="list-style-type: none"> Ports 0–23 and the uplink ports form a port group. <p>NOTE: Uplink ports include 2 SFP+ or XFP uplink ports, or 4 SFP uplink ports.</p>	4
EX3200-24T and EX3200-24P switches	1	<ul style="list-style-type: none"> Ports 0–23 and the uplink ports form a port group. <p>NOTE: Uplink ports include 2 SFP+ or XFP uplink ports or 4 SFP uplink ports.</p>	4
EX3200-48T and EX3200-48P switches	2	<ul style="list-style-type: none"> Ports 0–23 and 1 SFP+ or XFP uplink port or 4 SFP uplink ports form a port group. Ports 24–47 and 1 SFP+ or XFP uplink port form a port group. 	4

Table 12: Support for Scheduler Maps on Switches and Line Cards (*continued*)

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX4200-48T and EX4200-48P switches	3	<ul style="list-style-type: none"> Ports 0–23 form a port group. Ports 24–47 form a port group. 2 SFP+ or XFP uplink ports or 4 SFP uplink ports form a port group. 	4
EX4200-24T and EX4200-24P switches	2	<ul style="list-style-type: none"> Ports 0–23 form a port group. 2 SFP+ or XFP uplink ports or 4 SFP uplink ports form a port group. 	4
EX4300-24T and EX4300-24P switches	1	<ul style="list-style-type: none"> Ports 0–23 ports, 4 uplink ports, and 4 ports on the rear panel form a port group. <p>NOTE: Uplink ports in the front panel contains SFP or SFP+ ports 0–3, and uplink ports in the rear panel contains QSFP+ ports 0–3.</p>	64
EX4300-48T and EX4300-48P switches	1	<ul style="list-style-type: none"> Ports 0–47, 4 uplink ports, and 4 ports on the rear panel form a port group. <p>NOTE: Uplink ports in the front panel contains SFP or SFP+ ports 0–3, and uplink ports in the rear panel contains QSFP+ ports 0–3.</p>	64
EX4500-40F switch	2	<ul style="list-style-type: none"> SFP or SFP+ ports 0–19 and the first SFP or SFP+ port 0–4 form a port group. SFP or SFP+ ports 20–39 and the second SFP or SFP+ uplink port 0–4 form a port group. 	4
EX4550-32F switch	1	<ul style="list-style-type: none"> SFP or SFP+ ports 0–31 and the uplink ports in the front and rear panels form a port group. <p>NOTE: Uplink ports in the front panel contains SFP, SFP+, or RJ-45 ports 0–7, and uplink ports in the rear panel contains SFP, SFP+, or RJ-45 ports 0–7.</p>	5
EX6200-48T (48-port RJ-45) and EX6200-48P (48-port PoE+) line cards	2	<ul style="list-style-type: none"> Ports 0–23 form a port group. Ports 24–47 form a port group. 	5

Table 12: Support for Scheduler Maps on Switches and Line Cards (*continued*)

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX6200-SRE64-4XS	1	SFP+ ports 0–3 form a port group.	4
EX8200-8XS (8-port SFP+) line card	4	<ul style="list-style-type: none"> SFP+ ports 0 and 1 form a port group. SFP+ ports 2 and 3 form a port group. SFP+ ports 4 and 5 form a port group. SFP+ ports 6 and 7 form a port group. 	6
EX8200-40XS (40-port SFP+) line card	8	<ul style="list-style-type: none"> SFP+ ports 0–4 form a port group. SFP+ ports 5–9 form a port group. SFP+ ports 10–14 form a port group. SFP+ ports 15–19 form a port group. SFP+ ports 20–24 form a port group. SFP+ ports 25–29 form a port group. SFP+ ports 30–34 form a port group. SFP+ ports 35–39 form a port group. 	6
EX8200-48-F (48-port SFP) and EX8200-48T (48-port RJ-45) line cards	2	<ul style="list-style-type: none"> SFP or RJ-45 ports 0–23 form a port group. SFP or RJ-45 ports 24–47 form a port group. 	6
EX8200-2XS-40P (40-port PoE+ with 4-port SFP and 2-port SFP+) line card	3	<ul style="list-style-type: none"> Ports 0–19 and SFP ports 0 and 1 form a port group. Ports 20–39 and SFP ports 2 and 3 form a port group. 	5
		<ul style="list-style-type: none"> 2 SFP+ ports form a port group. 	6
EX8200-2XS-40T (40-port RJ-45 with 4-port SFP and 2-port SFP+) line card	3	<ul style="list-style-type: none"> Ports 0–19, and SFP ports 0 and 1 form a port group. Ports 20–39 and SFP ports 2 and 3 form a port group. 	5
		<ul style="list-style-type: none"> 2 SFP+ ports form a port group. 	6

Table 12: Support for Scheduler Maps on Switches and Line Cards (*continued*)

Switch/Line Card	Number of Port Groups	Port Grouping Details	Number of Scheduler Maps Supported for Each Port Group
EX8200-48PL (48-port PoE+ 20 Gbps) and EX8200-48TL (48-port RJ-45 20 Gbps) line cards	2	<ul style="list-style-type: none"> PoE+ or RJ-45 ports 0–23 form a port group. PoE+ or RJ-45 ports 24–47 form a port group. 	5

Related Documentation

- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)
- [Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)

Defining CoS Schedulers and Scheduler Maps (CLI Procedure)

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

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



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

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

This topic describes:

- [Configuring a Scheduler and a Scheduler Map on page 44](#)
- [Assigning a Scheduler Map to Interfaces on page 45](#)
- [Assigning Scheduler Maps to Interfaces on EX8200 Line Cards That Include Oversubscribed Ports on page 46](#)

Configuring a Scheduler and a Scheduler Map

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

To configure a scheduler and a scheduler map:

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

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

For various properties that you can define for an output queue, see the [schedulers](#) hierarchy.

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

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

Assigning a Scheduler Map to Interfaces

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

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

- To assign the scheduler map to one interface:

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

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

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

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

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

- To assign the scheduler map to all VCPs:

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



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

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

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

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

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

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

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

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

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

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

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

**Related
Documentation**

- [Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
- [Monitoring CoS Scheduler Maps on page 128](#)
- [Understanding CoS Schedulers on page 37](#)

Defining CoS Schedulers (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

To configure schedulers:

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



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

2. Select one of the following options:

- **Add**—Adds a scheduler. Enter information into the Schedulers page as described in [Table 13 on page 48](#).
- **Edit**—Modifies an existing scheduler. Enter information into the Schedulers page as described in [Table 13 on page 48](#).
- **Delete**—Deletes an existing scheduler.

Table 13: Schedulers Configuration Page

Field	Function	Your Action
Scheduler name	Specifies the name for a scheduler.	To name a scheduler, type the name—for example, be-scheduler .
Scheduling priority	<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 the scheduling priority at different levels in the 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 set 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. <p>To specify no scheduling priority, select the blank check box.</p>
Buffer size	<p>Defines the size of the delay buffer.</p> <p>By default, queues 0 through 11 are allotted the following percentages of the total available buffer space:</p> <ul style="list-style-type: none"> • Queue 0—75 percent • Queue 1—0 percent • Queue 2—0 percent • Queue 3—5 percent • Queue 4—0 percent • Queue 5—0 percent • Queue 6—0 percent • Queue 7—0 percent • Queue 8—15 percent • Queue 9—0 percent • Queue 10—0 percent • Queue 11—5 percent <p>NOTE: A large buffer size value correlates with a greater possibility of packet delays. Such a value might not be practical for sensitive traffic such as voice or video.</p>	<p>To define a delay buffer size for a scheduler, select the appropriate option:</p> <ul style="list-style-type: none"> • To specify no buffer size, select the blank check box. • To specify buffer size as a percentage of the total buffer, select Percent and type an integer from 1 through 100. • To specify buffer size as the remaining available buffer, select Remainder. <p>NOTE: On EX8200 and EX4300 switches, you can specify the buffer size as a temporal value. The queuing algorithm then drop packets after it has queued a computed number of bytes. This number is the product of the logical interface speed and the configured temporal value.</p>
Shaping rate	Specifies the rate at which queues transmit packets.	<ul style="list-style-type: none"> • To specify shaping rate as a percentage, select Percent and type an integer from 1 through 100. • To specify shaping rate as a number, select Rate and enter a value. • To specify no shaping rate, select the blank check box.

Table 13: Schedulers Configuration Page (*continued*)

Field	Function	Your Action
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 11 are allotted the following percentages of the transmission capacity:</p> <ul style="list-style-type: none"> • Queue 0—75 percent • Queue 1—0 percent • Queue 2—0 percent • Queue 3—5 percent • Queue 4—0 percent • Queue 5—0 percent • Queue 6—0 percent • Queue 7—0 percent • Queue 8—15 percent • Queue 9—0 percent • Queue 10—0 percent • Queue 11—5 percent 	<p>To define a transmit rate, select the appropriate option:</p> <ul style="list-style-type: none"> • To enforce the exact transmission rate, select Rate and enter a value. • To specify the remaining transmission capacity, select Remainder Available. • To specify a percentage of transmission capacity, select Percent and type an integer from 1 through 100. • To specify no transmit rate, select the blank check box.
Excess rate NOTE: This option is supported only on EX4300 switches.	<p>Defines the excess rate of a scheduler.</p>	<p>To define the excess rate, select the appropriate option:</p> <ul style="list-style-type: none"> • To specify a percentage of the excess rate, select Percent and type an integer from 1 through 100. • To specify no excess rate, select the blank check box.

- Related Documentation**
- [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)
 - [Monitoring CoS Scheduler Maps on page 128](#)

Defining CoS Scheduler Maps (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) for EX4600 switches.

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



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

To configure scheduler maps:

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



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

2. Select one of the following options:
 - **Add**—Adds a scheduler map. Enter information into the scheduler map page as described in [Table 14 on page 50](#).
 - **Edit**—Modifies an existing scheduler map. Enter information into the scheduler map page as described in [Table 14 on page 50](#).
 - **Delete**—Deletes an existing scheduler map.

Table 14: Scheduler Maps Configuration Fields

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

Related Documentation

- [Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)
- [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Monitoring CoS Scheduler Maps on page 128](#)

CHAPTER 5

Altering Outgoing Packet Headers Using Rewrite Rules to Ensure Forwarding Behavior

- [Understanding CoS Rewrite Rules on page 51](#)
- [Defining CoS Rewrite Rules \(CLI Procedure\) on page 54](#)
- [Defining CoS Rewrite Rules \(J-Web Procedure\) on page 55](#)

Understanding CoS Rewrite Rules

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

This topic covers:

- [How Rewrite Rules Work on page 51](#)
- [Default Rewrite Rule on page 52](#)

How Rewrite Rules Work

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

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

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

interface, and vice versa. You can define only DSCPv4 rewrite rules on integrated routing and bridging (IRB) interfaces and Layer 3 VLAN-tagged logical interfaces.

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

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



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

Default Rewrite Rule

To define a rewrite rule on an interface, you can either create your own rewrite rule and enable it on the interface or enable a default rewrite rule. See [“Defining CoS Rewrite Rules \(CLI Procedure\)” on page 54](#).

[Table 15 on page 52](#) shows the default rewrite-rule mappings. These are based on the default bit definitions of Differentiated Services code point (DSCP), IEEE 802.1p, and IP precedence values and the default forwarding classes. You can configure multiple CoS rewrite rules for DSCP, IP precedence and IEEE 802.1p.



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

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

Table 15: 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

Table 15: Default Packet Header Rewrite Mappings (*continued*)

Map from Forwarding Class	PLP Value	Map to DSCP/IEEE 802.1p/IP Precedence Value
best-effort	high	be
network-control	low	nc1/cs6
network-control	high	nc2/cs7

- Related Documentation**
- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)
 - [Defining CoS Rewrite Rules \(CLI Procedure\) on page 54](#)
 - [Defining CoS Rewrite Rules \(J-Web Procedure\) on page 55](#)

Defining CoS Rewrite Rules (CLI Procedure)

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

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

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

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



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

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

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

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

```

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

```

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

```

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

```

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

```

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

```

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

```

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

```

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

```

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

```

Related Documentation

- [Defining CoS Rewrite Rules \(J-Web Procedure\) on page 55](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Monitoring CoS Rewrite Rules on page 127](#)
- [Understanding CoS Rewrite Rules on page 51](#)

Defining CoS Rewrite Rules (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

To define rewrite rules:

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



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

2. Select one of the following options:
 - **Add**—Adds a rewrite rule. Enter information into the rewrite rule page as described in [Table 16 on page 56](#).
 - **Edit**—Modifies an existing rewrite rule. Enter information into the rewrite rule page as described in [Table 16 on page 56](#).
 - **Delete**—Deletes an existing rewrite rule.

Table 16: Rewrite Rules Configuration Page Summary

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

Table 16: 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 a CoS value assignment, follow these steps:</p> <p>To add a code point mapping:</p> <ol style="list-style-type: none"> 1. Click Add. 2. Select the code point. 3. Select a forwarding class from the following list: <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. 4. Select the loss priority. <p>To assign a loss priority, select one:</p> <ul style="list-style-type: none"> • high—Packet has a high loss priority. • low—Packet has a low loss priority. <p>To edit an existing code point mapping, select it and click Edit.</p> <p>To remove a code point mapping entry, select it and click Remove.</p>

- Related Documentation**
- [Defining CoS Rewrite Rules \(CLI Procedure\) on page 54](#)
 - [Understanding CoS Rewrite Rules on page 51](#)
 - [Monitoring CoS Rewrite Rules on page 127](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

CHAPTER 6

Controlling Congestion Using Drop Profiles, ECN, Traffic Shaping, and Two-Color Marking

- [Understanding CoS Congestion Management on page 59](#)
- [Configuring CoS Congestion Management \(CLI Procedure\) on page 64](#)
- [Defining CoS Drop Profiles \(J-Web Procedure\) on page 67](#)
- [Understanding CoS Explicit Congestion Notification on page 69](#)
- [Example: Configuring ECN on page 78](#)
- [Understanding Port Shaping and Queue Shaping for CoS on EX Series Switches on page 84](#)
- [Understanding CoS Two-Color Marking on page 85](#)

Understanding CoS Congestion Management

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

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

This topic describes:

- [Weighted Tail Drop Congestion Management on page 59](#)
- [Weighted Random Early Detection Congestion Management on page 60](#)

Weighted Tail Drop Congestion Management

A weighted tail drop (WTD) is a congestion management mechanism for packets to be dropped from the tail of the queue when the queue reaches a certain buffer capacity (that is, the fill level), and hence the name weighted tail drop. The packets that are

dropped are based on priority and are those marked with a packet loss priority (PLP) of *high*. You can configure a WTD profile (a WTD mechanism) usually on edge devices in a network.



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

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

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



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

Weighted Random Early Detection Congestion Management

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



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

Following are the different implementations of WRED:

- Segmented Drop Profile
- Interpolated Drop Profile

From a high level, segmented drop profile is a stair-step-like drop profile, whereas interpolated drop profile is a smother (curve) drop profile. [Figure 2 on page 61](#) and [Figure 3 on page 62](#) show a graphical representation of segmented and interpolated drop profiles. Regardless of the implementation, a drop profile represents a graph where the x-axis represents the percentage of fill level (l) and the y-axis represents the percentage of drop probability (p). The origin (0,0) represents the drop profile in which the drop probability is 0 percent when the queue fullness is 0 percent, and the point (100,100) represents that the drop probability is 100 percent when the queue fullness is 100 percent. Although the formation of graph lines in [Figure 2 on page 61](#) and [Figure 3 on page 62](#) is

different, the application of the profile is the same. When a packet reaches the head of the queue, a random number between 0 and 100 is calculated. This random number is plotted against the drop profile graph using the current queue fullness of that particular queue. When the random number falls above the graph line, the packet is transmitted. When the number falls below the graph line, the packet is dropped from the network.

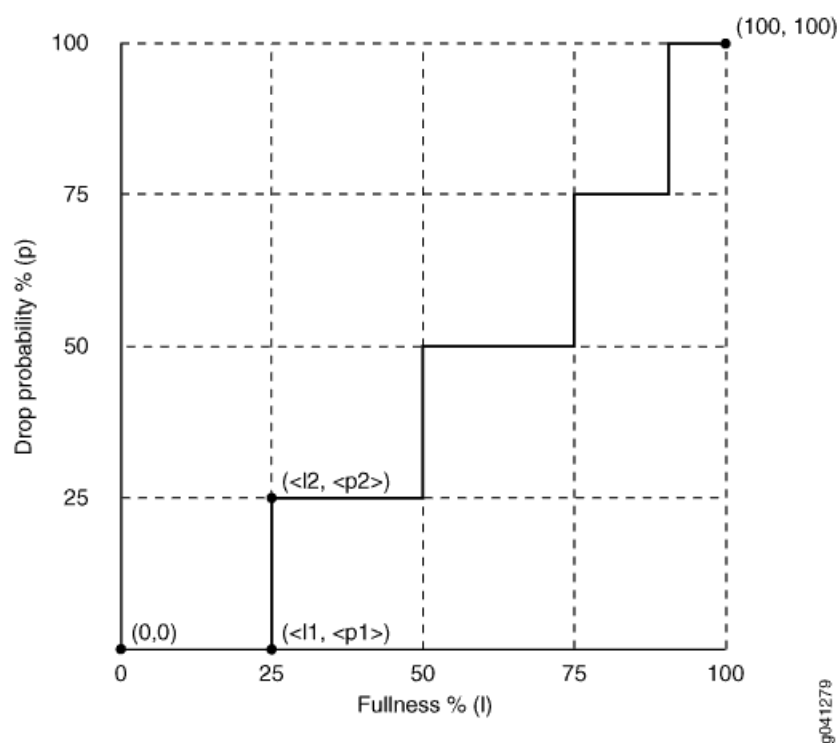
The following sections discuss the WRED drop profile implementations and parameters:

- [Segmented Drop Profile on page 61](#)
- [Interpolated Drop Profile on page 62](#)
- [Drop Profile Parameters on page 64](#)

Segmented Drop Profile

In a segmented drop profile configuration, you can define multiple data points for fill level and drop probability. [Figure 2 on page 61](#) shows a graphical representation of a segmented drop profile.

Figure 2: Graphical Representation of a Segmented Drop Profile



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

Interpolated Drop Profile

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

Following are interpolated drop profile configurations on EX Series switches:

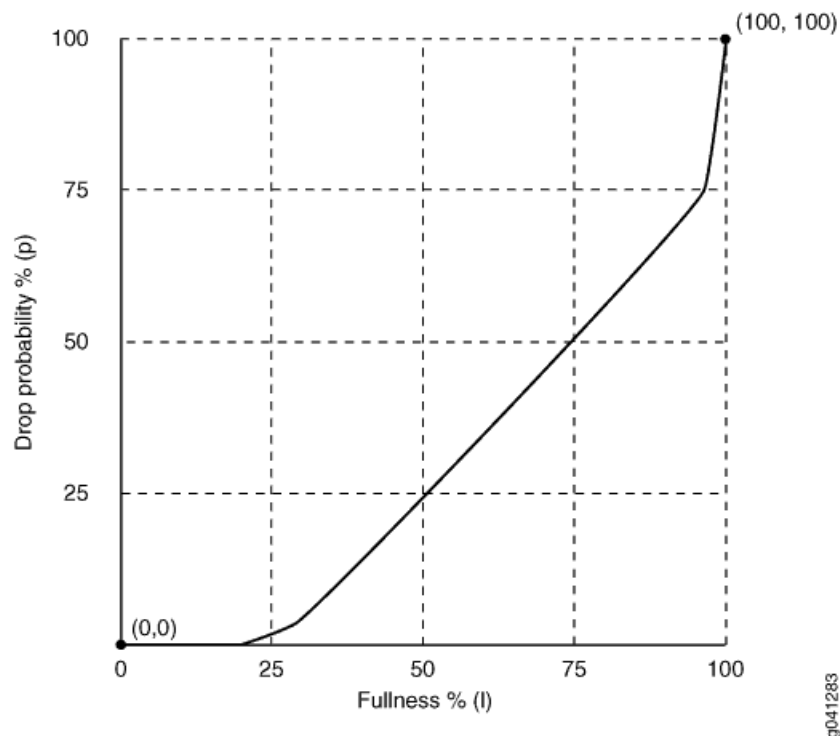
- [Interpolated Drop Profile Configuration on EX Series Switches Except EX4300 Switches on page 62](#)
- [Interpolated Drop Profile Configuration on EX4300 Switches on page 62](#)

Interpolated Drop Profile Configuration on EX Series Switches Except EX4300 Switches

An interpolated drop profile on all EX Series switches except EX4300 switches automatically generates 64 pairs of data points on the graph beginning at (0, 0) and ending at (100, 100). Along the way, the graph line intersects specific data points that you define for fullness and drop probability.

[Figure 3 on page 62](#) shows a graphical representation of an interpolated drop profile.

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



Interpolated Drop Profile Configuration on EX4300 Switches

On EX4300 switches, you can set two queue fill levels and two drop probabilities in each drop profile. The two fill levels and the two drop probabilities create two pairs of values.

The first fill level and the first drop probability create one value pair and the second fill level and the second drop probability create the second value pair.

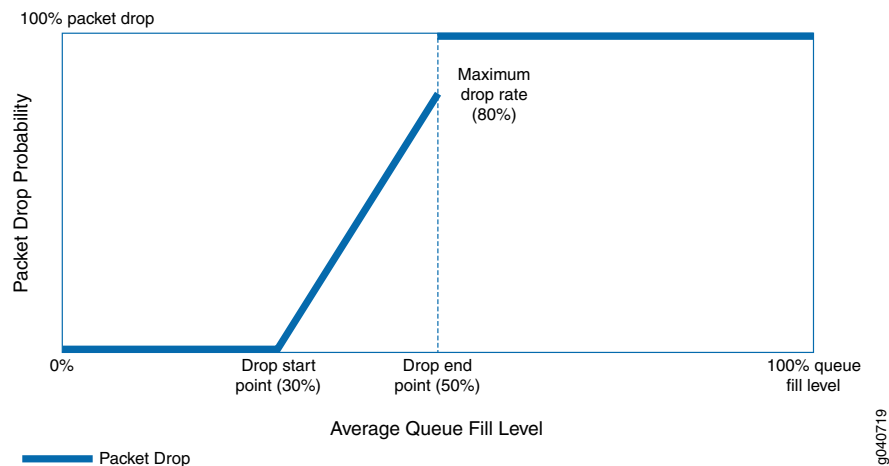


NOTE: You can configure a maximum of 64 drop profiles on EX4300 switches.

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

The first drop probability value is always 0 (zero). This pairs with the drop start point and specifies that until the queue fullness level reaches the first fill level, no packets drop. When the queue fullness exceeds the drop start point, packets begin to drop until the queue exceeds the second fill level, when all packets drop. The second drop probability value, known as the maximum drop rate, specifies the likelihood of dropping packets when the queue fullness reaches the drop end point. As the queue fills from the drop start point to the drop end point, packets drop in a smooth, linear pattern (called an interpolated graph) as shown in [Figure 4 on page 63](#). After the drop end point, all packets drop.

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



The thick line in [Figure 4 on page 63](#) shows the packet drop characteristics for a sample tail drop profile. At the drop start point, the queue reaches a fill level of 30 percent. At the drop end point, the queue fill level reaches 50 percent, and the maximum drop rate is 80 percent.

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

Drop Profile Parameters

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

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

Related Documentation

- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Configuring CoS Congestion Management \(CLI Procedure\) on page 64](#)

Configuring CoS Congestion Management (CLI Procedure)

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

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

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

This topic describes:

- [Configuring a Weighted Tail Drop Profile on page 64](#)
- [Configuring a Weighted Random Early Detection Drop Profile on page 65](#)

Configuring a Weighted Tail Drop Profile

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

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

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

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

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

Configuring a Weighted Random Early Detection Drop Profile

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



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

WRED has two implementations: segmented and interpolated. From a high level, segmented is a stair-step-like drop profile, whereas interpolated is a smoother (curve) drop profile. For a graphical representation of both these implementations, see [“Understanding CoS Congestion Management” on page 59](#). Although the formation of graph lines is different for both these implementations, the application of the profile is the same. On EX Series switches except EX4300 switches, when a packet reaches the head of the queue, a random number between 0 and 100 is calculated. This random number is plotted against the drop profile using the current queue fullness of that particular queue. When the random number falls above the graph line, the packet is transmitted. When the number falls below the graph line, the packet is dropped from the network.

For information about congestion management on EX4300 switches, see [“Understanding CoS Congestion Management” on page 59](#).



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

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

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

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

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

Following is a sample segmented drop profile:

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

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

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

Following is a sample interpolated drop profile:

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

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

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

Following is a sample interpolated drop profile:

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

**Related
Documentation**

- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Understanding CoS Congestion Management on page 59](#)

Defining CoS Drop Profiles (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

To configure CoS drop profiles:

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



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

2. Select one of the following options:

- **Add**—Adds a drop profile. Enter information into the drop profiles page as described in [Table 17 on page 67](#).
- **Edit**—Modifies an existing drop file. Enter information into the drop profiles page as described in [Table 17 on page 67](#).
- **Delete**—Deletes an existing drop profile.

Table 17: Drop Profiles Configuration parameters

Field	Function	Your Action
Drop Profile Name	Specifies the name for a drop profile.	Type the name.
Drop profile graph	Specifies the drop profile graph type	Select one: Segmented or Interpolated .

Table 17: Drop Profiles Configuration parameters (*continued*)

Field	Function	Your Action
Drop profile values	<p>Specifies values for the following two parameters of the drop profile: the queue fill level and the drop probability.</p> <p>The queue fill level represents a percentage of the memory used to store packets in relation to the total amount that has been allocated for that specific queue.</p> <p>The drop probability is a percentage value that correlates to the likelihood that an individual packet is dropped from the network.</p>	<p>To add new values:</p> <ol style="list-style-type: none"> 1. Click Add. 2. Enter the fill level. 3. Enter the drop probability. 4. Click OK. <p>To edit an existing value, click Edit and modify the fill level and drop probability.</p> <p>To delete a value, select it and click Delete.</p>
Release History Table	Release	Description
	14.1X53-A2	J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

- Related Documentation**
- [Monitoring CoS Drop Profiles on page 131](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

Understanding CoS Explicit Congestion Notification

Explicit congestion notification (ECN) enables end-to-end congestion notification between two endpoints on TCP/IP based networks. The two endpoints are an ECN-enabled sender and an ECN-enabled receiver. ECN must be enabled on both endpoints and on all of the intermediate devices between the endpoints for ECN to work properly. Any device in the transmission path that does not support ECN breaks the end-to-end ECN functionality.

ECN notifies networks about congestion with the goal of reducing packet loss and delay by making the sending device decrease the transmission rate until the congestion clears, without dropping packets. RFC 3168, *The Addition of Explicit Congestion Notification (ECN) to IP*, defines ECN.

ECN is disabled by default. Normally, you enable ECN only on queues that handle best-effort traffic because other traffic types use different methods of congestion notification—lossless traffic uses priority-based flow control (PFC) and strict-high priority traffic receives all of the port bandwidth it requires up to the point of a configured maximum rate.



NOTE: OCX Series switches do not support lossless transport and do not support PFC.

You enable ECN on individual output queues (as represented by forwarding classes) by enabling ECN in the queue scheduler configuration, mapping the scheduler to forwarding classes (queues), and then applying the scheduler to interfaces.



NOTE: For ECN to work on a queue, you must also apply a weighted random early detection (WRED) packet drop profile to the queue.

- [How ECN Works on page 69](#)
- [WRED Drop Profile Control of ECN Thresholds on page 74](#)
- [Support, Limitations, and Notes on page 77](#)

How ECN Works

Without ECN, switches respond to network congestion by dropping TCP/IP packets. Dropped packets signal the network that congestion is occurring. Devices on the IP network respond to TCP packet drops by reducing the packet transmission rate to allow the congestion to clear. However, the packet drop method of congestion notification and management has some disadvantages. For example, packets are dropped and must be retransmitted. Also, bursty traffic can cause the network to reduce the transmission rate too much, resulting in inefficient bandwidth utilization.

Instead of dropping packets to signal network congestion, ECN marks packets to signal network congestion, without dropping the packets. For ECN to work, all of the switches

in the path between two ECN-enabled endpoints must have ECN enabled. ECN is negotiated during the establishment of the TCP connection between the endpoints.

ECN-enabled switches determine the queue congestion state based on the WRED packet drop profile configuration applied to the queue, so each ECN-enabled queue must also have a WRED drop profile. If a queue fills to the level at which the WRED drop profile has a packet drop probability greater than zero (0), the switch might mark a packet as experiencing congestion. Whether or not a switch marks a packet as experiencing congestion is the same probability as the drop probability of the queue at that fill level.

ECN communicates whether or not congestion is experienced by marking the two least-significant bits in the differentiated services (DiffServ) field in the IP header. The most significant six bits in the DiffServ field contain the Differentiated Services Code Point (DSCP) bits. The state of the two ECN bits signals whether or not the packet is an ECN-capable packet and whether or not congestion has been experienced.

ECN-capable senders mark packets as ECN-capable. If a sender is not ECN-capable, it marks packets as not not ECN-capable. If an ECN-capable packet experiences congestion at the egress queue of a switch, the switch marks the packet as experiencing congestion. When the packet reaches the ECN-capable receiver (destination endpoint), the receiver echoes the congestion indicator to the sender (source endpoint) by sending a packet marked to indicate congestion.

After receiving the congestion indicator from the receiver, the source endpoint reduces the transmission rate to relieve the congestion. This is similar to the result of TCP congestion notification and management, but instead of dropping the packet to signal network congestion, ECN marks the packet and the receiver echoes the congestion notification to the sender. Because the packet is not dropped, the packet does not need to be retransmitted.

- [ECN Bits in the DiffServ Field on page 70](#)
- [End-to-End ECN Behavior on page 71](#)
- [ECN Compared to PFC and Ethernet PAUSE on page 73](#)

ECN Bits in the DiffServ Field

The two ECN bits in the DiffServ field provide four codes that determine if a packet is marked as an ECN-capable transport (ECT) packet, meaning that both endpoints of the transport protocol are ECN-capable, and if there is congestion experienced (CE), as shown in [Table 18 on page 70](#):

Table 18: ECN Bit Codes

ECN Bits (Code)	Meaning
00	Non-ECT—Packet is marked as not ECN-capable
01	ECT(1)—Endpoints of the transport protocol are ECN-capable
10	ECT(0)—Endpoints of the transport protocol are ECN-capable

Table 18: ECN Bit Codes (*continued*)

ECN Bits (Code)	Meaning
11	CE—Congestion experienced

Codes 01 and 10 have the same meaning: the sending and receiving endpoints of the transport protocol are ECN-capable. There is no difference between these codes.

End-to-End ECN Behavior

After the sending and receiving endpoints negotiate ECN, the sending endpoint marks packets as ECN-capable by setting the DiffServ ECN field to ECT(1) (01) or ECT(0) (10). Every intermediate switch between the endpoints must have ECN enabled or it does not work.

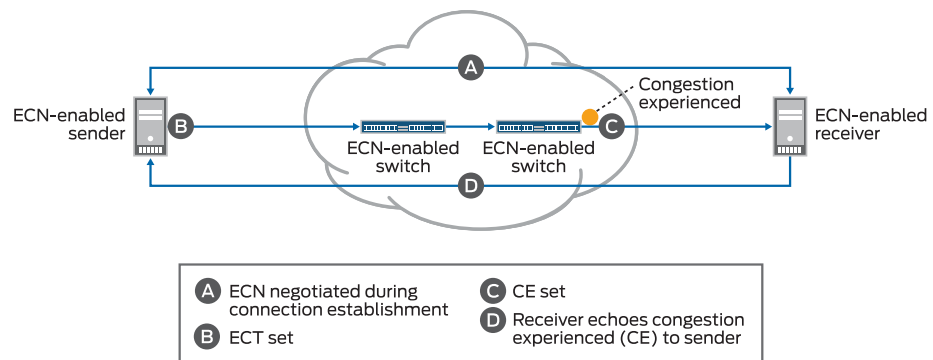
When a packet traverses a switch and experiences congestion at an output queue that uses the WRED packet drop mechanism, the switch marks the packet as experiencing congestion by setting the DiffServ ECN field to CE (11). Instead of dropping the packet (as with TCP congestion notification), the switch forwards the packet.



NOTE: At the egress queue, the WRED algorithm determines whether or not a packet is drop eligible based on the queue fill level (how full the queue is). If a packet is drop eligible and marked as ECN-capable, the packet can be marked CE and forwarded. If a packet is drop eligible and is not marked as ECN-capable, it might be dropped. See “[WRED Drop Profile Control of ECN Thresholds](#)” on page 74 for more information about the WRED algorithm.

When the packet reaches the receiver endpoint, the CE mark tells the receiver that there is network congestion. The receiver then sends (echoes) a message to the sender that indicates there is congestion on the network. The sender acknowledges the congestion notification message and reduces its transmission rate. [Figure 5 on page 71](#) summarizes how ECN works to mitigate network congestion:

Figure 5: Explicit Congestion Notification



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End-to-end ECN behavior includes:

1. The ECN-capable sender and receiver negotiate ECN capability during the establishment of their connection.
2. After successful negotiation of ECN capability, the ECN-capable sender sends IP packets with the ECT field set to the receiver.



NOTE: All of the intermediate devices in the path between the sender and the receiver must be ECN-enabled.

3. If the WRED algorithm on a switch egress queue determines that the queue is experiencing congestion and the packet is drop eligible, the switch can mark the packet as “congestion experienced” (CE) to indicate to the receiver that there is congestion on the network. If the packet has already been marked CE (congestion has already been experienced at the egress of another switch), the switch forwards the packet with CE marked.

If there is no congestion at the switch egress queue, the switch forwards the packet and does not change the ECT-enabled marking of the ECN bits, so the packet is still marked as ECN-capable but not as experiencing congestion.

On QFX5200, QFX5100, EX4600, QFX3500, and QFX3600 switches, and on QFabric systems, packets that are not marked as ECN-capable (ECT, 00) are treated according to the WRED drop profile configuration and might be dropped during periods of congestion.

On QFX10000 switches, the switch uses the tail-drop algorithm to drop packets that are marked ECT (00) during periods of congestion. (When a queue fills to its maximum level of fullness, tail-drop simply drops all subsequently arriving packets until there is space in the queue to buffer more packets. All non-ECN-capable packets are treated the same.)

4. The receiver receives a packet marked CE to indicate that congestion was experienced along the congestion path.
5. The receiver echoes (sends) a packet back to the sender with the ECE bit (bit 9) marked in the flag field of the TCP header. The ECE bit is the ECN echo flag bit, which notifies the sender that there is congestion on the network.
6. The sender reduces the data transmission rate and sends a packet to the receiver with the CWR bit (bit 8) marked in the flag field of the TCP header. The CWR bit is the congestion window reduced flag bit, which acknowledges to the receiver that the congestion experienced notification was received.
7. When the receiver receives the CWR flag, the receiver stops setting the ECE bit in replies to the sender.

Table 19 on page 73 summarizes the behavior of traffic on ECN-enabled queues.

Table 19: Traffic Behavior on ECN-Enabled Queues

Incoming IP Packet Marking of ECN Bits	ECN Configuration on the Output Queue	Action if WRED Algorithm Determines Packet is Drop Eligible	Outgoing Packet Marking of ECN Bits
Non-ECT (00)	Does not matter	Drop (QFX5200, QFX5100, EX4600, QFX3500, QFX3600, QFabric systems). Tail drop occurs when queue reaches maximum fullness because no WRED drop probability is applied (QFX10000 switches).	No ECN bits marked
ECT (10 or 01)	ECN disabled	Drop	Packet dropped—no ECN bits marked
ECT (10 or 01)	ECN enabled	Do not drop. Mark packet as experiencing congestion (CE, bits 11).	Packet marked ECT (11) to indicate congestion
CE (11)	ECN disabled	Drop	Packet dropped—no ECN bits marked
CE (11)	ECN enabled	Do not drop. Packet is already marked as experiencing congestion, forward packet without changing the ECN marking.	Packet marked ECT (11) to indicate congestion

When an output queue is not experiencing congestion as defined by the WRED drop profile mapped to the queue, all packets are forwarded, and no packets are dropped.

ECN Compared to PFC and Ethernet PAUSE

ECN is an end-to-end network congestion notification mechanism for IP traffic. Priority-based flow control (PFC) (IEEE 802.1Qbb) and Ethernet PAUSE (IEEE 802.3X) are different types of congestion management mechanisms.



NOTE: QFX10000 switches do not support Ethernet PAUSE.

OCX Series switches do not support PFC. OCX Series switches support Ethernet PAUSE on tagged Layer 3 interfaces.

ECN requires that an output queue must also have an associated WRED packet drop profile. Output queues used for traffic on which PFC is enabled should not have an associated WRED drop profile. Interfaces on which Ethernet PAUSE is enabled should not have an associated WRED drop profile.

PFC is a peer-to-peer flow control mechanism to support lossless traffic. PFC enables connected peer devices to pause flow transmission during periods of congestion. PFC enables you to pause traffic on a specified type of flow on a link instead of on all traffic on a link. For example, you can (and should) enable PFC on lossless traffic classes such as the **fc0e** forwarding class. Ethernet PAUSE is also a peer-to-peer flow control mechanism, but instead of pausing only specified traffic flows, Ethernet PAUSE pauses all traffic on a physical link.

With PFC and Ethernet PAUSE, the sending and receiving endpoints of a flow do not communicate congestion information to each other across the intermediate switches. Instead, PFC controls flows between two PFC-enabled peer devices (for example, switches) that support data center bridging (DCB) standards. PFC works by sending a pause message to the connected peer when the flow output queue becomes congested. Ethernet PAUSE simply pauses all traffic on a link during periods of congestion and does not require DCB.

PFC works this way: if a switch output queue fills to a certain threshold, the switch sends a PFC pause message to the connected peer device that is transmitting data. The pause message tells the transmitting switch to pause transmission of the flow. When the congestion clears, the switch sends another PFC message to tell the connected peer to resume transmission. (If the output queue of the transmitting switch also reaches a certain threshold, that switch can in turn send a PFC pause message to the connected peer that is transmitting to it. In this way, PFC can propagate a transmission pause back through the network.)

See *Understanding CoS Flow Control (Ethernet PAUSE and PFC)* for more information. For QFX5100 and EX4600 switches only, you can also refer to *Understanding PFC Functionality Across Layer 3 Interfaces*.

WRED Drop Profile Control of ECN Thresholds

You apply WRED drop profiles to forwarding classes (which are mapped to output queues) to control how the switch marks ECN-capable packets. A scheduler map associates a drop profile with a scheduler and a forwarding class, and then you apply the scheduler map to interfaces to implement the scheduling properties for the forwarding class on those interfaces.

Drop profiles define queue fill level (the percentage of queue fullness) and drop probability (the percentage probability that a packet is dropped) pairs. When a queue fills to a specified level, traffic that matches the drop profile has the drop probability paired with that fill level. When you configure a drop profile, you configure pairs of fill levels and drop probabilities to control how packets drop at different levels of queue fullness.

The first fill level and drop probability pair is the drop start point. Until the queue reaches the first fill level, packets are not dropped. When the queue reaches the first fill level, packets that exceed the fill level have a probability of being dropped that equals the drop probability paired with the fill level.

The last fill level and drop probability pair is the drop end point. When the queue reaches the last fill level, all packets are dropped unless they are configured for ECN.



NOTE: Lossless queues (forwarding class configured with the no-loss packet drop attribute) and strict-high priority queues do not use drop profiles. Lossless queues use PFC to control the flow of traffic. Strict-high priority queues receive all of the port bandwidth they require up to the configured maximum bandwidth limit (scheduler transmit-rate on QFX10000 switches, and shaping-rate on QFX5200, QFX5100, QFX3500, QFX3600, and EX4600 switches, and QFabric systems).

Different switches support different amounts of fill level/drop probability pairs in drop profiles. For example, QFX10000 switches support 32 fill level/drop probability pairs, so there can be as many as 30 intermediate fill level/drop probability pairs between the drop start and drop endpoints. QFX5200, QFX5100, QFX3500, QFX3600, and EX4600 switches, and QFabric systems support two fill level/drop probability pairs—by definition, the two pairs you configure on these switches are the drop start and drop end points.



NOTE: Do not configure the last fill level as 100 percent.

The drop profile configuration affects ECN packets as follows:

- Drop start point—ECN-capable packets might be marked as congestion experienced (CE).
- Drop end point—ECN-capable packets are always marked CE.

As a queue fills from the drop start point to the drop end point, the probability that an ECN packet is marked CE is the same as the probability that a non-ECN packet is dropped if you apply the drop profile to best-effort traffic. As the queue fills, the probability of an ECN packet being marked CE increases, just as the probability of a non-ECN packet being dropped increases when you apply the drop profile to best-effort traffic.

At the drop end point, all ECN packets are marked CE, but the ECN packets are not dropped. When the queue fill level exceeds the drop end point, all ECN packets are marked CE. (At this point on QFX5200, QFX5100, EX4600, QFX3500, and QFX3600 switches, and on QFabric systems, all non-ECN packets are dropped.) ECN packets (and all other packets) are tail-dropped if the queue fills completely.

To configure a WRED packet drop profile and apply it to an output queue (using hierarchical scheduling on switches that support ETS):

1. Configure a drop profile using the statement **set class-of-service drop-profiles *profile-name* interpolate fill-level *drop-start-point* fill-level *drop-end-point* drop-probability 0 drop-probability *percentage***.
2. Map the drop profile to a queue scheduler using the statement **set class-of-service schedulers *scheduler-name* drop-profile-map loss-priority (low | medium-high | high) protocol any drop-profile *profile-name***. The name of the drop-profile is the name of the WRED profile configured in Step 1.

3. Map the scheduler, which Step 2 associates with the drop profile, to the output queue using the statement **set class-of-service scheduler-maps *map-name* forwarding-class *forwarding-class-name* scheduler *scheduler-name***. The forwarding class identifies the output queue. Forwarding classes are mapped to output queues by default, and can be remapped to different queues by explicit user configuration. The scheduler name is the scheduler configured in Step 2.
4. Associate the scheduler map with a traffic control profile using the statement **set class-of-service traffic-control-profiles *tcp-name* scheduler-map *map-name***. The scheduler map name is the name configured in Step 3.
5. Associate the traffic control profile with an interface using the statement **set class-of-service interface *interface-name* forwarding-class-set *forwarding-class-set-name* output-traffic-control-profile *tcp-name***. The output traffic control profile name is the name of the traffic control profile configured in Step 4.

The interface uses the scheduler map in the traffic control profile to apply the drop profile (and other attributes, including the enable ECN attribute) to the output queue (forwarding class) on that interface. Because you can use different traffic control profiles to map different schedulers to different interfaces, the same queue number on different interfaces can handle traffic in different ways.

Starting in Release 15.1, you can configure a WRED packet drop profile and apply it to an output queue on switches that support port scheduling (ETS hierarchical scheduling is either not supported or not used). To configure a WRED packet drop profile and apply it to an output queue on switches that support port scheduling (ETS hierarchical scheduling is either not supported or not used):

1. Configure a drop profile using the statement **set class-of-service drop-profiles *profile-name* interpolate fill-level *level1* *level2* ... *level32* drop-probability *probability1* *probability2* ... *probability32***. You can specify as few as two fill level/drop probability pairs or as many as 32 pairs.
2. Map the drop profile to a queue scheduler using the statement **set class-of-service schedulers *scheduler-name* drop-profile-map loss-priority (low | medium-high | high) drop-profile *profile-name***. The name of the drop-profile is the name of the WRED profile configured in Step 1.
3. Map the scheduler, which Step 2 associates with the drop profile, to the output queue using the statement **set class-of-service scheduler-maps *map-name* forwarding-class *forwarding-class-name* scheduler *scheduler-name***. The forwarding class identifies the output queue. Forwarding classes are mapped to output queues by default, and can be remapped to different queues by explicit user configuration. The scheduler name is the scheduler configured in Step 2.
4. Associate the scheduler map with an interface using the statement **set class-of-service interfaces *interface-name* scheduler-map *scheduler-map-name***.

The interface uses the scheduler map to apply the drop profile (and other attributes) to the output queue mapped to the forwarding class on that interface. Because you can use different scheduler maps on different interfaces, the same queue number on different interfaces can handle traffic in different ways.

Support, Limitations, and Notes

If the WRED algorithm that is mapped to a queue does not find a packet drop eligible, then the ECN configuration and ECN bits marking does not matter. The packet transport behavior is the same as when ECN is not enabled.

ECN is disabled by default. Normally, you enable ECN only on queues that handle best-effort traffic, and you do not enable ECN on queues that handle lossless traffic or strict-high priority traffic.

ECN supports the following:

- IPv4 and IPv6 packets
- Untagged, single-tagged, and double-tagged packets
- The outer IP header of IP tunneled packets (but not the inner IP header)

ECN does not support the following:

- IP packets with MPLS encapsulation
- The inner IP header of IP tunneled packets (however, ECN works on the outer IP header)
- Multicast, broadcast, and destination lookup fail (DLF) traffic
- Non-IP traffic



.....
NOTE: On QFX10000 switches, when you enable a queue for ECN and apply a WRED drop profile to the queue, the WRED drop profile only sets the thresholds for marking ECN traffic as experiencing congestion (CE, 11). On ECN-enabled queues, the WRED drop profile does not set drop thresholds for non-ECT (00) traffic (traffic that is not ECN-capable). Instead, the switch uses the tail-drop algorithm on traffic that is marked non-ECT on ECN-enabled queues during periods of congestion.

To apply a WRED drop profile to non-ECT traffic, configure a multifield (MF) classifier to assign non-ECT traffic to a different output queue that is not ECN-enabled, and then apply the WRED drop profile to that queue.
.....

Release History Table

Release	Description
15.1	Starting in Release 15.1, you can configure a WRED packet drop profile and apply it to an output queue on switches that support port scheduling (ETS hierarchical scheduling is either not supported or not used).

Related Documentation

- [Example: Configuring ECN on page 78](#)

Example: Configuring ECN

This example shows how to enable explicit congestion notification (ECN) on an output queue.

- [Requirements on page 78](#)
- [Overview on page 78](#)
- [Configuration on page 80](#)
- [Verification on page 82](#)

Requirements

This example uses the following hardware and software components:

- One switch.
- Junos OS Release 13.2X51-D25 or later for the QFX Series or Junos OS Release 14.1X53-D20 for the OCX Series

Overview

ECN enables end-to-end congestion notification between two endpoints on TCP/IP based networks. The two endpoints are an ECN-enabled sender and an ECN-enabled receiver. ECN must be enabled on both endpoints and on all of the intermediate devices between the endpoints for ECN to work properly. Any device in the transmission path that does not support ECN breaks the end-to-end ECN functionality.

A weighted random early detection (WRED) packet drop profile must be applied to the output queues on which ECN is enabled. ECN uses the WRED drop profile thresholds to mark packets when the output queue experiences congestion.

ECN reduces packet loss by forwarding ECN-capable packets during periods of network congestion instead of dropping those packets. (TCP notifies the network about congestion by dropping packets.) During periods of congestion, ECN marks ECN-capable packets that egress from congested queues. When the receiver receives an ECN packet that is marked as experiencing congestion, the receiver echoes the congestion state back to the sender. The sender then reduces its transmission rate to clear the congestion.

ECN is disabled by default. You can enable ECN on best-effort traffic. ECN should not be enabled on lossless traffic queues, which uses priority-based flow control (PFC) for

congestion notification, and ECN should not be enabled on strict-high priority traffic queues.

To enable ECN on an output queue, you not only need to enable ECN in the queue scheduler, you also need to:

- Configure a WRED packet drop profile.
- Configure a queue scheduler that includes the WRED drop profile and enables ECN. (This example shows only ECN and drop profile configuration; you can also configure bandwidth, priority, and buffer settings in a scheduler.)
- Map the queue scheduler to a forwarding class (output queue) in a scheduler map.
- Starting in Junos OS 15.1, enhanced transmission selection (ETS) hierarchical scheduling is supported. If you are using enhanced transmission selection (ETS) hierarchical scheduling, add the forwarding class to a forwarding class set (priority group).
- If you are using ETS, associate the queue scheduler map with a traffic control profile (priority group scheduler for hierarchical scheduling).
- If you are using ETS, apply the traffic control profile and the forwarding class set to an interface. On that interface, the output queue uses the scheduler mapped to the forwarding class, as specified by the scheduler map attached to the traffic control profile. This enables ECN on the queue and applies the WRED drop profile to the queue.

If you are using port scheduling, apply the scheduler map to an interface. On that interface, the output queue uses the scheduler mapped to the forwarding class in the scheduler map, which enables ECN on the queue and applies the WRED drop profile to the queue.

Table 20 on page 79 shows the configuration components for this example.

Table 20: Components of the ECN Configuration Example

Component	Settings
Hardware	QFX Series switch
Drop profile (with two fill level/drop probability pairs)	Name: be-dp Drop start fill level: 30 percent Drop end fill level: 75 percent Drop probability at drop start (minimum drop rate): 0 percent Drop probability at drop end (maximum drop rate): 80 percent
Scheduler	Name: be-sched ECN: enabled Drop profile: be-dp Transmit rate: 25% Buffer size: 25% Priority: low

Table 20: Components of the ECN Configuration Example (*continued*)

Component	Settings
Scheduler map	Name: be-map Forwarding class: best-effort Scheduler: be-sched <i>NOTE:</i> By default, the best-effort forwarding class is mapped to output queue 0.
Forwarding class set (ETS only)	Name: be-pg Forwarding class: best-effort (queue 0)
Traffic control profile (ETS only)	Name: be-tcp Scheduler map: be-map
Interface (ETS only)	Name: xe-0/0/20 Forwarding class set: be-pg (Output) traffic control profile: be-tcp
Interface (port scheduling only)	Name: xe-0/0/20



NOTE: Only switches that support ETS hierarchical scheduling support forwarding class set and traffic control profile configuration. Direct port scheduling does not use the hierarchical scheduling structure.



NOTE: On QFX5100, EX4600, QFX3500, and QFX3600 switches, and on QFabric systems, the WRED drop profile also controls packet drop behavior for traffic that is not ECN-capable (packets marked non-ECT, ECN bit code 00).

On QFX10000 switches, when ECN is enabled on a queue, the WRED drop profile only sets the ECN thresholds, it does not control packet drop on non-ECN packets. On ECN-enabled queues, QFX10000 switches use the tail-drop algorithm on non-ECN packets during periods of congestion. If you do not enable ECN, then the queue uses the WRED packet drop mechanism.

Configuration

CLI Quick Configuration

To quickly configure the drop profile, scheduler with ECN enabled, and to map the scheduler to an output queue on an interface, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

ETS Quick Configuration

```
[edit class-of-service]
set drop-profile be-dp interpolate fill-level 30 fill-level 75 drop-probability 0 drop-probability 80
set schedulers be-sched explicit-congestion-notification
set schedulers be-sched drop-profile-map loss-priority low protocol any drop-profile be-dp
set schedulers be-sched transmit-rate percent 25
set schedulers be-sched buffer-size percent 25
set schedulers be-sched priority low
set scheduler-maps be-map forwarding-class best-effort scheduler be-sched
set forwarding-class-sets be-pg class best-effort
set traffic-control-profiles be-tcp scheduler-map be-map
set interfaces xe-0/0/20 forwarding-class-set be-pg output-traffic-control-profile be-tcp
```

Port Scheduling Quick Configuration (QFX10000 Switches)

```
[edit class-of-service]
set drop-profile be-dp interpolate fill-level 30 fill-level 75 drop-probability 0 drop-probability 80
set schedulers be-sched explicit-congestion-notification
set schedulers be-sched drop-profile-map loss-priority low protocol any drop-profile be-dp
set schedulers be-sched transmit-rate percent 25
set schedulers be-sched buffer-size percent 25
set schedulers be-sched priority low
set scheduler-maps be-map forwarding-class best-effort scheduler be-sched
set interfaces xe-0/0/20 scheduler-map be-map
```

Configuring ECN

Step-by-Step Procedure

To configure ECN:

1. Configure the WRED packet drop profile **be-dp**. This example uses a drop start point of **30** percent, a drop end point of **75** percent, a minimum drop rate of **0** percent, and a maximum drop rate of **80** percent:

```
[edit class-of-service]
user@switch# set drop-profile be-dp interpolate fill-level 30 fill-level 75 drop-probability 0 drop-probability 80
```

2. Create the scheduler **be-sched** with ECN enabled and associate the drop profile **be-dp** with the scheduler:

```
[edit class-of-service]
user@switch# set schedulers be-sched explicit-congestion-notification
user@switch# set schedulers be-sched drop-profile-map loss-priority low protocol any drop-profile be-dp
user@switch# set be-sched transmit-rate percent 25
user@switch# set be-sched buffer-size percent 25
user@switch# set be-sched priority low
```

3. Map the scheduler **be-sched** to the **best-effort** forwarding class (output queue 0) using scheduler map **be-map**:

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

4. If you are using ETS, add the forwarding class **best-effort** to the forwarding class set **be-pg**; if you are using direct port scheduling, skip this step:

```
[edit class-of-service]
user@switch# set forwarding-class-sets be-pg class best-effort
```

5. If you are using ETS, associate the scheduler map **be-map** with the traffic control profile **be-tcp**; if you are using direct port scheduling, skip this step:

```
[edit class-of-service]
user@switch# set traffic-control-profiles be-tcp scheduler-map be-map
```

6. If you are using ETS, associate the traffic control profile **be-tcp** and the forwarding class set **be-pg** with the interface on which you want to enable ECN on the best-effort queue:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/20 forwarding-class-set be-pg
output-traffic-control-profile be-tcp
```

If you are using direct port scheduling, associate the scheduler map **be-map** with the interface on which you want to enable ECN on the best-effort queue:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/20 scheduler map be-map
```

Verification

Verifying That ECN Is Enabled

Purpose Verify that ECN is enabled in the scheduler **be-sched** by showing the configuration for the scheduler map **be-map**.

Action Display the scheduler map configuration using the operational mode command **show class-of-service scheduler-map be-map**:

```
user@switch> show class-of-service scheduler-map be-map
Scheduler map: be-map, Index: 12240
```

```
Scheduler:be-sched, Forwarding class: best-effort, Index: 115
Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent,
Buffer Limit: none, Priority: low
Excess Priority: unspecified, Explicit Congestion Notification: enable
Drop profiles:
  Loss priority  Protocol  Index  Name
  Low           any       3312   be-dp
  Medium-high   any       1      <default-drop-profile>
  High          any       1      <default-drop-profile>
```

Meaning The **show class-of-service scheduler-map** operational command shows the configuration of the scheduler associated with the scheduler map and the forwarding class mapped to that scheduler. The output shows that:

- The scheduler associated with the scheduler map is **be-sched**.
- The scheduler map applies to the forwarding class **best-effort** (output queue 0).
- The scheduler **be-sched** has a transmit rate of **25** percent, a queue buffer size of **25** percent, and a drop priority of **low**.
- Explicit congestion notification state is **enable**.
- The WRED drop profile used for low drop priority traffic is **be-dp**.

Release History Table

Release	Description
15.1	Starting in Junos OS 15.1, enhanced transmission selection (ETS) hierarchical scheduling is supported.

Related Documentation

- [Understanding CoS Explicit Congestion Notification on page 69](#)

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

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

This topic covers:

- [Port Shaping on page 84](#)
- [Queue Shaping on page 84](#)

Port Shaping

Port shaping enables you to shape the aggregate traffic through a port or channel to a rate that is less than the line rate. You can configure interfaces to shape traffic based on the rate-limited bandwidth of the total interface bandwidth. This allows you to shape the output of the interface so that the interface transmits less traffic than it is capable of transmitting. For port shaping, you can specify shaping rate as the peak rate at which traffic can pass through the interface. You can specify rate as a value in bits per second (bps) either as a decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000) and the value can range from 1000 through 160,000,000,000 bps.

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

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

Queue Shaping

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

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

- Related Documentation**
- [Understanding CoS Schedulers on page 37](#)
 - [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)

Understanding CoS Two-Color Marking

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

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

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

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

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

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

CHAPTER 7

Assigning CoS Components to Interfaces

- [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
- [Assigning CoS Components to Interfaces \(J-Web Procedure\) on page 88](#)

Assigning CoS Components to Interfaces (CLI Procedure)

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

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

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

To assign CoS components to interfaces:

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

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

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

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

Related Documentation

- [Assigning CoS Components to Interfaces \(J-Web Procedure\) on page 88](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Monitoring Interfaces That Have CoS Components on page 126](#)
- [Understanding Junos OS CoS Components for EX Series Switches on page 6](#)

Assigning CoS Components to Interfaces (J-Web Procedure)



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

To assign CoS components to interfaces:

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



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

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



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

4. Click **OK**.
5. To manage a CoS assignment on a logical interface, Click one of the following options:

- **Add**—Adds a CoS service to a logical interface on a specified physical interface. Enter information as described in [Table 21 on page 89](#).
- **Edit**—Modifies a CoS service assignment to a logical interface. Enter information as described in [Table 21 on page 89](#).
- **Delete**—Deletes the CoS service assignment to a logical interface.

Table 21: Assigning CoS Components to Logical Interfaces

Field	Function	Your Action
Unit	Specifies the name of a logical interface. Enables you to assign CoS components when you configure a logical interface on a physical interface.	Type the interface name. To assign CoS to all logical interfaces configured on this physical interface, type the wildcard character (*).
Forwarding Class	Assigns a predefined forwarding class to incoming packets on a logical interface.	To assign a forwarding class to an interface, select the forwarding class.
Classifiers	Enables you to apply classification maps to a logical interface. Classifiers assign a forwarding class and loss priority to an incoming packet based on its CoS value.	To assign a classification map to an interface, select an appropriate classifier for each CoS value type used on the interface.
Rewrite Rules	Enables you to alter the CoS values in outgoing packets to meet the requirements of the targeted peer. A rewrite rule examines the forwarding class and loss priority of a packet and sets its bits to a corresponding value specified in the rule. NOTE: In EX4300 switches, this option is available only when you click Edit button in the Configure Interface Association table.	To assign rewrite rules to the interface, select the appropriate rewrite rule for each CoS value type used on the interface.

- Related Documentation**
- [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)
 - [Monitoring Interfaces That Have CoS Components on page 126](#)

CHAPTER 8

Example of CoS Configuration

- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Example: Configuring Multidestination \(Multicast, Broadcast, DLF\) Classifiers on page 117](#)

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 91](#)
- [Overview and Topology on page 91](#)
- [Configuration on page 94](#)
- [Verification on page 105](#)

Requirements

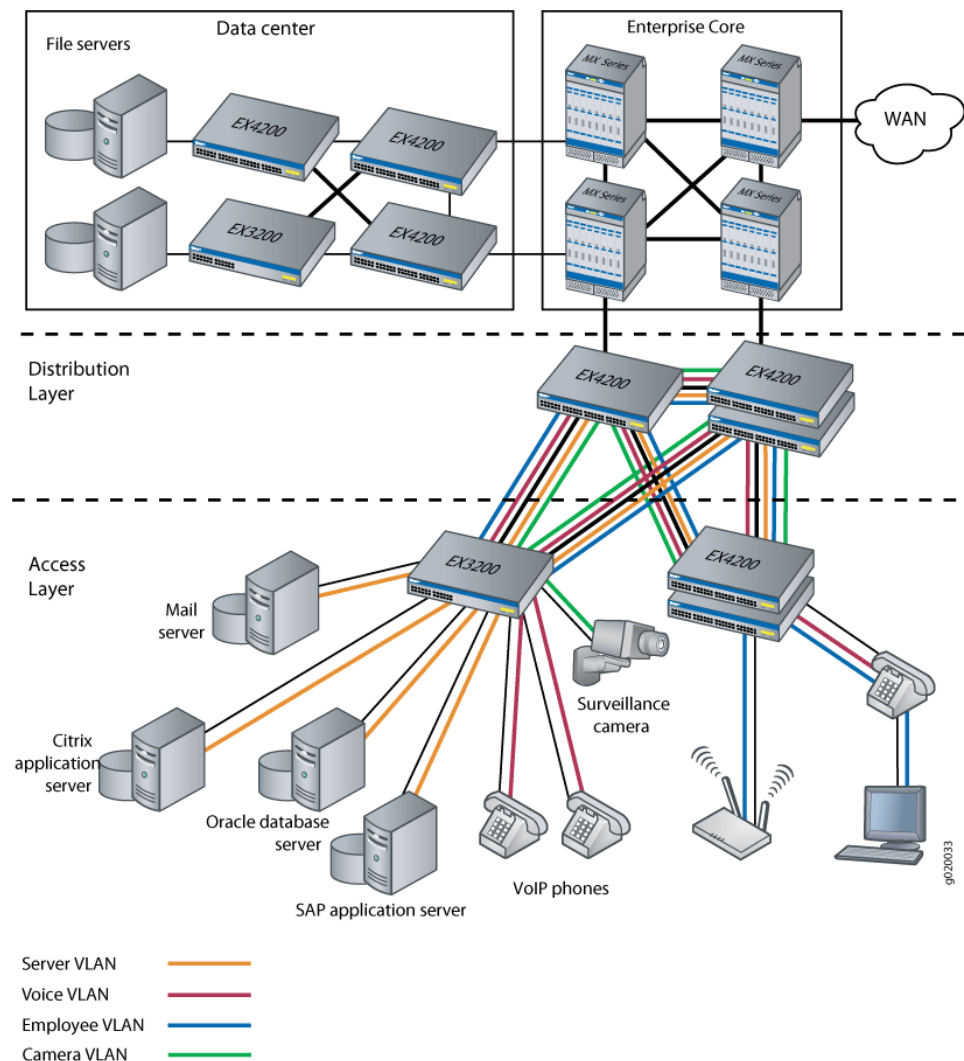
This example uses the following hardware and software components:

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

Overview and Topology

This example uses the topology shown in [Figure 6 on page 92](#).

Figure 6: Topology for Configuring CoS



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

The EX Series access switches are configured to support VLAN membership. On the EX3200 access layer switch, interfaces **ge-0/0/0** and **ge-0/0/1** are assigned to the voice VLAN (**voice-vlan**) for two VoIP IP phones. Switch interface **ge-0/0/2** is assigned to the camera VLAN (**camera-vlan**) for the surveillance camera. Switch interfaces **ge-0/0/3**, **ge-0/0/4**, **ge-0/0/5**, and **ge-0/0/6** are assigned to the server VLAN (**server-vlan**) for the servers hosting various applications such as those provided by Citrix, Microsoft, Oracle, and SAP. The EX3200 trunk ports, **ge-0/0/20** and **ge-0/0/21**, are assigned to the server, voice, employee, and camera VLANs and used as uplink ports to connect the distribution layer switches.

EX4200 switches are also included in the access layer to similarly connect employee and voice VLANs, although this example does not show configuration details for those switches.

Table 22 on page 93 shows the VLAN configuration components.

Table 22: Configuration Components: VLANs

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

PoE-capable ports on EX Series switches support Power over Ethernet (PoE) to provide both network connectivity and power for VoIP telephones connecting to the ports.

Table 23 on page 93 shows the switch interfaces that are assigned to the VLANs and the IP addresses for devices connected to the switch ports on a 48-port switch, all ports of which are PoE-capable.

Table 23: Configuration Components: Switch Interfaces Assigned to VLANs and Devices on a 48-Port All-PoE Switch

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



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

Configuration

CLI Quick Configuration

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

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

```

set firewall family ethernet-switching filter app_class term app from source-port [1494 2512 2513
2598 2897]
set firewall family ethernet-switching filter app_class term app then forwarding-class app
loss-priority low
set firewall family ethernet-switching filter app_class term mail from source-address
192.168.1.34/28
set firewall family ethernet-switching filter app_class term mail from protocol tcp
set firewall family ethernet-switching filter app_class term mail from source-port [25 143 389
691 993 3268 3269]
set firewall family ethernet-switching filter app_class term mail then forwarding-class mail
loss-priority low
set firewall family ethernet-switching filter app_class term db from source-address 192.168.1.35/28
set firewall family ethernet-switching filter app_class term db from protocol tcp
set firewall family ethernet-switching filter app_class term db from source-port [1521 1525 1527
1571 1810 2481]
set firewall family ethernet-switching filter app_class term db then forwarding-class db loss-priority
low
set firewall family ethernet-switching filter app_class term erp from source-address 192.168.1.36/28
set firewall family ethernet-switching filter app_class term erp from protocol tcp
set firewall family ethernet-switching filter app_class term erp from source-port [3200 3300
3301 3600]
set firewall family ethernet-switching filter app_class term erp then forwarding-class erp
loss-priority low
set firewall family ethernet-switching filter app_class term network_control from precedence
[net-control internet-control]
set firewall family ethernet-switching filter app_class term network_control then forwarding-class
network-control loss-priority low
set firewall family ethernet-switching filter app_class term best_effort_traffic then forwarding-class
best-effort loss-priority low
set interfaces ge-0/0/3 unit 0 family ethernet-switching filter input app_class
set interfaces ge-0/0/4 unit 0 family ethernet-switching filter input app_class
set interfaces ge-0/0/5 unit 0 family ethernet-switching filter input app_class
set interfaces ge-0/0/6 unit 0 family ethernet-switching filter input app_class
set class-of-service schedulers voice-sched buffer-size percent 10
set class-of-service schedulers voice-sched priority strict-high
set class-of-service schedulers voice-sched transmit-rate percent 10
set class-of-service schedulers video-sched buffer-size percent 15
set class-of-service schedulers video-sched priority low
set class-of-service schedulers video-sched transmit-rate percent 15
set class-of-service schedulers app-sched buffer-size percent 10
set class-of-service schedulers app-sched priority low
set class-of-service schedulers app-sched transmit-rate percent 10
set class-of-service schedulers mail-sched buffer-size percent 5
set class-of-service schedulers mail-sched priority low
set class-of-service schedulers mail-sched transmit-rate percent 5
set class-of-service schedulers db-sched buffer-size percent 10
set class-of-service schedulers db-sched priority low
set class-of-service schedulers db-sched transmit-rate percent 10
set class-of-service schedulers erp-sched buffer-size percent 10
set class-of-service schedulers erp-sched priority low
set class-of-service schedulers erp-sched transmit-rate percent 10
set class-of-service schedulers nc-sched buffer-size percent 5
set class-of-service schedulers nc-sched priority strict-high
set class-of-service schedulers nc-sched transmit-rate percent 5
set class-of-service schedulers be-sched buffer-size percent 35
set class-of-service schedulers be-sched priority low
set class-of-service schedulers be-sched transmit-rate percent 35
set class-of-service scheduler-maps ethernet-cos-map forwarding-class voice scheduler
voice-sched

```

```
set class-of-service scheduler-maps ethernet-cos-map forwarding-class video scheduler
video-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class app scheduler app-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class mail scheduler mail-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class db scheduler db-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class erp scheduler erp-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class network-control
scheduler nc-sched
set class-of-service scheduler-maps ethernet-cos-map forwarding-class best-effort scheduler
be-sched
set class-of-service interfaces ge-0/0/20 scheduler-map ethernet-cos-map
set class-of-service interfaces ge-0/0/21 scheduler-map ethernet-cos-map
set class-of-service schedulers voice-sched-queue-shap shaping-rate 30m
set class-of-service scheduler-maps sched-map-be forwarding-class best-effort scheduler
voice-sched-queue-shap
set class-of-service interfaces ge-0/0/2 scheduler-map sched-map-be
```

Step-by-Step Procedure

To configure and apply CoS:

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

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

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

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

3. Define the term **voip**:

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

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

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


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

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

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

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

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

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

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

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

9. Define the term **video**:

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

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

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

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

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

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

```
[edit interfaces]
user@switch# set ge-0/0/2 description video-ingress-port
```

```
user@switch# set ge-0/0/2 unit 0 family ethernet-switching filter input video_class
```

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

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

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

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

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

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

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

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

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

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

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

```
[edit firewall]
user@switch# set family ethernet-switching filter app_class term network_control from
precedence [net-control internet-control]
```

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

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

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

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

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

21. Configure schedulers:

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

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

```
[edit class-of-service]
user@switch# set scheduler-maps ethernet-cos-map forwarding-class voice scheduler
voice-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class video scheduler
video-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class app scheduler
app-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class mail scheduler
mail-sched
```

```
user@switch# set scheduler-maps ethernet-cos-map forwarding-class db scheduler
db-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class erp scheduler
erp-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class network-control
scheduler nc-sched
user@switch# set scheduler-maps ethernet-cos-map forwarding-class best-effort scheduler
be-sched
```

23. Associate the scheduler map with the outgoing interfaces:

```
[edit class-of-service interfaces]
user@switch# set ge-0/0/20 scheduler-map ethernet-cos-map
user@switch# set ge-0/0/21 scheduler-map ethernet-cos-map
```

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

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

Results Display the results of the configuration:

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

```

    }
  }
}
filter video_class {
  term video {
    from {
      source-address {
        192.168.1.17/28;
      }
      protocol udp;
      source-port 2979;
    }
    then {
      forwarding-class video;
      loss-priority low;
    }
  }
}
term network_control {
  from {
    precedence [net-control internet-control];
  }
  then {
    forwarding-class network-control;
    loss-priority low;
  }
}
term best_effort_traffic {
  then {
    forwarding-class best-effort;
    loss-priority low;
  }
}
}
filter app_class {
  term app {
    from {
      source-address {
        192.168.1.33/28;
      }
      protocol tcp;
      source-port [1491 2512 2513 2598 2897];
    }
    then {
      forwarding-class app;
      loss-priority low;
    }
  }
}
term mail {
  from {
    source-address {
      192.168.1.34/28;
    }
    protocol tcp;
    source-port [25 143 389 691 993 3268 3269];
  }
  then {

```

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

user@switch# show class-of-service

```
forwarding-classes {
  class app queue-num 5;
  class mail queue-num 1;
  class db queue-num 2;
  class erp queue-num 3;
  class video queue-num 4;
  class best-effort queue-num 0;
}
```

```
class voice queue-num 6;
class network-control queue-num 7;
}
interfaces {
  ge-0/0/0 {
    shaping-rate 100m;
  }
  ge-0/0/2 {
    scheduler-map sched-map-be;
  }
  ge-0/0/20 {
    scheduler-map ethernet-cos-map;
  }
  ge-0/0/21 {
    scheduler-map ethernet-cos-map;
  }
}
schedulers {
  voice-sched-queue-shap {
    shaping-rate 30m;
  }
  voice-sched {
    buffer-size percent 10;
    priority strict-high;
    transmit-rate percent 10;
  }
  video-sched {
    buffer-size percent 15;
    priority low;
    transmit-rate percent 15;
  }
  app-sched {
    buffer-size percent 10;
    priority low;
    transmit-rate percent 10;
  }
  mail-sched {
    buffer-size percent 5;
    priority low;
    transmit-rate percent 5;
  }
  db-sched {
    buffer-size percent 10;
    priority low;
    transmit-rate percent 10;
  }
  erp-sched {
    buffer-size percent 10;
    priority low;
    transmit-rate percent 10;
  }
  nc-sched {
    buffer-size percent 5;
    priority strict-high;
    transmit-rate percent 5;
  }
}
```

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

user@switch# show interfaces

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



```

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

```

Verification

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

- [Verifying That the Defined Forwarding Classes Exist and Are Mapped to Queues on page 105](#)
- [Verifying That the Forwarding Classes Have Been Assigned to Schedulers on page 106](#)
- [Verifying That the Scheduler Map Has Been Applied to the Interfaces on page 108](#)
- [Verifying That Port Shaping Has Been Applied on page 108](#)
- [Verifying That Queue Shaping Has Been Applied on page 112](#)

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

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

Action user@switch> **show class-of-service forwarding-class**

Forwarding class	ID	Queue
app	0	5
db	1	2
erp	2	3
best-effort	3	0
mail	4	1
voice	5	6
video	6	4
network-control	7	7

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

Verifying That the Forwarding Classes Have Been Assigned to Schedulers

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

Action user@switch> show class-of-service scheduler-map

Scheduler map: ethernet-cos-map, Index: 2

Scheduler: voice-sched, Forwarding class: voice, Index: 22

Transmit rate: 5 percent, Rate Limit: none, Buffer size: 15 percent,
Priority: Strict-high

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: video-sched, Forwarding class: video, Index: 22

Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: app-sched, Forwarding class: app, Index: 22

Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: mail-sched, Forwarding class: mail, Index: 22

Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: db-sched, Forwarding class: db, Index: 22

Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: erp-sched, Forwarding class: erp, Index: 22

Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: be-sched, Forwarding class: best-effort, Index: 20

Transmit rate: 35 percent, Rate Limit: none, Buffer size: 35 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: nc-sched, Forwarding class: network-control, Index: 22

Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,

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

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

Verifying That the Scheduler Map Has Been Applied to the Interfaces

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

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
...
Physical interface: ge-0/0/21, Index: 150
Queues supported: 8, Queues in use: 8
  Scheduler map: ethernet-cos-map, Index: 15103
  Input scheduler map: <default>, Index: 5
...
```

Meaning This output includes details of the interfaces to which the scheduler map (**ethernet-cos-map**) has been applied (**ge-0/0/20** and **ge-0/0/21**).

Verifying That Port Shaping Has Been Applied

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

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

```
user@switch> show interfaces ge-0/0/0 extensive
Physical interface: ge-0/0/0, Enabled, Physical link is Up
  Interface index: 239, SNMP ifIndex: 548, Generation: 242
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error:
None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,
  Media type: Copper
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d
```

```

Last flapped   : 2012-07-07 03:21:52 UTC (1d 18:02 ago)
Statistics last cleared: 2012-07-07 23:54:34 UTC (21:29:59 ago)
Traffic statistics:
  Input bytes   :                0                0 bps
  Output bytes  :      2299853696      345934816 bps
  Input packets :                0                0 pps
  Output packets:      17967609      337827 pps
IPv6 transit statistics:
  Input bytes   :                0
  Output bytes  :                0
  Input packets :                0
  Output packets:                0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runt: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 best-effort                0          18302337                0
  1 assured-forw                0                0                0
  5 expedited-fo                0                0                0
  7 network-cont                0                0                0

Queue number:      Mapped forwarding classes
  0                best-effort
  1                assured-forwarding
  5                expedited-forwarding
  7                network-control

Active alarms   : None
Active defects  : None
MAC statistics:
  Total octets      Receive      Transmit
  Total packets     0          2299853696
  Unicast packets   0          17967609
  Broadcast packets 0                0
  Multicast packets 0                0
  CRC/Align errors  0                0
  FIFO errors       0                0
  MAC control frames 0                0
  MAC pause frames  0                0
  Oversized frames  0
  Jabber frames     0
  Fragment frames   0
  Code violations    0

Autonegotiation information:
  Negotiation status: Complete
  Link partner:
    Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
  Local resolution:
    Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
  Destination slot: 1
CoS information:

```

Direction : Output		Bandwidth		Buffer Priority		Limit
CoS transmit queue						
	%	bps	%	usec		
0 best-effort	95	950000000	95	NA	low	none
7 network-control	5	50000000	5	NA	low	none

Interface transmit statistics: Disabled

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

Flags: SNMP-Traps 0x0 Encapsulation: ENET2

Traffic statistics:

Input bytes : 0
 Output bytes : 0
 Input packets: 0
 Output packets: 0

Local statistics:

Input bytes : 0
 Output bytes : 0
 Input packets: 0
 Output packets: 0

Transit statistics:

Input bytes : 0 0 bps
 Output bytes : 0 0 bps
 Input packets: 0 0 pps
 Output packets: 0 0 pps

Protocol eth-switch, Generation: 163, Route table: 0

Flags: Trunk-Mode

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

```
user@switch> show interfaces ge-0/0/0 statistics
```

Physical interface: ge-0/0/0, Enabled, Physical link is Up

Interface index: 239, SNMP ifIndex: 548, Generation: 242

Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,

Media type: Copper

Device flags : Present Running

Interface flags: SNMP-Traps Internal: 0x0

Link flags : None

CoS queues : 8 supported, 8 maximum usable queues

Hold-times : Up 0 ms, Down 0 ms

Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d

Last flapped : 2012-07-07 03:21:52 UTC (1d 18:10 ago)

Statistics last cleared: 2012-07-07 23:54:34 UTC (21:37:58 ago)

Traffic statistics:

Input bytes : 0 0 bps
 Output bytes : 15779512832 100223104 bps
 Input packets: 0 0 pps
 Output packets: 123277444 97874 pps

IPv6 transit statistics:

Input bytes : 0
 Output bytes : 0
 Input packets: 0

```

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

0 best-effort                0          123350092          57012484

1 assured-forw                0              0              0

5 expedited-fo                0              0              0

7 network-cont                0              0              0

Queue number:      Mapped forwarding classes
0                  best-effort
1                  assured-forwarding
5                  expedited-forwarding
7                  network-control

Active alarms : None
Active defects : None
MAC statistics:
Total octets      Receive      Transmit
Total packets      0      15779512832
Unicast packets    0      123277444
Broadcast packets  0      0
Multicast packets  0      0
CRC/Align errors   0      0
FIFO errors        0      0
MAC control frames 0      0
MAC pause frames   0      0
Oversized frames   0
Jabber frames      0
Fragment frames    0
Code violations     0

Autonegotiation information:
Negotiation status: Complete
Link partner:
  Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
Local resolution:
  Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
  Destination slot: 1
CoS information:
  Direction : Output
  CoS transmit queue      Bandwidth      Buffer Priority
Limit
0 best-effort      95      bps      %      usec      low
none
7 network-control   5      5000000      5      NA      low
none
Interface transmit statistics: Disabled

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

```

```

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

```

```

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

```

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

Verifying That Queue Shaping Has Been Applied

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

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

```

user@switch> show interfaces ge-0/0/2 extensive
Physical interface: ge-0/0/2, Enabled, Physical link is Up
  Interface index: 239, SNMP ifIndex: 548, Generation: 242
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto, BPDU Error:
None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online,
Media type: Copper
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x0
Link flags : None
CoS queues : 8 supported, 8 maximum usable queues
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:23:9c:0b:ae:8d, Hardware address: 00:23:9c:0b:ae:8d
Last flapped : 2012-07-07 03:21:52 UTC (1d 18:02 ago)
Statistics last cleared: 2012-07-07 23:54:34 UTC (21:29:59 ago)
Traffic statistics:
  Input bytes : 0 0 bps

```



```

Output bytes :          2299853696          345934816 bps
Input packets:          0              0 pps
Output packets:        17967609          337827 pps
IPv6 transit statistics:
  Input bytes :          0
  Output bytes :          0
  Input packets:         0
  Output packets:        0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runt: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 best-effort          0              18302337              0
  1 assured-forw          0              0              0
  5 expedited-fo          0              0              0
  7 network-cont          0              0              0

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

```

```

    0 best-effort          95      950000000    95          NA      low
none
    7 network-control      5      50000000    5          NA      low
none
Interface transmit statistics: Disabled

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

```

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

```

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

```

```

Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

    0 best-effort          0          41986978          57813642

    1 assured-forw          0              0              0

    5 expedited-fo          0              0              0

    7 network-cont          0              0              0

Queue number:      Mapped forwarding classes
    0              best-effort
    1              assured-forwarding
    5              expedited-forwarding
    7              network-control

Active alarms : None
Active defects : None
MAC statistics:
Total octets          Receive          Transmit
Total packets          0          5376128896
Unicast packets          0          42001003
Broadcast packets          0              0
Multicast packets          0              0
CRC/Align errors          0              0
FIFO errors            0              0
MAC control frames          0              0
MAC pause frames          0              0
Oversized frames          0
Jabber frames            0
Fragment frames          0
Code violations          0

Autonegotiation information:
Negotiation status: Complete
Link partner:
  Link mode: Full-duplex, Flow control: Symmetric, Remote fault: OK, Link
partner Speed: 1000 Mbps
Local resolution:
  Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
Destination slot: 1
CoS information:
Direction : Output
CoS transmit queue      Bandwidth      Buffer Priority
Limit
    0 best-effort          %          bps          %          usec
    none                  r          r          r          NA          low

Interface transmit statistics: Disabled

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

```

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

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

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

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

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

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

- Related Documentation**
- [Defining CoS Code-Point Aliases \(CLI Procedure\) on page 19](#)
 - [Defining CoS Classifiers \(CLI Procedure\) on page 24](#)
 - [Defining CoS Forwarding Classes \(CLI Procedure\) on page 33](#)
 - [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)
 - [Configuring CoS Tail Drop Profiles \(CLI Procedure\)](#)
 - [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
 - [Configuring Firewall Filters \(CLI Procedure\)](#)

Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers

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.

- [Requirements on page 117](#)
- [Overview on page 117](#)
- [Configuring Multidestination Classifiers on page 118](#)
- [Verification on page 118](#)

Requirements

This example uses the following hardware and software components:

- One switch (this example was tested on a Juniper Networks QFX3500 Switch)
- Junos OS Release 11.1 or later for the QFX Series.

Overview

Junos OS supports three general types of classifiers:

- Behavior aggregate or CoS value traffic classifiers—Examine the CoS value in the packet header. The value in this single field determines the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the CoS value.
- Fixed classifiers. Fixed classifiers classify all ingress traffic on a physical interface into one forwarding class, regardless of the CoS bits in the VLAN header or the DSCP bits in the packet header.
- Multifield traffic classifiers—Examine 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.

Multidestination classifiers apply to all of the switch interfaces and handle multicast, broadcast, and destination lookup fail (DLF) traffic. You cannot apply a multidestination classifier to a single interface or to a range of interfaces.



NOTE: You must assign unicast traffic and multicast traffic to different classifiers. One classifier cannot include both unicast and multicast forwarding classes. A multidestination classifier can include only forwarding classes for multicast traffic.

The following example describes how to configure a BA classifier called **ba-mcast-classifier**, which is applied to all of the switch interfaces. The BA classifier

assigns loss priorities, as shown in [Table 7 on page 24](#), to incoming packets in the multideestination forwarding class.

You can also use firewall filters to set multifield classifiers.

Table 24: BA-mcast-classifier Loss Priority Assignments

Multicast Forwarding Class	Traffic Type	ba-mcast-classifier Assignment
mcast	Best-effort multicast traffic	Low loss priority code point: 000

Configuring Multideestination Classifiers

To configure a multicast IEEE 802.1 BA classifier named **ba-mcast-classifier**:

1. Associate code point **000** with forwarding class **mcast** and loss priority **low**:

```
[edit class-of-service classifiers]
user@switch# set ieee-802.1 ba-mcast-classifier forwarding-class mcast loss-priority low
code-points 000
```

2. Configure the classifier as a multideestination classifier:

```
[edit class-of-service]
user@switch# set multi-destination classifiers ieee-802.1 ba-mcast-classifier
```

Verification

To verify the multideestination classifier configuration, perform these tasks:

- [Verifying the IEEE 802.1 Multideestination Classifier on page 118](#)
- [Verifying the Multideestination Classifier Configuration on page 118](#)

Verifying the IEEE 802.1 Multideestination Classifier

Purpose Verify that the classifier **ba-mcast-classifier** is configured as the IEEE 802.1 multideestination classifier:

Action Verify the results of the classifier configuration using the operational mode command **show configuration class-of-service multi-destination classifiers ieee-802.1**:

```
user@switch> show configuration class-of-service multi-destination classifiers ieee-802.1
ba-mcast-classifier;
```

Verifying the Multideestination Classifier Configuration

Purpose Verify that you configured the multideestination classifier with the correct forwarding classes, loss priorities, and code points.

Action List the classifier configuration using the operational mode command **show configuration class-of-service classifiers ieee-802.1 ba-mcast-classifier**:

```
user@switch> show configuration class-of-service classifiers ieee-802.1 ba-mcast-classifier
    forwarding-class mcast {
        loss-priority low code-points 000;
    }
```

- Related Documentation**
- *Example: Configuring Unicast Classifiers*
 - [Defining CoS BA Classifiers \(DSCP, DSCP IPv6, IEEE 802.1p\) on page 28](#)
 - *Monitoring CoS Classifiers*
 - *Understanding CoS Classifiers*
 - *Understanding CoS Classifiers*
 - *Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces*

PART 3

Monitoring and Troubleshooting Class of Service

- [Monitoring CoS Using J-Web on page 123](#)
- [Troubleshooting Procedures on page 133](#)

Monitoring CoS Using J-Web

- [Monitoring CoS Classifiers on page 123](#)
- [Monitoring CoS Forwarding Classes on page 124](#)
- [Monitoring Interfaces That Have CoS Components on page 126](#)
- [Monitoring CoS Rewrite Rules on page 127](#)
- [Monitoring CoS Scheduler Maps on page 128](#)
- [Monitoring CoS Value Aliases on page 130](#)
- [Monitoring CoS Drop Profiles on page 131](#)

Monitoring CoS Classifiers

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

Use the monitoring functionality to display the mapping of incoming CoS values to the 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 25 on page 123](#) summarizes key output fields for CoS classifiers.

Table 25: Summary of Key CoS Classifier Output Fields

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

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

Field	Values	Additional Information
CoS Value Type	The classifiers are displayed by type: <ul style="list-style-type: none"> • dscp—All classifiers of the DSCP type. • ieee-802.1—All classifiers of the IEEE 802.1 type. • inet-precedence—All classifiers of the IP precedence type. 	
Index	Internal index of the classifier.	
Incoming CoS Value	CoS value of the incoming packets, in bits. These values are used for classification.	
Assign to Forwarding Class	Forwarding class that the classifier assigns to an incoming packet. This class affects the forwarding and scheduling policies that are applied to the packet as it transits the switch.	
Assign to Loss Priority	Loss priority value that the classifier assigns to the incoming packet based on its CoS value.	

- Related Documentation**
- [Defining CoS Classifiers \(CLI Procedure\) on page 24](#)
 - [Defining CoS Classifiers \(J-Web Procedure\) on page 26](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

Monitoring CoS Forwarding Classes

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

View the current assignment of CoS forwarding classes to queues on the switch.

Action

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

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

```
show class-of-service forwarding-class
```

Meaning Table 26 on page 125 summarizes key output fields for CoS forwarding classes.

Table 26: Summary of Key CoS Forwarding Class Output Fields

Field	Values
Forwarding Class	<p>Names of forwarding classes assigned to queue numbers. The following are the default forwarding classes:</p> <ul style="list-style-type: none"> • best-effort—Provides no special CoS handling of packets. Loss priority is typically not carried in a CoS value. • expedited-forwarding—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service. • assured-forwarding—Provides high assurance for packets within the specified service profile. Excess packets are dropped. • network-control—Packets can be delayed but not dropped. <p>EX8200 switches have the following additional default forwarding classes:</p> <ul style="list-style-type: none"> • mcast-be—Provides no special CoS handling of packets. • mcast-ef—Provides low loss, low delay, low jitter, assured bandwidth, and end-to-end service. • mcast-af—Provides high assurance for packets within the specified service profile. Excess packets are dropped. <p>EX4300 switches supports all the forwarding classes mentioned above and the one mentioned in this section:</p> <ul style="list-style-type: none"> • mcast-nc—Provides multicast network-control traffic.
Queue	<p>Queue number corresponding to the forwarding class name. The default forwarding classes are assigned as follows:</p> <ul style="list-style-type: none"> • best-effort—0 • expedited-forwarding—5 • assured-forwarding—1 • network-control—7 • mcast-be—2 • mcast-ef—4 • mcast-af—6 <p>EX4300 switches have the following queue numbers for the forwarding classes:</p> <ul style="list-style-type: none"> • best-effort—0 • expedited-forwarding—1 • assured-forwarding—2 • network-control—3 • mcast-be—8 • mcast-ef—9 • mcast-af—10 • mcast-nc—11
Fabric Priority	<p>(EX8200 switches only) Fabric priority for the forwarding class, either high or low. The fabric priority determines the priority of packets entering the switch fabric.</p>

- Related Documentation**
- [Defining CoS Forwarding Classes \(CLI Procedure\) on page 33](#)
 - [Defining CoS Forwarding Classes \(J-Web Procedure\) on page 33](#)
 - [Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards \(CLI Procedure\)](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

Monitoring Interfaces That Have CoS Components

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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 27 on page 126](#) summarizes key output fields for CoS interfaces.

Table 27: 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.	

Table 27: Summary of Key CoS Interfaces Output Fields (*continued*)

Field	Values	Additional Information
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 Documentation

- [Assigning CoS Components to Interfaces \(CLI Procedure\) on page 87](#)
- [Assigning CoS Components to Interfaces \(J-Web Procedure\) on page 88](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)

Monitoring CoS Rewrite Rules

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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 28 on page 127](#) summarizes key output fields for CoS rewrite rules.

Table 28: Summary of Key CoS Rewrite Rules Output Fields

Field	Values	Additional Information
Rewrite Rule Name	Names of rewrite rules.	

Table 28: Summary of Key CoS Rewrite Rules Output Fields (*continued*)

Field	Values	Additional Information
CoS Value Type	Rewrite rule type: <ul style="list-style-type: none"> • dscp—For IPv4 DiffServ traffic. • exp—For MPLS traffic. • ieee-802.1—For Layer 2 traffic. • inet-precedence—For IPv4 traffic. 	To display forwarding classes, loss priorities, and rewritten CoS values, click the plus sign (+).
Index	Internal index for this particular rewrite rule.	
Forwarding Class	Forwarding class that is used to determine CoS values for rewriting in combination with loss priority.	Rewrite rules are applied to CoS values in outgoing packets based on forwarding class and loss priority setting.
Loss Priority	Loss priority that is used to determine CoS values for rewriting in combination with forwarding class.	
Rewrite CoS Value To	Value that the CoS value is rewritten to.	

- Related Documentation**
- [Defining CoS Rewrite Rules \(CLI Procedure\) on page 54](#)
 - [Defining CoS Rewrite Rules \(J-Web Procedure\) on page 55](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

Monitoring CoS Scheduler Maps

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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 29 on page 129](#) summarizes key output fields for CoS scheduler maps.

Table 29: 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	Configured transmit rate of the scheduler in bits per second (bps). The rate value can be either of the following: <ul style="list-style-type: none"> A percentage—The scheduler receives the specified percentage of the total interface bandwidth. remainder—The scheduler receives the remaining bandwidth of the interface after bandwidth allocation to other schedulers. 	
Buffer Size	Delay buffer size in the queue or the amount of transmit delay (in milliseconds). The buffer size can be either of the following: <ul style="list-style-type: none"> A percentage—The buffer is a percentage of the total buffer allocation. remainder—The buffer is sized according to what remains after other scheduler buffer allocations. 	
Priority	Scheduling priority of a queue: <ul style="list-style-type: none"> strict-high—Packets in this queue are transmitted first. low—Packets in this queue are transmitted last. 	
Excess rate	The percentage of excess bandwidth traffic to share.	
Drop Profiles	Name and index of a drop profile that is assigned to a specific loss priority and protocol pair.	
Loss Priority	Packet loss priority corresponding to a drop profile.	
Protocol	Transport protocol corresponding to a drop profile.	
Drop Profile Name	Name of the drop profile.	

Table 29: Summary of Key CoS Scheduler Maps Output Fields (*continued*)

Field	Values	Additional Information
Index	Index of a specific object—scheduler maps, schedulers, or drop profiles.	

Related Documentation

- [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44](#)
- [Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)
- [Example: Configuring CoS on EX Series Switches on page 91](#)

Monitoring CoS Value Aliases

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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 30 on page 130](#) summarizes key output fields for CoS value aliases.

Table 30: 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"> • dscp—Examines Layer 3 packet headers for IP packet classification. • ieee-802.1—Examines Layer 2 packet headers for packet classification. • inet-precedence—Examines Layer 3 packet headers for IP packet classification. 	To display aliases and bit patterns, click the plus sign (+).
CoS Value Alias	Name given to a set of bits—for example, af11 is a name for 001010 bits.	

Table 30: Summary of Key CoS Value Alias Output Fields (*continued*)

Field	Values	Additional Information
CoS Value	Set of bits associated with an alias.	

- Related Documentation**
- [Defining CoS Code-Point Aliases \(CLI Procedure\) on page 19](#)
 - [Defining CoS Code-Point Aliases \(J-Web Procedure\) on page 19](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

Monitoring CoS Drop Profiles

Purpose



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

J-Web Application package Release 14.1X53-A2 does not support Class of Service (CoS) on EX4600 switches.

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

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

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

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

Meaning [Table 31 on page 131](#) summarizes the key output fields for CoS RED drop profiles.

Table 31: Summary of the Key Output Fields for CoS Red Drop Profiles

Field	Values	Additional Information
RED Drop Profile Name	Name of the RED drop profile. A drop profile consists of pairs of values between 0 and 100, one for queue buffer fill level and the other for drop probability, that determine the relationship between a buffer's fullness and the likelihood it will drop packets.	To display profile values, click the plus sign (+).
Graph RED Profile	Links to a graph of a RED curve that the system uses to determine the drop probability based on queue buffer fullness.	The x axis represents the queue buffer fill level, and the y axis represents the drop probability.

Table 31: Summary of the Key Output Fields for CoS Red Drop Profiles (*continued*)

Field	Values	Additional Information
Type	Type of a specific drop profile: <ul style="list-style-type: none"> interpolated—The two coordinates (x and y) of the graph are interpolated to produce a smooth profile. segmented—The two coordinates (x and y) of the graph are represented by line fragments to produce a segmented profile. 	
Index	Internal index of this drop profile.	
Fill Level	Percentage fullness of a buffer queue. This value is the x coordinate of the RED drop profile graph.	
Drop Probability	Drop probability of a packet corresponding to a specific queue buffer fill level. This value is the y coordinate of the RED drop profile graph.	

- Related Documentation**
- [Defining CoS Drop Profiles \(J-Web Procedure\) on page 67](#)
 - [Example: Configuring CoS on EX Series Switches on page 91](#)

Troubleshooting Procedures

- [Troubleshooting a CoS Classifier Configuration for a TCAM Space Error on page 133](#)

Troubleshooting a CoS Classifier Configuration for a TCAM Space Error

Problem **Description:** When a CoS classifier configuration exceeds the amount of available ternary content addressable memory (TCAM) space, the switch returns the following system log message:

```
<number_of_rules_being_added> rules for <filter_name> class <filter_class> will  
not be installed, key: <bind_point>. no space in tcam db(<shared_pool_information>)
```

The switch returns this message during the commit operation if the number of classifiers defined in the CoS configuration or the number of bind points (interfaces) to which classifiers are bound causes the CoS configuration to exceed the amount of available TCAM space. However, the commit operation for the CoS configuration is completed in the CLI module.

Solution When a CoS configuration exceeds the amount of available TCAM table space, you must either define fewer classifiers or bind them to fewer interfaces, or both, so that the space requirements for the CoS configuration do not exceed the available space in TCAM.

To delete classifier definitions and bind points in a CoS configuration, and to apply a new CoS classifier definition to fewer bind points:

1. Delete either the CoS classifier definition or the bind points:

- To delete the CoS classifier definition:

- For behavioral classifiers:

```
[edit class-of-service]
user@switch# delete classifier dscp d1
```

- For multifield classifiers:

```
[edit]
user@switch# delete interfaces ge-3/0/2 unit 0 family ethernet-switching filter input
ipacl
```

This command deletes a multifield classifier defined for a port. Similarly, you can delete a multifield classifier defined for a VLAN or router.

You can also delete terms defined in a single multifield classifier:

```
[edit]
user@switch# delete firewall family inet filter f1 term t1
```

In both these examples (for behavioral and multifield classifiers), the assumption is that too many classifier definitions resulted in the error message.

- To delete the bind points:

```
[edit class-of-service]
user@switch# delete class-of-service interfaces ge-0/0/0
user@switch# delete class-of-service interfaces ge-0/0/1
user@switch# delete class-of-service interfaces ge-0/0/2
user@switch# delete class-of-service interfaces ge-0/0/3
user@switch# delete class-of-service interfaces ge-0/0/4
user@switch# delete class-of-service interfaces ge-0/0/5
user@switch# delete class-of-service interfaces ge-0/0/6
user@switch# delete class-of-service interfaces ge-0/0/7
user@switch# delete class-of-service interfaces ge-0/0/8
```

Here the assumption is that too many bind points (nine) in the configuration resulted in the error message.

2. Commit the operation:

```
[edit]
user@switch# commit
```

3. Define fewer classifiers in the CoS configuration or bind classifiers to fewer interfaces, or both, so that the CoS classifier configuration does not exceed the amount of available TCAM space on the switch:

- To define CoS classifiers:
 - For behavioral classifiers:

```
[edit]
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc1 loss-priority
low code-points 000001
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc2 loss-priority
low code-points 000010
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc3 loss-priority
low code-points 000011
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc4 loss-priority
low code-points 000100
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc5 loss-priority
low code-points 000101
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc6 loss-priority
low code-points 000110
user@switch# set class-of-service classifiers dscp d2 forwarding-class fc7 loss-priority
low code-points 000111
```

- For multifield Classifiers:

```
[edit]
user@switch# set firewall family inet filter f1 term t1 from protocol tcp
user@switch# set firewall family inet filter f1 term t1 then loss-priority high
user@switch# set firewall family inet filter f1 term t1 then forwarding-class best-effort
user@switch# set firewall family inet filter f1 term t2 from protocol udp
user@switch# set firewall family inet filter f1 term t2 then loss-priority high
user@switch# set firewall family inet filter f1 term t2 then forwarding-class
assured-forwarding
user@switch# set firewall family inet filter f1 term t3 from source-port ssh
user@switch# set firewall family inet filter f1 term t3 then loss-priority low
user@switch# set firewall family inet filter f1 term t3 then forwarding-class fc8
user@switch# set class-of-service forwarding-classes best-effort, assured-forwarding,
fc8
```

- To bind classifiers to fewer interfaces:

```
[edit]
user@switch# set class-of-service interfaces ge-0/0/0 unit 0 classifiers dscp d2
user@switch# set class-of-service interfaces ge-0/0/1 unit 0 classifiers dscp d2
user@switch# set class-of-service interfaces ge-0/0/2 unit 0 forwarding-class best-effort
user@switch# set class-of-service interfaces ge-0/0/3 unit 0 forwarding-class
assured-forwarding
user@switch# set class-of-service interfaces ge-0/0/4 unit 0 forwarding-class fc8
```

4. Commit the operation:

```
[edit]
user@switch# commit
```

5. Check system log for an error message. If an error message is not logged, then your classifier configuration has not exceeded the TCAM space limit.

If an error message is logged, then repeat this procedure by defining fewer classifiers or binding classifiers to fewer bind points.

- Related Documentation**
- [Understanding CoS Classifiers](#)
 - [Defining CoS Classifiers \(CLI Procedure\) on page 24](#)

PART 4

Configuration Statements and Operational Commands

- Configuration Statements on page 139
- Operational Commands on page 167

CHAPTER 11

Configuration Statements

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buffer-size

Syntax	buffer-size (exact percent <i>percentage</i> remainder temporal);
Hierarchy Level	[edit class-of-service schedulers <i>scheduler-name</i>]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify buffer size in a scheduler configuration.
Default	On EX Series switches except EX4300 switches, the default scheduler transmission rate and buffer size percentages for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent, respectively. On EX4300 switches, the default scheduler transmission rate and buffer size for queues 0 through 11 are 75, 0, 0, 5, 0, 0, 0, 0, 15, 0, 0 and 5 percent, respectively, of the total available buffer.
Options	<p>exact—(Except on EX8200 standalone switches and EX8200 Virtual Chassis) Enforce the exact buffer size. When this option is configured, sharing is disabled on the queue, restricting the usage to guaranteed buffers only.</p> <p>percent <i>percentage</i>—Buffer size as a percentage of the total buffer.</p> <p>remainder—Remaining buffer available.</p> <p>temporal—(EX4200 standalone switches, EX4200 Virtual Chassis, EX4300 standalone switches, EX4300 Virtual Chassis, EX8200 standalone switches, and EX8200 Virtual Chassis only) Buffer size as a temporal value.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44 or Defining CoS Schedulers (J-Web Procedure) on page 47• Understanding CoS Schedulers on page 37

classifiers

Syntax	<pre> classifiers { (dscp dscp-ipv6 ieee-802.1 inet-precedence) classifier-name { import (classifier-name default); forwarding-class class-name { loss-priority level { code-points [aliases] [6-bit-patterns]; } } } } </pre>
Hierarchy Level	[edit class-of-service], [edit class-of-service interfaces interface-name unit logical-unit-number]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches. Expanded to include EXP classifiers in Junos OS Release 10.1 for EX Series switches.
Description	<p>Apply a CoS aggregate behavior classifier to a logical interface. You can apply a default classifier or a custom classifier.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Example: Combining CoS with MPLS on EX Series Switches • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Assigning CoS Components to Interfaces (CLI Procedure) on page 87 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 88 • Understanding CoS Classifiers

code-point-aliases

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

Hierarchy Level [edit class-of-service]

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

Description Define an alias for a CoS marker.

The remaining statement is explained separately. See [CLI Explorer](#).

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

Related Documentation

- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Defining CoS Code-Point Aliases \(CLI Procedure\) on page 19](#) or [Defining CoS Code-Point Aliases \(J-Web Procedure\) on page 19](#)
- [Understanding CoS Code-Point Aliases on page 16](#)

code-points

Syntax	<code>code-points [<i>aliases</i>] [<i>6 bit-patterns</i>];</code>
Hierarchy Level	[edit class-of-service classifiers (dscp ieee-802.1 inet-precedence) forwarding-class class-name loss-priority level]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify one or more DSCP code-point aliases or bit sets for association with a forwarding class.
Options	<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>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Understanding CoS Classifiers

drop-profile-map

Syntax	<code>drop-profile-map loss-priority <i>loss-priority</i> protocol <i>protocol</i> drop-profile <i>profile-name</i>;</code>
Hierarchy Level	<code>[edit class-of-service schedulers <i>scheduler-name</i>]</code>
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Define the loss priority value for the specified drop profile.
Options	<code>drop-profile <i>profile-name</i></code> —Name of the drop profile. The remaining statements are explained separately. See CLI Explorer .
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44 or Defining CoS Schedulers (J-Web Procedure) on page 47• Understanding CoS Schedulers on page 37

dscp

Syntax	<pre> dscp classifier-name { import (classifier-name default); forwarding-class class-name { loss-priority level { code-points [aliases] [6-bit-patterns]; } } } </pre>
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 OS Release 9.0 for EX Series switches.
Description	Define the Differentiated Services code point (DSCP) mapping that is applied to the packets.
Options	<p>classifier-name—Name of the classifier.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Code-Point Aliases (CLI Procedure) on page 19 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 19 • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55 • Assigning CoS Components to Interfaces (CLI Procedure) on page 87 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 88 • Understanding CoS Classifiers

dscp-ipv6

Syntax	<pre> dscp-ipv6 classifier-name { import (classifier-name default); forwarding-class class-name { loss-priority level { code-points [aliases] [6-bit-patterns]; } } } </pre>
Hierarchy Level	[edit class-of-service classifiers], [edit class-of-service code-point-aliases], [edit class-of-service interfaces interface-name unit logical-unit-number classifiers] [edit class-of-service interfaces interface-name unit logical-unit-number rewrite-rules] [edit class-of-service rewrite-rules]
Release Information	Statement introduced in Junos OS Release 10.2 for EX Series switches.
Description	Define the Differentiated Services code point (DSCP) mapping that is applied to the IPv6 packets.
Options	<p>classifier-name—Name of the classifier.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Code-Point Aliases (CLI Procedure) on page 19 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 19 • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55 • Assigning CoS Components to Interfaces (CLI Procedure) on page 87 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 88 • Understanding CoS Classifiers

excess-rate (Schedulers)

Syntax	<pre>excess-rate { percent <i>percentage</i>; }</pre>
Hierarchy Level	[edit class-of-service schedulers <i>scheduler-name</i>]
Release Information	Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Description	(EX4300 switches only) Specify the percentage of excess bandwidth traffic to share.
Default	Excess bandwidth is shared in proportion to the configured transmit rate of each queue.
Options	<ul style="list-style-type: none">• percent—Percentage of the excess bandwidth to share.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Understanding CoS Schedulers on page 37• Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44 or Defining CoS Schedulers (J-Web Procedure) on page 47• Example: Configuring CoS on EX Series Switches on page 91

explicit-congestion-notification

Syntax	explicit-congestion-notification;
Hierarchy Level	[edit class-of-service schedulers <i>scheduler-name</i>]
Release Information	<p>Statement introduced in Junos OS Release 13.2X51 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	<p>Enable explicit congestion notification (ECN) on the output queue (forwarding class) or output queues (forwarding classes) mapped to the scheduler. ECN enables end-to-end congestion notification between two endpoints on TCP/IP based networks. The two endpoints are an ECN-enabled sender and an ECN-enabled receiver. ECN must be enabled on both endpoints and on all of the intermediate devices between the endpoints for ECN to work properly. Any device in the transmission path that does not support ECN breaks the end-to-end ECN functionality.</p> <p>A weighted random early detection (WRED) packet drop profile must be applied to the output queues on which ECN is enabled. ECN uses the WRED drop profile thresholds to mark packets when the output queue experiences congestion.</p> <p>ECN reduces packet loss by forwarding ECN-capable packets during periods of network congestion instead of dropping those packets. (TCP notifies the network about congestion by dropping packets.) During periods of congestion, ECN marks ECN-capable packets that egress from congested queues. When the receiver receives an ECN packet that is marked as experiencing congestion, the receiver echoes the congestion state back to the sender. The sender then reduces its transmission rate to clear the congestion.</p>
Required Privilege Level	<p>interfaces—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none">• Example: Configuring ECN on page 78• Understanding CoS Explicit Congestion Notification on page 69

forwarding-class

Syntax	<pre>forwarding-class <i>class-name</i> { loss-priority <i>level</i> { code-points [<i>aliases</i>] [<i>6-bit-patterns</i>]; } }</pre>
Hierarchy Level	[edit class-of-service classifiers (dscp ieee-802.1 inet-precedence) <i>classifier-name</i>], [edit class-of-service interfaces <i>interface-name</i> unit <i>logical-unit-number</i>], [edit class-of-service rewrite-rules] (dscp ieee-802.1 inet-precedence) <i>rewrite-rule-name</i>], [edit class-of-service scheduler-maps <i>map-name</i>], [edit class-of-service host-outbound-traffic]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Define forwarding class name and option values.
Options	<p><i>class-name</i> —Name of the forwarding class.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Forwarding Classes (CLI Procedure) on page 33 or Defining CoS Forwarding Classes (J-Web Procedure) on page 33 • Understanding CoS Forwarding Classes

forwarding-classes

Syntax	<pre>forwarding-classes { class <i>class-name</i> queue-num <i>queue-number</i> priority (high medium-high low medium-low); }</pre>
Hierarchy Level	[edit class-of-service]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	<p>Associate the forwarding class with a queue name and number.</p> <p>The remaining statement is explained separately. See CLI Explorer.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Forwarding Classes (CLI Procedure) on page 33 or Defining CoS Forwarding Classes (J-Web Procedure) on page 33• Understanding CoS Forwarding Classes

ieee-802.1

Syntax	<pre> ieee-802.1 classifier-name { import (classifier-name default); forwarding-class class-name { loss-priority level { code-points [aliases] [6 bit-patterns]; } } } </pre>
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 OS Release 9.0 for EX Series switches.
Description	Apply an IEEE-802.1 rewrite rule.
Options	<p>classifier-name —Name of the classifier.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Defining CoS Code-Point Aliases (CLI Procedure) on page 19 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 19 • Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55 • Understanding CoS Classifiers • Understanding CoS Rewrite Rules on page 51

import

Syntax	<code>import (classifier-name default);</code>
Hierarchy Level	<code>[edit class-of-service classifiers (dscp ieee-802.1 inet-precedence) classifier-name],</code> <code>[edit class-of-service rewrite-rules (dscp ieee-802.1 inet-precedence) rewrite-name]</code>
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify a default or previously defined classifier.
Options	classifier-name —Name of the classifier mapping configured at the <code>[edit class-of-service classifiers]</code> hierarchy level. default —Default classifier mapping.
Required Privilege Level	interface —To view this statement in the configuration. interface-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26• Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55• Understanding CoS Classifiers• Understanding CoS Rewrite Rules on page 51

inet-precedence

Syntax	<pre>inet-precedence classifier-name { import (classifier-name default); forwarding-class class-name { loss-priority level { code-points [aliases] [6-bit-patterns]; } } }</pre>
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 OS Release 9.0 for EX Series switches.
Description	Apply an IPv4 precedence rewrite rule.
Options	<p><i>classifier-name</i>—Name of the classifier.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Defining CoS Code-Point Aliases (CLI Procedure) on page 19 or Defining CoS Code-Point Aliases (J-Web Procedure) on page 19 • Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55 • Understanding CoS Classifiers • Understanding CoS Rewrite Rules on page 51

interfaces

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

Hierarchy Level [edit class-of-service]

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

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

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


The remaining statements are explained separately. See [CLI Explorer](#).

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

Related Documentation

- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Defining CoS Classifiers \(CLI Procedure\) on page 24 or Defining CoS Classifiers \(J-Web Procedure\) on page 26](#)
- [Defining CoS Forwarding Classes \(CLI Procedure\) on page 33 or Defining CoS Forwarding Classes \(J-Web Procedure\) on page 33](#)
- [Defining CoS Schedulers and Scheduler Maps \(CLI Procedure\) on page 44 or Defining CoS Schedulers \(J-Web Procedure\) on page 47](#)
- [Configuring Priority-Based Flow Control for an EX Series Switch \(CLI Procedure\)](#)

loss-priority (Classifiers and Rewrite Rules)

Syntax	<pre>loss-priority <i>level</i> { <i>code-points</i> [<i>aliases</i>] [<i>6-bit-patterns</i> <i>3-bit-patterns</i>]; }</pre>
Hierarchy Level	<p>[edit class-of-service classifiers (dscp ieee-802.1 inet-precedence exp) <i>classifier-name</i> forwarding-class <i>class-name</i>],</p> <p>[edit class-of-service rewrite-rules (dscp ieee-802.1 inet-precedence exp) <i>rewrite-rule-name</i> forwarding-class <i>class-name</i>]</p>
Release Information	<p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Statement expanded to apply to EXP classifiers in Junos OS Release 10.1 for EX Series switches.</p>
Description	Specify packet loss priority value for a specific set of code-point aliases and bit patterns.
Options	<p><i>level</i>—Can be one of the following:</p> <ul style="list-style-type: none"> high—Packet has high loss priority. medium-high— (On EX3200, EX4200, EX4300, and EX4500 switches only) Code points to classify to loss priority medium-high. low—Packet has low loss priority. medium-low — (On EX3200, EX4200, EX4300, and EX4500 switches only) Code points to classify to loss priority medium-low.
	<div>  <p>NOTE: The EX4300 hardware supports only three levels of loss priority — high, medium-high, and low. You can configure a loss priority of medium-low on the EX4300, but the hardware will convert it to medium-high.</p> </div>
	The remaining statement is explained separately. See CLI Explorer .
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Classifiers (CLI Procedure) on page 24 or Defining CoS Classifiers (J-Web Procedure) on page 26 • Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55 • Understanding CoS Classifiers

- [Understanding CoS Rewrite Rules on page 51](#)

multi-destination

Syntax	<pre>multi-destination { classifiers { (dscp dscp-ipv6 ieee-802.1 inet-precedence) <i>classifier-name</i>; } }</pre>
Hierarchy Level	[edit class-of-service], [edit class-of-service interfaces <i>interface-name</i>] (EX4300 only)
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series. Statement introduced in Junos OS Release 17.1 for the EX4300 switch.
Description	Define a multicast CoS behavior aggregate (BA) classifier.
Options	The remaining statements are explained separately. See CLI Explorer .
Required Privilege Level	interfaces—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Defining CoS BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 28• Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 117• <i>Assigning CoS Components to Interfaces</i>• <i>Understanding CoS Classifiers</i>• <i>Understanding CoS Classifiers</i>

policing

Syntax	<code>policing (filter <i>filter-name</i> no-automatic-policing);</code>
Hierarchy Level	<code>[edit protocols mpls label-switched-path <i>lsp-name</i>]</code> <code>[edit interfaces <i>interface-id</i> unit <i>number-of-logical-unit</i> family inet address <i>ip-address</i>]</code>
Release Information	Statement introduced in Junos OS Release 10.1 for EX Series switches.
Description	Apply a rate-limiting policer as the specified policing filter: <ul style="list-style-type: none"> • To the LSP for MPLS over CCC. • To the customer-edge interface for IP over MPLS.
Options	filter <i>filter-name</i> —Specify the name of the policing filter. no-automatic-policing —Disable automatic policing on this LSP.
Required Privilege Level	interface —To view this statement in the configuration. interface-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • <i>policer</i> • <i>Configuring Policers to Control Traffic Rates (CLI Procedure)</i> • <i>Configuring CoS on an MPLS Provider Edge Switch Using Circuit Cross-Connect (CLI Procedure)</i> • <i>Configuring CoS on an MPLS Provider Edge Switch Using IP Over MPLS (CLI Procedure)</i>

priority (Schedulers)

Syntax	<code>priority <i>priority</i>;</code>
Hierarchy Level	[edit class-of-service schedulers <i>scheduler-name</i>]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify packet-scheduling priority value.
Options	<i>priority</i> —It can be one of the following: <ul style="list-style-type: none">• low—Scheduler has low priority.• strict-high—Scheduler has strictly high priority.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44 or Defining CoS Schedulers (J-Web Procedure) on page 47• Understanding CoS Schedulers on page 37

protocol (Drop Profiles)

Syntax	<code>protocol <i>protocol</i> drop-profile <i>profile-name</i>;</code>
Hierarchy Level	[edit class-of-service schedulers <i>scheduler-name</i>]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify the protocol type for the specified drop profile.
Options	<p><code>drop-profile <i>profile-name</i></code> —Name of the drop profile.</p> <p><code><i>protocol</i></code> —Type of protocol. It can be:</p> <ul style="list-style-type: none"> • <code>any</code>—Accept any protocol type.
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Configuring CoS Tail Drop Profiles (CLI Procedure) • Understanding CoS Tail Drop Profiles

rewrite-rules

Syntax	<pre>rewrite-rules { (dscp dscp-ipv6 exp ieee-802.1 inet-precedence) rewrite-name { import (default rewrite-name); forwarding-class class-name { loss-priority level code-point (alias bits); } } }</pre>
Hierarchy Level	[edit class-of-service]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches. Statement expanded for use with global EXP classifiers in Junos OS Release 10.1 for EX Series switches.
Description	<p>Specify a rewrite-rules mapping for the traffic that passes through all queues on the interface.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Rewrite Rules (CLI Procedure) on page 54 or Defining CoS Rewrite Rules (J-Web Procedure) on page 55• Understanding CoS Rewrite Rules on page 51• Understanding Using CoS with MPLS Networks on EX Series Switches

scheduler-map

Syntax	<code>scheduler-map <i>map-name</i>;</code>
Hierarchy Level	[edit class-of-service interfaces], [edit class-of-service multi-destination]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Associate a scheduler map name with an interface or with a multidestination traffic configuration.
Options	<i>map-name</i> —Name of the scheduler map.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Assigning CoS Components to Interfaces (CLI Procedure) on page 87 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 88• Understanding CoS Schedulers on page 37• Understanding CoS Classifiers

scheduler-maps

Syntax	<pre>scheduler-maps { map-name { forwarding-class class-name scheduler scheduler-name; } }</pre>
Hierarchy Level	[edit class-of-service]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify a scheduler map name and associate it with the scheduler configuration and forwarding class.
Options	<p>map-name —Name of the scheduler map.</p> <p>The remaining statement is explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Defining CoS Forwarding Classes (CLI Procedure) on page 33 or Defining CoS Forwarding Classes (J-Web Procedure) on page 33• Understanding CoS Schedulers on page 37• Understanding CoS Forwarding Classes

schedulers (CoS)

Syntax	<pre> schedulers { scheduler-name { buffer-size (percent <i>percentage</i> remainder); drop-profile-map loss-priority <i>loss-priority</i> protocol <i>protocol</i> drop-profile <i>profile-name</i>; excess-rate (percent <i>percentage</i>); explicit-congestion-notification; priority <i>priority</i>; shaping-rate (<i>rate</i> percent <i>percentage</i>); transmit-rate (<i>rate</i> percent <i>percentage</i> remainder); } } </pre>
Hierarchy Level	[edit class-of-service]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify scheduler name and parameter values.
Options	<p><i>scheduler-name</i> —Name of the scheduler.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44 or Defining CoS Schedulers (J-Web Procedure) on page 47 • Understanding CoS Schedulers on page 37

shaping-rate

Syntax	shaping-rate (percent <i>percentage</i> rate);
Hierarchy Level	[edit class-of-service schedulers (CoS) <i>scheduler-name</i>]
Release Information	Statement introduced in Junos OS Release 9.3 for EX Series switches.
Description	<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>
Default	If you do not include this statement, the default shaping rate is 100 percent, which is the same as no shaping at all.
Options	<p>percent<i>percentage</i> —Shaping rate as a percentage of the available interface bandwidth. Range: 0 through 100 percent</p> <p>rate—Peak rate, in bits per second (bps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). Range: 3200 through 32,000,000,000 bps (EX4300 switches only) 8000 through 160,000,000,000 bps</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Understanding Junos OS CoS Components for EX Series Switches on page 6

transmit-rate (EX Series Switches)

Syntax	<code>transmit-rate (rate percent <i>percentage</i> remainder);</code>
Hierarchy Level	[edit class-of-service schedulers <i>scheduler-name</i>]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Specify the transmit rate or percentage for a scheduler.
Default	If you do not include this statement, the default scheduler transmission rate and buffer size percentages for queues 0 through 7 are 95, 0, 0, 0, 0, 0, 0, and 5 percent.
Options	<p>rate —Transmission rate, in bps. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).</p> <p>Range: 3200 through 160,000,000,000 bps</p> <p>(EX4300 switches only) 8000 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.</p> <p>Range: 0 through 100 percent</p> <p>remainder—Remaining rate available</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Example: Configuring CoS on EX Series Switches on page 91 • Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44 or Defining CoS Schedulers (J-Web Procedure) on page 47 • Understanding CoS Schedulers on page 37

unit

Syntax	<pre>unit <i>logical-unit-number</i> { forwarding-class <i>class-name</i>; classifiers { (<i>dscp</i> <i>ieee-802.1</i> <i>inet-precedence</i>) (<i>classifier-name</i> default); } }</pre>
Hierarchy Level	[edit class-of-service interfaces <i>interface-name</i>]
Release Information	Statement introduced in Junos OS Release 9.0 for EX Series switches.
Description	Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.
Options	<p><i>logical-unit-number</i> —Number of the logical unit.</p> <p>Range: 0 through 16,385</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Example: Configuring CoS on EX Series Switches on page 91• Assigning CoS Components to Interfaces (CLI Procedure) on page 87 or Assigning CoS Components to Interfaces (J-Web Procedure) on page 88

CHAPTER 12

Operational Commands

- `show class-of-service`
- `show class-of-service classifier`
- `show class-of-service code-point-aliases`
- `show class-of-service drop-profile`
- `show class-of-service forwarding-class`
- `show class-of-service forwarding-table`
- `show class-of-service forwarding-table classifier`
- `show class-of-service forwarding-table classifier mapping`
- `show class-of-service forwarding-table drop-profile`
- `show class-of-service forwarding-table rewrite-rule`
- `show class-of-service forwarding-table rewrite-rule mapping`
- `show class-of-service forwarding-table scheduler-map`
- `show class-of-service interface`
- `show class-of-service multi-destination`
- `show class-of-service rewrite-rule`
- `show class-of-service scheduler-map`
- `show interfaces queue`

show class-of-service

Syntax `show class-of-service`

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches. EXP classifiers added in Junos OS Release 10.1 for EX Series switches.

Description Display the class-of-service (CoS) information.

Required Privilege Level view

Related Documentation

- [Example: Configuring CoS on EX Series Switches on page 91](#)
- [Monitoring CoS Value Aliases on page 130](#)
- [Monitoring CoS Classifiers on page 123](#)
- [Monitoring CoS Forwarding Classes on page 124](#)
- [Monitoring CoS Scheduler Maps on page 128](#)
- [Monitoring CoS Rewrite Rules on page 127](#)

List of Sample Output [show class-of- service on page 169](#)
[show class-of-service rewrite-rule on page 172](#)

Output Fields [Table 32 on page 168](#) lists the output fields for the `show class-of-service` command. Output fields are listed in the approximate order in which they appear.

Table 32: show class-of-service Output Fields

Field Name	Field Description	Level of Output
Forwarding class	<p>The forwarding class configuration:</p> <ul style="list-style-type: none"> • Forwarding class—Name of the forwarding class. • ID—Forwarding class ID. • Queue—Queue number. • Fabric Priority—(EX8200 switches only) Fabric priority: either high or low. The fabric priority determines which CoS ingress queues packets are sent to. 	All levels
Code point type	<p>The type of code-point alias:</p> <ul style="list-style-type: none"> • dscp—Aliases for DiffServ code point (DSCP) values. • ieee-802.1—Aliases for IEEE 802.1p values. • inet-precedence—Aliases for IP precedence values. • exp—Aliases for experimental (EXP) values. 	All levels
Alias	Names given to CoS values.	All levels

Table 32: show class-of-service Output Fields (*continued*)

Field Name	Field Description	Level of Output
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
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 <i>high</i> packets beyond which <i>high</i> packets are dropped.	All levels
Scheduler	Name of the scheduler.	All levels
Transmit rate	Transmission rate of the scheduler.	All levels
Excess rate	Percentage of excess bandwidth traffic to share.	All levels
Buffer size	Delay buffer size in the queue.	All levels
Drop profiles	Drop profiles configured for the specified scheduler.	All levels
Protocol	Transport protocol corresponding to the drop profile.	All levels
Name	Name of the drop profile.	All levels
Queues supported	Number of queues that can be configured on the interface.	All levels
Queues in use	Number of queues currently configured.	All levels
Physical interface	Name of the physical interface.	All levels
Scheduler map	Name of the scheduler map.	All levels
Index	Internal index of a specific object.	All levels

Sample Output

show class-of- service

```
user@switch> show class-of-service
```

Forwarding class	ID	Queue
best-effort	0	0
expedited-forwarding	1	5
assured-forwarding	2	1
network-control	3	7

Code point type: dscp

Alias	Bit pattern
af11	001010
af12	001100
...	...

Code point type: ieee-802.1

Alias	Bit pattern
af11	010
...	...

Code point type: inet-precedence

Alias	Bit pattern
af11	001
...	...

Classifier: dscp-default, Code point type: dscp, Index: 7

Code point	Forwarding class	Loss priority
000000	best-effort	low
000001	best-effort	low
...

Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11

Code point	Forwarding class	Loss priority
000	best-effort	low
001	best-effort	low
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low
110	network-control	low
111	network-control	low

Classifier: ipprec-default, Code point type: inet-precedence, Index: 12

Code point	Forwarding class	Loss priority
000	best-effort	low
001	best-effort	low
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low
110	network-control	low
111	network-control	low

Classifier: ieee8021p-untrust, Code point type: ieee-802.1, Index: 16

Code point	Forwarding class	Loss priority
000	best-effort	low
001	best-effort	low
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low
110	best-effort	low
111	best-effort	low

Rewrite rule: dscp-default, Code point type: dscp, Index: 27

Forwarding class	Loss priority	Code point
best-effort	low	000000
best-effort	high	000000
expedited-forwarding	low	101110
expedited-forwarding	high	101110
assured-forwarding	low	001010
assured-forwarding	high	001100
network-control	low	110000
network-control	high	111000

Rewrite rule: ieee8021p-default, Code point type: ieee-802.1, Index: 30

Forwarding class	Loss priority	Code point
best-effort	low	000
best-effort	high	001
expedited-forwarding	low	100
expedited-forwarding	high	101
assured-forwarding	low	010
assured-forwarding	high	011
network-control	low	110
network-control	high	111

Rewrite rule: ipprec-default, Code point type: inet-precedence, Index: 31

Forwarding class	Loss priority	Code point
best-effort	low	000
best-effort	high	000
expedited-forwarding	low	101
expedited-forwarding	high	101
assured-forwarding	low	001
assured-forwarding	high	001
network-control	low	110
network-control	high	111

Drop profile: <default-drop-profile>, Type: discrete, Index: 1

Fill level
100

Scheduler map: <default>, Index: 2

Scheduler: <default-be>, Forwarding class: best-effort, Index: 20
Transmit rate: 95 percent, Rate Limit: none, Buffer size: 95 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Scheduler: <default-nc>, Forwarding class: network-control, Index: 22

Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,
Priority: low

Drop profiles:

Loss priority	Protocol	Index	Name
High	non-TCP	1	<default-drop-profile>
High	TCP	1	<default-drop-profile>

Physical interface: ge-0/0/0, Index: 129

Queues supported: 8, Queues in use: 4

Scheduler map: <default>, Index: 2

Physical interface: ge-0/0/1, Index: 130

Queues supported: 8, Queues in use: 4

```

Scheduler map: <default>, Index: 2
...
Fabric priority: low
Scheduler: <default-fabric>, Index: 23
Drop profiles:
  Loss priority  Protocol  Index  Name
  High          non-TCP    1      <default-drop-profile>
  High          TCP        1      <default-drop-profile>

Fabric priority: high
Scheduler: <default-fabric>, Index: 23
Drop profiles:
  Loss priority  Protocol  Index  Name
  High          non-TCP    1      <default-drop-profile>
  High          TCP        1      <default-drop-profile>

```

show class-of-service rewrite-rule

```

user@switch> show class-of-service rewrite-rule
Rewrite rule: dscp-default, Code point type: dscp, Index: 31
  Forwarding class      Loss priority  Code point
  best-effort           low           000000
  best-effort           high          000000
  expedited-forwarding  low           101110
  expedited-forwarding  high          101110
  fw-class              low           001010
  fw-class              high          001100
  network-control       low           110000
  network-control       high          111000

Rewrite rule: exp-default, Code point type: exp, Index: 33
  Forwarding class      Loss priority  Code point
  best-effort           low           000
  best-effort           high          001
  expedited-forwarding  low           010
  expedited-forwarding  high          011
  fw-class              low           100
  fw-class              high          101
  network-control       low           110
  network-control       high          111

Rewrite rule: ieee8021p-default, Code point type: ieee-802.1, Index: 34
  Forwarding class      Loss priority  Code point
  best-effort           low           000
  best-effort           high          001
  expedited-forwarding  low           010
  expedited-forwarding  high          011
  fw-class              low           100
  fw-class              high          101
  network-control       low           110
  network-control       high          111

Rewrite rule: ipprec-default, Code point type: inet-precedence, Index: 35
  Forwarding class      Loss priority  Code point
  best-effort           low           000
  best-effort           high          000
  expedited-forwarding  low           101
  expedited-forwarding  high          101
  fw-class              low           001

```

fw-class	high	001
network-control	low	110
network-control	high	111

show class-of-service classifier

Syntax	<pre>show class-of-service classifier <name <i>name</i>> <type dscp type dscp-ipv6 type exp type ieee-802.1 type inet-precedence></pre>
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	For each class-of-service (CoS) classifier, display the mapping of code point value to forwarding class and loss priority.
Options	<p>none—Display all classifiers.</p> <p>name <i>name</i>—(Optional) Display named classifier.</p> <p>type dscp—(Optional) Display all classifiers of the Differentiated Services code point (DSCP) type.</p> <p>type dscp-ipv6—(Optional) Display all classifiers of the DSCP for IPv6 type.</p> <p>type exp—(Optional) Display all classifiers of the MPLS experimental (EXP) type.</p> <p>type ieee-802.1—(Optional) Display all classifiers of the ieee-802.1 type.</p> <p>type inet-precedence—(Optional) Display all classifiers of the inet-precedence type.</p>
Required Privilege Level	view
List of Sample Output	<p>show class-of-service classifier type ieee-802.1 on page 175</p> <p>show class-of-service classifier type ieee-802.1 (QFX Series) on page 175</p>
Output Fields	Table 33 on page 174 describes the output fields for the show class-of-service classifier command. Output fields are listed in the approximate order in which they appear.

Table 33: show class-of-service classifier Output Fields

Field Name	Field Description
Classifier	Name of the classifier.
Code point type	Type of the classifier: exp (not on EX Series switch), dscp , dscp-ipv6 (not on EX Series switch), ieee-802.1 , or inet-precedence .
Index	Internal index of the classifier.
Code point	Code point value used for classification

Table 33: show class-of-service classifier Output Fields (*continued*)

Field Name	Field Description
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.
Loss priority	Loss priority value used for classification. For most platforms, the value is high or low . For some platforms, the value is high , medium-high , medium-low , or low .

Sample Output

show class-of-service classifier type ieee-802.1

```

user@host> show class-of-service classifier type ieee-802.1
Classifier: ieee802.1-default, Code point type: ieee-802.1, Index: 3
Code Point      Forwarding Class      Loss priority
000             best-effort           low
001             best-effort           high
010             expedited-forwarding  low
011             expedited-forwarding  high
100             assured-forwarding    low
101             assured-forwarding    medium-high
110             network-control       low
111             network-control       high

Classifier: users-ieee802.1, Code point type: ieee-802.1
Code point      Forwarding class      Loss priority
100             expedited-forwarding  low

```

show class-of-service classifier type ieee-802.1 (QFX Series)

```

user@switch> show class-of-service classifier type ieee-802.1
Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11
Code point      Forwarding class      Loss priority
000             best-effort           low
001             best-effort           low
010             best-effort           low
011             fcoe                  low
100             no-loss               low
101             best-effort           low
110             network-control       low
111             network-control       low

Classifier: 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

Classifier: ieee-mcast, Code point type: ieee-802.1, Index: 46
Code point      Forwarding class      Loss priority

```

000	mcast	low
001	mcast	low
010	mcast	low
011	mcast	low
100	mcast	low
101	mcast	low
110	mcast	low
111	mcast	low

show class-of-service code-point-aliases

Syntax	<code>show class-of-service code-point-aliases</code> <code><dscp dscp-ipv6 exp ieee-802.1 inet-precedence></code>
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 9.0 for EX Series switches. Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display the mapping of class-of-service (CoS) code point aliases to corresponding bit patterns.
Options	<p>none—Display code point aliases of all code point types.</p> <p>dscp—(Optional) Display Differentiated Services code point (DSCP) aliases.</p> <p>dscp-ipv6—(Optional) Display IPv6 DSCP aliases.</p> <p>exp—(Optional) Display MPLS EXP code point aliases.</p> <p>ieee-802.1—(Optional) Display IEEE-802.1 code point aliases.</p> <p>inet-precedence—(Optional) Display IPv4 precedence code point aliases.</p>
Required Privilege Level	view
List of Sample Output	show class-of-service code-point-aliases exp on page 178
Output Fields	Table 34 on page 177 describes the output fields for the show class-of-service code-point-aliases command. Output fields are listed in the approximate order in which they appear.

Table 34: show class-of-service code-point-aliases Output Fields

Field Name	Field Description
Code point type	Type of the code points displayed: dscp , dscp-ipv6 (not on EX Series switch), exp (not on EX Series switch or the QFX Series), ieee-802.1 , or inet-precedence (not on the QFX Series).
Alias	Alias for a bit pattern.
Bit pattern	Bit pattern for which the alias is displayed.

Sample Output

show class-of-service code-point-aliases exp

```
user@host> show class-of-service code-point-aliases exp
Code point type: exp
Alias      Bit pattern
af11       100
af12       101
be         000
be1        001
cs6        110
cs7        111
ef         010
ef1        011
nc1        110
nc2        111
```

show class-of-service drop-profile

Syntax	<code>show class-of-service drop-profile</code> <code><profile-name profile-name></code>
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 9.0 for EX Series switches. Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display data points for each class-of-service (CoS) random early detection (RED) drop profile.
Options	none —Display all drop profiles. profile-name profile-name —(Optional) Display the specified profile only.
Required Privilege Level	view
List of Sample Output	show class-of-service drop-profile on page 180 show class-of-service drop-profile (EX4200 Switch) on page 180 show class-of-service drop-profile (EX8200 Switch) on page 180
Output Fields	Table 35 on page 179 describes the output fields for the show class-of-service drop-profile command. Output fields are listed in the approximate order in which they appear.

Table 35: show class-of-service drop-profile Output Fields

Field Name	Field Description
Drop profile	Name of a drop profile.
Type	Type of drop profile: <ul style="list-style-type: none"> discrete (default) interpolated (EX8200 switches, QFX Series switches, QFabric systems, EX4600 switches, OCX Series switches only)
Index	Internal index of this drop profile.
Fill Level	Percentage fullness of a queue.
Drop probability	Drop probability at this fill level.

Sample Output

show class-of-service drop-profile

```
user@host> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
    100         100
Drop profile: user-drop-profile, Type: interpolated, Index: 2989
  Fill level    Drop probability
     0           0
     1           1
     2           2
     4           4
     5           5
     6           6
     8           8
    10          10
    12          15
    14          20
    15          23
... 64 entries total
    90          96
    92          96
    94          97
    95          98
    96          98
    98          99
    99          99
   100         100
```

show class-of-service drop-profile (EX4200 Switch)

```
user@switch> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level
    100
Drop profile: dp1, Type: discrete, Index: 40496
  Fill level
    10
```

show class-of-service drop-profile (EX8200 Switch)

```
user@switch> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
    100         100
Drop profile: dp1, Type: interpolated, Index: 40496
  Fill level    Drop probability
     0           0
     1          80
     2          90
     4          90
     5          90
     6          90
     8          90
    10          90
    12          91
    14          91
```

15	91
16	91
18	91
20	91
22	92
24	92
25	92
26	92
28	92
30	92
32	93
34	93
35	93
36	93
38	93
40	93
42	94
44	94
45	94
46	94
48	94
49	94
51	95
52	95
54	95
55	95
56	95
58	95
60	95
62	96
64	96
65	96
66	96
68	96
70	96
72	97
74	97
75	97
76	97
78	97
80	97
82	98
84	98
85	98
86	98
88	98
90	98
92	99
94	99
95	99
96	99
98	99
99	99
100	100
Drop profile: dp2, Type: discrete, Index: 40499	
Fill level	Drop probability
10	5
50	50

show class-of-service forwarding-class

Syntax	show class-of-service forwarding-class
Release Information	<p>Command introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	Display information about forwarding classes, including the mapping of forwarding classes to queue numbers.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • Monitoring CoS Forwarding Classes on page 124 • <i>Monitoring CoS Forwarding Classes</i>
List of Sample Output	<p>show class-of-service forwarding-class on page 183</p> <p>show class-of-service forwarding-class (EX8200 Switch) on page 183</p> <p>show class-of-service forwarding-class (QFX Series) on page 183</p>
Output Fields	<p>Table 36 on page 182 describes the output fields for the show class-of-service forwarding-class command. Output fields are listed in the approximate order in which they appear.</p>

Table 36: show class-of-service forwarding-class Output Fields

Field Name	Field Description
Forwarding class	Name of the forwarding class.
ID	Forwarding class identifier.
Queue	CoS output queue mapped to the forwarding class.
Policing priority	Not supported on EX Series switches or the QFX Series and can be ignored.
Fabric priority	(EX8200 switches only) Fabric priority for the forwarding class, either high or low . Determines the priority of packets entering the switch fabric.
No-Loss	<p>(QFX Series only) Packet loss attribute to differentiate lossless forwarding classes from lossy forwarding classes:</p> <ul style="list-style-type: none"> • Disabled—Lossless transport is not configured on the forwarding class (packet drop attribute is drop). • Enabled—Lossless transport is configured on the forwarding class (packet drop attribute is no-loss).

Sample Output

show class-of-service forwarding-class

```
user@switch> show class-of-service forwarding-class
Forwarding class      ID      Queue Policing priority
best-effort           0        0      normal
expedited-forwarding  1        5      normal
assured-forwarding    2        1      normal
network-control       3        7      normal
```

Sample Output

show class-of-service forwarding-class (EX8200 Switch)

```
user@switch> show class-of-service forwarding-class
Forwarding class      ID      Queue Fabric priority
best-effort           0        0      low
expedited-forwarding  1        5      low
assured-forwarding    2        1      low
network-control       3        7      low
mcast-be              4        2      low
mcast-ef              5        4      low
mcast-af              6        6      low
```

Sample Output

show class-of-service forwarding-class (QFX Series)

```
user@switch> show class-of-service forwarding-class
Forwarding class      ID      Queue Policing priority No-Loss
best-effort           0        0      normal      Disabled
fcoe                  1        3      normal      Enabled
no-loss               2        4      normal      Enabled
network-control       3        7      normal      Disabled
mcast                 8        8      normal      Disabled
```

On switches that do not use different forwarding classes and output queues for unicast and multidestination (multicast, broadcast, destination lookup fail) traffic, there is no **mcast** forwarding class and there is no queue 8. (Switches that use different forwarding classes and output queues for unicast and multidestination traffic support 12 forwarding classes and output queues, of which four of each are dedicated to multidestination traffic. Switches that use the same forwarding classes and output queues for unicast and multidestination traffic support eight forwarding classes and eight output queues.)

show class-of-service forwarding-table

List of Syntax	Syntax on page 184 Syntax (TX Matrix and TX Matrix Plus Router) on page 184
Syntax	show class-of-service forwarding-table
Syntax (TX Matrix and TX Matrix Plus Router)	show class-of-service forwarding-table <lcc number> <sfc number>
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display the entire class-of-service (CoS) configuration as it exists in the forwarding table. Executing this command is equivalent to executing all show class-of-service forwarding-table commands in succession.
Options	<p>lcc number—(TX Matrix and TX Matrix Plus router only) (Optional) On a TX Matrix router, display the forwarding table configuration for a specific T640 router (or line-card chassis) configured in a routing matrix. On a TX Matrix Plus router, display the forwarding table configuration for a specific router (or line-card chassis) configured in the routing matrix.</p> <p>Replace <i>number</i> with the following values depending on the LCC configuration:</p> <ul style="list-style-type: none">• 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.• 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.• 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.• 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix. <p>sfc number—(TX Matrix Plus routers only) (Optional) Display the forwarding table configuration for the TX Matrix Plus router. Replace <i>number</i> with 0.</p>
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table on page 185 show class-of-service forwarding-table lcc (TX Matrix Plus Router) on page 186
Output Fields	See the output field descriptions for show class-of-service forwarding-table commands:

- `show class-of-service forwarding-table classifier`
- `show class-of-service forwarding-table classifier mapping`
- `show class-of-service forwarding-table drop-profile`
- `show class-of-service forwarding-table fabric scheduler-map`
- `show class-of-service forwarding-table rewrite-rule`
- `show class-of-service forwarding-table rewrite-rule mapping`
- `show class-of-service forwarding-table scheduler-map`

Sample Output

show class-of-service forwarding-table

```

user@host> show class-of-service forwarding-table
Classifier table index: 9, # entries: 8, Table type: EXP
Entry #   Code point   Forwarding-class #   PLP
  0         000         0                   0
  1         001         0                   1
  2         010         1                   0
  3         011         1                   1
  4         100         2                   0
  5         101         2                   1
  6         110         3                   0
  7         111         3                   1

Interface      Index      Table Index/
              Q num      Table type
sp-0/0/0.1001   66         11      IPv4 precedence
sp-0/0/0.2001   67         11      IPv4 precedence
sp-0/0/0.16383  68         11      IPv4 precedence
fe-0/0/0.0      69         11      IPv4 precedence

Interface: sp-0/0/0 (Index: 129, Map index: 2, Map type: FINAL,
Num of queues: 2):
  Entry 0 (Scheduler index: 16, Forwarding-class #: 0):
    Tx rate: 0 Kb (95%), Buffer size: 95 percent
  Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 18, Forwarding-class #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
  Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

Interface: fe-0/0/0 (Index: 137, Map index: 2, Map type: FINAL,
Num of queues: 2):
  Entry 0 (Scheduler index: 16, Forwarding-class #: 0):
    Tx rate: 0 Kb (95%), Buffer size: 95 percent
  Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 18, Forwarding-class #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
  Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

Interface: fe-0/0/1 (Index: 138, Map index: 2, Map type: FINAL,
Num of queues: 2):
  Entry 0 (Scheduler index: 16, Forwarding-class #: 0):

```

```

    Tx rate: 0 Kb (95%), Buffer size: 95 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
    Entry 1 (Scheduler index: 18, Forwarding-class #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

```

```
...
```

```
RED drop profile index: 1, # entries: 1
```

```

Drop
Entry      Fullness(%)  Drop
              Probability(%)
0              100          100

```

show class-of-service forwarding-table lcc (TX Matrix Plus Router)

```

user@host> show class-of-service forwarding-table lcc 0
lcc0-re0:

```

```
-----
Classifier table index: 9, # entries: 64, Table type: IPv6 DSCP
```

Entry #	Code point	Forwarding-class #	PLP
0	000000	0	0
1	000001	0	0
2	000010	0	0
3	000011	0	0
4	000100	0	0
5	000101	0	0
6	000110	0	0
7	000111	0	0
8	001000	0	0
9	001001	0	0
10	001010	0	0
11	001011	0	0
12	001100	0	0
13	001101	0	0
14	001110	0	0
15	001111	0	0
16	010000	0	0
17	010001	0	0
18	010010	0	0
19	010011	0	0
20	010100	0	0
21	010101	0	0
22	010110	0	0
23	010111	0	0
24	011000	0	0
25	011001	0	0
26	011010	0	0
27	011011	0	0
28	011100	0	0
29	011101	0	0
30	011110	0	0
31	011111	0	0
32	100000	0	0
33	100001	0	0
34	100010	0	0
35	100011	0	0
36	100100	0	0
37	100101	0	0

38	100110	0	0
39	100111	0	0
40	101000	0	0
41	101001	0	0
42	101010	0	0
43	101011	0	0
44	101100	0	0
45	101101	0	0
46	101110	0	0
...			

show class-of-service forwarding-table classifier

Syntax	show class-of-service forwarding-table classifier
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	Display the mapping of code point value to queue number and loss priority for each classifier as it exists in the forwarding table.
Options	This command has no options.
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table classifier on page 189
Output Fields	Table 37 on page 188 describes the output fields for the show class-of-service forwarding-table classifier command. Output fields are listed in the approximate order in which they appear.

Table 37: show class-of-service forwarding-table classifier Output Fields

Field Name	Field Description
Classifier table index	Index of the classifier table.
entries	Total number of entries.
Table type	Type of code points in the table: DSCP , EXP (not on the QFX Series), IEEE 802.1 , IPv4 precedence (not on the QFX Series), or IPv6 DSCP .
Entry #	Entry number.
Code point	Code point value used for classification.
Forwarding-class #	Forwarding class to which the code point is assigned.
PLP	Packet loss priority value set by classification. For most platforms, the value can be 0 or 1 . For some platforms, the value is 0 , 1 , 2 , or 3 . The value 0 represents low PLP. The value 1 represents high PLP. The value 2 represents medium-low PLP. The value 3 represents medium-high PLP.

Sample Output

show class-of-service forwarding-table classifier

```
user@host> show class-of-service forwarding-table classifier
Classifier table index: 62436, # entries: 64, Table type: DSCP
```

Entry #	Code point	Forwarding-class #	PLP
0	000000	0	0
1	000001	0	0
2	000010	0	0
3	000011	0	0
4	000100	0	0
5	000101	0	0
6	000110	0	0
7	000111	0	0
8	001000	0	0
9	001001	0	0
10	001010	1	1
11	001011	0	0
...			
60	111100	0	0
61	111101	0	0
62	111110	0	0
63	111111	0	0

show class-of-service forwarding-table classifier mapping

Syntax	show class-of-service forwarding-table classifier mapping
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	For each logical interface, display either the table index of the classifier for a given code point type or the queue number (if it is a fixed classification) in the forwarding table.
Options	This command has no options.
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table classifier mapping on page 190
Output Fields	<p>Table 38 on page 190 describes the output fields for the show class-of-service forwarding-table classifier mapping command. Output fields are listed in the approximate order in which they appear.</p>

Table 38: show class-of-service forwarding-table classifier mapping Output Fields

Field Name	Field Description
Table index/ Q num	If the table type is Fixed , the number of the queue to which the interface is mapped. For all other types, this value is the classifier index number.
Interface	Name of the logical interface. This field can also show the physical interface (QFX Series).
Index	Logical interface index.
Table type	Type of code points in the table: DSCP , EXP (not on the QFX Series), Fixed , IEEE 802.1 , IPv4 precedence (not on the QFX Series), or IPv6 DSCP . none if no-default option set.

Sample Output

show class-of-service forwarding-table classifier mapping

```

user@host> show class-of-service forwarding-table classifier mapping
Table index/
Interface      Index  Q num  Table type
so-5/0/0.0     10    62436  DSCP
so-0/1/0.0     11    62436  DSCP
so-0/2/0.0     12      1    Fixed

```

so-0/2/1.0	13	62436	DSCP
so-0/2/1.0	13	62437	IEEE 802.1
so-0/2/2.0	14	62436	DSCP
so-0/2/2.0	14	62438	IPv4 precedence

show class-of-service forwarding-table drop-profile

Syntax	show class-of-service forwarding-table drop-profile
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display the data points of all random early detection (RED) drop profiles as they exist in the forwarding table.
Options	This command has no options.
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table drop-profile on page 192
Output Fields	Table 39 on page 192 describes the output fields for the show class-of-service forwarding-table drop-profile command. Output fields are listed in the approximate order in which they appear.

Table 39: show class-of-service forwarding-table drop-profile Output Fields

Field Name	Field Description
RED drop profile index	Index of this drop profile.
# entries	Number of entries in a particular RED drop profile index.
Entry	Drop profile entry number.
Fullness(%)	Percentage fullness of a queue.
Drop probability(%)	Drop probability at this fill level.

Sample Output

show class-of-service forwarding-table drop-profile

```

user@host> show class-of-service forwarding-table drop-profile
RED drop profile index: 4, # entries: 1
      Drop
Entry    Fullness(%)  Probability(%)
  0         100           100

RED drop profile index: 8742, # entries: 3
      Drop

```


Entry	Fullness(%)	Probability(%)
0	10	10
1	20	20
2	30	30

RED drop profile index: 24627, # entries: 64

Entry	Fullness(%)	Drop Probability(%)
0	0	0
1	1	1
2	2	2
3	4	4
...		
61	98	99
62	99	99
63	100	100

RED drop profile index: 25393, # entries: 64

Entry	Fullness(%)	Drop Probability(%)
0	0	0
1	1	1
2	2	2
3	4	4
...		
61	98	98
62	99	99
63	100	100

show class-of-service forwarding-table rewrite-rule

Syntax	show class-of-service forwarding-table rewrite-rule
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display mapping of queue number and loss priority to code point value for each rewrite rule as it exists in the forwarding table.
Options	This command has no options.
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table rewrite-rule on page 194
Output Fields	Table 40 on page 194 describes the output fields for the show class-of-service forwarding-table rewrite-rule command. Output fields are listed in the approximate order in which they appear.

Table 40: show class-of-service forwarding-table rewrite-rule Output Fields

Field Name	Field Description
Rewrite table index	Index for this rewrite rule.
# entries	Number of entries in this rewrite rule.
Table type	Type of table: DSCP , EXP (not on the QFX Series), EXP-PUSH-3 (not on the QFX Series), IEEE 802.1,IPv4 precedence (not on the QFX Series), IPv6 DSCP , or Fixed .
Q#	Queue number to which this entry is assigned.
Low bits	Code point value for low-priority loss profile.
State	State of this code point: enabled , rewritten , or disabled .
High bits	Code point value for high-priority loss profile.

Sample Output

show class-of-service forwarding-table rewrite-rule

```
user@host> show class-of-service forwarding-table rewrite-rule
```

Rewrite table index: 3753, # entries: 4, Table type: DSCP

Q#	Low bits	State	High bits	State
0	000111	Enabled	001010	Enabled
2	000000	Disabled	001100	Enabled
1	101110	Enabled	110111	Enabled
3	110000	Enabled	111000	Enabled

show class-of-service forwarding-table rewrite-rule mapping

Syntax	show class-of-service forwarding-table rewrite-rule mapping
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	For each logical interface, display the table identifier of the rewrite rule map for each code point type.
Options	This command has no options.
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table rewrite-rule mapping on page 196
Output Fields	<p>Table 41 on page 196 describes the output fields for the show class-of-service forwarding-table rewrite-rule mapping command. Output fields are listed in the approximate order in which they appear.</p>

Table 41: show class-of-service forwarding-table rewrite-rule mapping Output Fields

Field Name	Field Description
Interface	Name of the logical interface. This field can also show the physical interface (QFX Series).
Index	Logical interface index.
Table index	Rewrite table index.
Type	Type of classifier: DSCP , EXP (not on the QFX Series), EXP-PUSH-3 (not on the QFX Series), EXP-SWAP-PUSH-2 (not on the QFX Series), IEEE 802.1 , IPv4 precedence (not on the QFX Series), IPv6 DSCP , or Fixed .

Sample Output

show class-of-service forwarding-table rewrite-rule mapping

```

user@host> show class-of-service forwarding-table rewrite-rule mapping
Interface      Index  Table index  Type
so-5/0/0.0     10     3753        DSCP
so-0/1/0.0     11     3753        DSCP
so-0/2/0.0     12     3753        DSCP
so-0/2/1.0     13     3753        DSCP

```

so-0/2/2.0	14	3753	DSCP
so-0/2/3.0	15	3753	DSCP

show class-of-service forwarding-table scheduler-map

Syntax	show class-of-service forwarding-table scheduler-map
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	For each physical interface, display the scheduler map information as it exists in the forwarding table.
Options	This command has no options.
Required Privilege Level	view
List of Sample Output	show class-of-service forwarding-table scheduler-map on page 199
Output Fields	Table 42 on page 198 describes the output fields for the show class-of-service forwarding-table scheduler-map command. Output fields are listed in the approximate order in which they appear.

Table 42: show class-of-service forwarding-table scheduler-map Output Fields

Field Name	Field Description
Interface	Name of the physical interface.
Index	Physical interface index.
Map index	Scheduler map index.
Num of queues	Number of queues defined in this scheduler map.
Entry	Number of this entry in the scheduler map.
Scheduler index	Scheduler policy index.
Forwarding-class #	Forwarding class number to which this entry is applied.
Tx rate	Configured transmit rate of the scheduler (in bps). The rate is a percentage of the total interface bandwidth, or the keyword remainder , which indicates that the scheduler receives the remaining bandwidth of the interface.
Max buffer delay	Amount of transmit delay (in milliseconds) or buffer size of the queue. This amount is a percentage of the total interface buffer allocation or the keyword remainder , which indicates that the buffer is sized according to what remains after other scheduler buffer allocations.

Table 42: show class-of-service forwarding-table scheduler-map Output Fields (*continued*)

Field Name	Field Description
Priority	<ul style="list-style-type: none"> high—Queue priority is high. low—Queue priority is low.
PLP high	Drop profile index for a high packet loss priority profile.
PLP low	Drop profile index for a low packet loss priority profile.
PLP medium-high	Drop profile index for a medium-high packet loss priority profile.
PLP medium-low	Drop profile index for a medium-low packet loss priority profile.
TCP PLP high	Drop profile index for a high TCP packet loss priority profile.
TCP PLP low	Drop profile index for a low TCP packet loss priority profile.
Policy is exact	If this line appears in the output, exact rate limiting is enabled. Otherwise, no rate limiting is enabled.

Sample Output

show class-of-service forwarding-table scheduler-map

```

user@host> show class-of-service forwarding-table scheduler-map
Interface: so-5/0/0 (Index: 9, Map index: 17638, Num of queues: 2):
  Entry 0 (Scheduler index: 6090, Forwarding-class #: 0):
    Tx rate: 0 Kb (30%), Max buffer delay: 39 bytes (0%)
    Priority low
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742
    Policy is exact
  Entry 1 (Scheduler index: 38372, Forwarding-class #: 1):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (40%), Max buffer delay: 68 bytes (0%)
    Priority high
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742

Interface: at-6/1/0 (Index: 10, Map index: 17638, Num of queues: 2):
  Entry 0 (Scheduler index: 6090, Forwarding-class #: 0):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (30%), Max buffer delay: 39 bytes (0%)
    Priority high
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742
  Entry 1 (Scheduler index: 38372, Forwarding-class #: 1):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (40%), Max buffer delay: 68 bytes (0%)
    Priority low
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742

```

show class-of-service interface

Syntax `show class-of-service interface`
 `<comprehensive | detail> <interface-name>`

Release Information Command introduced before Junos OS Release 7.4.
 Command introduced in Junos OS Release 9.0 for EX Series switches.
 Forwarding class map information added in Junos OS Release 9.4.
 Command introduced in Junos OS Release 11.1 for the QFX Series.
 Command introduced in Junos OS Release 12.1 for the PTX Series Packet Transport Routers.
 Command introduced in Junos OS Release 12.2 for the ACX Series Universal Access routers.
 Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
 Options **detail** and **comprehensive** introduced in Junos OS Release 11.4.
 Command introduced in Junos OS Release 15.1R3 on MX Series routers for enhanced subscriber management.

Description Display the logical and physical interface associations for the classifier, rewrite rules, and scheduler map objects.



NOTE: On routing platforms with dual Routing Engines, running this command on the backup Routing Engine, with or without any of the available options, is not supported and produces the following error message:

error: the class-of-service subsystem is not running

Options **none**—Display CoS associations for all physical and logical interfaces.

comprehensive—(M Series, MX Series, and T Series routers) (Optional) Display comprehensive quality-of-service (QoS) information about all physical and logical interfaces.

detail—(M Series, MX Series, and T Series routers) (Optional) Display QoS and CoS information based on the interface.

If the **interface** *interface-name* is a physical interface, the output includes:

- Brief QoS information about the physical interface
- Brief QoS information about the logical interface
- CoS information about the physical interface
- Brief information about filters or policers of the logical interface
- Brief CoS information about the logical interface

If the **interface** *interface-name* is a logical interface, the output includes:

- Brief QoS information about the logical interface
- Information about filters or policers for the logical interface
- CoS information about the logical interface

interface-name—(Optional) Display class-of-service (CoS) associations for the specified interface.

none—Display CoS associations for all physical and logical interfaces.

Required Privilege Level

view

Related Documentation

- *Verifying and Managing Junos OS Enhanced Subscriber Management*

List of Sample Output

[show class-of-service interface \(Physical\) on page 212](#)
[show class-of-service interface \(Logical\) on page 213](#)
[show class-of-service interface \(Gigabit Ethernet\) on page 213](#)
[show class-of-service interface \(ANCP\) on page 213](#)
[show class-of-service interface \(PPPoE Interface\) on page 213](#)
[show class-of-service interface \(DHCP Interface\) on page 214](#)
[show class-of-service interface \(T4000 Routers with Type 5 FPCs\) on page 214](#)
[show class-of-service interface detail on page 214](#)
[show class-of-service interface comprehensive on page 215](#)
[show class-of-service interface \(ACX Series Routers\) on page 226](#)
[show class-of-service interface \(PPPoE Subscriber Interface for Enhanced Subscriber Management\) on page 228](#)

Output Fields

[Table 43 on page 201](#) describes the output fields for the **show class-of-service interface** command. Output fields are listed in the approximate order in which they appear.

Table 43: show class-of-service interface Output Fields

Field Name	Field Description
Physical interface	Name of a physical interface.
Index	Index of this interface or the internal index of this object. (Enhanced subscriber management for MX Series routers) Index values for dynamic CoS traffic control profiles and dynamic scheduler maps are larger for enhanced subscriber management than they are for legacy subscriber management.
Dedicated Queues	Status of dedicated queues configured on an interface. Supported only on Trio MPC/MIC interfaces on MX Series routers. (Enhanced subscriber management for MX-Series routers) This field is not displayed for enhanced subscriber management.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Maximum usable queues	Number of queues you can configure on the interface.
Maximum usable queues	Maximum number of queues you can use.
Total non-default queues created	Number of queues created in addition to the default queues. Supported only on Trio MPC/MIC interfaces on MX Series routers. (Enhanced subscriber management for MX Series routers) This field is not displayed for enhanced subscriber management.
Rewrite Input IEEE Code-point	(QFX3500 switches only) IEEE 802.1p code point (priority) rewrite value. Incoming traffic from the Fibre Channel (FC) SAN is classified into the forwarding class specified in the native FC interface (NP_Port) fixed classifier and uses the priority specified as the IEEE 802.1p rewrite value.
Shaping rate	Maximum transmission rate on the physical interface. You can configure the shaping rate on the physical interface, or on the logical interface, but not on both. Therefore, the Shaping rate field is displayed for either the physical interface or the logical interface.
Scheduler map	Name of the output scheduler map associated with this interface. (Enhanced subscriber management for MX Series routers) The name of the dynamic scheduler map object is associated with a generated UID (for example, SMAP-1_UID1002) instead of with a subscriber interface.
Scheduler map forwarding class sets	(QFX Series only) Name of the output fabric scheduler map associated with a QFabric system Interconnect device interface.
Input shaping rate	For Gigabit Ethernet IQ2 PICs, maximum transmission rate on the input interface.
Input scheduler map	For Gigabit Ethernet IQ2 PICs, name of the input scheduler map associated with this interface.
Chassis scheduler map	Name of the scheduler map associated with the packet forwarding component queues.
Rewrite	Name and type of the rewrite rules associated with this interface.
Traffic-control-profile	Name of the associated traffic control profile. (Enhanced subscriber management for MX Series routers) The name of the dynamic traffic control profile object is associated with a generated UID (for example, TC_PROF_100_199_SERIES_UID1006) instead of with a subscriber interface.
Classifier	Name and type of classifiers associated with this interface.
Forwarding-class-map	Name of the forwarding map associated with this interface.
Congestion-notification	(QFX Series and EX4600 switches only) Congestion notification state, enabled or disabled .
Logical interface	Name of a logical interface.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Object	Category of an object: Classifier , Fragmentation-map (for LSQ interfaces only), Scheduler-map , Rewrite , Translation Table (for IQE PICs only), or traffic-class-map (for T4000 routers with Type 5 FPCs).
Name	Name of an object.
Type	Type of an object: dscp , dscp-ipv6 , exp , ieee-802.1 , ip , inet-precedence , or ieee-802.1ad (for traffic class map on T4000 routers with Type 5 FPCs)..
Link-level type	Encapsulation on the physical interface.
MTU	MTU size on the physical interface.
Speed	Speed at which the interface is running.
Loopback	Whether loopback is enabled and the type of loopback.
Source filtering	Whether source filtering is enabled or disabled.
Flow control	Whether flow control is enabled or disabled.
Auto-negotiation	(Gigabit Ethernet interfaces) Whether autonegotiation is enabled or disabled.
Remote-fault	(Gigabit Ethernet interfaces) Remote fault status. <ul style="list-style-type: none"> • Online—Autonegotiation is manually configured as online. • Offline—Autonegotiation is manually configured as offline.
Device flags	The Device flags field provides information about the physical device and displays one or more of the following values: <ul style="list-style-type: none"> • Down—Device has been administratively disabled. • Hear-Own-Xmit—Device receives its own transmissions. • Link-Layer-Down—The link-layer protocol has failed to connect with the remote endpoint. • Loopback—Device is in physical loopback. • Loop-Detected—The link layer has received frames that it sent, thereby detecting a physical loopback. • No-Carrier—On media that support carrier recognition, no carrier is currently detected. • No-Multicast—Device does not support multicast traffic. • Present—Device is physically present and recognized. • Promiscuous—Device is in promiscuous mode and recognizes frames addressed to all physical addresses on the media. • Quench—Transmission on the device is quenched because the output buffer is overflowing. • Recv-All-Multicasts—Device is in multicast promiscuous mode and therefore provides no multicast filtering. • Running—Device is active and enabled.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Interface flags	<p>The Interface flags field provides information about the physical interface and displays one or more of the following values:</p> <ul style="list-style-type: none"> • Admin-Test—Interface is in test mode and some sanity checking, such as loop detection, is disabled. • Disabled—Interface is administratively disabled. • Down—A hardware failure has occurred. • Hardware-Down—Interface is nonfunctional or incorrectly connected. • Link-Layer-Down—Interface keepalives have indicated that the link is incomplete. • No-Multicast—Interface does not support multicast traffic. • No-receive No-transmit—Passive monitor mode is configured on the interface. • Point-To-Point—Interface is point-to-point. • Pop all MPLS labels from packets of depth—MPLS labels are removed as packets arrive on an interface that has the pop-all-labels statement configured. The depth value can be one of the following: <ul style="list-style-type: none"> • 1—Takes effect for incoming packets with one label only. • 2—Takes effect for incoming packets with two labels only. • [1 2]—Takes effect for incoming packets with either one or two labels. • Promiscuous—Interface is in promiscuous mode and recognizes frames addressed to all physical addresses. • Recv-All-Multicasts—Interface is in multicast promiscuous mode and provides no multicast filtering. • SNMP-Traps—SNMP trap notifications are enabled. • Up—Interface is enabled and operational.
Flags	<p>The Logical interface flags field provides information about the logical interface and displays one or more of the following values:</p> <ul style="list-style-type: none"> • ACFC Encapsulation—Address control field Compression (ACFC) encapsulation is enabled (negotiated successfully with a peer). • Device-down—Device has been administratively disabled. • Disabled—Interface is administratively disabled. • Down—A hardware failure has occurred. • Clear-DF-Bit—GRE tunnel or IPsec tunnel is configured to clear the Don't Fragment (DF) bit. • Hardware-Down—Interface protocol initialization failed to complete successfully. • PFC—Protocol field compression is enabled for the PPP session. • Point-To-Point—Interface is point-to-point. • SNMP-Traps—SNMP trap notifications are enabled. • Up—Interface is enabled and operational.
Encapsulation	Encapsulation on the logical interface.
Admin	Administrative state of the interface (Up or Down).
Link	Status of physical link (Up or Down).
Proto	Protocol configured on the interface.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Input Filter	Names of any firewall filters to be evaluated when packets are received on the interface, including any filters attached through activation of dynamic service.
Output Filter	Names of any firewall filters to be evaluated when packets are transmitted on the interface, including any filters attached through activation of dynamic service.
Link flags	Provides information about the physical link and displays one or more of the following values: <ul style="list-style-type: none"> • ACFC—Address control field compression is configured. The Point-to-Point Protocol (PPP) session negotiates the ACFC option. • Give-Up—Link protocol does not continue connection attempts after repeated failures. • Loose-LCP—PPP does not use the Link Control Protocol (LCP) to indicate whether the link protocol is operational. • Loose-LMI—Frame Relay does not use the Local Management Interface (LMI) to indicate whether the link protocol is operational. • Loose-NCP—PPP does not use the Network Control Protocol (NCP) to indicate whether the device is operational. • Keepalives—Link protocol keepalives are enabled. • No-Keepalives—Link protocol keepalives are disabled. • PFC—Protocol field compression is configured. The PPP session negotiates the PFC option.
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.
CoS queues	Number of CoS queues configured.
Last flapped	Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago) . For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago) .
Statistics last cleared	Number and rate of bytes and packets received and transmitted on the physical interface. <ul style="list-style-type: none"> • Input bytes—Number of bytes received on the interface. • Output bytes—Number of bytes transmitted on the interface. • Input packets—Number of packets received on the interface. • Output packets—Number of packets transmitted on the interface.
IPv6 transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Input errors	<p>Input errors on the interface. The labels are explained in the following list:</p> <ul style="list-style-type: none"> • Errors—Sum of the incoming frame aborts and FCS errors. • Drops—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • Framing errors—Number of packets received with an invalid frame checksum (FCS). • Runts—Number of frames received that are smaller than the runt threshold. • Giants—Number of frames received that are larger than the giant threshold. • Bucket Drops—Drops resulting from the traffic load exceeding the interface transmit or receive leaky bucket configuration. • Policed discards—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • L3 incompletes—Number of incoming packets discarded because they failed Layer 3 (usually IPv4) sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. Layer 3 incomplete errors can be ignored by configuring the ignore-l3-incompletes statement. • L2 channel errors—Number of times the software did not find a valid logical interface for an incoming frame. • L2 mismatch timeouts—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable. • HS link CRC errors—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces. • HS link FIFO overflows—Number of FIFO overflows on the high-speed links between the ASICs responsible for handling the router interfaces.
Output errors	<p>Output errors on the interface. The labels are explained in the following list:</p> <ul style="list-style-type: none"> • Carrier transitions—Number of times the interface has gone from down to up. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC is malfunctioning. • Errors—Sum of the outgoing frame aborts and FCS errors. • Drops—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. <p>NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the Drops field does not always use the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</p> <ul style="list-style-type: none"> • Aged packets—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware. • HS link FIFO underflows—Number of FIFO underflows on the high-speed links between the ASICs responsible for handling the router interfaces. • MTU errors—Number of packets whose size exceeds the MTU of the interface.
Egress queues	Total number of egress Maximum usable queues on the specified interface.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Queue counters	<p>CoS queue number and its associated user-configured forwarding class name.</p> <ul style="list-style-type: none"> • Queued packets—Number of queued packets. • Transmitted packets—Number of transmitted packets. • Dropped packets—Number of packets dropped by the ASIC's RED mechanism. <p>NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the Dropped packets field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</p>
SONET alarms SONET defects	<p>(SONET) SONET media-specific alarms and defects that prevent the interface from passing packets. When a defect persists for a certain period, it is promoted to an alarm. Based on the router configuration, an alarm can ring the red or yellow alarm bell on the router or light the red or yellow alarm LED on the craft interface. See these fields for possible alarms and defects: SONET PHY, SONET section, SONET line, and SONET path.</p>
SONET PHY	<p>Counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> • Seconds—Number of seconds the defect has been active. • Count—Number of times that the defect has gone from inactive to active. • State—State of the error. A state other than OK indicates a problem. <p>The SONET PHY field has the following subfields:</p> <ul style="list-style-type: none"> • PLL Lock—Phase-locked loop • PHY Light—Loss of optical signal
SONET section	<p>Counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> • Seconds—Number of seconds the defect has been active. • Count—Number of times that the defect has gone from inactive to active. • State—State of the error. A state other than OK indicates a problem. <p>The SONET section field has the following subfields:</p> <ul style="list-style-type: none"> • BIP-BI—Bit interleaved parity for SONET section overhead • SEF—Severely errored framing • LOS—Loss of signal • LOF—Loss of frame • ES-S—Errored seconds (section) • SES-S—Severely errored seconds (section) • SEFS-S—Severely errored framing seconds (section)

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
SONET line	<p>Active alarms and defects, plus counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> • Seconds—Number of seconds the defect has been active. • Count—Number of times that the defect has gone from inactive to active. • State—State of the error. A state other than OK indicates a problem. <p>The SONET line field has the following subfields:</p> <ul style="list-style-type: none"> • BIP-B2—Bit interleaved parity for SONET line overhead • REI-L—Remote error indication (near-end line) • RDI-L—Remote defect indication (near-end line) • AIS-L—Alarm indication signal (near-end line) • BERR-SF—Bit error rate fault (signal failure) • BERR-SD—Bit error rate defect (signal degradation) • ES-L—Errored seconds (near-end line) • SES-L—Severely errored seconds (near-end line) • UAS-L—Unavailable seconds (near-end line) • ES-LFE—Errored seconds (far-end line) • SES-LFE—Severely errored seconds (far-end line) • UAS-LFE—Unavailable seconds (far-end line)
SONET path	<p>Active alarms and defects, plus counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> • Seconds—Number of seconds the defect has been active. • Count—Number of times that the defect has gone from inactive to active. • State—State of the error. A state other than OK indicates a problem. <p>The SONET path field has the following subfields:</p> <ul style="list-style-type: none"> • BIP-B3—Bit interleaved parity for SONET section overhead • REI-P—Remote error indication • LOP-P—Loss of pointer (path) • AIS-P—Path alarm indication signal • RDI-P—Path remote defect indication • UNEQ-P—Path unequipped • PLM-P—Path payload (signal) label mismatch • ES-P—Errored seconds (near-end STS path) • SES-P—Severely errored seconds (near-end STS path) • UAS-P—Unavailable seconds (near-end STS path) • ES-PFE—Errored seconds (far-end STS path) • SES-PFE—Severely errored seconds (far-end STS path) • UAS-PFE—Unavailable seconds (far-end STS path)

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Received SONET overhead	Values of the received and transmitted SONET overhead: <ul style="list-style-type: none"> • C2—Signal label. Allocated to identify the construction and content of the STS-level SPE and for PDI-P. • F1—Section user channel byte. This byte is set aside for the purposes of users. • K1 and K2—These bytes are allocated for APS signaling for the protection of the multiplex section. • J0—Section trace. This byte is defined for STS-1 number 1 of an STS-<i>N</i> signal. Used to transmit a 1-byte fixed-length string or a 16-byte message so that a receiving terminal in a section can verify its continued connection to the intended transmitter. • S1—Synchronization status. The S1 byte is located in the first STS-1 number of an STS-<i>N</i> signal. • Z3 and Z4—Allocated for future use.
Transmitted SONET overhead	
Received path trace	SONET/SDH interfaces allow path trace bytes to be sent inband across the SONET/SDH link. Juniper Networks and other router manufacturers use these bytes to help diagnose misconfigurations and network errors by setting the transmitted path trace message so that it contains the system hostname and name of the physical interface. The received path trace value is the message received from the router at the other end of the fiber. The transmitted path trace value is the message that this router transmits.
Transmitted path trace	
HDLC configuration	Information about the HDLC configuration. <ul style="list-style-type: none"> • Policing bucket—Configured state of the receiving policer. • Shaping bucket—Configured state of the transmitting shaper. • Giant threshold—Giant threshold programmed into the hardware. • Runt threshold—Runt threshold programmed into the hardware.
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: <ul style="list-style-type: none"> • Destination slot—FPC slot number. • PLP byte—Packet Level Protocol byte.
CoS information	Information about the CoS queue for the physical interface. <ul style="list-style-type: none"> • CoS transmit queue—Queue number and its associated user-configured forwarding class name. • Bandwidth %—Percentage of bandwidth allocated to the queue. • Bandwidth bps—Bandwidth allocated to the queue (in bps). • Buffer %—Percentage of buffer space allocated to the queue. • Buffer usec—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time. • Priority—Queue priority: low or high. • Limit—Displayed if rate limiting is configured for the queue. Possible values are none and exact. If exact is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If none is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.
Forwarding classes	Total number of forwarding classes supported on the specified interface.
Egress queues	Total number of egress Maximum usable queues on the specified interface.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Queue	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. The byte counts vary by PIC type.
Transmitted Packets	Number of packets transmitted by this queue. When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (displayed under the Packet Forwarding Engine Chassis Queues field) shows the prefragmentation values.
Transmitted Bytes	Number of bytes transmitted by this queue. The byte counts vary by PIC type.
Tail-dropped packets	Number of packets dropped because of tail drop.
RED-dropped packets	<p>Number of packets dropped because of random early detection (RED).</p> <ul style="list-style-type: none"> • (M Series and T Series routers only) On M320 and M120 routers and the T Series routers, the total number of dropped packets is displayed. On all other M Series routers, the output classifies dropped packets into the following categories: <ul style="list-style-type: none"> • Low, non-TCP—Number of low-loss priority non-TCP packets dropped because of RED. • Low, TCP—Number of low-loss priority TCP packets dropped because of RED. • High, non-TCP—Number of high-loss priority non-TCP packets dropped because of RED. • High, TCP—Number of high-loss priority TCP packets dropped because of RED. • (MX Series routers with enhanced DPCs, and T Series routers with enhanced FPCs only) The output classifies dropped packets into the following categories: <ul style="list-style-type: none"> • Low—Number of low-loss priority packets dropped because of RED. • Medium-low—Number of medium-low loss priority packets dropped because of RED. • Medium-high—Number of medium-high loss priority packets dropped because of RED. • High—Number of high-loss priority packets dropped because of RED. <p>NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</p>

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
RED-dropped bytes	<p>Number of bytes dropped because of RED. The byte counts vary by PIC type.</p> <ul style="list-style-type: none"> (M Series and T Series routers only) On M320 and M120 routers and the T Series routers, only the total number of dropped bytes is displayed. On all other M Series routers, the output classifies dropped bytes into the following categories: <ul style="list-style-type: none"> Low, non-TCP—Number of low-loss priority non-TCP bytes dropped because of RED. Low, TCP—Number of low-loss priority TCP bytes dropped because of RED. High, non-TCP—Number of high-loss priority non-TCP bytes dropped because of RED. High, TCP—Number of high-loss priority TCP bytes dropped because of RED. <p>NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</p>
Transmit rate	Configured transmit rate of the scheduler. The rate is a percentage of the total interface bandwidth.
Rate Limit	<p>Rate limiting configuration of the queue. Possible values are :</p> <ul style="list-style-type: none"> None—No rate limit. exact—Queue transmits at the configured rate.
Buffer size	Delay buffer size in the queue.
Priority	Scheduling priority configured as low or high .
Excess Priority	Priority of the excess bandwidth traffic on a scheduler: low , medium-low , medium-high , high , or none .
Drop profiles	<p>Display the assignment of drop profiles.</p> <ul style="list-style-type: none"> Loss priority—Packet loss priority for drop profile assignment. Protocol—Transport protocol for drop profile assignment. Index—Index of the indicated object. Objects that have indexes in this output include schedulers and drop profiles. Name—Name of the drop profile. Type—Type of the drop profile: discrete or interpolated. Fill Level—Percentage fullness of a queue. Drop probability—Drop probability at this fill level.
Excess Priority	Priority of the excess bandwidth traffic on a scheduler.

Table 43: show class-of-service interface Output Fields (*continued*)

Field Name	Field Description
Drop profiles	<p>Display the assignment of drop profiles.</p> <ul style="list-style-type: none"> • Loss priority—Packet loss priority for drop profile assignment. • Protocol—Transport protocol for drop profile assignment. • Index—Index of the indicated object. Objects that have indexes in this output include schedulers and drop profiles. • Name—Name of the drop profile. • Type—Type of the drop profile: discrete or interpolated. • Fill Level—Percentage fullness of a queue. • Drop probability—Drop probability at this fill level.
Adjustment information	<p>Display the assignment of shaping-rate adjustments on a scheduler node or queue.</p> <ul style="list-style-type: none"> • Adjusting application—Application that is performing the shaping-rate adjustment. <ul style="list-style-type: none"> • The adjusting application can appear as ancp LS-0, which is the Junos OS Access Node Control Profile process (ancpd) that performs shaping-rate adjustments on schedule nodes. • The adjusting application can appear as DHCP, which adjusts the shaping-rate and overhead-accounting class-of-service attributes based on DHCP option 82, suboption 9 (Vendor Specific Information). The shaping rate is based on the actual-data-rate-downstream attribute. The overhead accounting value is based on the access-loop-encapsulation attribute and specifies whether the access loop uses Ethernet (frame mode) or ATM (cell mode). • The adjusting application can also appear as pppoe, which adjusts the shaping-rate and overhead-accounting class-of-service attributes on dynamic subscriber interfaces in a broadband access network based on access line parameters in Point-to-Point Protocol over Ethernet (PPPoE) Tags [TR-101]. This feature is supported on MPC/MIC interfaces on MX Series routers. The shaping rate is based on the actual-data-rate-downstream attribute. The overhead accounting value is based on the access-loop-encapsulation attribute and specifies whether the access loop uses Ethernet (frame mode) or ATM (cell mode). • Adjustment type—Type of adjustment: absolute or delta. • Configured shaping rate—Shaping rate configured for the scheduler node or queue. • Adjustment value—Value of adjusted shaping rate. • Adjustment target—Level of shaping-rate adjustment performed: node or queue. • Adjustment overhead-accounting mode—Configured shaping mode: frame or cell. • Adjustment overhead bytes—Number of bytes that the ANCP agent adds to or subtracts from the actual downstream frame overhead before reporting the adjusted values to CoS. • Adjustment target—Level of shaping-rate adjustment performed: node or queue. • Adjustment multicast index—

Sample Output

show class-of-service interface (Physical)

```

user@host> show class-of-service interface so-0/2/3
Physical interface: so-0/2/3, Index: 135
Maximum usable queues: 8, Queues in use: 4
Total non-default queues created: 4
  Scheduler map: <default>, Index: 2032638653

Logical interface: fe-0/0/1.0, Index: 68, Dedicated Queues: no

```

```

Shaping rate: 32000
Object      Name      Type      Index
Scheduler-map <default>
Rewrite     exp-default exp        21
Classifier   exp-default exp         5
Classifier   ipprec-compatibility ip         8
Forwarding-class-map exp-default exp         5

```

show class-of-service interface (Logical)

```

user@host> show class-of-service interface so-0/2/3.0
Logical interface: so-0/2/3.0, Index: 68, Dedicated Queues: no
Shaping rate: 32000
Object      Name      Type      Index
Scheduler-map <default>
Rewrite     exp-default exp        21
Classifier   exp-default exp         5
Classifier   ipprec-compatibility ip         8
Forwarding-class-map exp-default exp         5

```

show class-of-service interface (Gigabit Ethernet)

```

user@host> show class-of-service interface ge-6/2/0
Physical interface: ge-6/2/0, Index: 175
Maximum usable queues: 4, Queues in use: 4
Scheduler map: <default>, Index: 2
Input scheduler map: <default>, Index: 3
Chassis scheduler map: <default-chassis>, Index: 4

```

show class-of-service interface (ANCP)

```

user@host> show class-of-service interface pp0.1073741842
Logical interface: pp0.1073741842, Index: 341
Object      Name      Type      Index
Traffic-control-profile TCP-CVLAN Output    12408
Classifier   dscp-ipv6-compatibility dscp-ipv6 9
Classifier   ipprec-compatibility ip        13

Adjusting application: ancp LS-0
Adjustment type: absolute
Configured shaping rate: 4000000
Adjustment value: 11228000
Adjustment overhead-accounting mode: Frame Mode
Adjustment overhead bytes: 50
Adjustment target: node

```

show class-of-service interface (PPPoE Interface)

```

user@host> show class-of-service interface pp0.1
Logical interface: pp0.1, Index: 85
Object      Name      Type      Index
Traffic-control-profile tcp-pppoe.o.pp0.1 Output    2726446535
Classifier   ipprec-compatibility ip        13

Adjusting application: PPPoE
Adjustment type: absolute
Adjustment value: 5000000
Adjustment overhead-accounting mode: cell
Adjustment target: node

```

show class-of-service interface (DHCP Interface)

```

user@host> show class-of-service interface demux0.1
Logical interface: pp0.1, Index: 85
  Object      Name                                     Type      Index
  Traffic-control-profile tcp-dhcp.o.demux0.1      Output    2726446535
  Classifier    ipprec-compatibility ip         13

Adjusting application: DHCP
Adjustment type: absolute
Adjustment value: 5000000
Adjustment overhead-accounting mode: cell
Adjustment target: node

```

show class-of-service interface (T4000 Routers with Type 5 FPCs)

```

user@host> show class-of-service interface xe-4/0/0
Physical interface: xe-4/0/0, Index: 153
  Maximum usable queues: 8, Queues in use: 4
  Shaping rate: 5000000000 bps
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

Logical interface: xe-4/0/0.0, Index: 77
  Object      Name                                     Type
Index
  Classifier    ipprec-compatibility ip
13

```

show class-of-service interface detail

```

user@host> show class-of-service interface ge-0/3/0 detail

Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
  Remote fault: Online
  Device flags : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000

Physical interface: ge-0/3/0, Index: 138
  Maximum usable queues: 4, Queues in use: 5
  Shaping rate: 50000 bps
  Scheduler map: interface-scheduler-map, Index: 58414
  Input shaping rate: 10000 bps
  Input scheduler map: scheduler-map, Index: 15103
  Chassis scheduler map: <default-chassis>, Index: 4
  Congestion-notification: Disabled

Logical interface ge-0/3/0.0
  Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ] Encapsulation: ENET2
  inet
  mpls
Interface      Admin Link Proto Input Filter      Output Filter
ge-0/3/0.0     up    up    inet
               up    up    mpls
Interface      Admin Link Proto Input Policer      Output Policer
ge-0/3/0.0     up    up    inet
               up    up    mpls

```

```

Logical interface: ge-0/3/0.0, Index: 68
Object      Name      Type      Index
Rewrite     exp-default  exp (mpls-any)  33
Classifier   exp-default  exp           10
Classifier   ipprec-compatibility  ip           13

```

```

Logical interface ge-0/3/0.1
Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ] Encapsulation: ENET2
inet
Interface    Admin Link Proto Input Filter      Output Filter
ge-0/3/0.1   up    up    inet
Interface    Admin Link Proto Input Policer      Output Policer
ge-0/3/0.1   up    up    inet

```

```

Logical interface: ge-0/3/0.1, Index: 69
Object      Name      Type      Index
Classifier   ipprec-compatibility  ip           13

```

show class-of-service interface comprehensive

```

user@host> show class-of-service interface ge-0/3/0 comprehensive
Physical interface: ge-0/3/0, Enabled, Physical link is Up
Interface index: 138, SNMP ifIndex: 601, Generation: 141
Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled, Flow
control: Enabled,
Auto-negotiation: Enabled, Remote fault: Online
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
CoS queues : 4 supported, 4 maximum usable queues
Schedulers : 256
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:14:f6:f4:b4:5d, Hardware address: 00:14:f6:f4:b4:5d
Last flapped : 2010-09-07 06:35:22 PDT (15:14:42 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes : 0 0 bps
Output bytes : 0 0 bps
Input packets: 0 0 pps
Output packets: 0 0 pps
IPv6 total statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Ingress traffic statistics at Packet Forwarding Engine:
Input bytes : 0 0 bps
Input packets: 0 0 pps
Drop bytes : 0 0 bps
Drop packets: 0 0 pps
Label-switched interface (LSI) traffic statistics:
Input bytes : 0 0 bps
Input packets: 0 0 pps
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
Output errors:
Carrier transitions: 5, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0

```

```

Ingress queues: 4 supported, 5 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 af3                0                0                0
  1 af2                0                0                0
  2 ef2                0                0                0
  3 ef1                0                0                0

Egress queues: 4 supported, 5 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 af3                0                0                0
  1 af2                0                0                0
  2 ef2                0                0                0
  3 ef1                0                0                0

Active alarms : None
Active defects : None
MAC statistics:
  Receive          Transmit
Total octets      0          0
Total packets    0          0
Unicast packets  0          0
Broadcast packets 0          0
Multicast packets 0          0
CRC/Align errors 0          0
FIFO errors       0          0
MAC control frames 0          0
MAC pause frames  0          0
Oversized frames  0
Jabber frames     0
Fragment frames   0
VLAN tagged frames 0
Code violations    0
Filter statistics:
  Input packet count      0
  Input packet rejects    0
  Input DA rejects        0
  Input SA rejects        0
  Output packet count      0
  Output packet pad count  0
  Output packet error count 0
  CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
  Negotiation status: Complete
  Link partner:
    Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote fault:
OK
  Local resolution:
    Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
  Destination slot: 0
CoS information:
  Direction : Output
  CoS transmit queue      Bandwidth      Buffer Priority
Limit

```


	%	bps	%	usec	
2 ef2	39	19500	0	120	high
none					
Direction : Input					
CoS transmit queue		Bandwidth		Buffer	Priority
Limit					
	%	bps	%	usec	
0 af3	30	3000	45	0	low
none					

Physical interface: ge-0/3/0, Enabled, Physical link is Up

Interface index: 138, SNMP ifIndex: 601

Forwarding classes: 16 supported, 5 in use

Ingress queues: 4 supported, 5 in use

Queue: 0, Forwarding classes: af3

Queued:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Transmitted:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Tail-dropped packets : Not Available

RED-dropped packets	:	0	0 pps
---------------------	---	---	-------

RED-dropped bytes	:	0	0 bps
-------------------	---	---	-------

Queue: 1, Forwarding classes: af2

Queued:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Transmitted:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Tail-dropped packets : Not Available

RED-dropped packets	:	0	0 pps
---------------------	---	---	-------

RED-dropped bytes	:	0	0 bps
-------------------	---	---	-------

Queue: 2, Forwarding classes: ef2

Queued:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Transmitted:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Tail-dropped packets : Not Available

RED-dropped packets	:	0	0 pps
---------------------	---	---	-------

RED-dropped bytes	:	0	0 bps
-------------------	---	---	-------

Queue: 3, Forwarding classes: ef1

Queued:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Transmitted:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Tail-dropped packets : Not Available

RED-dropped packets	:	0	0 pps
---------------------	---	---	-------

RED-dropped bytes	:	0	0 bps
-------------------	---	---	-------

Forwarding classes: 16 supported, 5 in use

Egress queues: 4 supported, 5 in use

Queue: 0, Forwarding classes: af3

Queued:

Packets	:	0	0 pps
Bytes	:	0	0 bps

Transmitted:

```

Packets          : 0 0 pps
Bytes            : 0 0 bps
Tail-dropped packets : Not Available
RL-dropped packets : 0 0 pps
RL-dropped bytes   : 0 0 bps
RED-dropped packets : 0 0 pps
RED-dropped bytes   : 0 0 bps
Queue: 1, Forwarding classes: af2
  Queued:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
  Transmitted:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets : 0 0 pps
    RL-dropped bytes   : 0 0 bps
    RED-dropped packets : 0 0 pps
    RED-dropped bytes   : 0 0 bps
Queue: 2, Forwarding classes: ef2
  Queued:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
  Transmitted:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets : 0 0 pps
    RL-dropped bytes   : 0 0 bps
    RED-dropped packets : 0 0 pps
    RED-dropped bytes   : 0 0 bps
Queue: 3, Forwarding classes: ef1
  Queued:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
  Transmitted:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets : 0 0 pps
    RL-dropped bytes   : 0 0 bps
    RED-dropped packets : 0 0 pps
    RED-dropped bytes   : 0 0 bps

Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 5 in use
Queue: 0, Forwarding classes: af3
  Queued:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
  Transmitted:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
    Tail-dropped packets : 0 0 pps
    RED-dropped packets : Not Available
    RED-dropped bytes   : Not Available
Queue: 1, Forwarding classes: af2
  Queued:
    Packets      : 0 0 pps
    Bytes        : 0 0 bps
  Transmitted:

```

```

Packets          :                0                0 pps
Bytes            :                0                0 bps
Tail-dropped packets :                0                0 pps
RED-dropped packets : Not Available
RED-dropped bytes  : Not Available
Queue: 2, Forwarding classes: ef2
  Queued:
    Packets          :                0                0 pps
    Bytes            :                0                0 bps
  Transmitted:
    Packets          :                0                0 pps
    Bytes            :                0                0 bps
    Tail-dropped packets :                0                0 pps
    RED-dropped packets : Not Available
    RED-dropped bytes  : Not Available
Queue: 3, Forwarding classes: ef1
  Queued:
    Packets          :             108546                0 pps
    Bytes            :          12754752            376 bps
  Transmitted:
    Packets          :             108546                0 pps
    Bytes            :          12754752            376 bps
    Tail-dropped packets :                0                0 pps
    RED-dropped packets : Not Available
    RED-dropped bytes  : Not Available

```

```

Physical interface: ge-0/3/0, Index: 138
Maximum usable queues: 4, Queues in use: 5
Shaping rate: 50000 bps

```

```
Scheduler map: interface-scheduler-map, Index: 58414
```

```

Scheduler: ef2, Forwarding class: ef2, Index: 39155
  Transmit rate: 39 percent, Rate Limit: none, Buffer size: 120 us, Buffer
  Limit: none, Priority: high
  Excess Priority: unspecified
  Drop profiles:
    Loss priority  Protocol  Index  Name
    Low           any       1      < default-drop-profile>
    Medium low    any       1      < default-drop-profile>
    Medium high   any       1      < default-drop-profile>
    High          any       1      < default-drop-profile>
  Drop profile: < default-drop-profile>, Type: discrete, Index: 1
    Fill level  Drop probability
    100         100
  Drop profile: < default-drop-profile>, Type: discrete, Index: 1
    Fill level  Drop probability
    100         100
  Drop profile: < default-drop-profile>, Type: discrete, Index: 1
    Fill level  Drop probability
    100         100
  Drop profile: < default-drop-profile>, Type: discrete, Index: 1
    Fill level  Drop probability
    100         100
  Input shaping rate: 10000 bps
  Input scheduler map: scheduler-map

```

```
Scheduler map: scheduler-map, Index: 15103
```

```

Scheduler: af3, Forwarding class: af3, Index: 35058
  Transmit rate: 30 percent, Rate Limit: none, Buffer size: 45 percent, Buffer

```

```

Limit: none, Priority: low
Excess Priority: unspecified
Drop profiles:
  Loss priority  Protocol  Index  Name
  Low           any       40582  green
  Medium low    any       1      < default-drop-profile>
  Medium high   any       1      < default-drop-profile>
  High          any      18928  yellow
Drop profile: green, Type: discrete, Index: 40582
  Fill level  Drop probability
    50         0
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: yellow, Type: discrete, Index: 18928
  Fill level  Drop probability
    50         0
    100        100
Chassis scheduler map: < default-drop-profile>
Scheduler map: < default-drop-profile>, Index: 4

Scheduler: < default-drop-profile>, Forwarding class: af3, Index: 25
  Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
Limit: none, Priority: low
Excess Priority: low
Drop profiles:
  Loss priority  Protocol  Index  Name
  Low           any       1      < default-drop-profile>
  Medium low    any       1      < default-drop-profile>
  Medium high   any       1      < default-drop-profile>
  High          any       1      < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100

Scheduler: < default-drop-profile>, Forwarding class: af2, Index: 25
  Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
Limit: none, Priority: low
Excess Priority: low
Drop profiles:
  Loss priority  Protocol  Index  Name
  Low           any       1      < default-drop-profile>
  Medium low    any       1      < default-drop-profile>
  Medium high   any       1      < default-drop-profile>
  High          any       1      < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100

```

```

Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100

Scheduler: < default-drop-profile>, Forwarding class: ef2, Index: 25
  Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
  Limit: none, Priority: low
  Excess Priority: low
  Drop profiles:
    Loss priority  Protocol  Index  Name
    Low           any       1      < default-drop-profile>
    Medium low    any       1      < default-drop-profile>
    Medium high   any       1      < default-drop-profile>
    High          any       1      < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100

Scheduler: < default-drop-profile>, Forwarding class: ef1, Index: 25
  Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
  Limit: none, Priority: low
  Excess Priority: low
  Drop profiles:
    Loss priority  Protocol  Index  Name
    Low           any       1      < default-drop-profile>
    Medium low    any       1      < default-drop-profile>
    Medium high   any       1      < default-drop-profile>
    High          any       1      < default-drop-profile>
Drop profile: , Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level  Drop probability
    100        100
  Congestion-notification: Disabled
Forwarding class
priority Policing priority
af3      normal          0      0      0      low
af2      normal          1      1      1      low

```

ef2	normal	2	2	2	high
ef1	normal	3	3	3	high
af1	normal	4	4	0	low

Logical interface ge-0/3/0.0 (Index 68) (SNMP ifIndex 152) (Generation 159)
 Flags: SNMP-Traps 0x4000 VLAN-Tag [0x8100.1] Encapsulation: ENET2

Traffic statistics:

Input bytes : 0
 Output bytes : 0
 Input packets: 0
 Output packets: 0

Local statistics:

Input bytes : 0
 Output bytes : 0
 Input packets: 0
 Output packets: 0

Transit statistics:

Input bytes : 0 0 bps
 Output bytes : 0 0 bps
 Input packets: 0 0 pps
 Output packets: 0 0 pps

Protocol inet, MTU: 1500, Generation: 172, Route table: 0

Flags: Sendbcst-pkt-to-re

Input Filters: filter-in-ge-0/3/0.0-i,

Policer: Input: p1-ge-0/3/0.0-inet-i

Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 173, Route table: 0

Flags: Is-Primary

Output Filters: exp-filter,,,,,

Logical interface ge-1/2/0.0 (Index 347) (SNMP ifIndex 638) (Generation 156)

Forwarding class ID	Queue	Restricted queue	Fabric priority	Policing priority
SPU priority				
best-effort	0	0	low	normal
low				

Aggregate Forwarding-class statistics per forwarding-class

Aggregate Forwarding-class statistics:

Forwarding-class statistics:

Forwarding-class best-effort statistics:

Input unicast bytes: 0
 Output unicast bytes: 0
 Input unicast packets: 0
 Output unicast packets: 0

Input multicast bytes: 0
 Output multicast bytes: 0
 Input multicast packets: 0
 Output multicast packets: 0

Forwarding-class expedited-forwarding statistics:

Input unicast bytes: 0
 Output unicast bytes: 0
 Input unicast packets: 0
 Output unicast packets: 0

```
Input multicast bytes:    0
Output multicast bytes:  0
Input multicast packets: 0
Output multicast packets: 0

IPv4 protocol forwarding-class statistics:
Forwarding-class statistics:
Forwarding-class best-effort statistics:

Input unicast bytes:      0
Output unicast bytes:     0
Input unicast packets:    0
Output unicast packets:   0

Input multicast bytes:    0
Output multicast bytes:   0
Input multicast packets:  0
Output multicast packets: 0

Forwarding-class expedited-forwarding statistics:
Input unicast bytes:      0
Output unicast bytes:     0
Input unicast packets:    0
Output unicast packets:   0

Input multicast bytes:    0
Output multicast bytes:   0
Input multicast packets:  0
Output multicast packets: 0

IPv6 protocol forwarding-class statistics:
Forwarding-class statistics:
Forwarding-class best-effort statistics:

Input unicast bytes:      0
Output unicast bytes:     0
Input unicast packets:    0
Output unicast packets:   0

Input multicast bytes:    0
Output multicast bytes:   0
Input multicast packets:  0
Output multicast packets: 0

Forwarding-class expedited-forwarding statistics:
Input unicast bytes:      0
Output unicast bytes:     0
Input unicast packets:    0
Output unicast packets:   0

Input multicast bytes:    0
Output multicast bytes:   0
Input multicast packets:  0
Output multicast packets: 0

Logical interface ge-0/3/0.0 (Index 68) (SNMP ifIndex 152)
Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ] Encapsulation: ENET2
Input packets : 0
Output packets: 0
```

```

Interface      Admin Link Proto Input Filter      Output Filter
ge-0/3/0.0    up   up   inet  filter-in-ge-0/3/0.0-i
              up   up   mpls
              up   up   mpls
Interface      Admin Link Proto Input Policer      Output Policer
ge-0/3/0.0    up   up   inet  p1-ge-0/3/0.0-inet-i
              up   up   mpls

```

Filter: filter-in-ge-0/3/0.0-i

Counters:

Name	Bytes	Packets
count-filter-in-ge-0/3/0.0-i	0	0

Filter: exp-filter

Counters:

Name	Bytes	Packets
count-exp-seven-match	0	0
count-exp-zero-match	0	0

Policers:

Name	Packets
p1-ge-0/3/0.0-inet-i	0

Logical interface: ge-0/3/0.0, Index: 68

Object	Name	Type	Index
Rewrite	exp-default	exp (mpls-any)	33

Rewrite rule: exp-default, Code point type: exp, Index: 33

Forwarding class	Loss priority	Code point
af3	low	000
af3	high	001
af2	low	010
af2	high	011
ef2	low	100
ef2	high	101
ef1	low	110
ef1	high	111

Object	Name	Type	Index
Classifier	exp-default	exp	10

Classifier: exp-default, Code point type: exp, Index: 10

Code point	Forwarding class	Loss priority
000	af3	low
001	af3	high
010	af2	low
011	af2	high
100	ef2	low
101	ef2	high
110	ef1	low
111	ef1	high

Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13

Classifier: ipprec-compatibility, Code point type: inet-precedence, Index: 13

Code point	Forwarding class	Loss priority
000	af3	low
001	af3	high
010	af3	low

011	af3	high
100	af3	low
101	af3	high
110	ef1	low
111	ef1	high
Forwarding class		
priority	Policing priority	ID Queue Restricted queue Fabric
af3		0 0 0 low
	normal	
af2		1 1 1 low
	normal	
ef2		2 2 2 high
	normal	
ef1		3 3 3 high
	normal	
af1		4 4 0 low
	normal	

Logical interface ge-0/3/0.1 (Index 69) (SNMP ifIndex 154) (Generation 160)

Flags: SNMP-Traps 0x4000 VLAN-Tag [0x8100.2] Encapsulation: ENET2

Traffic statistics:

Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0

Local statistics:

Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0

Transit statistics:

Input bytes : 0 0 bps
Output bytes : 0 0 bps
Input packets: 0 0 pps
Output packets: 0 0 pps

Protocol inet, MTU: 1500, Generation: 174, Route table: 0

Flags: Sendbcst-pkt-to-re

Logical interface ge-0/3/0.1 (Index 69) (SNMP ifIndex 154)

Flags: SNMP-Traps 0x4000 VLAN-Tag [0x8100.2] Encapsulation: ENET2

Input packets : 0

Output packets: 0

Interface	Admin	Link	Proto	Input Filter	Output Filter
ge-0/3/0.1	up	up	mpls		
Interface	Admin	Link	Proto	Input Policer	Output Policer
ge-0/3/0.1	up	up			
			mpls		

Logical interface: ge-0/3/0.1, Index: 69

Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13

Classifier: ipprec-compatibility, Code point type: inet-precedence, Index: 13

Code point	Forwarding class	Loss priority
000	af3	low
001	af3	high
010	af3	low
011	af3	high

100	af3	low		
101	af3	high		
110	ef1	low		
111	ef1	high		
Forwarding class	ID	Queue	Restricted queue	Fabric
priority	Policing priority			
af3		0	0	low
	normal			
af2		1	1	low
	normal			
ef2		2	2	high
	normal			
ef1		3	3	high
	normal			
af1		4	4	low
	normal			

show class-of-service interface (ACX Series Routers)

```

user@host-g11# show class-of-service interface
Physical interface: at-0/0/0, Index: 130
Maximum usable queues: 4, Queues in use: 4
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

Logical interface: at-0/0/0.0, Index: 69

Logical interface: at-0/0/0.32767, Index: 70

Physical interface: at-0/0/1, Index: 133
Maximum usable queues: 4, Queues in use: 4
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

Logical interface: at-0/0/1.0, Index: 71

Logical interface: at-0/0/1.32767, Index: 72

Physical interface: ge-0/1/0, Index: 146
Maximum usable queues: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object      Name      Type      Index
Rewrite     dscp-default dscp      31
Classifier   d1         dscp      11331
Classifier   ci         ieee8021p 583

Logical interface: ge-0/1/0.0, Index: 73
Object      Name      Type      Index
Rewrite     custom-exp exp (mpls-any) 46413

Logical interface: ge-0/1/0.1, Index: 74

Logical interface: ge-0/1/0.32767, Index: 75

Physical interface: ge-0/1/1, Index: 147
Maximum usable queues: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

```

Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13
Logical interface: ge-0/1/1.0, Index: 76			
Physical interface: ge-0/1/2, Index: 148			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Rewrite	ri	ieee8021p (outer)	35392
Classifier	ci	ieee8021p	583
Physical interface: ge-0/1/3, Index: 149			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13
Logical interface: ge-0/1/3.0, Index: 77			
Object	Name	Type	Index
Rewrite	custom-exp2	exp (mpls-any)	53581
Physical interface: ge-0/1/4, Index: 150			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13
Physical interface: ge-0/1/5, Index: 151			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13
Physical interface: ge-0/1/6, Index: 152			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13
Physical interface: ge-0/1/7, Index: 153			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Classifier	d1	dscp	11331
Physical interface: ge-0/2/0, Index: 154			
Maximum usable queues: 8, Queues in use: 5			
Scheduler map: <default>, Index: 2			
Congestion-notification: Disabled			
Object	Name	Type	Index
Classifier	ipprec-compatibility	ip	13
Physical interface: ge-0/2/1, Index: 155			
Maximum usable queues: 8, Queues in use: 5			

```

    Scheduler map: <default>, Index: 2
    Congestion-notification: Disabled
Object      Name      Type      Index
Classifier  ipprec-compatibility  ip      13

    Logical interface: ge-0/2/1.0, Index: 78

    Logical interface: ge-0/2/1.32767, Index: 79

Physical interface: xe-0/3/0, Index: 156
Maximum usable queues: 8, Queues in use: 5
    Scheduler map: <default>, Index: 2
    Congestion-notification: Disabled
Object      Name      Type      Index
Classifier  ipprec-compatibility  ip      13

    Logical interface: xe-0/3/0.0, Index: 80

Physical interface: xe-0/3/1, Index: 157
Maximum usable queues: 8, Queues in use: 5
    Scheduler map: <default>, Index: 2
    Congestion-notification: Disabled
Object      Name      Type      Index
Classifier  ipprec-compatibility  ip      13

    Logical interface: xe-0/3/1.0, Index: 81

[edit]
user@host-g11#

```

show class-of-service interface (PPPoE Subscriber Interface for Enhanced Subscriber Management)

```

user@host> show class-of-service interface pp0.3221225474
    Logical interface: pp0.3221225475, Index: 3221225475
Object      Name      Type      Index
Traffic-control-profile TC_PROF_100_199_SERIES_UID1006 Output  4294967312
Scheduler-map SMAP-1_UID1002 Output  4294967327
Rewrite-Output ieee-rewrite 60432
Rewrite-Output rule1 ip 50463

    Adjusting application: PPPoE IA tags
    Adjustment type: absolute
    Configured shaping rate: 11000000
    Adjustment value: 5000000
    Adjustment target: node

    Adjusting application: ucac
    Adjustment type: delta
    Configured shaping rate: 5000000
    Adjustment value: 100000
    Adjustment target: node

```

show class-of-service multi-destination

Syntax	show class-of-service multi-destination
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p> <p>Command introduced in Junos OS Release 17.1 for the EX4300 switch.</p>
Description	For each class-of-service (CoS) multidestination classifier, display the classifier type.
Options	none —Display all multidestination classifiers.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • Defining CoS BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 28 • Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 117 • <i>Understanding CoS Classifiers</i> • <i>Understanding CoS Classifiers</i> • <i>Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces</i> • <i>Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces</i>
Output Fields	<p>Table 44 on page 229 describes the output fields for the show class-of-service multi-destination command. Output fields are listed in the approximate order in which they appear.</p>

Table 44: show class-of-service multi-destination Output Fields

Field Name	Field Description
Family ethernet	Family to which the classifier belongs.
Classifier Name	Name of the classifier.
Classifier Type	Type of the classifier: dscp or ieee-802.1 .
Classifier Index	Internal index of the classifier.

Sample Output

show class-of-service multi-destination

```
user@switch> show class-of-service multi-destination
```

```
Family ethernet:
```

Classifier Name	Classifier Type	Classifier Index
ba-mcast-classifier	ieee-802.1	62376

show class-of-service rewrite-rule

Syntax	show class-of-service rewrite-rule <name <i>name</i> > <type <i>type</i> >
Release Information	Command introduced before Junos OS Release 7.4.
Description	Display the mapping of forwarding classes and loss priority to code point values.
Options	<p>none—Display all rewrite rules.</p> <p>name <i>name</i>—(Optional) Display the specified rewrite rule.</p> <p>type <i>type</i>—(Optional) Display the rewrite rule of the specified type. The rewrite rule type can be one of the following:</p> <ul style="list-style-type: none"> • dscp—For IPv4 traffic. • dscp-ipv6—For IPv6 traffic. • exp—For MPLS traffic. • frame-relay-de— For Frame Relay traffic. • ieee-802.1—For Layer 2 traffic. • inet-precedence—For IPv4 traffic.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • <i>Rewrite Rules Overview</i>
List of Sample Output	show class-of-service rewrite-rule type dscp on page 232
Output Fields	Table 45 on page 231 describes the output fields for the show class-of-service rewrite-rule command. Output fields are listed in the approximate order in which they appear.

Table 45: show class-of-service rewrite-rule Output Fields

Field Name	Field Description
Rewrite rule	Name of the rewrite rule.
Code point type	Type of rewrite rule: dscp , dscp-ipv6 , exp , frame-relay-de , or inet-precedence .
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router or switch.

Table 45: show class-of-service rewrite-rule Output Fields (*continued*)

Field Name	Field Description
Index	Internal index for this particular rewrite rule.
Loss priority	Loss priority for rewriting.
Code point	Code point value to rewrite.

Sample Output

show class-of-service rewrite-rule type dscp

```

user@host> show class-of-service rewrite-rule type dscp
Rewrite rule: dscp-default, Code point type: dscp
  Forwarding class      Loss priority      Code point
  gold                  high              000000
  silver                low               110000
  silver                high              111000
  bronze                low               001010
  bronze                high              001100
  lead                  high              101110

Rewrite rule: abc-dscp-rewrite, Code point type: dscp, Index: 3245
  Forwarding class      Loss priority      Code point
  gold                  low               000111
  gold                  high              001010
  silver                low               110000
  silver                high              111000
  bronze                high              001100
  lead                  low               101110
  lead                  high              110111

```


show class-of-service scheduler-map

Syntax	<code>show class-of-service scheduler-map</code> <code><name></code>
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 15.1R3 on MX Series routers for enhanced subscriber management.
Description	Display the mapping of schedulers to forwarding classes and a summary of scheduler parameters for each entry.
Options	none —Display all scheduler maps. name —(Optional) Display a summary of scheduler parameters for each forwarding class to which the named scheduler is assigned.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • <i>Verifying and Managing Junos OS Enhanced Subscriber Management</i>
List of Sample Output	show class-of-service scheduler-map on page 234 show class-of-service scheduler-map (QFX Series) on page 235
Output Fields	Table 46 on page 233 describes the output fields for the show class-of-service scheduler-map command. Output fields are listed in the approximate order in which they appear.

Table 46: show class-of-service scheduler-map Output Fields

Field Name	Field Description
Scheduler map	<p>Name of the scheduler map.</p> <p>(Enhanced subscriber management for MX Series routers) The name of the dynamic scheduler map object is associated with a generated UID (for example, SMAP-1_UID1002) instead of with a subscriber interface.</p>
Index	<p>Index of the indicated object. Objects having indexes in this output include scheduler maps, schedulers, and drop profiles.</p> <p>(Enhanced subscriber management for MX Series routers) Index values for dynamic CoS traffic control profiles are larger for enhanced subscriber management than they are for legacy subscriber management.</p>
Scheduler	Name of the scheduler.

Table 46: show class-of-service scheduler-map Output Fields (*continued*)

Field Name	Field Description
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.
Transmit rate	Configured transmit rate of the scheduler (in bps). The rate is a percentage of the total interface bandwidth, or the keyword remainder , which indicates that the scheduler receives the remaining bandwidth of the interface.
Rate Limit	Rate limiting configuration of the queue. Possible values are none , meaning no rate limiting, and exact , meaning the queue only transmits at the configured rate.
Maximum buffer delay	Amount of transmit delay (in milliseconds) or the buffer size of the queue. The buffer size is shown as a percentage of the total interface buffer allocation, or by the keyword remainder to indicate that the buffer is sized according to what remains after other scheduler buffer allocations.
Priority	Scheduling priority: low or high .
Excess priority	Priority of excess bandwidth: low , medium-low , medium-high , high , or none .
Explicit Congestion Notification	(QFX Series, OCX Series, and EX4600 switches only) Explicit congestion notification (ECN) state: <ul style="list-style-type: none"> • Disable—ECN is disabled on the specified scheduler • Enable—ECN is enabled on the specified scheduler ECN is disabled by default.
Adjust minimum	Minimum shaping rate for an adjusted queue, in bps.
Adjust percent	Bandwidth adjustment applied to a queue, in percent.
Drop profiles	Table displaying the assignment of drop profiles by name and index to a given loss priority and protocol pair.
Loss priority	Packet loss priority for drop profile assignment.
Protocol	Transport protocol for drop profile assignment.
Name	Name of the drop profile.

Sample Output

show class-of-service scheduler-map

```

user@host> show class-of-service scheduler-map
Scheduler map: dd-scheduler-map, Index: 84

Scheduler: aa-scheduler, Index: 8721, Forwarding class: aa-forwarding-class
Transmit rate: 30 percent, Rate Limit: none, Maximum buffer delay: 39 ms,
Priority: high
Drop profiles:
  Loss priority  Protocol  Index  Name

```

Low	non-TCP	8724	aa-drop-profile
Low	TCP	9874	bb-drop-profile
High	non-TCP	8833	cc-drop-profile
High	TCP	8484	dd-drop-profile

Scheduler: bb-scheduler, Forwarding class: aa-forwarding-class
 Transmit rate: 40 percent, Rate limit: none, Maximum buffer delay: 68 ms,
 Priority: high
 Drop profiles:

Loss priority	Protocol	Index	Name
Low	non-TCP	8724	aa-drop-profile
Low	TCP	9874	bb-drop-profile
High	non-TCP	8833	cc-drop-profile
High	TCP	8484	dd-drop-profile

show class-of-service scheduler-map (QFX Series)

```
user@switch# show class-of-service scheduler-map
Scheduler map: be-map, Index: 12240
```

Scheduler:be-sched, Forwarding class: best-effort, Index: 115
 Transmit rate: 30 percent, Rate Limit: none, Buffer size: remainder,
 Buffer Limit: none, Priority: low
 Excess Priority: unspecified, Explicit Congestion Notification: disable

Drop profiles:

Loss priority	Protocol	Index	Name
Low	any	3312	lan-dp
Medium-high	any	2714	be-dp1
High	any	3178	be-dp2

show interfaces queue

Syntax	<code>show interfaces queue</code> <code><both-ingress-egress></code> <code><egress></code> <code><forwarding-class <i>forwarding-class</i>></code> <code><ingress></code> <code><interface-name></code>
Release Information	Command introduced in Junos OS Release 9.0 for EX Series switches.
Description	Display class-of-service (CoS) queue information for physical interfaces.
Options	<p>none—Show detailed CoS queue statistics for all physical interfaces.</p> <p>both-ingress-egress—(Optional) Show both ingress and egress queue statistics. (Ingress statistics are not available for all interfaces.)</p> <p>egress—(Optional) Show egress queue statistics only.</p> <p>forwarding-class <i>forwarding-class</i>—(Optional) Show queue statistics only for the specified forwarding class.</p> <p>ingress—(Optional) Show ingress queue statistics only. (Ingress statistics are not available for all interfaces.)</p> <p>interface-name—(Optional) Show queue statistics for the specified interface.</p>
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none">• Monitoring Interface Status and Traffic• Monitoring Interfaces That Have CoS Components on page 126• Defining CoS Schedulers and Scheduler Maps (CLI Procedure) on page 44• Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards (CLI Procedure)
List of Sample Output	show interfaces queue ge-0/0/0 (EX2200 Switch) on page 238 show interfaces queue xe-6/0/39 (Line Card with Oversubscribed Ports in an EX8200 Switch) on page 239
Output Fields	Table 47 on page 237 lists the output fields for the show interfaces queue command. Output fields are listed in the approximate order in which they appear.

Table 47: show interfaces queue Output Fields

Field Name	Field Description
Physical Interface and Forwarding Class Information	
Physical interface	Name of the physical interface.
Enabled	State of the interface. Possible values are: <ul style="list-style-type: none"> • Administratively down, Physical link is Down—The interface is turned off, and the physical link is inoperable. • Administratively down, Physical link is Up—The interface is turned off, but the physical link is operational and can pass packets when it is enabled. • Enabled, Physical link is Down—The interface is turned on, but the physical link is inoperable and cannot pass packets. • Enabled, Physical link is Up—The interface is turned on, and the physical link is operational and can pass packets.
Interface index	Index number of the physical interface, which reflects its initialization sequence.
SNMP ifIndex	SNMP index number for the physical interface.
Description	User-configured interface description.
Forwarding classes	Number of forwarding classes supported and in use for the interface.
Ingress Queues Information (not shown for all interfaces)	
Ingress queues	Number of input queues supported and in use on the specified interface. For an interface on a line card with oversubscribed ports, the ingress queue handles low priority traffic on the interface.
Transmitted	Transmission statistics for the queue: <ul style="list-style-type: none"> • Packets—Number of packets transmitted by this queue. • Bytes—Number of bytes transmitted by this queue. • Tail-dropped packets—Number of packets dropped because the queue buffers were full.
PFE chassis queues	For an interface on a line card with oversubscribed ports, the number of Packet Forwarding Engine chassis queues supported and in use for the port group to which the interface belongs. The Packet Forwarding Engine chassis queue for a port group handles high priority traffic from all the interfaces in the port group.
Egress Queues Information	
Egress queues	Number of output queues supported and in use on the specified interface.
Queue	CoS queue number.
Queued	This counter is not supported on EX Series switches.

Table 47: show interfaces queue Output Fields (*continued*)

Field Name	Field Description
Transmitted	<p>Number of packets and bytes transmitted by this queue. Information on transmitted packets and bytes can include:</p> <ul style="list-style-type: none"> • Packets—Number of packets transmitted. • Bytes—Number of bytes transmitted. • Tail-dropped packets—Number of arriving packets dropped because output queue buffers were full. • RED-dropped packets—Number of packets dropped because of random early detection (RED). <ul style="list-style-type: none"> • Low—Number of low loss priority packets dropped because of RED. • High—Number of high loss priority packets dropped because of RED. • RED-dropped bytes—Number of bytes dropped because of random early detection (RED). <ul style="list-style-type: none"> • Low—Number of low loss priority bytes dropped because of RED. • High—Number of high loss priority bytes dropped because of RED.
Packet Forwarding Engine Chassis Queues	<p>For an interface on a line card with oversubscribed ports, the number of Packet Forwarding Engine chassis queues supported and in use for the port group to which the interface belongs. The queue statistics reflect the traffic flowing on all the interfaces in the port group.</p>

Sample Output

show interfaces queue ge-0/0/0 (EX2200 Switch)

```

user@switch> show interfaces queue ge-0/0/0
Physical interface: ge-0/0/0, Enabled, Physical link is Down
  Interface index: 130, SNMP ifIndex: 501
  Forwarding classes: 16 supported, 4 in use
  Egress queues: 8 supported, 4 in use
  Queue: 0, Forwarding classes: best-effort
    Queued:
      Transmitted:
        Packets          :                0
        Bytes            :                0
        Tail-dropped packets :            0
  Queue: 1, Forwarding classes: assured-forwarding
    Queued:
      Transmitted:
        Packets          :                0
        Bytes            :                0
        Tail-dropped packets :            0
  Queue: 5, Forwarding classes: expedited-forwarding
    Queued:
      Transmitted:
        Packets          :                0
        Bytes            :                0
        Tail-dropped packets :            0
  Queue: 7, Forwarding classes: network-control
    Queued:
      Transmitted:
        Packets          :                0

```

```

Bytes          :          0
Tail-dropped packets :          0

```

show interfaces queue xe-6/0/39 (Line Card with Oversubscribed Ports in an EX8200 Switch)

```

user@switch> show interfaces queue xe-6/0/39

Physical interface: xe-6/0/39, Enabled, Physical link is Up
  Interface index: 291, SNMP ifIndex: 1641
Forwarding classes: 16 supported, 7 in use
Ingress queues: 1 supported, 1 in use
  Transmitted:
    Packets          :          337069086018
    Bytes            :          43144843010304
    Tail-dropped packets :          8003867575
PFE chassis queues: 1 supported, 1 in use
  Transmitted:
    Packets          :          0
    Bytes            :          0
    Tail-dropped packets :          0
Forwarding classes: 16 supported, 7 in use
Egress queues: 8 supported, 7 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Transmitted:
      Packets          :          334481399932
      Bytes            :          44151544791024
      Tail-dropped packets :          0
    Queue: 1, Forwarding classes: assured-forwarding
      Queued:
        Transmitted:
          Packets          :          0
          Bytes            :          0
          Tail-dropped packets :          0
      Queue: 2, Forwarding classes: mcast-be
        Queued:
          Transmitted:
            Packets          :          274948977
            Bytes            :          36293264964
            Tail-dropped packets :          0
      Queue: 4, Forwarding classes: mcast-ef
        Queued:
          Transmitted:
            Packets          :          0
            Bytes            :          0
            Tail-dropped packets :          0
      Queue: 5, Forwarding classes: expedited-forwarding
        Queued:
          Transmitted:
            Packets          :          0
            Bytes            :          0
            Tail-dropped packets :          0
      Queue: 6, Forwarding classes: mcast-af
        Queued:
          Transmitted:
            Packets          :          0
            Bytes            :          0
            Tail-dropped packets :          0
      Queue: 7, Forwarding classes: network-control
        Queued:
          Transmitted:

```

```
Packets           :           46714
Bytes             :           6901326
Tail-dropped packets :           0
```

Packet Forwarding Engine Chassis Queues:

Queues: 8 supported, 7 in use

Queue: 0, Forwarding classes: best-effort

Queued:

Transmitted:

```
Packets           :           739338141426
Bytes             :           94635282101928
Tail-dropped packets :           0
RED-dropped packets :           5606426444
  Low             :           5606426444
  High            :           0
RED-dropped bytes  :           683262846464
  Low             :           683262846464
  High            :           0
```

Queue: 1, Forwarding classes: assured-forwarding

Queued:

Transmitted:

```
Packets           :           0
Bytes             :           0
Tail-dropped packets :           0
RED-dropped packets :           0
  Low             :           0
  High            :           0
RED-dropped bytes  :           0
  Low             :           0
  High            :           0
```

Queue: 2, Forwarding classes: mcast-be

Queued:

Transmitted:

```
Packets           :           0
Bytes             :           0
Tail-dropped packets :           0
RED-dropped packets :           0
  Low             :           0
  High            :           0
RED-dropped bytes  :           0
  Low             :           0
  High            :           0
```

Queue: 4, Forwarding classes: mcast-ef

Queued:

Transmitted:

```
Packets           :           0
Bytes             :           0
Tail-dropped packets :           0
RED-dropped packets :           0
  Low             :           0
  High            :           0
RED-dropped bytes  :           0
  Low             :           0
  High            :           0
```

Queue: 5, Forwarding classes: expedited-forwarding

Queued:

Transmitted:

```
Packets           :           0
Bytes             :           0
Tail-dropped packets :           0
RED-dropped packets :           0
```



```
      Low                :                0
      High               :                0
      RED-dropped bytes  :                0
      Low                :                0
      High               :                0
Queue: 6, Forwarding classes: mcast-af
Queued:
Transmitted:
  Packets                :                0
  Bytes                  :                0
  Tail-dropped packets :                0
  RED-dropped packets  :                0
  Low                   :                0
  High                  :                0
  RED-dropped bytes    :                0
  Low                   :                0
  High                  :                0
Queue: 7, Forwarding classes: network-control
Queued:
Transmitted:
  Packets                :                97990
  Bytes                  :            14987506
  Tail-dropped packets :                0
  RED-dropped packets  :                0
  Low                   :                0
  High                  :                0
  RED-dropped bytes    :                0
  Low                   :                0
  High                  :                0
```

