JUNIPER NETWORKS

Junos® OS

CoS Ingress Traffic Policing Feature Guide for Routing Devices

Release
14.1

Published: 2014-06-24

Juniper Networks, Inc.
1194 North Mathilda Avenue
Sunnyvale, California 94089
USA
408-745-2000
www.juniper.net

Junos® OS CoS Ingress Traffic Policing Feature Guide for Routing Devices
14.1

Table of Contents

List of Figures

List of Tables

About the Documentation

Documentation and Release Notes

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

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

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

Supported Platforms

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

- T Series
- M Series
- MX Series
- PTX Series

Using the Examples in This Manual

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

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

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

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

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

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

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

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

Documentation Conventions

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

Table 1: Notice Icons

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

Table 2 on page 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`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Encloses optional keywords or variables.	**stub <default-metric** *metric***>;**
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** **(*string1* | *string2* | *string3*)**
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	**community name members [** *community-ids* **]**

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

; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	

GUI Conventions

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

Convention	Description	Examples
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (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 at the Juniper Networks Technical Documentation 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 https://www.juniper.net/cgi-bin/docbugreport/.
- 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 JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf.
- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/.
- 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

CHAPTER 1

Tricolor Marking Policers

Traffic Policing Overview

This topic covers the following information:

Congestion Management for IP Traffic Flows

Traffic policing, also known *rate limiting*, is an essential component of network access security that is designed to thwart denial-of-service (DoS) attacks. Traffic policing enables you to control the maximum rate of IP traffic sent or received on an interface and also to partition network traffic into multiple priority levels, also known as *classes of service*. A policer defines a set of traffic rate limits and sets consequences for traffic that does not conform to the configured limits. Packets in a traffic flow that does not conform to traffic limits are either discarded or marked with a different forwarding class or packet loss priority (PLP) level.

With the exception of policers configured to rate-limit aggregate traffic (all protocol families and logical interfaces configured on a physical interface), you can apply a policer to all IP packets in a Layer 2 or Layer 3 traffic flow at a logical interface.

With the exception of policers configured to rate-limit based on physical interface media rate, you can apply a policer to specific IP packets in a Layer 3 traffic flow at a logical interface by using a stateless firewall filter.

You can apply a policer to inbound or outbound interface traffic. Policers applied to inbound traffic help to conserve resources by dropping traffic that does not need to be routed through a network. Dropping inbound traffic also helps to thwart denial-of-service (DoS) attacks. Policers applied to outbound traffic control the bandwidth used.

NOTE: Traffic policers are instantiated on a per-PIC basis. Traffic policing does not work when the traffic for one local policy decision function (L-PDF) subscriber is distributed over multiple Multiservices PICs in an AMS group.

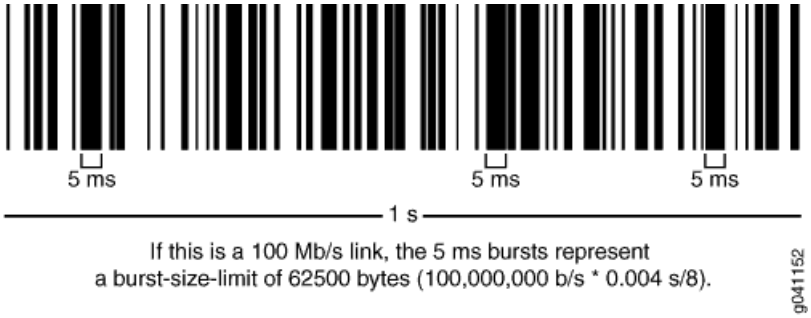
Traffic Limits

Junos OS policers use a *token bucket algorithm* to enforce a limit on an average transmit or receive rate of traffic at an interface while allowing bursts of traffic up to a maximum value based on the configured bandwidth limit and configured burst size. The token bucket algorithm offers more flexibility than a *leaky bucket algorithm* in that you can allow a specified traffic burst before starting to discard packets or apply a penalty such as packet output-queuing priority or packet-drop priority.

In the token-bucket model, the bucket represents the rate-limiting function of the policer. Tokens are added to the bucket at a fixed rate, but once the specified depth of the bucket is reached, tokens allocated after cannot be stored and used. Each token represents a “credit” for some number of bits, and tokens in the bucket are “cashed in” for the ability to transmit or receive traffic at the interface. When sufficient tokens are present in the bucket, a traffic flow continues unrestricted. Otherwise, packets might be dropped or else re-marked with a lower forwarding class, a higher packet loss priority (PLP) level, or both.

- The rate at which tokens are added to the bucket represents the highest average transmit or receive rate in bits per second allowed for a given service level. You specify this highest average traffic rate as the *bandwidth limit* of the policer. If the traffic arrival rate (or fixed bits-per-second) is so high that at some point insufficient tokens are present in the bucket, then the traffic flow is no longer conforming to the traffic limit. During periods of relatively low traffic (traffic that arrives at or departs from the interface at average rates below the token arrival rate), unused tokens accumulate in the bucket.
- The depth of the bucket in bytes controls the amount of back-to-back bursting allowed. You specify this factor as the *burst-size limit* of the policer. This second limit affects the average transmit or receive rate by limiting the number of bytes permitted in a transmission burst for a given interval of time. Bursts exceeding the current burst-size limit are dropped until there are sufficient tokens available to permit the burst to proceed.

Figure 1: Network Traffic and Burst Rates



As shown in the figure above, a UPC bar code is a good facsimile of what traffic looks like on the line; an interface is either transmitting (bursting at full rate) or it is not. The black lines represent periods of data transmission and the white space represents periods of silence when the token bucket can replenish.

Depending on the type of policer used, packets in a policed traffic flow that surpasses the defined limits might be implicitly set to a higher PLP level, assigned to a configured forwarding class or set to a configured PLP level (or both), or simply discarded. If packets encounter downstream congestion, packets with a **low** PLP level are less likely to be discarded than those with a **medium-low**, **medium-high**, or **high** PLP level.

Traffic Color Marking

Based on the particular set of traffic limits configured, a policer identifies a traffic flow as belonging to one of either two or three categories that are similar to the colors of a traffic light used to control automobile traffic.

A *two-color-marking* policer categorizes traffic as either conforming to the traffic limits (green) or violating the traffic limits (red):

- Green—Two-color-marking policers implicitly set the packets in a green flow to the low PLP level, and you cannot configure any policer actions for conforming traffic.
- Red—Two-color-marking policers do not perform any implicit actions on packets in a red flow. Instead, those packets are handled according to the actions specified in the policer configuration. You can configure a two-color-marking policer to simply discard packets if the traffic flow is red. Alternatively, you can configure a two-color-marking policer to handle the packets in a red flow by setting the PLP level to either **low** or **high**, assigning the packets to any forwarding class already configured, or both.

  On MX Series, M120, and M320 routers and M7i and M10i routers with the Enhanced CFEB (CFEB-E) and EX Series switches only, you can specify two additional PLP levels for packets in a red flow: **medium-low** or **medium-high**.

Three-color-marking policers categorize traffic as conforming to the traffic limits (green), violating the traffic limits (red), or exceeding the traffic limits but within an allowed range (yellow):

- Green—Like two-color-marking policers, three-color-marking policers implicitly set the packets in a green flow to the low PLP level, and you cannot configure any policer actions for conforming traffic.
- Yellow—Unlike two-color-marking policers, three-color-marking policers categorize a second type of nonconforming traffic: yellow.

  Single-rate three-color policing categorizes as yellow traffic that exceeds the traffic limits while conforming to a second defined burst-size limit. Two-rate three-color policing categorizes as yellow traffic that exceeds the traffic limits while conforming to both a second defined burst-size limit and a second defined bandwidth limit.

  Three-color-marking policers implicitly set the packets in a yellow flow to the medium-high PLP level so that the packets incur a less severe penalty than those in a red flow. You cannot configure any policer actions for yellow traffic.
- Red—Unlike two-color-marking policers, three-color-marking policers implicitly set the packets in a red flow to the high PLP level, which is the highest PLP value. You can also configure a three-color-marking policer to discard the packets in a red flow instead of forwarding them with a high PLP setting.

Two-color-marking policers allows bursts of traffic for short periods, whereas three-color-marking policers allow more sustained bursts of traffic.

Forwarding Classes and PLP Levels

A packet's forwarding class assignment and PLP level are used by the Junos OS class of service (CoS) features. The Junos CoS features include a set of mechanisms that you can use to provide differentiated services when best-effort traffic delivery is insufficient. For router (and switch) interfaces that carry IPv4, IPv6, and MPLS traffic, you can configure CoS features to take in a single flow of traffic entering at the edge of your network and provide different levels of service across the network—internal forwarding and scheduling (queuing) for output—based on the forwarding class assignments and PLP levels of the individual packets.

NOTE: **Forwarding-class or loss-priority assignments performed by a policer or a stateless firewall filter override any such assignments performed on the ingress by the CoS default IP precedence classification at all logical interfaces or by any configured behavior aggregate (BA) classifier that is explicitly mapped to a logical interface.**

Based on CoS configurations, packets of a given forwarding class are transmitted through a specific output queue, and each output queue is associated with a transmission service level defined in a *scheduler*.

Based on other CoS configurations, when packets in an output queue encounter congestion, packets with higher loss-priority values are more likely to be dropped by the

random early detection (RED) algorithm. Packet loss priority values affect the scheduling of a packet without affecting the packet's relative ordering within the traffic flow.

Policer Application to Traffic

After you have defined and named a policer, it is stored as a template. You can later use the same policer name to provide the same policer configuration each time you want to use it. This eliminates the need to define the same policer values more than once.

You can apply a policer to a traffic flow in either of two ways:

- You can configure a standard stateless firewall filter that specifies the **policer *policer-name*** nonterminating action or the **three-color-policer (single-rate | two-rate) *policer-name*** nonterminating action. When you apply the standard filter to the input or output at a logical interface, the policer is applied to all packets of the filter-specific protocol family that match the conditions specified in the filter configuration.

  With this method of applying a policer, you can define specific classes of traffic on an interface and apply traffic rate-limiting to each class.

- You can apply a policer directly to an interface so that traffic rate-limiting applies to all traffic on that interface, regardless of protocol family or any match conditions.

You can configure policers at the queue, logical interface, or Layer 2 (MAC) level. Only a single policer is applied to a packet at the egress queue, and the search for policers occurs in this order:

- Queue level
- Logical interface level
- Layer 2 (MAC) level

Related Documentation

- *Stateless Firewall Filter Overview*.
- *Traffic Policer Types*
- *Order of Policer and Firewall Filter Operations*
- *Packet Flow Through the CoS Process Overview*

Policer Overview

Policing, or rate limiting, enables you to limit the amount of traffic that passes into or out of an interface. It is an essential component of firewall filters that is designed to thwart denial-of-service (DoS) attacks. 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 if packets encounter downstream congestion, they are discarded first.

Policing uses the *token-bucket algorithm*, which enforces a limit on average bandwidth while allowing bursts up to a specified maximum value. It offers more flexibility than the *leaky bucket algorithm* (see the *Junos OS Class of Service Library for Routing Devices*) in allowing a certain amount of bursty traffic before it starts discarding packets.

You can define specific classes of traffic on an interface and apply a set of rate limits to each. You can use a policer in one of two ways: as part of a filter configuration or as part of a logical interface (where the policer is applied to all traffic on that interface).

After you have defined and named a policer, it is stored as a template. You can later use the same policer name to provide the same policer configuration each time you wish to use it. This eliminates the need to define the same policer values more than once.

Juniper Networks routing platform architectures can support three types of policer:

- Single-rate two-color—A two-color policer (or "policer" when used without qualification) meters the traffic stream and classifies packets into two categories of packet loss priority (PLP) according to a configured bandwidth and burst-size limit. You can mark packets that exceed the bandwidth and burst-size limit in some way, or simply discard them. A policer is most useful for metering traffic at the port (physical interface) level.
- Single-rate three-color—This type of policer is defined in RFC 2697, *A Single Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on the configured committed information rate (CIR), committed burst size (CBS), and the excess burst size (EBS). Traffic is marked as belonging to one of three categories (green, yellow, or red) based on whether the packets arriving are below the CBS (green), exceed the CBS (yellow) but not the EBS, or exceed the EBS (red). A single-rate three-color policer is most useful when a service is structured according to packet length and not peak arrival rate.
- Two-rate three-color—This type of policer is defined in RFC 2698, *A Two Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on the configured CIR and peak information rate (PIR), along with their associated burst sizes, the CBS and *peak burst size* (PBS). Traffic is marked as belonging to one of three categories (green, yellow, or red) based on whether the packets arriving are below the CIR (green), exceed the CIR (yellow) but not the

PIR, or exceed the PIR (red). A two-rate three-color policer is most useful when a service is structured according to arrival rates and not necessarily packet length.

Policer actions are implicit or explicit and vary by policer type. The term *Implicit* means that Junos assigns the loss-priority automatically. Table 3 on page 9 describes the policer actions.

Table 3: Policer Actions

Policer	Marking	Implicit Action	Configurable Action
Single-rate two-color	Green (Conforming)	Assign low loss priority	None
	Red (Nonconforming)	None	Assign low or high loss priority, assign a forwarding class, or discard On some platforms, you can assign medium-low or medium-high loss priority
Single-rate three-color	Green (Conforming)	Assign low loss priority	None
	Yellow (Above the CIR and CBS)	Assign medium-high loss priority	None
	Red (Above the EBS)	Assign high loss priority	Discard
Two-rate three-color	Green (Conforming)	Assign low loss priority	None
	Yellow (Above the CIR and CBS)	Assign medium-high loss priority	None
	Red (Above the PIR and PBS)	Assign high loss priority	Discard

You can configure policers at the queue, logical interface, or Layer 2 (MAC) level. Only a single policer is applied to a packet at the egress queue, and the search for policers occurs in this order:

- Queue level
- Logical interface level
- Layer 2 (MAC) level

Three-color policers are not bound by a green-yellow-red coloring convention. Packets are marked with low, medium-high, or high PLP bit configurations based on color, so both three-color policer schemes extend the functionality of class-of-service (CoS) traffic

policing by providing three levels of drop precedence (loss priority) instead of the two normally available in port-level policers. Both single-rate and two-rate three-color policer schemes can operate in two modes:

- Color-blind—In color-blind mode, the three-color policer assumes that all packets examined have not been previously marked or metered. In other words, the three-color policer is "blind" to any previous coloring a packet might have had.
- Color-aware—In color-aware mode, the three-color policer assumes that all packets examined have been previously marked or metered. In other words, the three-color policer is "aware" of the previous coloring a packet might have had. In color-aware mode, the three-color policer can increase the PLP of a packet, but never decrease it. For example, if a color-aware three-color policer meters a packet with a medium PLP marking, it can raise the PLP level to high, but cannot reduce the PLP level to low.

NOTE: We recommend you use the naming convention ***policertypeTCM#-color type*** when configuring three-color policers and *policer#* when configuring two-color policers. TCM stands for three-color marker. Because policers can be numerous and must be applied correctly to work, a simple naming convention makes it easier to apply the policers properly.

For example, the first single-rate, color-aware three-color policer configured would be named **srTCM1-ca**. The second two-rate, color-blind three-color configured would be named **trTCM2-cb**.

Platform Support for Tricolor Marking

Tricolor marking is supported on the following Juniper Networks routers:

- M120 Multiservice Edge Routers
- M320 Multiservice Edge Routers and T Series Core Routers with Enhanced II Flexible PIC Concentrators (FPCs)
- MX Series 3D Universal Edge Routers
- T640 Core Routers with Enhanced Scaling FPC4
- T640 and T1600 Core Routers with Enhanced Scaling FPC3
- T1600 Core Routers with T1600 Enhanced Scaling FPC4
- T4000 Core Routers

NOTE: On MX Series and M120 routers, you can apply three-color policers to aggregated interfaces.

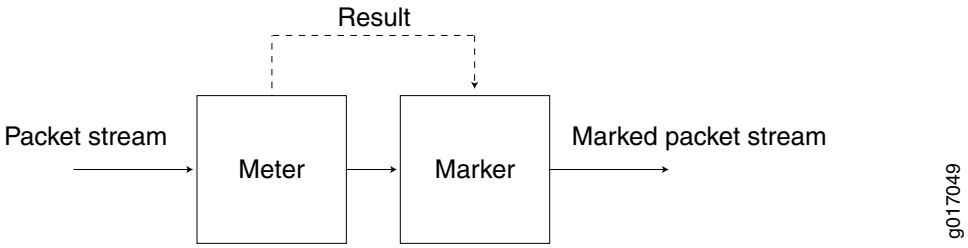
NOTE: On T Series routers, three-color policers and hierarchical policers are supported on aggregated interfaces if all child links are hosted on Enhanced Scaling FPCs.

Tricolor Marking Architecture

Policers provide two functions: metering and marking.

The policer meters each packet and passes the packet and the metering result to the marker, as shown in Figure 2 on page 11.

Figure 2: Flow of Tricolor Marking Policer Operation



The meter operates in two modes. In the color-blind mode, the meter treats the packet stream as uncolored. Any preset loss priorities are ignored. In the color-aware mode, the meter inspects the packet loss priority (PLP) field, which has been set by an upstream device as PLP high, medium-high, medium-low, or low; in other words, the PLP field has already been set by a behavior aggregate (BA) or multifield classifier. The marker changes the PLP of each incoming IP packet according to the results of the meter. For more information, see "Configuring Two-Rate Tricolor Marking" on page 21.

This chapter emphasizes configuration and use of TCM policers. For more information about configuring and using two-color policers ("policers"), see the *Traffic Policers Feature Guide for Routing Devices*.

Single-rate TCM is so called because traffic is policed according to one rate—the CBR—and two burst sizes: the CBS and EBS. The CBS specifies the usual burst size in bytes and the EBS specifies the maximum burst size in bytes for packets that are admitted to the network. The EBS is greater than or equal to the CBS, and neither can be 0. As each packet enters the network, its bytes are counted. Packets that do not exceed the CBS are marked low PLP. Packets that exceed the CBS but are below the EBS are marked medium-high PLP. Packets that exceed the EBS are marked high PLP.

Two-rate TCM is so called because traffic is policed according to two rates: the CIR and the PIR. The PIR is greater than or equal to the CIR. The CIR specifies the average rate at which bits are admitted to the network and the PIR specifies the maximum rate at which bits are admitted to the network. As each packet enters the network, its bits are counted. Bits in packets that do not exceed the CIR have their packets marked low PLP. Bits in packets that exceed the CIR but are below the PIR have their packets marked medium-high PLP. Bits in packets that exceed the PIR have their packets marked high PLP.

For information about how to use marking policers with BA and multifield classifiers, see "Using BA Classifiers to Set PLP" on page 31 and "Using Multifield Classifiers to Set PLP" on page 32.

Tricolor Marking Limitations

Tricolor Marking (TCM) has some limitations that must be kept in mind during configuration and operation.

The following limitations apply to TCM:

- When you enable TCM on a 10-port Gigabit Ethernet PIC or a 10-Gigabit Ethernet PIC, for queues 6 and 7 only, the output of the **show interfaces queue** *interface-name* command does not display the number of queued bytes and packets, or the number of bytes and packets dropped due to RED. If you do not configure tricolor marking on the interface, these statistics are available for all queues.
- When you enable TCM, Transmission Control Protocol (TCP)-based configurations for drop profiles are rejected. In other words, you cannot include the **protocol** statement at the **[edit class-of-service schedulers** *scheduler-name* **drop-profile-map]** hierarchy level. The result is that drop profiles are applied to packets with the specified PLP and any protocol type.
- On Gigabit Ethernet IQ PICs, for IEEE 802.1 rewrite rules, only two loss priorities are supported. Exiting packets with medium-high loss priority are treated as high, and packets with medium-low loss priority are treated as low. In other words rewrite rules corresponding to high and low apply instead of those corresponding to medium-high and medium-low. For IQ PICs, you can only configure one IEEE 802.1 rewrite rule on a physical port. All logical ports (units) on that physical port should apply the same IEEE 802.1 rewrite rule.
- When some PICs with Frame Relay encapsulation mark a packet with high loss priority, the packet is treated as having medium-high loss priority on M320 Multiservice Edge Routers and T Series Core Routers with Enhanced II FPCs and T640 Core Routers with Enhanced Scaling FPC4.
- TCM is not supported on aggregated Ethernet and aggregated SONET/SDH interfaces.
- In a single firewall filter term, you cannot configure both the **loss-priority** action modifier and the **three-color-policer** action modifier. These statements are mutually exclusive.

Policer Support for Aggregated Ethernet Bundle Overview

Aggregated interfaces support single-rate policers, three-color marking policers, two-rate three-color marking policers, hierarchical policers, and percentage-based policers. By default, policer bandwidth and burst-size applied on aggregated bundles is not matched to the user-configured bandwidth and burst-size.

You can configure interface-specific policers applied on an aggregated Ethernet bundle or an aggregated SONET bundle to match the effective bandwidth and burst-size to user-configured values. The **shared-bandwidth-policer** statement is required to achieve this match behavior.

This capability applies to all interface-specific policers of the following types: single-rate policers, single-rate three-color marking policers, two-rate three-color marking policers, and hierarchical policers. Percentage-based policers match the bandwidth to the user-configured values by default, and do not require shared-bandwidth-policer configuration. The **shared-bandwidth-policer** statement causes a split in burst-size for percentage-based policers.

NOTE: This feature is supported on the following platforms: T Series routers, M120, M10i, M7i (CFEB-E only), M320 (SFPC only), MX240, MX480, and MX960 (DPC only),and EX Series switches.

The following usage scenarios are supported:

- Interface policers used by the following configuration:

  [edit] interfaces (ae*X* | as*X*) unit *unit-num* **family** *family* **policer [input | output | arp]**

- Policers and three-color policers (both single-rate three-color marking and two-rate three-color marking) used inside interface-specific filters; that is, filters that have an interface-specific keyword and are used by the following configuration:

  [edit] interfaces (ae*X* | as*X*) unit *unit-num* **family** *family* **filter [input | output]**

- Common-edge service filters, which are derived from CLI-configured filters and thus inherit interface-specific properties. All policers and three-color policers used by these filters are also affected.

The following usage scenarios are not supported:

- Policers and three-color policers used inside filters that are not interface specific; such a filter is meant to be shared across multiple interfaces.
- Any implicit policers or policers that are part of implicit filters; for example, the default ARP policer applied to an aggregate Ethernet interface. Such a policer is meant to be shared across multiple interfaces.
- Prefix-specific action policers.

To configure this feature, include the **shared-bandwidth-policer** statement at the following hierarchy levels: **[edit firewall policer** *policer-name***]**, **[edit firewall three-color-policer** *policer-name***]**, or **[edit firewall hierarchical-policer** *policer-name***]**.

Related Documentation

- shared-bandwidth-policer on page 93

PART 2

Configuration

CHAPTER 2

Configuration Tasks for Tricolor Marking Policers

Configuring Tricolor Marking

You configure marking policers by defining the policer and multiple levels of PLP for classifiers, rewrite rules, random early detection (RED) drop profiles, and firewall filters. To configure marking policers, include the following statements at the **[edit class-of-service]** hierarchy level:

```
[edit class-of-service]
tri-color;
classifiers {
   (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) classifier-name {
      import classifier-name | default);
      forwarding-class class-name {
         loss-priority (low | medium-low | medium-high | high) code-points [ aliases ]
            [ bit-patterns ];
      }
   }
}
rewrite-rules {
   (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) rewrite-name {
      import (rewrite-name | default);
      forwarding-class class-name {
         loss-priority (low | medium-low | medium-high | high) code-point (aliases |
            bit-patterns;
      }
   }
```

```
}
schedulers {
  scheduler-name {
    drop-profile-map loss-priority (any | low | medium-low | medium-high | high)protocol
      any drop-profile profile-name;
  }
}

[edit firewall]
policer name {
  then loss-priority (low | medium-low | medium-high | high);
}
three-color-policer policer-name {
  action {
    loss-priority high then discard; # Only for IQ2 PICs
  }
  logical-interface-policer;
  single-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    excess-burst-size bytes;
  }
  two-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    peak-information-rate bps;
    peak-burst-size bytes;
  }
}
filter filter-name {
  <family family> {
    term rule-name {
      then {
        three-color-policer (single-rate | two-rate) policer-name;
      }
    }
  }
}
```

Related Documentation

- Traffic Policing Overview on page 3

Configuring Single-Rate Tricolor Marking

With TCM, you can configure traffic policing according to two separate modes—color-blind and color-aware. In color-blind mode, the current PLP value is ignored. In color-aware mode, the current PLP values are considered by the policer and can only be increased.

- Configuring Color-Blind Mode for Single-Rate Tricolor Marking on page 19
- Configuring Color-Aware Mode for Single-Rate Tricolor Marking on page 19

Configuring Color-Blind Mode for Single-Rate Tricolor Marking

All packets are evaluated by the CBS. If a packet exceeds the CBS, it is evaluated by the EBS. In color-blind mode, the policer supports three loss priorities only: low, medium-high, and high.

In color-blind mode, packets that exceed the CBS but are below the EBS are marked yellow (medium-high). Packets that exceed the EBS are marked red (high), as shown in Table 4 on page 19.

Table 4: Color-Blind Mode TCM Color-to-PLP Mapping

Color	PLP	Meaning
Green	**low**	Packet does not exceed the CBS.
Yellow	**medium-high**	Packet exceeds the CBS but does not exceed the EBS.
Red	**high**	Packet exceeds the EBS.

If you are using color-blind mode and you wish to configure an output policer that marks packets to have medium-low loss priority, you must configure a policer at the **[edit firewall policer *policer-name*]** hierarchy level. For example:

```
firewall {
   policer 4PLP {
      if-exceeding {
         bandwidth-limit 40k;
         burst-size-limit 4k;
      }
      then loss-priority medium-low;
   }
}
```

Apply this policer at one or both of the following hierarchy levels:

- **[edit firewall family *family* filter *filter-name* term *rule-name* then policer *policer-name*]**
- **[edit interfaces *interface-name* unit *logical-unit-number* family *family* filter *filter-name*]**

Configuring Color-Aware Mode for Single-Rate Tricolor Marking

In color-aware mode, the metering treatment the packet receives depends on its classification. Metering can increase a packet's preassigned PLP, but cannot decrease it, as shown in Table 5 on page 20.

Table 5: Color-Aware Mode TCM PLP Mapping

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
low	CBS and EBS	Packet does not exceed the CBS.	**low**
		Packet exceeds the CBS but not the EBS.	**medium-high**
		Packet exceeds the EBS.	**high**
medium-low	EBS only	Packet does not exceed the CBS.	**medium-low**
		Packet does not exceed the EBS.	**medium-low**
		Packet exceeds the EBS.	**high**
medium-high	EBS only	Packet does not exceed the CBS.	**medium-high**
		Packet does not exceed the EBS.	**medium-high**
		Packet exceeds the EBS.	**high**
high	Not metered by the policer.	All cases.	**high**

The following sections describe single-rate color-aware PLP mapping in more detail.

Effect on Low PLP of Single-Rate Policer

Packets belonging to the green class have already been marked by a classifier with low PLP. The marking policer can leave the packet's PLP unchanged or increase the PLP to medium-high or high. Therefore, these packets are metered against both the CBS and the EBS.

For example, if a BA or multifield classifier marks a packet with low PLP according to the type-of-service (ToS) bits in the IP header, and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CBS, packets remain marked as low PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, some of the packets are marked as medium-high PLP, and some of the packets remain marked as low PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP, and some of the packets remain marked as low PLP.

Effect on Medium-Low PLP of Single-Rate Policer

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the packet's PLP

unchanged or increase the PLP to high. Therefore, these packets are metered against the EBS only.

For example, if a BA or multifield classifier marks a packet with medium-low PLP according to the ToS bits in the IP header, and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CBS, packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP, and some of the packets remain marked as medium-low PLP.

Effect on Medium-High PLP of Single-Rate Policer

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the packet's PLP unchanged or increase the PLP to high. Therefore, these packets are metered against the EBS only.

For example, if a BA or multifield classifier marks a packet with medium-high PLP according to the ToS bits in the IP header, and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CBS, packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP, and some of the packets remain marked as medium-high PLP.

Effect on High PLP of Single-Rate Policer

Packets belonging to the red class have already been marked by a classifier with high PLP. The marking policer can only leave the packet's PLP unchanged. Therefore, these packets are not metered against the CBS or the EBS and all the packets remain marked as high PLP.

Configuring Two-Rate Tricolor Marking

With TCM, you can configure traffic policing according to two separate modes—color-blind and color-aware. In color-blind mode, the current PLP value is ignored. In color-aware mode, the current PLP values are considered by the policer and can only be increased.

- Configuring Color-Blind Mode for Two-Rate Tricolor Marking on page 22
- Configuring Color-Aware Mode for Two-Rate Tricolor Marking on page 22

Configuring Color-Blind Mode for Two-Rate Tricolor Marking

All packets are evaluated by the CIR. If a packet exceeds the CIR, it is evaluated by the PIR. In color-blind mode, the policer supports three loss priorities only: low, medium-high, and high.

In color-blind mode, packets that exceed the CIR but are below the PIR are marked yellow (medium-high). Packets that exceed the PIR are marked red (high), as shown in Table 6 on page 22.

Table 6: Color-Blind Mode TCM Color-to-PLP Mapping

Color	PLP	Meaning
Green	**low**	Packet does not exceed the CIR.
Yellow	**medium-high**	Packet exceeds the CIR but does not exceed the PIR.
Red	**high**	Packet exceeds the PIR.

If you are using color-blind mode and you wish to configure an output policer that marks packets to have medium-low loss priority, you must configure a policer at the **[edit firewall policer *policer-name*]** hierarchy level. For example:

```
firewall {
   policer 4PLP {
      if-exceeding {
         bandwidth-limit 40k;
         burst-size-limit 4k;
      }
      then loss-priority medium-low;
   }
}
```

Apply this policer at one or both of the following hierarchy levels:

- **[edit firewall family *family* filer *filter-name* term *rule-name* then policer *policer-name*]**
- **[edit interfaces *interface-name* unit *logical-unit-number* family *family* filter *filter-name*]**

Configuring Color-Aware Mode for Two-Rate Tricolor Marking

In color-aware mode, the metering treatment the packet receives depends on its classification. Metering can increase a packet's preassigned PLP, but cannot decrease it, as shown in Table 7 on page 23.

Table 7: Color-Aware Mode TCM Mapping

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
low	CIR and PIR	Packet does not exceed the CIR.	**low**
		Packet exceeds the CIR but not the PIR.	**medium-high**
		Packet exceeds the PIR.	**high**
medium-low	PIR only	Packet does not exceed the CIR.	**medium-low**
		Packet does not exceed the PIR.	**medium-low**
		Packet exceeds the PIR.	**high**
medium-high	PIR only	Packet does not exceed the CIR.	**medium-high**
		Packet does not exceed the PIR.	**medium-high**
		Packet exceeds the PIR.	**high**
high	Not metered by the policer.	All cases.	**high**

The following sections describe color-aware two-rate PLP mapping in more detail.

Effect on Low PLP of Two-Rate Policer

Packets belonging to the green class have already been marked by a classifier with low PLP. The marking policer can leave the packet's PLP unchanged or increase the PLP to medium-high or high. Therefore, these packets are metered against both the CIR and the PIR.

For example, if a BA or multifield classifier marks a packet with low PLP according to the ToS bits in the IP header, and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, packets remain marked as low PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, some of the packets are marked as medium-high PLP, and some of the packets remain marked as low PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP, and some of the packets remain marked as low PLP.

Effect on Medium-Low PLP of Two-Rate Policer

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the packet's PLP

unchanged or increase the PLP to high. Therefore, these packets are metered against the PIR only.

For example, if a BA or multifield classifier marks a packet with medium-low PLP according to the ToS bits in the IP header, and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the CIR/CBS but less than the PIR, packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP, and some of the packets remain marked as medium-low PLP.

Effect on Medium-High PLP of Two-Rate Policer

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the packet's PLP unchanged or increase the PLP to high. Therefore, these packets are metered against the PIR only.

For example, if a BA or multifield classifier marks a packet with medium-high PLP according to the ToS bits in the IP header, and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP, and some of the packets remain marked as medium-high PLP.

Effect on High PLP of Two-Rate Policer

Packets belonging to the red class have already been marked by a classifier with high PLP. The marking policer can only leave the packet's PLP unchanged. Therefore, these packets are not metered against the CIR or the PIR and all the packets remain marked as high PLP.

Enabling Tricolor Marking

By default, TCM is enabled on M120, MX Series, and T4000 routers, and EX Series switches. To enable TCM on other routers, include the **tri-color** statement at the **[edit class-of-service]** hierarchy level:

```
[edit class-of-service]
tri-color;
```

This statement is necessary on the following routers:

- M320 and T Series routers with Enhanced II FPCs
- T640 routers with Enhanced Scaling FPC4s

If you do not include this statement in the configuration on platforms that require it, you cannot configure medium-low or medium-high PLP for classifiers, rewrite rules, drop profiles, or firewall filters.

Configuring Tricolor Marking Policers

A tricolor marking policer polices traffic on the basis of metering rates, including the CIR, the PIR, their associated burst sizes, and any policing actions configured for the traffic. To configure a tricolor marking policer, include the following statements at the **[edit firewall]** hierarchy level:

```
[edit firewall]
three-color-policer name {
  action {
    loss-priority high then discard; # Only for IQ2 PICs
  }
  logical-interface-policer;
  single-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    excess-burst-size bytes;
  }
  two-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    peak-information-rate bps;
    peak-burst-size bytes;
  }
}
```

You can configure a tricolor policer to discard high loss priority traffic on a logical interface in the ingress or egress direction. To configure a policer on a logical interface using tricolor marking policing to discard high loss priority traffic, include the **logical-interface-policer** statement and **action** statement.

In all cases, the range of allowable bits-per-second or byte values is 1500 to 100,000,000,000. You can specify the values for bps and bytes either as complete decimal numbers or as decimal numbers followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

The color-aware policer implicitly marks packets into four loss priority categories:

- Low
- Medium-low

- Medium-high
- High

The color-blind policer implicitly marks packets into three loss priority categories:

- Low
- Medium-high
- High

Table 8 on page 26 describes all the configurable TCM statements.

Table 8: Tricolor Marking Policer Statements

Statement	Meaning	Configurable Values
single-rate	Marking is based on the CIR, CBS, and EBS.	–
two-rate	Marking is based on the CIR, PIR, and rated burst sizes.	–
color-aware	Metering depends on the packet's preclassification. Metering can increase a packet's assigned PLP, but cannot decrease it.	–
color-blind	All packets are evaluated by the CIR or CBS. If a packet exceeds the CIR or CBS, it is evaluated by the PIR or EBS.	–
committed-information-rate	Guaranteed bandwidth under normal line conditions and the average rate up to which packets are marked green.	1500 through 100,000,000,000 bps
committed-burst-size	Maximum number of bytes allowed for incoming packets to burst above the CIR, but still be marked green.	1500 through 100,000,000,000 bytes
excess-burst-size	Maximum number of bytes allowed for incoming packets to burst above the CIR, but still be marked yellow.	1500 through 100,000,000,000 bytes
peak-information-rate	Maximum achievable rate. Packets that exceed the CIR but are below the PIR are marked yellow. Packets that exceed the PIR are marked red.	1500 through 100,000,000,000 bps
peak-burst-size	Maximum number of bytes allowed for incoming packets to burst above the PIR, but still be marked yellow.	1500 through 100,000,000,000 bytes

Applying Tricolor Marking Policers to Firewall Filters

To rate-limit traffic by applying a tricolor marking policer to a firewall filter, include the **three-color-policer** statement:

```
three-color-policer {
   (single-rate | two-rate) policer-name;
}
```

You can include this statement at the following hierarchy levels:

- **[edit firewall family *family* filter *filter-name* term *rule-name* then]**
- **[edit firewall filter *filter-name* term *rule-name* then]**

In the **family** statement, the protocol family can be **any**, **ccc**, **inet**, **inet6**, **mpls**, or **vpls**.

You must identify the referenced policer as a **single-rate** or **two-rate** policer, and this statement must match the configured TCM policer. Otherwise, an error message appears in the configuration listing.

For example, if you configure **srTCM** as a single-rate TCM policer and try to apply it as a two-rate policer, the following message appears:

```
[edit firewall]
user@host# show three-color-policer srTCM
single-rate {
   color-aware;
   ...
}
user@host# show filter TESTER
term A {
   then {
      three-color-policer {
         ##
         ## Warning: Referenced two-rate policer does not exist
         ##
         two-rate srTCM;
      }
   }
}
```

Example: Applying a Two-Rate Tricolor Marking Policer to a Firewall Filter

Apply the **trtcm1-cb** policer to a firewall filter:

```
firewall {
   three-color-policer trtcm1-cb {  # Configure the trtcm1-cb policer.
   two-rate {
      color-blind;
      committed-information-rate 1048576;
      committed-burst-size 65536;
      peak-information-rate 10485760;
      peak-burst-size 131072;
   }
}
filter fil {   # Configure the fil firewall filter, applying the trtcm1-cb policer.
term default {
   then {
      three-color-policer {
         two-rate trtcm1-cb;
      }
   }
}
```

Related Documentation

- *Firewall Filters Feature Guide for Routing Devices*

Applying Firewall Filter Tricolor Marking Policers to Interfaces

To apply a tricolor marking policer to an interface, you must reference the filter name in the interface configuration. To do this, include the **filter** statement:

```
filter {
  input filter-name;
  output filter-name;
}
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number* family *family*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]**

The filter name that you reference should have an attached tricolor marking policer, as shown in "Applying Tricolor Marking Policers to Firewall Filters" on page 26.

Example: Applying a Single-Rate Tricolor Marking Policer to an Interface

Apply the **trtcm1-cb** policer to an interface:

```
firewall {
  three-color-policer srtcm1 {    # Configure the srtcm1-cb policer.
  single-rate {
    color-blind;
    committed-information-rate 1048576;
    committed-burst-size 65536;
    excess-burst-size 131072;
  }
}
filter fil {    # Configure the fil firewall filter, applying the srtcm1-cb policer.
term default {
  then {
    three-color-policer {
      single-rate srtcm1-cb;    # The TCM policer must be single-rate.
    }
  }
}
interfaces {    # Configure the interface, which attaches the fil firewall filter.
so-1/0/0 {
  unit 0 {
    family inet {
      filter {
        input fil;
      }
    }
  }
}
```

Applying Layer 2 Policers to Gigabit Ethernet Interfaces

To rate-limit traffic by applying a policer to a Gigabit Ethernet interface (or a 10-Gigabit Ethernet interface [**xe-*fpc/pic/port***]), include the **layer2-policer** statement with the direction, type, and name of the policer:

```
[edit interfaces ge-fpc/pic/port unit 0]
layer2-policer {
  input-policer policer-name;
  input-three-color policer-name;
  output-policer policer-name;
  output-three-color policer-name;
}
```

The direction (input or output) and type (policer or three-color) are combined into one statement and the policer named must be properly configured.

One input or output policer of either type can be configured on the interface.

Examples: Applying Layer 2 Policers to a Gigabit Ethernet Interface

Apply color-blind and color-aware two-rate TCM policers as input and output policers to a Gigabit Ethernet interface:

```
ge-1/0/0 {
  unit 0
  layer2-policer {
    input-three-color trTCM1-cb;   # Apply the trTCM1-color-blind policer.
    output-three-color trTCM1-ca;   # Apply the trTCM1-color-aware policer.
  }
}
```

Apply two-level and color-blind single-rate TCM policers as input and output policers to a Gigabit Ethernet interface:

```
ge-1/0/0 {
  unit 1
  layer2-policer {
    input-policer two-color-policer;   # Apply a two-color policer.
    output-three-color srTCM2-cb;   # Apply the srTCM1-color-blind policer.
  }
}
```

Apply a color-aware single-rate TCM policer as output policer on a Gigabit Ethernet interface:

```
ge-1/0/0 {
  unit 2
  layer2-policer {
    output-three-color srTCM3-ca {   # Apply the srTCM3-color-aware policer.
  }
}
```


CHAPTER 3

Configuration Tasks for Packet Loss Priority

Using BA Classifiers to Set PLP

Behavior aggregate (BA) classifiers take action on incoming packets. When TCM is enabled, Juniper Networks M320 Multiservice Edge Routers and T Series Core Routers support four classifier PLP designations: **low**, **medium-low**, **medium-high**, and **high**. To configure the PLP for a classifier, include the following statements at the **[edit class-of-service]** hierarchy level:

```
[edit class-of-service]
classifiers {
  (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) classifier-name {
    import (classifier-name | default);
    forwarding-class class-name {
      loss-priority (low | medium-low | medium-high | high) code-points [ aliases ]
        [ bit-patterns ];
    }
  }
}
```

The inputs for a classifier are the CoS values. The outputs for a classifier are the forwarding class and the loss priority (PLP). A classifier sets the forwarding class and the PLP for each packet entering the interface with a specific set of CoS values.

For example, in the following configuration, the **assured-forwarding** forwarding class and **medium-low** PLP are assigned to all packets entering the interface with the **101110** CoS values:

```
class-of-service {
  classifiers {
    dscp dscp-cl {
      forwarding-class assured-forwarding {
        loss-priority medium-low {
```

```
            code-points 101110;
          }
        }
      }
    }
  }
```

To use this classifier, you must configure the settings for the **assured-forwarding** forwarding class at the **[edit class-of-service forwarding-classes queue *queue-number* assured-forwarding]** hierarchy level. For more information, see *Overview of Forwarding Classes*.

Using Multifield Classifiers to Set PLP

Multifield classifiers take action on incoming or outgoing packets, depending whether the firewall rule is applied as an input filter or an output filter. When TCM is enabled, Juniper Networks M320 Multiservice Edge Routers and T Series Core Routers support four multifield classifier PLP designations: **low**, **medium-low**, **medium-high**, and **high**.

To configure the PLP for a multifield classifier, include the **loss-priority** statement in a policer or firewall filter that you configure at the at the **[edit firewall]** hierarchy level:

```
[edit firewall]
family family-name {
  filter filter-name {
    term term-name {
      from {
        match-conditions;
      }
      then {
        loss-priority (low | medium-low | medium-high | high);
        forwarding-class class-name;
      }
    }
  }
}
```

The inputs (match conditions) for a multifield classifier are one or more of the six packet header fields: destination address, source address, IP protocol, source port, destination port, and DSCP. The outputs for a multifield classifier are the forwarding class and the loss priority (PLP). In other words, a multifield classifier sets the forwarding class and the PLP for each packet entering or exiting the interface with a specific destination address, source address, IP protocol, source port, destination port, or DSCP.

For example, in the following configuration, the forwarding class **expedited-forwarding** and PLP **medium-high** are assigned to all IPv4 packets with the **10.1.1.0/24** or **10.1.2.0/24** source address:

```
firewall {
  family inet {
    filter classify-customers {
      term isp1-customers {
        from {
          source-address 10.1.1.0/24;
```

```
            source-address 10.1.2.0/24;
          }
          then {
            loss-priority medium-high;
            forwarding-class expedited-forwarding;
          }
        }
      }
    }
  }
```

To use this classifier, you must configure the settings for the **expedited-forwarding** forwarding class at the **[edit class-of-service forwarding-classes queue *queue-number* expedited-forwarding]** hierarchy level. For more information, see *Overview of Forwarding Classes*.

Configuring PLP for Drop-Profile Maps

RED drop profiles take action on outgoing packets. When TCM is enabled, M320 and T Series routers support four drop-profile map PLP designations: **low**, **medium-low**, **medium-high**, and **high**.

To configure the PLP for the drop-profile map, include the **schedulers** statement at the **[edit class-of-service]** hierarchy level:

```
[edit class-of-service]
schedulers {
  scheduler-name {
    drop-profile-map loss-priority (any | low | medium-low | medium-high | high)protocol
      any drop-profile profile-name;
  }
}
```

When you configure TCM, the drop-profile map's protocol type must be **any**.

The inputs for a drop-profile map are the loss priority and the protocol type. The output for a drop-profile map is the drop profile name. In other words, the map sets the drop profile for each packet with a specific PLP and protocol type exiting the interface.

For example, in the following configuration, the **dp** drop profile is assigned to all packets exiting the interface with a medium-low PLP and belonging to any protocol:

```
class-of-service {
  schedulers {
    af {
      drop-profile-map loss-priority medium-low protocol any drop-profile dp;
    }
  }
}
```

To use this drop-profile map, you must configure the settings for the **dp** drop profile at the **[edit class-of-service drop-profiles dp]** hierarchy level. For more information, see *RED Drop Profiles Overview*.

Configuring Rewrite Rules Based on PLP

Rewrite rules take action on outgoing packets. When TCM is enabled, M320 and T Series routers support four rewrite PLP designations: **low**, **medium-low**, **medium-high**, and **high**. To configure the PLP for a rewrite rule, include the following statements at the **[edit class-of-service]** hierarchy level:

```
[edit class-of-service]
rewrite-rules {
   (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) rewrite-name {
      import (rewrite-name | default);
      forwarding-class class-name {
         loss-priority (low | medium-low | medium-high | high) code-point (alias | bits);
      }
   }
}
```

The inputs for a rewrite rule are the forwarding class and the loss priority (PLP). The output for a rewrite rule are the CoS values. In other words, a rewrite rule sets the CoS values for each packet exiting the interface with a specific forwarding class and PLP.

For example, if you configure the following, the **000000** CoS values are assigned to all packets exiting the interface with the **assured-forwarding** forwarding class and **medium-high** PLP:

```
class-of-service {
   rewrite-rules {
      dscp dscp-rw {
         forwarding-class assured-forwarding {
            loss-priority medium-high code-point 000000;
         }
      }
   }
}
```

To use this classifier, you must configure the settings for the **assured-forwarding** forwarding class at the **[edit class-of-service forwarding-classes queue *queue-number* assured-forwarding]** hierarchy level. For more information, see *Overview of Forwarding Classes*.

CHAPTER 4

Policers Examples

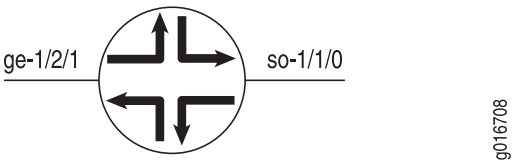
Example: Configuring and Verifying Two-Rate Tricolor Marking

This example configures a two-rate tricolor marking policer on an input Gigabit Ethernet interface and shows commands to verify its operation.

Traffic enters the Gigabit Ethernet interface and exits a SONET/SDH OC12 interface. Oversubscription occurs when you send line-rate traffic from the Gigabit Ethernet interface out the OC12 interface.

Figure 3 on page 35 shows the sample topology.

Figure 3: Tricolor Marking Sample Topology



Applying a Policer to the Input Interface

The tricolor marking and policer are applied on the ingress Gigabit Ethernet interface. Incoming packets are metered. Packets that do not exceed the CIR are marked with low loss priority. Packets that exceed the CIR but do not exceed the PIR are marked with medium-high loss priority. Packets that exceed the PIR are marked with high loss priority.

[edit]

```
interfaces {
   ge-1/2/1 {
      unit 0 {
         family inet {
            filter {
               input trtcm-filter;
            }
         }
      }
   }
}
firewall {
   three-color-policer trtcm1 {
      two-rate {
         color-aware;
         committed-information-rate 100m;
         committed-burst-size 65536;
         peak-information-rate 200m;
         peak-burst-size 131072;
      }
   }
   filter trtcm-filter {
      term one {
         then {
            three-color-policer {
               two-rate trtcm1;
            }
         }
      }
   }
}
```

Applying Profiles to the Output Interface

Transmission scheduling and weighted random early detection (WRED) profiles are applied on the output OC12 interface. The software drops traffic in the low, medium-high, and high drop priorities proportionally to the configured drop profiles.

```
[edit]
class-of-service {
   drop-profiles {
      low-tcm {
         fill-level 80 drop-probability 100;
      }
      med-tcm {
         fill-level 40 drop-probability 100;
      }
      high-tcm {
         fill-level 10 drop-probability 100;
      }
   }
   tri-color;
   interfaces {
      so-1/1/0 {
         scheduler-map tcm-sched;
      }
```

```
    }
    scheduler-maps {
      tcm-sched {
        forwarding-class queue-0 scheduler q0-sched;
        forwarding-class queue-3 scheduler q3-sched;
      }
    }
    schedulers {
      q0-sched {
        transmit-rate percent 50;
        buffer-size percent 50;
        drop-profile-map loss-priority low protocol any drop-profile low-tcm;
        drop-profile-map loss-priority medium-high protocol any drop-profile med-tcm;
        drop-profile-map loss-priority high protocol any drop-profile high-tcm;
      }
      q3-sched {
        transmit-rate percent 50;
        buffer-size percent 50;
      }
    }
}
```

Marking Packets with Medium-Low Loss Priority

In another example, the 4PLP filter and policer causes certain packets to be marked with medium-low loss priority.

```
interfaces {
  ge-7/2/0 {
    unit 0 {
      family inet {
        filter {
          input 4PLP;
        }
        policer {
          input 4PLP;
        }
        address 10.45.10.2/30;
      }
    }
  }
}

firewall {
  three-color-policer trTCM {
    two-rate {
      color-blind;
      committed-information-rate 400m;
      committed-burst-size 100m;
      peak-information-rate 1g;
      peak-burst-size 500m;
    }
  }
  policer 4PLP {
    if-exceeding {
      bandwidth-limit 40k;
```

```
        burst-size-limit 4k;
      }
      then loss-priority medium-low;
    }
    family inet {
      filter 4PLP {
        term 0 {
          from {
            precedence 1;
          }
          then loss-priority medium-low;
        }
      }
      filter filter_trTCM {
        term default {
          then {
            three-color-policer {
              two-rate trTCM;
            }
          }
        }
      }
    }
  }
```

Verifying Two-Rate Tricolor Marking Operation

The following operational mode commands are useful for checking the results of your configuration:

- **show class-of-service forwarding-table classifiers**
- **show interfaces *interface-name* extensive**
- **show interfaces queue *interface-name***

For information about these commands, see the CLI Explorer.

Example: Performing CoS at an Egress Network Boundary by Configuring an Egress Single-Rate Two-Color Policer

This example shows how to configure an egress single-rate two-color policer. Policers use a concept known as a token bucket. The policer enforces the class-of-service (CoS) strategy for in-contract and out-of-contract traffic. You can apply a single-rate two-color policer to incoming packets, outgoing packets, or both. This example applies the policer as an output (egress) policer. This example is an introduction to policing by using an example that shows traffic policing in action.

A thorough explanation of the token bucket concept and its underlying algorithms is beyond the scope of this document. For more information about traffic policing, and CoS in general, refer to *QOS-Enabled Networks—Tools and Foundations* by Miguel Barreiros

and Peter Lundqvist. This book is available at many online booksellers and at www.juniper.net/books .

Requirements

To verify this procedure, this example uses a traffic generator. The traffic generator can be hardware-based or it can be software running on a server or host machine.

The functionality in this procedure is widely supported on devices that run Junos OS. The example shown here was tested and verified on MX Series routers running Junos OS Release 10.4.

Overview

Single-rate two-color policing enforces a configured rate of traffic flow for a particular service level by applying implicit or configured actions to traffic that does not conform to the limits. When you apply a single-rate two-color policer to the input or output traffic at an interface, the policer meters the traffic flow to the rate limit defined by the following components:

- Bandwidth limit—The average number of bits per second permitted for packets received or transmitted at the interface. You can specify the bandwidth limit as an absolute number of bits per second or as a percentage value from 1 through 100. If a percentage value is specified, the effective bandwidth limit is calculated as a percentage of either the physical interface media rate or the logical interface configured shaping rate.
- Burst-size limit—The maximum size permitted for bursts of data. Burst sizes are measured in megabytes. We recommend two formulas for calculating burst size:

  Burst size = bandwidth x allowable time for burst traffic / 8

  Or

  Burst size = interface mtu x 10

  For information about configuring the burst size, see *Determining Proper Burst Size for Traffic Policers*.

NOTE: **There is a finite buffer space for an interface. In general, the estimated total buffer depth for an interface is about 125 ms.**

For a traffic flow that conforms to the configured limits (categorized as green traffic), packets are implicitly marked with a packet loss priority (PLP) level of low and are allowed to pass through the interface unrestricted.

For a traffic flow that exceeds the configured limits (categorized as red traffic), packets are handled according to the traffic-policing actions configured for the policer. This example discards packets that burst over the 15 KBps limit.

To rate-limit Layer 3 traffic, you can apply a two-color policer in the following ways:

- Directly to a logical interface, at a specific protocol level.
- As the action of a standard stateless firewall filter that is applied to a logical interface, at a specific protocol level. This is the technique used in this example.

To rate-limit Layer 2 traffic, you can apply a two-color policer as a logical interface policer only. You cannot apply a two-color policer to Layer 2 traffic through a firewall filter.

CAUTION: You can choose either bandwidth-limit or bandwidth percent within the policer, as they are mutually exclusive. You cannot configure a policer to use bandwidth percent for aggregate, tunnel, or software interfaces.

In this example, the host is a traffic generator emulating a webserver. Devices R1 and R2 are owned by a service provider. The webserver is accessed by users behind Device R2. The host will be sending traffic with a source TCP HTTP port of 80 to the users. A single-rate two-color policer is configured and applied to the interface on Device R1 that connects to Device R2. The policer enforces the contractual bandwidth availability made between the owner of the webserver (in this case emulated by the host) and the service provider that owns Devices R1 and R2 for the web traffic that flows over the link that connects Devices R1 and R2.

In accordance with the contractual bandwidth availability made between the owner of the webserver and the service provider that owns Devices R1 and R2, the policer will limit the HTTP port 80 traffic originating from the host to using 700 Mbps (70 percent) of the available bandwidth with an allowable burst rate of 10 x the MTU size of the gigabit Ethernet interface between Devices R1 and R2.

NOTE: In a real-world scenario you would probably also rate-limit traffic for a variety of other ports such as FTP, SFTP, SSH, TELNET, SMTP, IMAP, and POP3 because they are often included as additional services with web hosting services.

NOTE: You need to leave some additional bandwidth available that is not rate-limited for network control protocols such as routing protocols, DNS, and any other protocols required to keep network connectivity operational. This is why the firewall filter has a final accept condition on it.

Topology

This example uses the topology in Figure 4 on page 41.

Figure 4: Single-Rate Two-Color Policer Scenario

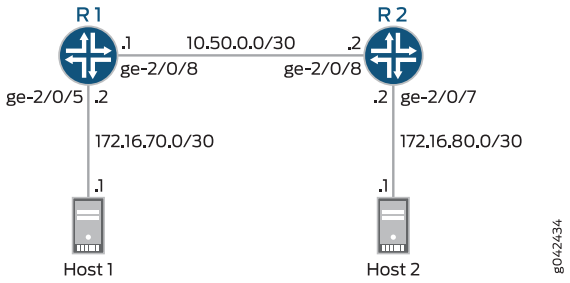
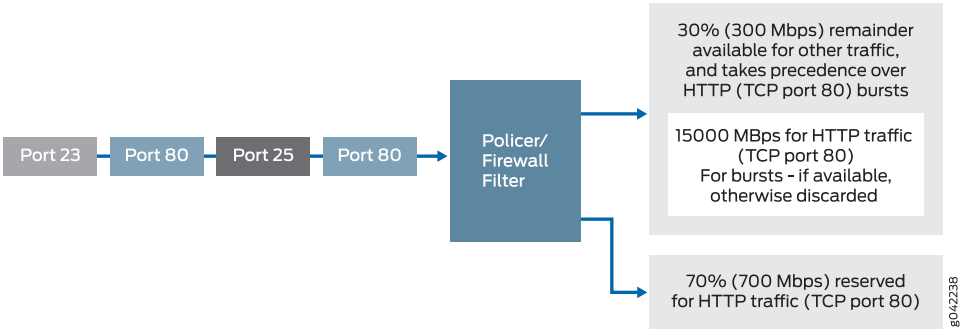


Figure 5 on page 41 shows the policing behavior.

Figure 5: Traffic Limiting in a Single-Rate Two-Color Policer Scenario



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces ge-2/0/5 description to-Host
set interfaces ge-2/0/5 unit 0 family inet address 172.16.70.2/30
set interfaces ge-2/0/8 description to-R2
set interfaces ge-2/0/8 unit 0 family inet address 10.50.0.1/30
set interfaces ge-2/0/8 unit 0 family inet filter output mf-classifier
set interfaces lo0 unit 0 description looback-interface
set interfaces lo0 unit 0 family inet address 192.168.13.1/32
set firewall policer discard if-exceeding bandwidth-limit 700m
set firewall policer discard if-exceeding burst-size-limit 15k
set firewall policer discard then discard
set firewall family inet filter mf-classifier term t1 from protocol tcp
set firewall family inet filter mf-classifier term t1 from port 80
set firewall family inet filter mf-classifier term t1 then policer discard
set firewall family inet filter mf-classifier term t2 then accept
set protocols ospf area 0.0.0.0 interface ge-2/0/5.0 passive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/0/8.0
```

Device R2

```
set interfaces ge-2/0/7 description to-Host
set interfaces ge-2/0/7 unit 0 family inet address 172.16.80.2/30
set interfaces ge-2/0/8 description to-R1
set interfaces ge-2/0/8 unit 0 family inet address 10.50.0.2/30
set interfaces lo0 unit 0 description looback-interface
set interfaces lo0 unit 0 family inet address 192.168.14.1/32
set protocols ospf area 0.0.0.0 interface ge-2/0/7.0 passive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/0/8.0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the device interfaces.

   ```
   [edit interfaces]
   user@R1#set ge-2/0/5 description to-Host
   user@R1#set ge-2/0/5 unit 0 family inet address 172.16.70.2/30
   user@R1#set ge-2/0/8 description to-R2
   user@R1#set ge-2/0/8 unit 0 family inet address 10.50.0.1/30
   user@R1# set lo0 unit 0 description looback-interface
   user@R1#set lo0 unit 0 family inet address 192.168.13.1/32
   ```

2. Configure the policer to rate-limit to a bandwidth of 700 Mbps and a burst size of 15 KBps for HTTP traffic (TCP port 80).

   ```
   [edit firewall policer discard]
   user@R1# set if-exceeding bandwidth-limit 700m
   user@R1# set if-exceeding burst-size-limit 15k
   ```

3. Configure the policer to discard packets in the red traffic flow.

   ```
   [edit firewall policer discard]
   user@R1# set then discard
   ```

4. Configure the first two conditions of the firewall to accept all TCP traffic to port HTTP (port 80).

   ```
   [edit firewall family inet filter mf-classifier]
   user@R1# set term t1 from protocol tcp
   user@R1# set term t1 from port 80
   ```

5. Configure the third condition to rate-limit HTTP TCP traffic using the policer.

   ```
   [edit firewall family inet filter mf-classifier]
   user@R1# set term t1 then policer discard
   ```

6. At the end of the firewall filter, configure a default condition that accepts all other traffic.

   Otherwise, all traffic that arrives on the interface and is not explicitly accepted by the firewall is discarded.

   ```
   [edit firewall family inet filter mf-classifier]
   user@R1# set term t2 then accept
   ```

7. Apply the firewall filter to interface ge-2/0/8 as an output filter.

```
[edit interfaces ge-2/0/8 unit 0 family inet]
user@R1# set filter output mf-classifier
```

8. Configure OSPF.

```
[edit protocols ospf]
user@R1# set area 0.0.0.0 interface ge-2/0/5.0 passive
user@R1# set area 0.0.0.0 interface lo0.0 passive
user@R1# set area 0.0.0.0 interface ge-2/0/8.0
```

Step-by-Step Procedure

To configure Device R2:

1. Configure the device interfaces.

```
[edit interfaces]
set ge-2/0/7 description to-Host
set ge-2/0/7 unit 0 family inet address 172.16.80.2/30
set ge-2/0/8 description to-R1
set ge-2/0/8 unit 0 family inet address 10.50.0.2/30
set lo0 unit 0 description looback-interface
set lo0 unit 0 family inet address 192.168.14.1/32
```

2. Configure OSPF.

```
[edit protocols ospf]
set area 0.0.0.0 interface ge-2/0/7.0 passive
set area 0.0.0.0 interface lo0.0 passive
set area 0.0.0.0 interface ge-2/0/8.0
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show firewall**, and **show protocols OSPF** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
ge-2/0/5 {
    description to-Host;
    unit 0 {
        family inet {
            address 172.16.70.2/30;
        }
    }
}
ge-2/0/8 {
    description to-R2;
    unit 0 {
        family inet {
            filter {
                output mf-classifier;
            }
            address 10.50.0.1/30;
        }
    }
}
lo0 {
    unit 0 {
        description looback-interface;
```

```
      family inet {
        address 192.168.13.1/32;
      }
    }
}
```

```
user@R1# show firewall
family inet {
    filter mf-classifier {
        term t1 {
            from {
                protocol tcp;
                port 80;
            }
            then policer discard;
        }
        term t2 {
            then accept;
        }
    }
}
policer discard {
    if-exceeding {
        bandwidth-limit 700m;
        burst-size-limit 15k;
    }
    then discard;
}
```

```
policer discard {
    if-exceeding {
        bandwidth-limit 700m;
        burst-size-limit 15k;
    }
    then discard;
}
```

```
user@R1# show protocols ospf
area 0.0.0.0 {
    interface ge-2/0/5.0 {
        passive;
    }
    interface lo0.0 {
        passive;
    }
    interface ge-2/0/8.0;
}
```

If you are done configuring Device R1, enter **commit** from configuration mode.

```
user@R2# show interfaces
ge-2/0/7 {
    description to-Host;
    unit 0 {
        family inet {
            address 172.16.80.2/30;
        }
```

```
    }
  }
  ge-2/0/8 {
    description to-R1;
    unit 0 {
      family inet {
        address 10.50.0.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      description looback-interface;
      family inet {
        address 192.168.14.1/32;
      }
    }
  }
```

```
user@R2# show protocols ospf
area 0.0.0.0 {
  interface ge-2/0/7.0 {
    passive;
  }
  interface lo0.0 {
    passive;
  }
  interface ge-2/0/8.0;
}
```

If you are done configuring Device R2, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Clearing the Counters

Purpose Confirm that the firewall counters are cleared.

Action On Device R1, run the **clear firewall all** command to reset the firewall counters to 0.

```
user@R1> clear firewall all
```

Sending TCP Traffic into the Network and Monitoring the Discards

Purpose Make sure that the traffic of interest that is sent is rate-limited on the output interface (ge-2/0/8).

Action

1. Use a traffic generator to send 20 TCP packets with a source port of 80.

The -s flag sets the source port. The -k flag causes the source port to remain steady at 80 instead of incrementing. The -c flag sets the number of packets to 10. The -d flag sets the packet size.

The destination IP address of 172.16.80.1 represents a user that is downstream of Device R2. The user has requested a webpage from the host (the webserver emulated by the traffic generator), and the packets are sent in response to the request.

NOTE: In this example the policer numbers are reduced to a bandwidth limit of 8 Kbps and a burst size limit of 1500 KBps to ensure that some packets are dropped.

```
[root@host]#  hping 172.16.80.1 -s 80 -k -d 375 -c 20


[root@tp-lnx03 rtwright]# hping 172.16.80.1 -s 80 -k -d 375 -c 20
HPING 172.16.80.1 (eth1 172.16.80.1): NO FLAGS are set, 40 headers + 375 data
 bytes
len=46 ip=172.16.80.1 ttl=62 DF id=0 sport=0 flags=RA seq=0 win=0 rtt=4000.8
ms
.
.
.
--- 172.16.80.1 hping statistic ---
20 packets transmitted, 12 packets received, 40% packet loss
```

2. On Device R1, check the firewall counters by using the **show firewall** command.

```
user@R1> show firewall


user@sugar# run show firewall

Filter: mf-classifier
Policers:
Name                                                Bytes              Packets
discard-t1                                      3320                8
```

Meaning In Steps 1 and 2 the output from both devices shows that 8 packets were discarded. This means that there was at least 8 Kbps of green (in-contract HTTP port 80) traffic and that the 1500 KBps burst option for red out-of-contract HTTP port 80 traffic was exceeded.

Related Documentation

- *Junos OS Routing Protocols and Policies Configuration Guide for Security Devices*
- *Junos OS Firewall Filters and Traffic Policers Library for Routing Devices*
- *Junos OS Feature Support Reference for SRX Series and J Series Devices*
- *Example: Configuring a Two-Rate Three-Color Policer*

Example: Limiting Outbound Traffic Within Your Network by Configuring an Egress Single-Rate Two-Color Policer and Configuring Multifield Classifiers

This example shows how to limit customer traffic within your network using a single-rate two-color policer. Policers use a concept known as a token bucket to identify which traffic to drop. The policer enforces the class-of-service (CoS) strategy of in-contract and out-of-contract traffic at the interface level. You can apply a single-rate two-color policer to incoming packets, outgoing packets, or both. This example applies the policer as an output (egress) policer for outgoing traffic. The multifield classifier CoS queueing option places the traffic into the assigned queues which will help you manage resource utilization at the output interface level by applying scheduling and shaping at a later date.

A thorough explanation of the token bucket concept and its underlying algorithms is beyond the scope of this document. For more information about traffic policing, and CoS in general, refer to *QOS-Enabled Networks—Tools and Foundations* by Miguel Barreiros and Peter Lundqvist. This book is available at many online booksellers and at www.juniper.net/books .

Requirements

To verify this procedure, this example uses a traffic generator. The traffic generator can be hardware-based or it can be software running on a server or host machine.

The functionality in this procedure is widely supported on devices that run Junos OS. The example shown here was tested and verified on MX Series routers running Junos OS Release 10.4.

Overview

Policing

Single-rate two-color policing enforces a configured rate of traffic flow for a particular service level by applying implicit or configured actions to traffic that does not conform to the limits. When you apply a single-rate two-color policer to the input or output traffic at an interface, the policer meters the traffic flow to the rate limit defined by the following components:

- Bandwidth limit—The average number of bits per second permitted for packets received or transmitted at the interface. You can specify the bandwidth limit as an absolute number of bits per second or as a percentage value from 1 through 100. If a percentage value is specified, the effective bandwidth limit is calculated as a percentage of either the physical interface media rate or the logical interface configured shaping rate.
- Burst-size limit—The maximum size permitted for bursts of data. Burst sizes are measured in megabytes. We recommend two formulas for calculating burst size:

Burst size = bandwidth x allowable time for burst traffic / 8

Or

Burst size = interface mtu x 10

For information about configuring the burst size, see *Determining Proper Burst Size for Traffic Policers*.

NOTE: **There is a finite buffer space for an interface. In general, the estimated total buffer depth for an interface is about 125 ms.**

For a traffic flow that conforms to the configured limits (categorized as green traffic), packets are implicitly marked with a packet loss priority (PLP) level of low and are allowed to pass through the interface unrestricted.

For a traffic flow that exceeds the configured limits (categorized as red traffic), packets are handled according to the traffic-policing actions configured for the policer. This example discards packets that burst over the 15 KBps limit.

To rate-limit Layer 3 traffic, you can apply a two-color policer in the following ways:

- Directly to a logical interface, at a specific protocol level.
- As the action of a standard stateless firewall filter that is applied to a logical interface, at a specific protocol level. This is the technique used in this example.

To rate-limit Layer 2 traffic, you can apply a two-color policer as a logical interface policer only. You cannot apply a two-color policer to Layer 2 traffic through a firewall filter.

CAUTION: **You can choose either bandwidth-limit or bandwidth percent, within the policer, as they are mutually exclusive. You cannot configure a policer to use bandwidth percent for aggregate, tunnel, and software interfaces.**

In this example, the host connected to Device 1 is a traffic generator emulating a webserver. Devices R1, R2, and R3 are owned by a service provider. The webserver is accessed by users behind Device R2. Both hosts are owned by the same customers and their traffic needs to be managed. The host connected to Device 1 will be sending traffic with a source TCP HTTP port of 80 to the users. A single-rate two-color policer is configured and applied to the interface on Device R1 that connects to Device R2. The policer enforces the contractual bandwidth availability made between the owner of the webserver (in this case emulated by the host connected to Device R1) and the service provider that owns Devices R1, R2, and R3 for the web traffic that flows over the link that connects Devices R1 and R2.

The reason that this example is applying the policer as an egress policer between Devices R1 and R2 is because this is the point where the traffic from both customers sites shares the same link. This makes it easier to enforce the required policing parameters. Trying to rate-limit the combined customer traffic on the link between Devices R1 and R2 by applying

the policers as ingress policers on interfaces ge-0/0/0 on Device R3 and ge-2/0/5 on Device R1 would be very complicated because using the contracted rate of 700 Mbps (70 percent) of the available bandwidth with an allowable burst rate of 10 x the MTU size of the gigabit Ethernet interface between the host and Device R3 and the host and Device R1 would result in allowing a maximum throughput of 1400 Mbps over the link between Devices R1 and R2. Therefore, the rate-limiting applied to the host connections between the hosts and Devices R3 and R1 would have to be reduced below 700 Mbps. The calculation of what to reduce the rate-limit number to would be problematic because just reducing each host to 350 Mbps would mean that if one host was transmitting traffic while the other host was not transmitting, the maximum throughput on the link between Devices R1 and R2 would be only one half of the contracted rate (350 Mbps instead of 700 Mbps). This is why this example is useful to show the amount of thought that has to go into applying CoS in a network to achieve the desired goals.

In accordance with the contractual bandwidth availability made between the owner of the webservers and the service provider that owns Devices R1, R2 and R3, the egress policer on Device R1 will limit the HTTP port 80 traffic originating from the host to using 700 Mbps (70 percent) of the available bandwidth with an allowable burst rate of 10 x the MTU size of the gigabit Ethernet interface between Devices R1 and R2.

Additional traffic from TCP source port 12345 is used in this example to further illustrate how traffic is allocated to the outbound queues.

NOTE: In a real-world scenario you would probably also rate-limit traffic for a variety of other ports such as FTP, SFTP, SSH, TELNET, SMTP, IMAP, and POP3 because they are often included as additional services with web hosting services.

NOTE: You need to leave some additional bandwidth available that is not rate-limited for network control protocols such as routing protocols, DNS, and any other protocols required to keep network connectivity operational. This is why the firewall filter has a final accept condition on it.

Topology

This example uses the topology in Figure 4 on page 41.

Figure 6: Single-Rate Two-Color Policer Scenario

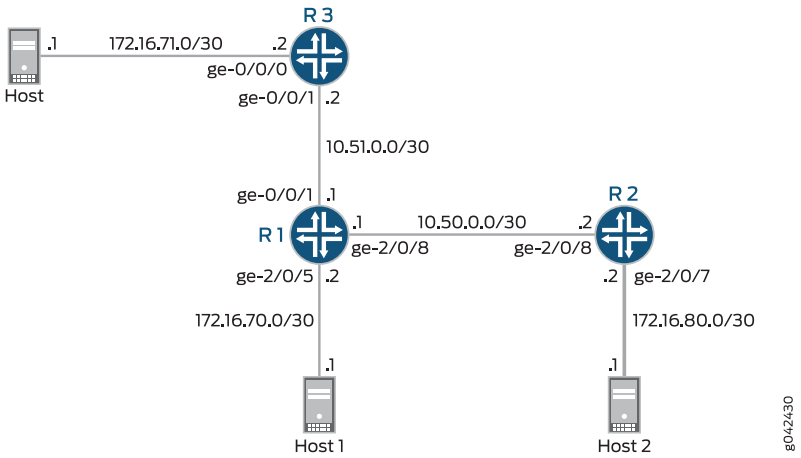
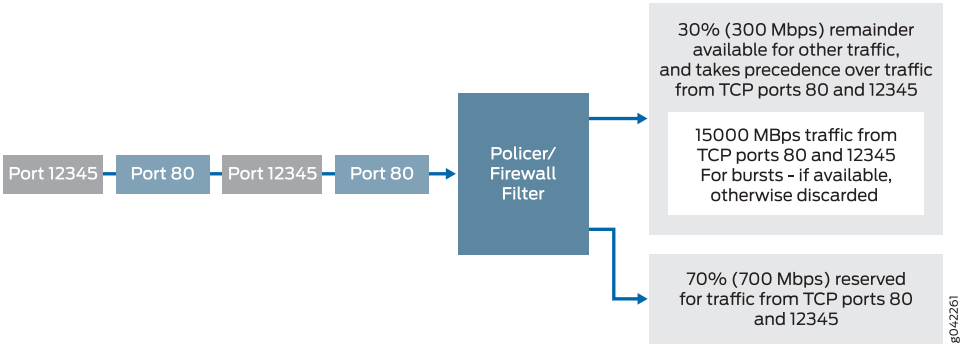


Figure 5 on page 41 shows the policing behavior.

Figure 7: Traffic Limiting in a Single-Rate Two-Color Policer Scenario



Multifield Classifying

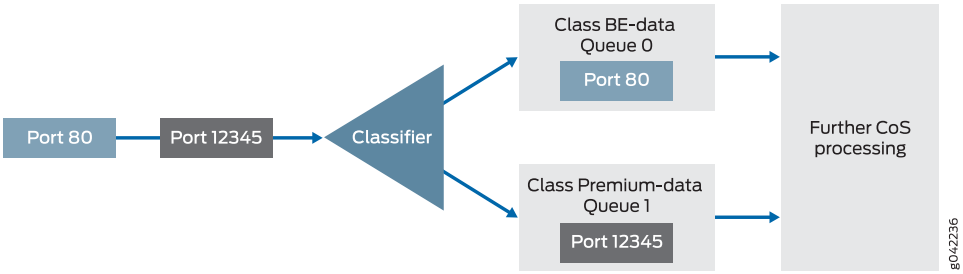
A classifier is a software operation that a router or switch uses to inspect and classify a packet after it has made it through any policing, if policing is configured. During classification, the packet header contents are examined, and this examination determines how the packet is treated when the outbound interface becomes too busy to handle all of the packets and you want your device to drop packets intelligently, instead of dropping packets indiscriminately. One common way to detect packets of interest is by source port number. The TCP source port numbers 80 and 12345 are used in this example, but many other matching criteria for packet detection are available to multifield classifiers, using firewall filter match conditions. The configuration in this example specifies that TCP packets with a source port 80 are classified into the BE-data forwarding class and queue number 0, and TCP packets with a source port 12345 are classified into the Premium-data forwarding class and queue number 1. Traffic from both port numbers is monitored by the policer first. If the traffic makes it through the policer, it is handed off to the outbound interface in the assigned queue for transmission.

Multifield classifiers are typically used at the network edge as packets enter an autonomous system (AS). However, as explained previously in the policing section, in this example the multifield classifier is configured within the AS of the service provider.

In this example, you configure the firewall filter **mf-classifier** and specify some custom forwarding classes on Device R1. In specifying the custom forwarding classes, you also associate each class with a queue.

The classifier operation is shown in Figure 8 on page 51.

Figure 8: Multifield Classifier Based on TCP Source Ports



You monitor the behavior of the queues on the interfaces that the traffic is transmitted over. In this example, to determine how the queues are being serviced, you examine the traffic statistics on interface ge-2/0/8 on Device R1 by using the **extensive** option in the **show interfaces** command.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces ge-0/0/1 description to-R3
set interfaces ge-0/0/1 unit 0 family inet address 10.51.0.1/30
set interfaces ge-2/0/5 description to-Host
set interfaces ge-2/0/5 unit 0 family inet address 172.16.70.2/30
set interfaces ge-2/0/8 description to-R2
set interfaces ge-2/0/8 unit 0 family inet address 10.50.0.1/30
set interfaces ge-2/0/8 unit 0 family inet filter output mf-classifier
set interfaces lo0 unit 0 description looback-interface
set interfaces lo0 unit 0 family inet address 192.168.13.1/32
set firewall policer discard if-exceeding bandwidth-limit 700m
set firewall policer discard if-exceeding burst-size-limit 15k
set firewall policer discard then discard
set class-of-service forwarding-classes class BE-data queue-num 0
set class-of-service forwarding-classes class Premium-data queue-num 1
set class-of-service forwarding-classes class Voice queue-num 2
set class-of-service forwarding-classes class NC queue-num 3
set firewall family inet filter mf-classifier term BE-data from protocol tcp
set firewall family inet filter mf-classifier term BE-data from port http
set firewall family inet filter mf-classifier term BE-data then forwarding-class BE-data
set firewall family inet filter mf-classifier term BE-data then policer discard
```

```
set firewall family inet filter mf-classifier term Premium-data from protocol tcp
set firewall family inet filter mf-classifier term Premium-data from port 12345
set firewall family inet filter mf-classifier term Premium-data then forwarding-class
  Premium-data
set firewall family inet filter mf-classifier term Premium-data then policer discard
set firewall family inet filter mf-classifier term accept then accept
set protocols ospf area 0.0.0.0 interface ge-2/0/5.0 passive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
set protocols ospf area 0.0.0.0 interface ge-2/0/8.0
```

Device R2

```
set interfaces ge-2/0/7 description to-Host
set interfaces ge-2/0/7 unit 0 family inet address 172.16.80.2/30
set interfaces ge-2/0/8 description to-R1
set interfaces ge-2/0/8 unit 0 family inet address 10.50.0.2/30
set interfaces lo0 unit 0 description looback-interface
set interfaces lo0 unit 0 family inet address 192.168.14.1/32
set protocols ospf area 0.0.0.0 interface ge-2/0/7.0 passive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/0/8.0
```

Device R3

```
set interfaces ge-0/0/0 description to-Host
set interfaces ge-0/0/0 unit 0 family inet address 172.16.71.1/30
set interfaces ge-0/0/1 description to-R1
set interfaces ge-0/0/1 unit 0 family inet address 10.51.0.2/30
set interfaces lo0 unit 0 description looback-interface
set interfaces lo0 unit 0 family inet address 192.168.15.1/32
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0 passive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the device interfaces.

   ```
   [edit interfaces]
   user@R1# set ge-0/0/1 description to-R3
   user@R1# set ge-0/0/1 unit 0 family inet address 10.51.0.1/30
   user@R1# set ge-2/0/5 description to-Host
   user@R1# set ge-2/0/5 unit 0 family inet address 172.16.70.2/30
   user@R1# set ge-2/0/8 description to-R2
   user@R1# set ge-2/0/8 unit 0 family inet address 10.50.0.1/30
   ```

2. Configure the policer to rate-limit to a bandwidth of 700 Mbps and a burst size of 15 KBps.

   ```
   [edit firewall policer discard]
   user@R1# set if-exceeding bandwidth-limit 700m
   user@R1# set if-exceeding burst-size-limit 15k
   ```

3. Configure the policer to discard packets in the red traffic flow.

   ```
   [edit firewall policer discard]
   ```

```
user@R1# set then discard
```

4. Configure the custom forwarding classes and associated queue numbers.

```
[edit class-of-service forwarding-classes]
user@R1# set class BE-data queue-num 0
user@R1# set class Premium-data queue-num 1
user@R1# set class Voice queue-num 2
user@R1# set class NC queue-num 3
```

5. Configure the firewall filter term that places TCP traffic with a source port of 80 (HTTP traffic) into the BE-data forwarding class, associated with queue 0.

```
[edit firewall family inet filter mf-classifier]
user@R1# set term BE-data from protocol tcp
user@R1# set term BE-data from port http
user@R1# set term BE-data then forwarding-class BE-data
user@R1# set term BE-data then policer discard
```

6. Configure the firewall filter term that places TCP traffic with a source port of 12345 into the Premium-data forwarding class, associated with queue 1.

```
[edit firewall family inet filter mf-classifier]
user@R1# set term Premium-data from protocol tcp
user@R1# set term Premium-data from port 12345
user@R1# set term Premium-data then forwarding-class Premium-data
user@R1# set term Premium-data then policer discard
```

7. At the end of your firewall filter, configure a default term that accepts all other traffic.

   Otherwise, all traffic that arrives on the interface that is not explicitly accepted by the firewall filter is discarded.

```
[edit firewall family inet filter mf-classifier]
user@R1# set term accept then accept
```

8. Apply the firewall filter to interface ge-2/0/8 as an output filter.

```
[edit interfaces]
user@R1# set ge-2/0/8 unit 0 family inet filter output mf-classifier
```

9. Configure OSPF.

```
[edit protocols ospf]
user@R1# set area 0.0.0.0 interface ge-2/0/5.0 passive
user@R1# set area 0.0.0.0 interface lo0.0 passive
user@R1# set area 0.0.0.0 interface ge-0/0/1.0
user@R1# set area 0.0.0.0 interface ge-2/0/8.0
```

Step-by-Step Procedure

To configure Device R2:

1. Configure the device interfaces.

```
[edit]
user@R2# set interfaces ge-2/0/7 description to-Host
user@R2# set interfaces ge-2/0/7 unit 0 family inet address 172.16.80.2/30
user@R2# set interfaces ge-2/0/8 description to-R1
user@R2# set interfaces ge-2/0/8 unit 0 family inet address 10.50.0.2/30
user@R2# set interfaces lo0 unit 0 description looback-interface
```

```
user@R2# set interfaces lo0 unit 0 family inet address 192.168.14.1/32
```

Configure OSPF.

```
[edit protocols ospf]
user@R2# set area 0.0.0.0 interface ge-2/0/7.0 passive
user@R2# set area 0.0.0.0 interface lo0.0 passive
user@R2# set area 0.0.0.0 interface ge-2/0/8.0
```

Step-by-Step Procedure

To configure Device R3:

1. Configure the interfaces.

```
[edit]
user@R3# set interfaces ge-0/0/0 description to-Host
user@R3# set interfaces ge-0/0/0 unit 0 family inet address 172.16.71.1/30
user@R3# set interfaces ge-0/0/1 description to-R1
user@R3# set interfaces ge-0/0/1 unit 0 family inet address 10.51.0.2/30
user@R3# set interfaces lo0 unit 0 description looback-interface
user@R3# set interfaces lo0 unit 0 family inet address 192.168.15.1/32
```

2. Configure OSPF

```
[edit protocols ospf]
user@R3# set protocols ospf area 0.0.0.0 interface ge-0/0/0.0 passive
user@R3# set protocols ospf area 0.0.0.0 interface lo0.0 passive
user@R3# set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show class-of-service**, **show firewall**, and **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
ge-0/0/1 {
   description to-R3;
   unit 0 {
      family inet {
         address 10.51.0.1/30;
      }
   }
}
}
   ge-2/0/5 {
      description to-Host;
      unit 0 {
         family inet {
            address 172.16.70.2/30;
         }
      }
   }
   ge-2/0/8 {
      description to-R2;
      unit 0 {
         family inet {
            filter {
```

```
            output mf-classifier;
          }
          address 10.50.0.1/30;
        }
      }
    }
lo0 {
    unit 0 {
      description looback-interface;
      family inet {
        address 192.168.13.1/32;
      }
    }
}
```

```
user@R1# show class-of-service
forwarding-classes {
    class BE-data queue-num 0;
    class Premium-data queue-num 1;
    class Voice queue-num 2;
    class NC queue-num 3;
}
```

```
user@R1# show firewall
family inet {
    filter mf-classifier {
      term BE-data {
        from {
          protocol tcp;
          port http;
        }
        then {
          policer discard;
          forwarding-class BE-data;
        }
      }
      term Premium-data {
        from {
          protocol tcp;
          port 12345;
        }
        then {
          policer discard;
          forwarding-class Premium-data;
        }
      }
      term accept {
        then accept;
      }
    }
}
policer discard {
    if-exceeding {
      bandwidth-limit 700m;
      burst-size-limit 15k;
    }
    then discard;
```

```
}
```

```
user@R1# show protocols ospf
area 0.0.0.0 {
  interface ge-2/0/5.0 {
    passive;
  }
  interface lo0.0 {
    passive;
  }
  interface ge-0/0/1.0;
  interface ge-2/0/8.0;
}
```

If you are done configuring Device R1, enter **commit** from configuration mode.

```
user@R2# show interfaces
ge-2/0/7 {
  description to-Host;
  unit 0 {
    family inet {
      address 172.16.80.2/30;
    }
  }
}
ge-2/0/8 {
  description to-R1;
  unit 0 {
    family inet {
      address 10.50.0.2/30;
    }
  }
}
lo0 {
  unit 0 {
    description looback-interface;
    family inet {
      address 192.168.14.1/32;
    }
  }
}
```

```
user@R2# show protocols ospf
area 0.0.0.0 {
  interface ge-2/0/7.0 {
    passive;
  }
  interface lo0.0 {
    passive;
  }
  interface ge-2/0/8.0;
}
```

If you are done configuring Device R2, enter **commit** from configuration mode.

```
user@R3# show interfaces
ge-0/0/0 {
```

```
    description to-Host;
    unit 0 {
      family inet {
        address 172.16.71.2/30;
      }
    }
  }
  ge-0/0/1 {
    description to-R1;
    unit 0 {
      family inet {
        address 10.51.0.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      description looback-interface;
      family inet {
        address 192.168.15.1/32;
      }
    }
  }
```

```
user@R3# show protocols ospf
area 0.0.0.0 {
  interface ge-0/0/0.0 {
    passive;
  }
  interface lo0.0 {
    passive;
  }
  interface ge-0/0/1.0;
}
```

If you are done configuring Device R3, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the CoS Settings on page 57
- Clearing the Counters on page 58
- Sending Traffic into the Network from TCP HTTP Port 80 and Monitoring the Results on page 58
- Sending Traffic into the Network from TCP Port 12345 and Monitoring the Results on page 59

Checking the CoS Settings

Purpose Confirm that the forwarding classes are configured correctly.

Action From Device R1, run the **show class-of-service forwarding-class** command.

```
user@R1> show class-of-service forwarding-class

Forwarding class                          ID      Queue  Restricted queue  Fabric
priority  Policing priority   SPU priority
  BE-data                                 0       0          0             low
            normal            low
  Premium-data                            1       1          1             low
            normal            low
  Voice                                   2       2          2             low
            normal            low
  NC                                      3       3          3             low
            normal            low
```

Meaning The output shows the configured custom classifier settings.

Clearing the Counters

Purpose Confirm that the firewall and interface counters are cleared.

Action

- On Device R1, run the **clear firewall all** command to reset the firewall counters to 0.

  ```
  user@R1> clear firewall all
  ```

- On Device R1, run the **clear interface statistics ge-2/0/5** command to reset the interface counters to 0.

  ```
  user@R1> clear interface statistics ge-2/0/8
  ```

Sending Traffic into the Network from TCP HTTP Port 80 and Monitoring the Results

Purpose Send traffic that can monitored at the policer and custom queue level.

Action

1. Use a traffic generator to send 20 TCP packets with a source port of 80 into the network.

   The -s flag sets the source port. The -k flag causes the source port to remain steady at 80 instead of incrementing. The -c flag sets the number of packets to 20. The -d flag sets the packet size.

   NOTE: In this example the policer numbers are reduced to a bandwidth limit of 8 Kbps and a burst size limit of 1500 KBps to ensure that some packets are dropped.

   ```
   [User@host]# hping 172.16.80.1 -c 20 -s 80 -k -d 300

   [User@Host]# hping 172.16.80.1 -s 80 -k -c 20 -d 375
   HPING 172.16.80.1 (eth1 172.16.80.1): NO FLAGS are set, 40 headers + 375 data
    bytes
   len=46 ip=172.16.80.1 ttl=62 DF id=0 sport=0 flags=RA seq=0 win=0 rtt=1001.0
   ms
   .
   ```

```
.
.
--- 172.16.80.1 hping statistic ---
20 packets transmitted, 14 packets received, 30% packet loss
round-trip min/avg/max = 1001.0/10287.1/19002.1 ms
```

2. On Device R1, check the firewall counters by using the **show firewall** command.

```
user@R1> show firewall

Filter: mf-classifier
Policers:
Name                                                Bytes              Packets
discard-BE-data                                      2490                    6
discard-Premium-data                                    0                    0
```

Notice that in the hping output that there was 30% packet loss (6 packets out of 20) and the same number of packets were dropped by the policer as shown in the output of the **show firewall** command. Also notice that the drops are associated with the queue BE-data as specified in the mf-classifier in the firewall configuration.

3. On Device R1, check the queue counters by using the **show interfaces extensive ge-2/0/8| find "Queue counters"** command.

```
user@R1> show interfaces extensive ge-2/0/8| find "Queue counters"
 Queue counters:       Queued packets  Transmitted packets     Dropped packets

 0                                 14                  14                   0
 1                                  0                   0                   0
 2                                  0                   0                   0
 3                                 16                  16                   0
 Queue number:         Mapped forwarding classes
 0                     BE-data
 1                     Premium-data
 2                     Voice
 3                     NC
```

Notice that 14 packets were transmitted out interface 2/0/8 using the queue BE-data as specified in the mf-classifier in the firewall configuration. The remaining 6 packets were dropped by the policer, as shown above. The 16 packets sent to queue 3 are network control traffic. They are possibly routing protocol updates.

Meaning The output from both devices shows that 6 packets were discarded This means that there was at least 8 Kbps of green (in-contract HTTP port 80) traffic and that the 1500 KBps burst option for red out-of-contract HTTP port 80 traffic was exceeded. In Steps 2 and 3, you can see that the correct queues were used to transmit the remaining traffic out interface 2/0/8.

Sending Traffic into the Network from TCP Port 12345 and Monitoring the Results

Purpose Send traffic that can monitored at the policer and custom queue level.

Action

1. Clear the counters again as shown in section "Clearing the Counters" on page 58.
2. Use a traffic generator to send 20 TCP packets with a source port of 12345 into the network.

   The -s flag sets the source port. The -k flag causes the source port to remain steady at 12345 instead of incrementing. The -c flag sets the number of packets to 20. The -d flag sets the packet size.

   ```
   [User@host]#  hping 172.16.80.1 -c 20 -s 12345 -k -d 300
   [Host@User]# hping 172.16.80.1 -s 12345 -k -c 20 -d 375
   HPING 172.16.80.1 (eth1 172.16.80.1): NO FLAGS are set, 40 headers + 375 data
    bytes
   len=46 ip=172.16.80.1 ttl=62 DF id=0 sport=0 flags=RA seq=0 win=0 rtt=1000.4
   ms
   .
   .
   .

   --- 172.16.80.1 hping statistic ---
   20 packets transmitted, 13 packets received, 35% packet loss
   round-trip min/avg/max = 1000.4/10924.5/19002.2 ms
   ```

3. On Device R1, check the firewall counters by using the **show firewall** command.

   ```
   user@R1> show firewall
   Filter: mf-classifier
   Policers:
   Name                                                Bytes              Packets
   discard-BE-data                                         0                    0
   discard-Premium-data                                 2905                    7
   ```

   Notice that in the hping output that there was 35% packet loss (7 packets out of 20) and the same number of packets were dropped by the policer as shown in the output of the **show firewall** command. Also notice that the drops are associated with the queue Premium-data as specified in the mf-classifier in the firewall configuration.

4. On Device R1, check the queue counters by using the **show interfaces extensive ge-2/0/8| find "Queue counters"** command.

   ```
   user@R1> show interfaces extensive ge-2/0/8| find "Queue counters"
   Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0                             0                 0                    0
    1                            13                13                    0
    2                             0                 0                    0
    3                            16                16                    0
    Queue number:       Mapped forwarding classes
    0                   BE-data
    1                   Premium-data
    2                   Voice
    3                   NC
   ```

   Notice that 13 packets were transmitted out interface 2/0/8 using the Premium-data queues specified in the mf-classifier in the firewall configuration. The remaining 7 packets were dropped by the policer, as shown above. The 16 packets sent to queue 3 are network control traffic. They are possibly routing protocol updates.

Meaning The output from both devices shows that 7 packets were discarded. This means that there was at least 8 Kbps of green (in-contract HTTP port 80) traffic and that the 1500 KBps burst option for red out-of-contract HTTP port 80 traffic was exceeded. In Steps 3 and 4, you can see that the correct queues were used to transmit the remaining traffic out interface 2/0/8.

Related Documentation

- *Junos OS Routing Protocols and Policies Configuration Guide for Security Devices*
- *Junos OS Firewall Filters and Traffic Policers Library for Routing Devices*
- *Junos OS Feature Support Reference for SRX Series and J Series Devices*
- *Example: Configuring a Two-Rate Three-Color Policer*

CHAPTER 5

Configuration Statements for Tricolor Marking Policers

action

Syntax

```
action {
  loss-priority high then discard;
}
```

Hierarchy Level

[edit dynamic-profiles *profile-name* firewall three-color-policer *name*],
[edit firewall three-color-policer *name*],
[edit logical-systems *logical-system-name* firewall three-color-policer *name*]

Release Information

Statement introduced in Junos OS Release 8.2.
Logical systems support introduced in Junos OS Release 9.3.
Support at the **[edit dynamic-profiles ... three-color-policer]** hierarchy level introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Discard traffic on a logical interface using tricolor marking policing.

NOTE: This statement is supported only on IQ2 interfaces.

The remaining statement is explained separately.

Required Privilege Level

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

Related Documentation

- *Three-Color Policer Configuration Overview*
- *Basic Single-Rate Three-Color Policers*
- *Basic Two-Rate Three-Color Policers*
- *Two-Color and Three-Color Logical Interface Policers*
- *Two-Color and Three-Color Physical Interface Policers*
- *Two-Color and Three-Color Policers at Layer 2*
- *loss-priority high then discard*

classifiers (Definition)

Syntax

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

Hierarchy Level

[edit class-of-service],
[edit class-of-service routing-instances *routing-instance-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
ieee-802.1ad option introduced in Junos OS Release 9.2.

Description

Define a CoS behavior aggregate (BA) classifier for classifying packets. You can associate the classifier with a forwarding class or code-point mapping, and import a default classifier or one that is previously defined.

NOTE: The **[edit class-of-service routing-instances *routing-instance-name*]** hierarchy level and the **dscp-ipv6** and **ieee-802.1ad** classifier types are not supported on ACX Series routers.

Options

classifier-name—Name of the aggregate behavior classifier.

type—Traffic type: **dscp**, **dscp-ipv6**, **exp**, **ieee-802.1**, **ieee-802.1ad**, **inet-precedence**.

Required Privilege Level

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

Related Documentation

- *Overview of BA Classifier Types*

code-points

Syntax code-points ([*aliases*] | [*bit-patterns*]);

Hierarchy Level [edit class-of-service classifiers *type classifier-name* forwarding-class *class-name* loss-priority *level*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.2 for SRX Series devices.

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

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

bit-patterns—Value of the code-point bits, in six-bit binary form.

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

Related Documentation
- *Overview of BA Classifier Types*
- *Example: Configuring a Custom DSCP Behavior Aggregate Classifier*

drop-profile (Schedulers)

Syntax drop-profile *profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name* drop-profile-map loss-priority (any | low | medium-low | medium-high | high) protocol (any | non-tcp | tcp)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 12.2 for ACX Series Routers.

Description Define drop profiles for RED. When a packet arrives, RED checks the queue fill level. If the fill level corresponds to a nonzero drop probability, the RED algorithm determines whether to drop the arriving packet.

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

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

Related Documentation
- *Configuring Drop Profile Maps for Schedulers*
- *RED Drop Profiles Overview*

drop-profile-map (Schedulers)

Syntax drop-profile-map loss-priority (any | low | medium-low | medium-high | high) protocol(any | non-tcp | tcp) drop-profile (Schedulers) *profile-name*;

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

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 12.2 for ACX Series Routers.

Description Define the loss-priority value for a drop profile.

The statements are explained separately.

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

Related Documentation
- *Default Schedulers Overview*
- *Configuring Drop Profile Maps for Schedulers*

dscp (Multifield Classifier)

Syntax dscp [0 | *value*];

Hierarchy Level [edit firewall family *family-name* filter *filter-name* term *term-name* then]

Release Information Statement introduced in Junos OS Release 7.4.

Description For M320 and T Series routers, set the DSCP field of incoming or outgoing packets to **000000**. On the same packets, you can use a behavior aggregate (BA) classifier and a rewrite rule to rewrite the MPLS EXP field.

For MX Series routers with MPCs and EX Series switches, the DSCP field can be set from a numeric range.

For MX Series routers and EX Series switches, if you configure a firewall filter with a DSCP action or traffic-class action on a DPC, the commit does not fail, but the filter is not applied to the interface, a warning displays, and an entry is made in the syslog.

Options ***value***—For MX Series routers with MPCs, specify the field of incoming or outgoing packets in the range from **0** through **63**.

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

Related Documentation
- Applying Tricolor Marking Policers to Firewall Filters on page 26

dscp (Rewrite Rules)

Syntax dscp (*rewrite-name* | default) protocol mpls;

Hierarchy Level [edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules]

Release Information Statement introduced before Junos OS Release 7.4.

Description For IPv4 traffic, apply a Differentiated Services (DiffServ) code point (DSCP) rewrite rule.

Logical interfaces do not support multiple **dscp** rewrite rules for the same protocol.

DSCP and DSCP IPv6 rewrite rules are supported on M Series and T Series routers when non-queuing PICs are installed, but are disabled when queuing PICs are installed with the following exceptions:

- On M320 routers, DSCP rewrite is supported on IQ, IQ2, IQE, and IQ2E PICs when used with the Enhanced III FPC.
- On M120 routers, DSCP rewrite is supported on IQ, IQ2, IQE, and IQ2E PICs.

DSCP and DCSP IPv6 rewrite rules are supported on MIC and MPC interfaces on MX Series routers.

DSCP rewrite rules are not supported on T Series routers when IQ, IQ2, IQE, IQ2E, SONET/SDH OC48/STM16 IQE, or PD-5-10XGE-SFPP PICs are installed.

Options ***rewrite-name***—Name of a **rewrite-rules** mapping configured at the **[edit class-of-service rewrite-rules dscp]** hierarchy level.

default—The default mapping.

protocol mpls—(Optional for ingress MPLS tunnel nodes) For interfaces on MX Series routers or hosted on Enhanced III FPCs in M120 or M320 routers only, rewrite the MPLS EXP bits in the MPLS header independently of the IPv4 DSCP value for IPv4 packets entering an MPLS tunnel.

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

Related Documentation

- *Configuring Rewrite Rules*
- *Applying Rewrite Rules to Output Logical Interfaces*
- *protocol (Rewrite Rules)*
- *Rewriting MPLS and IPv4 Packet Headers*
- rewrite-rules (Definition) on page 91

dscp-ipv6 (Class-of-Service)

Syntax dscp-ipv6 (*rewrite-name* | <default>) protocol mpls;

Hierarchy Level [edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules]

Release Information Statement introduced before Junos OS Release 7.4.
Support for **protocol mpls** option introduced in Junos OS Release 10.4R2.

Description For IPv6 traffic, apply a DSCP rewrite rule.

Logical interfaces do not support multiple **dscp-ipv6** rewrite rules for the same protocol.

DSCP and DSCP IPv6 rewrite rules are supported on M Series and T Series routers when non-queuing PICs are installed, but are disabled when queuing PICs are installed with the following exceptions:

- On M320 routers, DSCP rewrite is supported on IQ, IQ2, IQE, and IQ2E PICs when used with the Enhanced III FPC.
- On M120 routers, DSCP rewrite is supported on IQ, IQ2, IQE, and IQ2E PICs.

DSCP and DCSP IPv6 rewrite rules are supported on MIC and MPC interfaces on MX Series routers.

DSCP rewrite rules are not supported on T Series routers when IQ, IQ2, IQE, IQ2E, SONET/SDH OC48/STM16 IQE, or PD-5-10XGE-SFPP PICs are installed.

Options ***rewrite-name***—Name of a **rewrite-rules** mapping configured at the **[edit class-of-service rewrite-rules dscp-ipv6]** hierarchy level.

default—Default mapping.

protocol mpls—(Optional for ingress MPLS tunnel nodes) For interfaces on MX Series routers or hosted on Enhanced III FPCs in M120 or M320 routers only, rewrite the MPLS EXP bits in the MPLS header independently of the IPv6 DSCP value for IPv6 packets entering an MPLS tunnel.

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

Related Documentation

- *Configuring Rewrite Rules*
- *protocol*
- *Setting IPv6 DSCP and MPLS EXP Values Independently*
- *Configuring DSCP Values for IPv6 Packets Entering the MPLS Tunnel*
- *Applying Rewrite Rules to Output Logical Interfaces*
- rewrite-rules (Definition) on page 91

exp

Syntax exp (*rewrite-name* | default) protocol *protocol-types*;

Hierarchy Level [edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced before Junos OS Release 12.2. for ACX series

Description Apply an MPLS experimental (EXP) rewrite rule.

Options ***rewrite-name***—Name of a **rewrite-rules** mapping configured at the **[edit class-of-service rewrite-rules exp]** hierarchy level.

default—The default mapping.

By default, IP precedence rewrite rules alter the first three bits on the type-of-service (ToS) byte while leaving the last three bits unchanged. This default behavior applies to rewrite rules you configure for MPLS packets with IPv4 payloads. You configure these types of rewrite rules by including the **mpls-inet-both** or **mpls-inet-both-non-vpn** option at the **[edit class-of-service interfaces interface *interface-name* unit *logical-unit-number* rewrite-rules exp *rewrite-rule-name* protocol]** hierarchy level. The IP precedence rewrite rules explanation does not apply to ACX Series Universal Access routers.

On interfaces configured on Modular Port Concentrators (MPCs) and Modular Interface Cards (MICs) on MX Series 3D Universal Edge Routers and EX Series switches, we highly recommend that you configure the **default** option when you configure a behavior aggregate (BA) classifier that does not include a specific rewrite rule for MPLS packets. Doing so ensures that MPLS exp value is rewritten according to the BA classifier rules configured for forwarding or packet loss priority. This does not apply to ACX Series Universal Access routers.

protocol-types—Specify one or more protocol matching criteria:

- **mpls-any**—Apply to MPLS packets, write MPLS header only.
- **mpls-inet-both**—Apply to IPv4 MPLS packets, write MPLS and IPv4 header.
- **mpls-inet-both-non-vpn**—Apply to IPv4 MPLS packets, write MPLS and IPv4 header for only non VPN traffic.

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

Related Documentation

- *Configuring Rewrite Rules*
- *Rewriting the EXP Bits of All Three Labels of an Outgoing Packet*
- *Applying Rewrite Rules to Output Logical Interfaces*
- *protocol (Rewrite Rules)*

- rewrite-rules (Definition) on page 91

family (Multifield Classifier)

Syntax

```
family family-name {
  filter filter-name {
    term term-name {
      ... term_configuration ...
    }
  }
}
```

Hierarchy Level [edit firewall]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure a firewall filter for IP version 4 (IPv4) or IP version 6 (IPv6) traffic.

Options *family-name*—Protocol family:

- **ccc**—Circuit cross-connect parameters
- **inet**—IPv4 parameters
- **inet6**—IPv6 protocol parameters
- **iso**—OSI ISO protocol parameters
- **mlppp**—Multilink PPP protocol parameters
- **mpls**—MPLS protocol parameters
- **tcc**—Translational cross-connect parameters
- **vpls**—Virtual private LAN service parameters.

The remaining statements are explained separately.

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

Related Documentation

- *Configuring Multifield Classifiers*

filter (Applying to a Logical Interface)

Syntax

```
filter {
  group filter-group-number;
  input filter-name;
  input-list [ filter-names ];
  output filter-name;
  output-list [ filter-names ];
}
```

Hierarchy Level

Protocol-independent firewall filter on MX Series router logical interface:

[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

All other standard firewall filters on all other devices:

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Apply a stateless firewall filter to a logical interface at a specific protocol level.

Options

group *filter-group-number*—Number of the group to which the interface belongs. Range: 1 through 255

input *filter-name*—Name of one filter to evaluate when packets are received on the interface.

input-list [*filter-names*]—Names of filters to evaluate when packets are received on the interface. Up to 16 filters can be included in a filter input list.

output *filter-name*—Name of one filter to evaluate when packets are transmitted on the interface.

output-list [*filter-names*]—Names of filters to evaluate when packets are transmitted on the interface. Up to 16 filters can be included in a filter output list.

Required Privilege Level

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

Related Documentation

- *Guidelines for Configuring Firewall Filters*
- *Guidelines for Applying Firewall Filters*

filter (Configuring)

Syntax

```
filter filter-name {
  accounting-profile name;
  enhanced-mode;
  interface-shared;
  interface-specific;
  physical-interface-filter;
  term term-name {
    ... term configuration ...
  }
}
```

Hierarchy Level

[edit dynamic-profiles *profile-name* firewall family *family-name*],
[edit firewall family *family-name*],
[edit logical-systems *logical-system-name* firewall family *family-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Logical systems support introduced in Junos OS Release 9.3.
physical-interface-filter statement introduced in Junos OS Release 9.6.
Support at the **[edit dynamic-profiles ... family family-name]** hierarchy level introduced in Junos OS Release 11.4.
Support for the **interface-shared**> statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Configure firewall filters.

Options

filter-name—Name that identifies the filter. This must be a non-reserved string of not more than 64 characters. To include spaces in the name, enclose it in quotation marks (" "). In Junos OS Release 9.0 and later, you can no longer use special characters within the name of a firewall filter. Firewall filter names are restricted from having the form **__.*__** (beginning and ending with underscores) or **__.*** (beginning with an underscore.

The remaining statements are explained separately.

Required Privilege Level

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

Related Documentation

- *Guidelines for Configuring Firewall Filters*
- *Guidelines for Applying Firewall Filters*
- *Configuring Multifield Classifiers*
- Using Multifield Classifiers to Set PLP on page 32
- *simple-filter (Configuring)*

firewall

Syntax

```
firewall {
  atm-policer atm-policer-name {
    ... atm-policer-configuration ...
  }
  family protocol-family-name {
    ... protocol-family-configuration ...
  }
  filter ipv4-filter-name {
    ... ipv4-filter-configuration ...
  }
  hierarchical-policer hierarchical-policer-name {
    ... hierarchical-policer-configuration ...
  }
  interface-set interface-set-name {
    ... interface-set-configuration ...
  }
  policer two-color-policer-name {
    ... two-color-policer-configuration ...
  }
  three-color-policer three-color-policer-name {
    ... three-color-policer-configuration ...
  }
}
```

Hierarchy Level

[edit],
[edit logical-systems *logical-system-name*]
[edit dynamic-profiles *profile-name*],

Release Information

Statement introduced before Junos OS Release 7.4.
Logical systems support introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Configure firewall filters.

The statements are explained separately.

Required Privilege Level

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

Related Documentation

- *Guidelines for Configuring Firewall Filters*
- *Guidelines for Configuring Service Filters*
- *Guidelines for Configuring Simple Filters*
- *Configuring Multifield Classifiers*
- Using Multifield Classifiers to Set PLP on page 32

forwarding-class (BA Classifiers)

Syntax

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

Hierarchy Level [edit class-of-service classifiers *type classifier-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Define forwarding class name and option values.

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

The remaining statements are explained separately.

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

Related Documentation

- *Defining Classifiers*

ieee-802.1 (Rewrite Rules on Logical Interface)

Syntax ieee-802.1 (*rewrite-name* | default) vlan-tag (outer | outer-and-inner);

Hierarchy Level [edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules]

Release Information Statement introduced before Junos OS Release 7.4.
vlan-tag statement introduced in Junos OS Release 8.1.

Description Apply an IEEE-802.1 rewrite rule. For IQ PICs, you can only configure one IEEE 802.1 rewrite rule on a physical port. All logical ports (units) on that physical port should apply the same IEEE 802.1 rewrite rule.

Options ***rewrite-name***—Name of a **rewrite-rules** mapping configured at the **[edit class-of-service rewrite-rules ieee-802.1]** hierarchy level.

default—The default mapping.

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

Related Documentation

- *Configuring Rewrite Rules*
- dscp (Rewrite Rules) on page 69
- dscp-ipv6 (Class-of-Service) on page 70
- exp on page 71
- *exp-push-push-push*
- *exp-swap-push-push*
- *ieee-802.1ad*
- inet-precedence on page 79
- rewrite-rules (Definition) on page 91

import (Classifiers)

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

Hierarchy Level [edit class-of-service classifiers *type classifier-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify a default or previously defined classifier.

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

default—The 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
- *Overview of BA Classifier Types*

import (Rewrite Rules)

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

Hierarchy Level [edit class-of-service rewrite-rules *type rewrite-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify a default or previously defined **rewrite-rules** mapping to import.

Options ***rewrite-name***—Name of a rewrite-rules mapping configured at the **[edit class-of-service rewrite-rules]** hierarchy level.

default—The default **rewrite-rules** mapping.

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

Related Documentation
- *Configuring Rewrite Rules*

inet-precedence

Syntax inet-precedence (*rewrite-name* | default);

Hierarchy Level [edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules]

Release Information Statement introduced before Junos OS Release 7.4.

Description Apply a IPv4 precedence rewrite rule.

Options

rewrite-name—Name of a **rewrite-rules** mapping configured at the **[edit class-of-service rewrite-rules inet-precedence]** hierarchy level.

default—The default mapping. By default, IP precedence rewrite rules alter the first three bits on the type of service (ToS) byte while leaving the last three bits unchanged.

Required Privilege Level

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

Related Documentation

- *Configuring Rewrite Rules*
- *Applying Rewrite Rules to Output Logical Interfaces*
- *protocol (Rewrite Rules)*
- rewrite-rules (Definition) on page 91

input-policer

Syntax input-policer *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Apply a single-rate two-color policer to the Layer 2 input traffic at the logical interface. The **input-policer** and **input-three-color** statements are mutually exclusive.

Options ***policer-name***—Name of the single-rate two-color policer that you define at the **[edit firewall]** hierarchy level.

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

Related Documentation

- *Two-Color and Three-Color Policers at Layer 2*
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces on page 29
- *Configuring a Gigabit Ethernet Policer*
- input-three-color on page 81
- layer2-policer on page 82
- logical-interface-policer on page 83
- output-policer on page 86
- output-three-color on page 87

input-three-color

Syntax input-three-color *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Apply a single-rate or two-rate three-color policer to the Layer 2 input traffic at the logical interface. The **input-three-color** and **input-policer** statements are mutually exclusive.

Options ***policer-name***—Name of the single-rate or two-rate three-color policer.

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

Related Documentation

- *Two-Color and Three-Color Policers at Layer 2*
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces on page 29
- *Configuring a Gigabit Ethernet Policer*
- input-policer on page 80
- layer2-policer on page 82
- logical-interface-policer on page 83
- output-policer on page 86
- output-three-color on page 87

layer2-policer

Syntax

```
layer2-policer {
  input-policer policer-name;
  input-three-color policer-name;
  output-policer policer-name;
  output-three-color policer-name;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M Series, MX Series, and T Series routers, and for aggregated Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces on EX Series switches, apply Layer 2 logical interface policers. The following policers are supported:

- Two-color
- Single-rate tricolor marking (srTCM)
- Two-rate tricolor marking (trTCM)

Two-color and tricolor policers are configured at the **[edit firewall]** hierarchy level.

Options

input-policer *policer-name*—Two-color input policer to associate with the interface. This statement is mutually exclusive with the **input-three-color** statement.

input-three-color *policer-name*—Tricolor input policer to associate with the interface. This statement is mutually exclusive with the **input-policer** statement.

output-policer *policer-name*—Two-color output policer to associate with the interface. This statement is mutually exclusive with the **output-three-color** statement.

output-three-color *policer-name*—Tricolor output policer to associate with the interface. This statement is mutually exclusive with the **output-policer** statement.

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

Related Documentation

- Applying Layer 2 Policers to Gigabit Ethernet Interfaces on page 29
- *Configuring Gigabit Ethernet Two-Color and Tricolor Policers*

logical-interface-policer

Syntax logical-interface-policer;

Hierarchy Level
[edit dynamic-profiles *profile-name* firewall policer *policer-name*],
[edit dynamic-profiles *profile-name* firewall three-color-policer *name*],
[edit firewall atm-policer*atm-policer-name*]
[edit firewall policer *policer-name*],
[edit firewall policer *policer-template-name*],
[edit firewall three-color-policer *policer-name*],
[edit logical-systems *logical-system-name* firewall policer *policer-name*],
[edit logical-systems *logical-system-name* firewall three-color-policer *name*]

Release Information
Statement introduced before Junos OS Release 7.4.
Support at the **[edit firewall three-color-policer *policer-name*]** hierarchy level introduced in Junos OS Release 8.2.
Logical systems support introduced in Junos OS Release 9.3.
Support at the **[edit dynamic-profiles ... policer *policer-name*]** and **[edit dynamic-profiles ... three-color-policer *name*]** hierarchy levels introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure a logical interface policer.

NOTE: Starting in Junos OS Release 12.2R2, on T Series Core Routers only, you can configure an MPLS LSP policer for a specific LSP to be shared across different protocol family types. You must include the **logical-interface-policer** statement to do so.

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

Related Documentation

- *Two-Color and Three-Color Logical Interface Policers*
- *Traffic Policer Types*
- Configuring Tricolor Marking Policers on page 25
- **action on page 65**
- *Configuring Gigabit Ethernet Two-Color and Tricolor Policers*
- *action*

loss-priority (Normal Filter)

Syntax loss-priority (high | low);

Hierarchy Level [edit firewall family *family-name* filter *filter-name* term *term-name* then]

Release Information Statement introduced before Junos OS Release 7.4.

Description Set the loss priority of incoming packets.

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

Related Documentation
- *Configuring Multifield Classifiers*

loss-priority (Simple Filter)

Syntax loss-priority (high | low | medium);

Hierarchy Level [edit firewall family *family-name* simple-filter *filter-name* term *term-name* then]

Release Information Statement introduced in Junos OS Release 7.6.

Description Set the loss priority of incoming packets.

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

Related Documentation
- *Configuring Multifield Classifiers*

loss-priority (Scheduler Drop Profiles)

Syntax loss-priority (any | high | low | medium-high | medium-low);

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

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 12.2 for ACX Series Routers.

Description Specify a loss priority to which to apply a drop profile. The drop profile map sets the drop profile for a specific PLP and protocol type. The inputs for the map are the PLP designation and the protocol type. The output is the drop profile.

Options **any**—The drop profile applies to packets with any PLP.

NOTE: On ACX Series Routers, only the any option is supported when you configure the non-tcp option for protocol.

high—The drop profile applies to packets with high PLP.

low—The drop profile applies to packets with low PLP.

medium-high—The drop profile applies to packets with medium-high PLP.

medium-low—The drop profile applies to packets with medium-low PLP.

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

Related Documentation

- *Default Schedulers Overview*
- *Configuring Drop Profile Maps for Schedulers*
- *Configuring Schedulers for Priority Scheduling*
- Configuring Tricolor Marking on page 17
- protocol (Schedulers) on page 90

output-policer

Syntax output-policer *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Apply a single-rate two-color policer to the Layer 2 output traffic at the logical interface. The **output-policer** and **output-three-color** statements are mutually exclusive.

Options ***policer-name***—Name of the single-rate two-color policer that you define at the **[edit firewall]** hierarchy level.

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

Related Documentation

- *Two-Color and Three-Color Policers at Layer 2*
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces on page 29
- *Configuring a Gigabit Ethernet Policer*
- input-policer on page 80
- input-three-color on page 81
- layer2-policer on page 82
- logical-interface-policer on page 83
- output-three-color on page 87

output-three-color

Syntax output-three-color *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Apply a single-rate or two-rate three-color policer to the Layer 2 output traffic at the logical interface. The **output-three-color** and **output-policer** statements are mutually exclusive.

Options ***policer-name***—Name of the single-rate or two-rate three-color policer.

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

Related Documentation

- *Two-Color and Three-Color Policers at Layer 2*
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces on page 29
- *Configuring a Gigabit Ethernet Policer*
- input-three-color on page 81
- input-policer on page 80
- layer2-policer on page 82
- logical-interface-policer on page 83
- output-policer on page 86

policer (Configuring)

Syntax

```
policer policer-name {
  filter-specific;
  if-exceeding {
    bandwidth-limit bps;
    bandwidth-percent number;
    burst-size-limit bytes;
  }
  logical-bandwidth-policer;
  logical-interface-policer;
  physical-interface-policer;
  shared-bandwidth-policer;
  then {
    policer-action;
  }
}
```

Hierarchy Level

[edit dynamic-profiles *profile-name* firewall],
[edit firewall],
[edit logical-systems *logical-system-name* firewall]

Release Information

Statement introduced before Junos OS Release 7.4.
The **out-of-profile** policer action added in Junos OS Release 8.1.
The **logical-bandwidth-policer** statement added in Junos OS Release 8.2.
Logical systems support introduced in Junos OS Release 9.3.
The **physical-interface-policer** statement introduced in Junos OS Release 9.6.
The **shared-bandwidth-policer** statement added in Junos OS Release 11.2
Support at the **[edit dynamic-profiles ... firewall]** hierarchy level introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Configure policer rate limits and actions. When included at the **[edit firewall]** hierarchy level, the **policer** statement creates a template, and you do not have to configure a policer individually for every firewall filter or interface. To activate a policer, you must include the **policer-action** modifier in the **then** statement in a firewall filter term or on an interface.

Options

policer-action—One or more actions to take:

- **discard**—Discard traffic that exceeds the rate limits.
- **forwarding-class *class-name***—Specify the particular forwarding class.
- **loss-priority**—Set the packet loss priority (PLP) to **low**, **medium-low**, **medium-high**, or **high**.
- **out-of-profile**—On J Series routers with strict priority queuing, prevent starvation of other queues by rate limiting the data stream entering the strict priority queue, marking the packets that exceed the rate limit as out-of-profile, and dropping the out-of-profile packets if the physical interface is congested.

policer-name—Name that identifies the policer. The name can contain letters, numbers, and hyphens (-), and can be up to 255 characters long. To include spaces in the name, enclose it in quotation marks (" "). Policer names cannot begin with an underscore in the form **__.***.

then—Actions to take on matching packets.

The remaining statements are explained separately.

Required Privilege Level

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

Related Documentation

- *Bandwidth Policer Overview*
- *Configuring Firewall Filters and Policers for VPLS*
- *Configuring Multifield Classifiers*
- *Logical Interface (Aggregate) Policer Overview*
- *Physical Interface Policer Overview*
- *Statement Hierarchy for Configuring Policers*
- *Single-Rate Two-Color Policer Overview*
- Using Multifield Classifiers to Set PLP on page 32
- **filter (Configuring) on page 74**
- *priority (Schedulers)*

protocol (Schedulers)

Syntax protocol (any | non-tcp | tcp);

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

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 12.2 for ACX Series Routers.

Description Specify the protocol type for the specified scheduler.

Options **any**—Accept any protocol type.

non-tcp—(ACX Series Routers, M Series and T Series (except T4000) routers only) Accept any protocol type other than TCP/IP.

NOTE: On ACX Series Routers, when you configure the non-tcp option, only the any option is supported for loss-priority.

tcp—(ACX Series Routers, M Series and T Series (except T4000) routers only) Accept TCP/IP protocol type.

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

Related Documentation

- *Configuring Schedulers*

rewrite-rules (Definition)

Syntax

```
rewrite-rules {
  type rewrite-name{
    import (rewrite-name | default);
    forwarding-class class-name {
      loss-priority level code-point [ aliases ] [ bit-patterns ];
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced before Junos OS Release 7.4.
ieee-802.1ad option introduced in Junos OS Release 9.2.

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

Options ***rewrite-name***—Name of a **rewrite-rules** mapping.

type—Traffic type.

Values: **dscp**, **dscp-ipv6**, **exp**, **frame-relay-de** (J Series routers only), **ieee-802.1**, **ieee-802.1ad**, **inet-precedence**

The remaining statements are explained separately.

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

Related Documentation

- *Configuring Rewrite Rules*
- J Series router documentation

schedulers (Class of Service)

Syntax

```
schedulers {
  scheduler-name {
    adjust-minimum rate;
    adjust-percent percentage;
    buffer-size (seconds | percent percentage | remainder | temporal microseconds);
    drop-profile-map loss-priority (any | low | medium-low | medium-high | high) protocol
      (any | non-tcp | tcp) drop-profile profile-name;
    excess-priority [ low | medium-low | medium-high | high | none];
    excess-rate (percent percentage | proportion value);
    priority priority-level;
    shaping-rate (percent percentage | rate);
    transmit-rate (percent percentage | rate | remainder) <exact | rate-limit>;
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series routers.

Description Specify the scheduler name and parameter values.

Options ***scheduler-name***—Name of the scheduler to be configured.

The remaining statements are explained separately.

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

Related Documentation

- *Schedulers Overview*
- *Default Schedulers Overview*
- *Configuring Schedulers*
- *Configuring a Scheduler*

shared-bandwidth-policer

Syntax shared-bandwidth-policer;

Hierarchy Level [edit firewall policer *policer-name*]

[edit firewall three-color-policer *policer-name*]
[edit firewall hierarchical-policer *policer-name*]

Release Information Statement introduced in Junos OS Release 11.2.
Support for MX Series MPC and MIC interfaces added in Junos OS Release 12.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Policer instances share bandwidth. This enables configuration of interface-specific policers applied on an aggregated Ethernet bundle or an aggregated SONET bundle to match the effective bandwidth and burst-size to user-configured values. This feature is supported on the following platforms: T Series routers, M120, M10i, M7i (CFEB-E only), M320 (SFPC only), MX240, MX480, and MX960 with DPC, MIC, and MPC interfaces and EX Series switches.

NOTE: **This statement is not supported on T4000 Type 5 FPCs.**

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

Related Documentation

- Policer Support for Aggregated Ethernet Bundle Overview on page 13

then

Syntax

```
then {
  application-profileprofile-name;
  dscp (alias | bits);
  forwarding-class class-name;
  syslog;
  (reflexive | reverse) {
    application-profile profile-name;
    dscp (alias | bits);
    forwarding-class class-name;
    syslog;
  }
}
```

Hierarchy Level [edit services cos rule *rule-name* term *term-name*]

Release Information Statement introduced in Junos OS Release 8.1.

Description Define the CoS term actions.

The remaining statements are explained separately.

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

Related Documentation

- *Configuring Actions in a CoS Rule*
- *Configuring Actions in CoS Rules*

three-color-policer (Applying)

Syntax

```
three-color-policer {
    (single-rate | two-rate) policer-name;
}
```

Hierarchy Level

[edit firewall family *family-name* filter *filter-name* term *term-name* then]
[edit logical-systems *logical-system-name* firewall family *family-name* filter *filter-name* term *term-name* then]

Release Information

Statement introduced in Junos OS Release 7.4.
single-rate statement added in Junos OS Release 8.2.
Logical systems support introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

For M320 and T Series routers with Enhanced II Flexible PIC Concentrators (FPCs) and the T640 router with Enhanced Scaling FPC4, apply a tricolor marking policer.

Options

single-rate—Named tricolor policer is a single-rate policer.

two-rate—Named tricolor policer is a two-rate policer.

policer-name—Name of a tricolor policer.

Required Privilege Level

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

Related Documentation

- Applying Tricolor Marking Policers to Firewall Filters on page 26
- *Firewall Filter Nonterminating Actions*
- *Three-Color Policer Configuration Overview*

three-color-policer (Configuring)

Syntax

```
three-color-policer policer-name {
  action {
    loss-priority high then discard;
  }
  filter-specific;
  logical-interface-policer;
  physical-interface-policer;
  shared-bandwidth-policer;
  single-rate {
    (color-aware | color-blind);
    committed-burst-size bytes;
    committed-information-rate bps;
    excess-burst-size bytes;
  }
  two-rate {
    (color-aware | color-blind);
    committed-burst-size bytes;
    committed-information-rate bps;
    peak-burst-size bytes;
    peak-information-rate bps;
  }
}
```

Hierarchy Level

[edit dynamic-profiles *profile-name* firewall],
[edit firewall],
[edit logical-systems *logical-system-name* firewall]

Release Information

Statement introduced before Junos OS Release 7.4.
The **action** and **single-rate** statements added in Junos OS Release 8.2.
Logical systems support introduced in Junos OS Release 9.3.
Support at the **[edit dynamic-profiles ... firewall]** hierarchy level introduced in Junos OS Release 11.4.

Description

Configure a three-color policer.

Options

policer-name—Name of the three-color policer. Reference this name when you apply the policer to an interface.

The remaining statements are explained separately.

Required Privilege Level

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

Related Documentation

- *Statement Hierarchy for Configuring Policers*
- Configuring Tricolor Marking Policers on page 25
- *Three-Color Policer Configuration Guidelines*
- *Basic Single-Rate Three-Color Policers*
- *Basic Two-Rate Three-Color Policers*

- *Two-Color and Three-Color Logical Interface Policers*
- *Two-Color and Three-Color Physical Interface Policers*
- *Two-Color and Three-Color Policers at Layer 2*

tri-color

Syntax tri-color;

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 7.4.

Description For IPv4 packets on M320, MX Series, T Series routers with Enhanced II Flexible PIC Concentrators (FPCs), and EX Series switches, enable two-rate tricolor marking (TCM), as defined in RFC 2698.

Default If you do not include this statement, tricolor marking is not enabled and the medium packet loss priority (PLP) is not configurable.

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

Related Documentation
- Configuring Tricolor Marking on page 17

PART 3

Index

Index

Symbols

A

B

C

D

E

F

I

L