JUNIPER NETWORKS

Junos® OS

Class of Service Using IPv6 DiffServ

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

Junos® OS Class of Service Using IPv6 DiffServ
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PART 1

Overview

CHAPTER 1

Product Overview

Overview of Class of Service Using IPv6 DiffServ

Class of service (CoS) is the assignment of traffic flows to different service levels. Service providers can use router-based CoS features to define service levels that provide different delay, jitter (delay variation), and packet loss characteristics to particular applications served by specific traffic flows.

Usually, IP routers forward packets independently and without any control on throughput or delay. This is known as *best-effort* service. This service is as good as the network equipment and links, and the result is satisfactory for many traditional IP applications emphasizing data delivery, such as e-mail or Web browsing. However, newer IP applications such as real-time video and audio (or voice) require lower delay, jitter, and loss parameters than simple best-effort networks can provide. CoS is intended for networks supporting these types of time-sensitive video and audio applications.

A router cannot compromise best-effort forwarding performance in order to deliver CoS features, because this merely trades one problem for another. When CoS features are enabled, they must allow routers to better process critical packets as well as best-effort traffic flows, even during times of congestion. Network throughput is determined by a combination of available bandwidth and delay. CoS guarantees a minimum bandwidth dedicated to a service class.

The main impact of CoS on network delay is in queueing delays, when packets are normally queued for output in the order of arrival, regardless of service class. Queuing delays increase with network congestion and often result in lost packets when queue buffers overflow. The other two elements of overall network delay, serial transmission delays determined by link speeds and propagation delays determined by media type, are not affected by CoS settings.

Any CoS implementation must work consistently end to end through the network. A standards-based, vendor-neutral CoS implementation satisfies this requirement best.

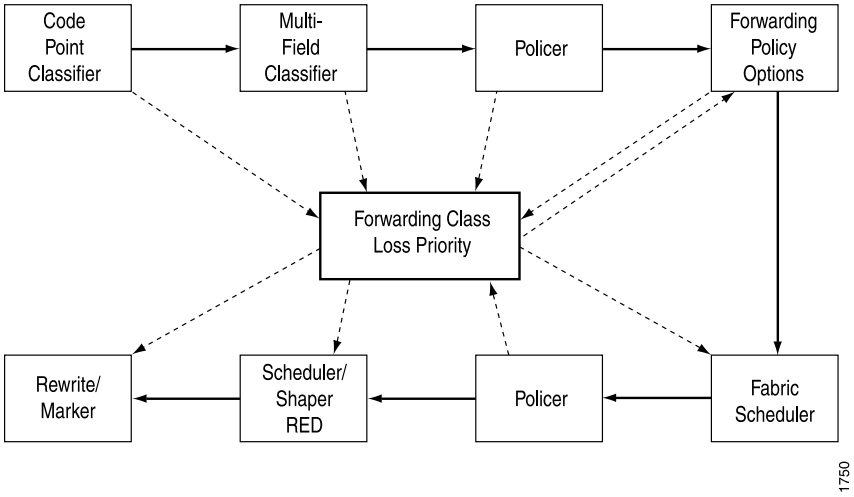
Juniper Networks CoS features interoperate with other vendors' CoS implementations because they are based on IETF Differentiated Services (DiffServ) standards.

DiffServ specifications establish a six-bit field in the IPv4 and IPv6 packet header to indicate the service class that should be applied to the packet. The bit values in the DiffServ field form DiffServ code points (DSCPs) that can be set by the application or a router on the edge of a DiffServ-enabled network.

Although CoS methods such as DiffServ specify the position and length of the DSCP in the packet header, the implementation of the router mechanisms to deliver DiffServ internally is vendor-specific. CoS functions in Junos OS are configured through a series of mechanisms that you can configure individually or in combination to define particular service offerings.

Figure 1 on page 4 shows the components of the Junos CoS features, illustrating the sequence in which they interact.

Figure 1: Packet Flow Through CoS-Configurable Components



You can configure one or more of the following Junos CoS mechanisms:

- Classifiers—Allow you to associate incoming packets with a forwarding class and packet loss priority (PLP). Two general types of classifiers are supported:
  - Behavior aggregate (BA) or code point traffic classifiers allow you to set the forwarding class and PLP based on DSCP.
  - Multifield (MF) traffic classifiers allow you to set the forwarding class and PLP based on firewall filter rules. This is usually done at the edge of the network for packets that do not have valid DSCPs in the packet headers.
- Forwarding classes—Allow you to set the scheduling and marking of packets as they transit the router. Known as ordered aggregates in the DiffServ architecture, the forwarding class plus the loss priority determine the router's per-hop behavior (PHB in DiffServ) for CoS.

- Loss priorities—Allow you to set the priority of dropping a packet before it is sent. Loss priority affects the scheduling of a packet without affecting the packet's relative ordering.
- Forwarding policy options—Allow you to associate forwarding classes with next hops. Forwarding policy options also allow you to create classification overrides, which assign forwarding classes to sets of prefixes.
- Transmission scheduling and rate control—Provide you with a variety of tools to manage traffic flows:
  - Schedulers—Allow you to define the priority, bandwidth, delay buffer size, rate control status, and RED drop profiles to be applied to a particular forwarding class for packet transmission.
  - Fabric schedulers—For M120, M320, and T Series routers only, fabric schedulers allow you to identify a packet as high or low priority based on its forwarding class, and to associate schedulers with the fabric priorities.
  - Policers for traffic classes—Allow you to limit traffic of a certain class to a specified bandwidth and burst size. Packets exceeding the policer limits can be discarded, or can be assigned to a different forwarding class or to a different loss priority, or to both. You define policers with filters that can be associated with input or output interfaces.
- Rewrite markers—Allow you to redefine the DSCP value of outgoing packets. Rewriting or marking outbound packets is useful when the router is at the border of a network and must alter the code points to meet the policies of the targeted peer.

Typically, rewrites of the DSCPs on outgoing packets are done once, when packets enter the DiffServ portion of the network, either because the packets do not arrive from the customer with the proper DSCP bit set or because the service provider wishes to verify that the customer has set the DSCP properly. CoS schemes that accept the DSCP and classify and schedule traffic solely on DSCP value perform behavior aggregate (BA) DiffServ functions and do not usually rewrite the DSCP. DSCP rewrites typically occur in multifield (MF) DiffServ scenarios.

Related Documentation

- Class of Service Using IPv6 DiffServ
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21
- System Requirements for CoS with DiffServ for IPv6 on page 13
- Example: CoS with IPv6 DiffServ Configuration on page 33

Default DHCP Mappings

Table 1 on page 6 shows the mapping of DiffServ service class meanings (aliases) to DSCPs.

Table 1: Default DSCP Mappings

DiffServ Service Class Alias	IPv4 and IPv6 DSCP Mapping
ef	101110
af11	001010
af12	001100
af13	001110
af21	010010
af22	010100
af23	010110
af31	011010
af32	011100
af33	011110
af41	100010
af42	100100
af43	100110
be	000000
cs1	001000
cs2	010000
cs3	011000
cs4	100000
cs5	101000
nc1/cs6	110000
nc2/cs7	111000

None of the aliases are established by DiffServ specifications. The aliases are well-known only through usage. For example, it is widely accepted that the alias for DSCP **101110** is **ef** (expedited forwarding). The 21 well-known DSCPs establish 5 DiffServ service classes:

- **Best-effort (be)**—The router does not apply any special CoS handling to packets with **000000** in the DiffServ field, a backward compatibility feature. There is usually a high probability that these packets will be dropped under congested network conditions.
- **Assured forwarding (af)**—The router offers a high level of assurance that the packets are delivered as long as the packet flow from the customer stays within a certain service profile (the service provider defines the values). The router accepts excess traffic, but applies a random early discard (RED) drop profile to decide if the excess packets should be dropped and not forwarded. Three drop probabilities (low, medium, and high) are defined for this service class.
- **Expedited forwarding (ef)**—The router delivers assured bandwidth, low loss, low delay, and low delay variation (jitter) end-to-end for packets in this service class. Routers accept excess traffic in this class, but in contrast to assured forwarding, out-of-profile expedited-forwarding packets can be forwarded out of sequence or dropped.
- **Conversational services (cs)**—The router delivers assured (usually low) bandwidth with low delay and jitter for packets in this service class. Packets can be dropped, but never delivered out of sequence. Packetized voice is a good example of a conversational service.
- **Network control (nc)**—The router delivers packets in this service class with a low priority (these packets are not delay-sensitive). Typically, these packets represent routing protocol hello or keepalive messages and loss of these packets jeopardizes proper network operation, so delay is preferable to discard.

Related Documentation

- Class of Service Using IPv6 DiffServ
- Overview of Class of Service Using IPv6 DiffServ on page 3
- System Requirements for CoS with DiffServ for IPv6 on page 13
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Default Forwarding Classes

Table 2 on page 7 shows the default forwarding class and packet loss priority (PLP) for the well-known DSCPs. It is important to note that although several DSCPs map to the **expedited-forwarding** and **assured-forwarding** classes, by default no resources are assigned to these forwarding classes. All of these settings can be changed through configuration.

Table 2: Default Behavior Aggregate Classification

DSCP and DSCP IPv6	Forwarding Class	PLP
ef	expedited-forwarding	low

Table 2: Default Behavior Aggregate Classification *(continued)*

DSCP and DSCP IPv6	Forwarding Class	PLP
af11	assured-forwarding	low
af12	assured forwarding	high
af13	assured forwarding	high
af21	best-effort	low
af22	best-effort	low
af23	best-effort	low
af31	best-effort	low
af32	best-effort	low
af33	best-effort	low
af41	best-effort	low
af42	best-effort	low
af43	best-effort	low
be	best-effort	low
cs1	best-effort	low
cs2	best-effort	low
cs3	best-effort	low
cs4	best-effort	low
cs5	best-effort	low
nc1/cs6	network-control	low
nc2/cs7	network control	low
other	best-effort	low

Table 3 on page 9 shows the router forwarding classes associated with each well-known DSCP code point and the resources assigned to their output queues.

Table 3: Classification Forwarding Classes and Queues

DCSP Alias	DSCP Bits	Forwarding Class	PLP	Queue
ef	101110	expedited-forwarding	low	1
af11	001010	assured-forwarding	low	2
af12	001100	assured-forwarding	high	2
af13	001110	assured-forwarding	high	2
af21	010010	best-effort	low	0
af22	010100	best-effort	low	0
af23	010110	best-effort	low	0
af31	011010	best-effort	low	0
af32	011100	best-effort	low	0
af33	011110	best-effort	low	0
af41	100010	best-effort	low	0
af42	100100	best-effort	low	0
af43	100110	best-effort	low	0
be	000000	best-effort	low	0
cs1	001000	best-effort	low	0
cs2	010000	best-effort	low	0
cs3	011000	best-effort	low	0
cs4	100000	best-effort	low	0
cs5	101000	best-effort	low	0
nc1/cs6	110000	network-control	low	3
nc2/cs7	111000	network-control	low	3
other	—	best-effort	low	0

Table 4 on page 10 shows the resources assigned to the four forwarding classes in this example.

Table 4: Resources Assigned to Queues

Queue	Forwarding Class	Transmit Rate	Buffer Size	Priority
0	**be** (data)	40%	40%	Low
1	**ef** (financial)	10%	10%	High
2	**af** (audiovisual)	45%	45%	High (with RED)
3	**nc** (network control)	5%	5%	Low

The table shows how the 95 percent of output link transmission rate and buffer size (queue) resources assigned by default to Q0 (best-effort) are distributed to Q1 (expedited forwarding) and Q2 (assured forwarding). The audiovisual traffic consumes more bandwidth than other applications, but the financial information, although critical, is carried in fewer packets. In keeping with DiffServ specifications, a RED drop profile is applied to the assured forwarding class. The financial data has a strict set of traffic parameters that must be respected.

The three DiffServ assured forwarding classes supported (**af11**, **af12**, and **af13**, with low, medium, and high packet drop probability, respectively) are distinguished by using a low PLP and RED drop profile for **af11** and a high PLP and RED for **af12** and **af13**. All of these parameters should be closely monitored initially for performance and adjusted as necessary.

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Juniper Networks Default Forwarding Classes

Most M Series routers have only four queues built into the hardware. M120, M320, MX Series, and T Series routers can be configured for up to eight queues. If a classifier does not assign a packet to any other queue (for example, for other than well-known DSCPs that have not been added to the classifier), the packet is assigned by default to the class associated with queue 0 (Q0).

Table 5 on page 11 shows the four forwarding classes and queues to which Juniper Networks classifiers assign a packet based on the DSCP values in arriving packet headers.

Table 5: Default Forwarding Classes

Forwarding Class Name	Queue
best-effort	queue 0
expedited-forwarding	queue 1
assured-forwarding	queue 2
network-control	queue 3

Each forwarding class has an associated scheduler priority. Only two forwarding classes, **best-effort** and **network-control** (Q0 and Q3), are actually referenced in the default scheduler configuration. However, you can manually configure resources for the **expedited-forwarding** and **assured-forwarding** classes (Q1 and Q2).

The default scheduler settings are not visible in the output of the **show class-of-service** command; rather, they are implicit.

Default Scheduler

```
[edit class-of-service]
schedulers {
    network-control {
        transmit-rate percent 5;
        buffer-size percent 5;
        priority low;
        drop-profile-map loss-priority any protocol any;
        drop-profile terminal;
    }
    best-effort {
        transmit-rate percent 95;
        buffer-size percent 95;
        priority low;
        drop-profile-map loss-priority any protocol any;
        drop-profile terminal;
    }
}
drop-profiles {
    terminal {
        fill-level 100 drop-probability 100;
    }
}
```

By default, the **best-effort** forwarding class (Q0) receives 95 percent of the output link bandwidth and buffer space, and the **network-control** forwarding class (Q3) receives 5 percent of the output link bandwidth and buffer space. The default drop profile provides *tail drop*, where the buffer fills and then discards all packets until there is space in the buffer again. There are no schedulers for the **expedited-forwarding** or **assured-forwarding** classes because by default no resources are assigned to Q1 and Q2.

All **af** classes other than **af1*x*** are mapped to **best-effort**, since RFC 2597 prohibits a node from aggregating classes. In effect, mapping to **best-effort** implies that the node does not support that class.

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CHAPTER 2

System Requirements

System Requirements for CoS with DiffServ for IPv6

To implement CoS with DiffServ for IPv6, your system must meet these minimum requirements:

- Junos OS Release 8.2 or later for MX Series routers
- Junos OS Release 6.3 or later for M Series and T Series routers
- Three Juniper Networks M Series, MX Series, or T Series routers
- For M Series routers, Enhanced FPCs capable of supporting DSCPs and, for MF classifiers, Internet Processor II ASICs

Related Documentation

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CHAPTER 3

Glossary

Terms and Acronyms for CoS with DiffServ for IPv6

C

class of service — A set of forwarding class parameters that define different treatment for different traffic flows.

classifier — A method of reading a sequence of bits in a packet header or label and determining the packet's forwarding class.

D

Differentiated Services (DiffServ) — A standards-based method of associating CoS parameters with traffic flows and their forwarding classes.

Differentiated Services code point (DSCP) — Values for a 6-bit field defined for IPv4 and IPv6 packet headers that can be used to enforce CoS distinctions in routers.

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CHAPTER 4

Standards

For More Information about CoS using DiffServ and IPv6

For additional information about CoS using DiffServ and IPv6, see the following:

- RFC 1924, *A Compact Representation of IPv6 Addresses*
- RFC 2474, *Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers*
- RFC 2475, *An Architecture for Differentiated Services*
- RFC 2640, *Internet Protocol, Version 6 (IPv6) Specification*
- RFC 2983, *Differentiated Service and Tunnels*
- RFC 3260, *New Terminology and Clarifications for DiffServ*
- RFC 3317, *Differentiated Services Quality of Service Policy Information Base*
- RFC 3513, *IP Version 6 Addressing Architecture*

Related Documentation

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- Roadmap for Configuring CoS with IPv6 DiffServ on page 21

PART 2

Configuration

CHAPTER 5

Configuration Overview

Roadmap for Configuring CoS with IPv6 DiffServ

To configure class of service (CoS) over IPv6, you must:

- Configure a multifield (MF) classifier for IPv6 to detect packets of interest to CoS and assign the packet to the proper forwarding class independently of Differentiated Services Code Point (DSCP). See "Configuring a Firewall Filter for an MF Classifier on Customer Interfaces" on page 23.

  Next, apply the MF classifier to the appropriate interface. See "Applying the Firewall Filter to Customer Interfaces" on page 24.

- Assign the forwarding classes established by the MF classifier to output queues. See "Assigning Forwarding Classes to Output Queues" on page 27.

- Configure rewrite rules to replace DSCPs on packets received from the customer with the values expected by other routers. See "Configuring Rewrite Rules" on page 27.

  Next, apply the rewrite rules to the appropriate interface. See "Applying Rewrite Rules to an Interface" on page 26.

- Configure behavior aggregate (BA) classifiers for IPv6 on network interfaces because the DSCPs have been explicitly rewritten on the edge routers. See "Configuring BA Classifiers" on page 25.

  Next, apply the BA classifier to the appropriate interface. See "Applying a BA Classifier to an Interface" on page 26.

- Configure random early discard (RED) drop profiles to determine the probability of DiffServ assured forwarding packets being discarded under congested conditions. See "Configuring RED Drop Profiles" on page 28.

- Configure schedulers to assign resources, priorities, and drop profiles to output queues. See "Configuring Schedulers" on page 28.

- Configure a scheduler map to assign a forwarding class to a scheduler. See "Configuring Scheduler Maps" on page 29.

  Next, apply the scheduler map to the appropriate interface. See "Applying a Scheduler Map to an Interface" on page 30.

Related Documentation

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CHAPTER 6

Configuration Steps

Configuring a Firewall Filter for an MF Classifier on Customer Interfaces

You configure an MF classifier for IPv6 to detect packets of interest to CoS and assign the packet to the proper forwarding class independently of DSCP. To configure an MF classifier on a customer-facing link, configure a policer for the expedited forwarding traffic and a firewall filter to classify traffic.

```
[edit firewall]
policer ef-FIN-Policer-Profile {
   if-exceeding {
      bandwidth-percent 10;
      burst-size-limit 2k;
   }
   then loss-priority high;
}
family inet6 {
   filter mf-classifier {
      filter-specific;
      term AV {
         from {
            destination-address {
               0:0:FFFF:172.16.79.11;
            }
         }
```

```
        then {
          loss-priority low;
          forwarding-class af-AV-class;
        }
      }
      term Finance {
        from {
          destination-address {
            O:0:FFFF:172.16.79.63;
          }
        }
        then {
          policer ef-FIN-Policer-Profile;
          forwarding-class ef-FIN-class;
        }
      }
      term Network-Control {
        from {
          traffic-class 192; # 192 is the 110000 traffic class.
        }
        then {
          forwarding-class nc-CONTROL-class; # This is network control traffic.
        }
      }
      term Data {
        then forwarding-class be-DATA-class; # The rest is data.
      }
    }
  }
```

Related Documentation

- Applying the Firewall Filter to Customer Interfaces on page 24
- Class of Service Using IPv6 DiffServ
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21
- Overview of Class of Service Using IPv6 DiffServ on page 3
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Applying the Firewall Filter to Customer Interfaces

You apply an MF classifier firewall filter for IPv6 to customer interfaces. To apply an MF classifier firewall filter on customer-facing links, apply the classifier as an input filter at the **[edit interfaces]** hierarchy level.

```
[edit interfaces]
so-0/0/1 {
  unit 0 {
    family inet {
      address 192.168.54.1/24;
    }
    family inet6 {
      filter {
```

```
            input mf-classifier;
          }
          address 0:0:FFFF:192.168.54.1/120;
        }
      }
    }
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Configuring a Firewall Filter for an MF Classifier on Customer Interfaces on page 23
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Configuring BA Classifiers

You configure BA classifiers for IPv6 on network interfaces because the DSCPs have been explicitly rewritten on the edge routers. To configure a BA classifier for IPv6 DSCPs, include the **dscp-ipv6** statement and give the classifier a name. Then import the default classifier and specify the forwarding class, loss priority, and code points for each established traffic class at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
classifiers {
  dscp-ipv6 IPv6-classifier {
    import default; # Uses the DSCP default map.
    forwarding-class be-DATA-class {
      loss-priority high code-points 000001;
    }
    forwarding-class ef-FIN-class {
      loss-priority high code-points 101111;
    }
    forwarding-class af-AV-class {
      loss-priority high code-points 001100;
    }
    forwarding-class nc-CONTROL-class {
      loss-priority high code-points 110001;
    }
  }
}
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Applying a BA Classifier to an Interface on page 26
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Applying a BA Classifier to an Interface

To apply the configured classifier, include the **classifiers** statement at the **[edit class-of-service interfaces]** hierarchy level.

```
[edit class-of-service interfaces]
so-0/1/1 {
  unit 0 {
    classifiers {
      dscp-ipv6 IPv6-classifier;
    }
  }
}
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Configuring BA Classifiers on page 25
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21
- Overview of Class of Service Using IPv6 DiffServ on page 3
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Applying Rewrite Rules to an Interface

To apply the configured rewrite rules, include the **rewrite-rules** statement at the **[edit class-of-service interfaces]** hierarchy level.

```
[edit class-of-service interfaces]
so-0/1/1 {
  unit 0 {
    rewrite-rules {
      dscp-ipv6 rewrite-IPv6-dscps;
    }
  }
}
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Configuring Rewrite Rules on page 27
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Configuring Rewrite Rules

You configure rewrite rules to replace DSCPs on packets received from the customer with the values expected by other routers. Rewrite rules use the forwarding class information and packet loss priority (PLP) used internally by the router to establish the DSCP on outbound packets. To configure rewrite rules, include the **rewrite-rules** statement at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
rewrite-rules rewrite-IPv6-dscps {
   forwarding-class be-DATA-class {
      loss-priority low code points 000000;
      loss-priority high code points 000001;
   }
   forwarding-class ef-FIN-class {
      loss-priority low code points 101110;
      loss-priority high code points 101111;
   }
   forwarding-class af-AV-class {
      loss-priority low code points 001010;
      loss-priority high code points 001100;
   }
   forwarding-class nc-CONTROL-class {
      loss-priority low code points 110000;
      loss-priority high code points 110001;
   }
}
```

Related Documentation

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Assigning Forwarding Classes to Output Queues

You must assign the forwarding classes established by the MF classifier to output queues. To assign a forwarding class to an output queue, include the **forwarding-classes** statement at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
forwarding-classes {
   queue 0 be-DATA-class;
   queue 1 ef-FIN-class;
   queue 2 af-AV-class;
   queue 3 nc-CONTROL-class;
}
```

Related Documentation

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Configuring RED Drop Profiles

You configure RED drop profiles to determine the probability of DiffServ assured forwarding packets being discarded under congested conditions. To configure RED drop profiles for assured forwarding without the PLP bit set and with the PLP bit set, include the **drop-profiles** statement at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
drop-profiles {
  af-AV-normal {
    interpolate {
      fill-level [95 100];
      drop-probability [0 100];
    }
  }
  af-AV-with-PLP {
    interpolate {
      fill-level [60 70 80 90 95];
      drop-probability [80 90 95 97 100];
    }
  }
}
```

Assured forwarding traffic with the PLP bit set has a more aggressive drop probability than traffic without the PLP bit set.

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- Example: CoS with IPv6 DiffServ Configuration on page 33

Configuring Schedulers

You configure schedulers to assign resources, priorities, and drop profiles to output queues. To configure a scheduler, include the **schedulers** statement at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
schedulers {
  be-DATA-scheduler {
```

```
        transmit-rate percent 40;
        buffer-size percent 40;
        priority low;
      }
      ef-FIN-scheduler {
        transmit-rate percent 10;
        buffer-size percent 10;
        priority high;
      }
      af-AV-scheduler {
        transmit-rate percent 45;
        buffer-size percent 45;
        priority high;
        drop-profile-map loss-priority low protocol any drop-profile af-AV-normal;
        drop-profile-map loss-priority high protocol any drop-profile af-AV-with-PLP;
      }
      nc-CONTROL-scheduler {
        transmit-rate percent 5;
        buffer-size percent 5;
        priority low;
      }
    }
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21
- Overview of Class of Service Using IPv6 DiffServ on page 3
- System Requirements for CoS with DiffServ for IPv6 on page 13
- Example: CoS with IPv6 DiffServ Configuration on page 33

Configuring Scheduler Maps

You configure a scheduler map to assign a forwarding class to a scheduler. To configure a scheduler map, include the **scheduler-maps** statement and scheduler name at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
scheduler-maps {
  diffserv-cos-map {
    forwarding-class be-DATA-class scheduler be-DATA-scheduler;
    forwarding-class ef-FIN-class scheduler ef-FIN-scheduler;
    forwarding-class af-AV-class scheduler af-AV-scheduler;
    forwarding-class nc-CONTROL-class scheduler nc-CONTROL-scheduler;
  }
}
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Applying a Scheduler Map to an Interface on page 30
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21
- Overview of Class of Service Using IPv6 DiffServ on page 3

- System Requirements for CoS with DiffServ for IPv6 on page 13
- Example: CoS with IPv6 DiffServ Configuration on page 33

Applying a Scheduler Map to an Interface

To apply the configured scheduler map, include the **scheduler-map** statement at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
interfaces {
   so-1/0/1 {
      scheduler-map diffserv-cos-map;
   }
}
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Configuring Scheduler Maps on page 29
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21
- Overview of Class of Service Using IPv6 DiffServ on page 3
- System Requirements for CoS with DiffServ for IPv6 on page 13
- Example: CoS with IPv6 DiffServ Configuration on page 33

PART 3

Examples

CHAPTER 7

Examples

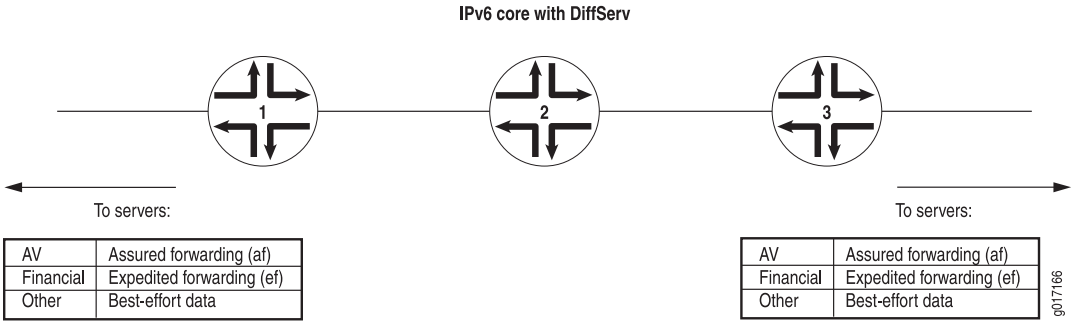
Example: CoS with IPv6 DiffServ Configuration

Example: CoS with IPv6 DiffServ Configuration

The example assigns expedited forwarding to Q1 and a subset of the assured forwarding classes (**af1*x***) to Q2, and distributes resources among all four forwarding classes.

Figure 2 on page 33 shows the topology of the three routers and links that are used as a case study in this chapter.

Figure 2: Basic IPv6 DiffServ Topology



In this case study, the service provider has agreed to provide high-priority delivery of packets for two applications between the customer's servers at two sites. The first application generates streams of high-definition audiovisual (television) packet flows and the second generates large quantities of time-sensitive financial information. In all cases, the packet flow is from server to server. The service provider marks the packets appropriately as they enter the network from either site, configures special queues and forwarding classes for this traffic on the three routers, and uses DiffServ for IPv6 for this purpose.

Routers 1 and 3 use multifield (MF) classifiers on the customer-facing interfaces to detect high-priority packets and rewrite the Differentiated Services code points (DSCPs)

appropriately. Best-effort data and network control packets are not affected. All three routers are configured with consistent schedulers and resources to handle high-priority packets properly.

Figure 3: IPv6 DiffServ Configuration

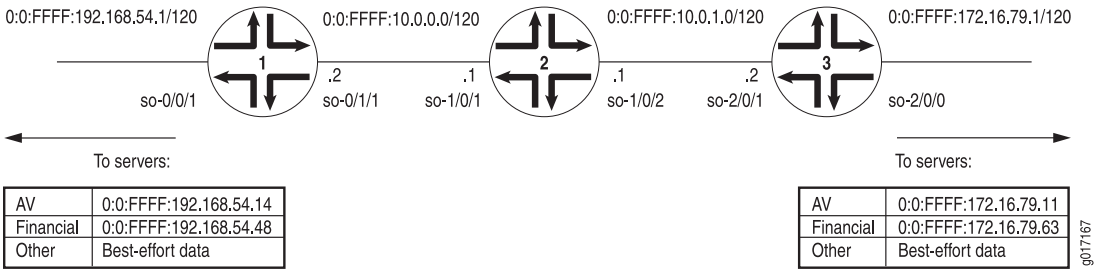


Figure 3 on page 34 shows the complete topology for IPv6 DiffServ, complete with interfaces and IPv6 addresses. The IPv4-mapped IPv6 address format described in RFC 1884 is used.

Begin your configuration on Router 2, the core router. This ensures that when DiffServ is enabled on the edge routers, class of service (CoS) is enabled end to end through the network. The core router configuration is a little simpler because no MF classification is configured in the core.

Router 2

```
[edit]
class-of-service {
  classifiers { # Router 2 classifiers.
    dscp-ipv6 IPv6-classifier {
      import default; # Uses the DSCP default map.
      forwarding-class be-DATA-class {
        loss-priority high code-points 000001;
      }
      forwarding-class ef-FIN-class {
        loss-priority high code-points 101111;
      }
      forwarding-class af-AV-class {
        loss-priority high code-points 001100;
      }
      forwarding-class nc-CONTROL-class {
        loss-priority high code-points 110001;
      }
    }
  }
  drop-profiles { # Router 2 drop profiles.
    af-AV-normal {
      interpolate {
        fill-level [95 100];
        drop-probability [0 100];
      }
    }
    af-AV-with-PLP {
      interpolate {
        fill-level [60 70 80 90 95];
        drop-probability [80 90 95 97 100];
      }
```

```
    }
}
forwarding-classes { # Router 2 forwarding classes.
    queue 0 be-DATA-class;
    queue 1 ef-FIN-class;
    queue 2 af-AV-class;
    queue 3 nc-CONTROL-class;
}
interfaces { # Router 2 class-of-service interfaces.
    so-1/0/1 { # Connected to R1.
        scheduler-map diffserv-cos-map;
        unit 0 {
            classifiers {
                dscp-ipv6 IPv6-classifier;
            }
            rewrite-rules {
                dscp-ipv6 rewrite-IPv6-dscp;
            }
        }
    }
    so-1/0/2 { # Connected to R3.
        scheduler-map diffserv-cos-map;
        unit 0 {
            classifiers {
                dscp-ipv6 IPv6-classifier;
            }
            rewrite-rules {
                dscp-ipv6 rewrite-IPv6-dscp;
            }
        }
    }
}
rewrite-rules rewrite-IPv6-dscps { # Router 2 rewrite rules.
    forwarding-class be-DATA-class {
        loss-priority low code points 000000;
        loss-priority high code points 000001;
    }
    forwarding-class ef-FIN-class {
        loss-priority low code points 101110;
        loss-priority high code points 101111;
    }
    forwarding-class af-AV-class {
        loss-priority low code points 001010;
        loss-priority high code points 001100;
    }
    forwarding-class nc-CONTROL-class {
        loss-priority low code points 110000;
        loss-priority high code points 110001;
    }
}
scheduler-maps { # Router 2 scheduler maps.
    diffserv-cos-map {
        forwarding-class be-DATA-class scheduler be-DATA-scheduler;
        forwarding-class ef-FIN-class scheduler ef-FIN-scheduler;
        forwarding-class af-AV-class scheduler af-AV-scheduler;
        forwarding-class nc-CONTROL-class scheduler nc-CONTROL-scheduler;
```

```
        }
    }
    schedulers { # Router 2 schedulers.
        be-DATA-scheduler {
            transmit-rate percent 40;
            buffer-size percent 40;
            priority low;
        }
        ef-FIN-scheduler {
            transmit-rate percent 10;
            buffer-size percent 10;
            priority high;
        }
        af-AV-scheduler {
            transmit-rate percent 45;
            buffer-size percent 45;
            priority high;
            drop-profile-map loss-priority low protocol any drop-profile af-AV-normal;
            drop-profile-map loss-priority high protocol any drop-profile af-AV-with-PLP;
        }
        nc-CONTROL-scheduler {
            transmit-rate percent 5;
            buffer-size percent 5;
            priority low;
        }
    }
}
interfaces { # R2 interfaces.
    so-1/0/1 { # Connected to R1.
        unit 0 {
            family inet {
                address 10.0.0.1/24;
            }
            family inet6 {
                address 0:0:FFFF:10.0.0.1/120;
            }
        }
    }
    so-1/0/2 { # Connected to R3.
        unit 0 {
            family inet {
                address 10.0.1.1/24;
            }
            family inet6 {
                address 0:0:FFFF:10.0.1.1/120;
            }
        }
    }
}
```

Continue your configuration on Router 1 and Router 3, the edge routers. These routers get firewall-filter-based MF classifiers and rewrite rules for markers as well as schedulers and drop profiles on the core-facing interfaces.

Router 1

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

```
classifiers { # Router 1 classifiers.
  dscp-ipv6 IPv6-classifier {
    import default; # Uses the DSCP default map.
    forwarding-class be-DATA-class {
      loss-priority high code-points 000001;
    }
    forwarding-class ef-FIN-class {
      loss-priority high code-points 101111;
    }
    forwarding-class af-AV-class {
      loss-priority high code-points 001100;
    }
    forwarding-class nc-CONTROL-class {
      loss-priority high code-points 110001;
    }
  }
}
drop-profiles { # Router 1 drop profiles.
  af-AV-normal {
    interpolate {
      fill-level [95 100];
      drop-probability [0 100];
    }
  }
  af-AV-with-PLP {
    interpolate {
      fill-level [60 70 80 90 95];
      drop-probability [80 90 95 97 100];
    }
  }
}
forwarding-classes { # Router 1 forwarding classes.
  queue 0 be-DATA-class;
  queue 1 ef-FIN-class;
  queue 2 af-AV-class;
  queue 3 nc-CONTROL-class;
}
interfaces { # Router 1 class-of-service interfaces.
  so-0/1/1 { # To servers.
    scheduler-map diffserv-cos-map;
    unit 0 {
      classifiers {
        dscp-ipv6 IPv6-classifier;
      }
      rewrite-rules {
        dscp-ipv6 rewrite-IPv6-dscp;
      }
    }
  }
  rewrite-rules rewrite-IPv6-dscps { # Router 1 rewrite rules.
    forwarding-class be-DATA-class {
      loss-priority low code points 000000;
      loss-priority high code points 000001;
    }
    forwarding-class ef-FIN-class {
      loss-priority low code points 101110;
```

```
            loss-priority high code points 101111;
        }
        forwarding-class af-AV-class {
            loss-priority low code points 001010;
            loss-priority high code points 001100;
        }
        forwarding-class nc-CONTROL-class {
            loss-priority low code points 110000;
            loss-priority high code points 110001;
        }
    }
    scheduler-maps { # Router 1 scheduler map.
        diffserv-cos-map {
            forwarding-class be-DATA-class scheduler be-DATA-scheduler;
            forwarding-class ef-FIN-class scheduler ef-FIN-scheduler;
            forwarding-class af-AV-class scheduler af-AV-scheduler;
            forwarding-class nc-CONTROL-class scheduler nc-CONTROL-scheduler;
        }
    }
    schedulers { # Router 1 schedulers.
        be-DATA-scheduler {
            transmit-rate percent 40;
            buffer-size percent 40;
            priority low;
        }
        ef-FIN-scheduler {
            transmit-rate percent 10;
            buffer-size percent 10;
            priority high;
        }
        af-AV-scheduler {
            transmit-rate percent 45;
            buffer-size percent 45;
            priority high;
            drop-profile-map loss-priority low protocol any drop-profile af-AV-normal;
            drop-profile-map loss-priority high protocol any drop-profile af-AV-with-PLP;
        }
        nc-CONTROL-scheduler {
            transmit-rate percent 5;
            buffer-size percent 5;
            priority low;
        }
    }
}
firewall { # Router 1 firewall policer and filter.
    policer ef-FIN-Policer-Profile {
        if-exceeding {
            bandwidth-percent 10;
            burst-size-limit 2k;
        }
        then loss-priority high;
    }
    family inet6 {
        filter mf-classifier {
            filter-specific;
            term AV {
```

```
            from {
              destination-address {
                0:0:FFFF:172.16.79.11;
              }
            }
            then {
              loss-priority low;
              forwarding-class af-AV-class;
            }
          }
          term Finance {
            from {
              destination-address {
                O:0:FFFF:172.16.79.63;
              }
            }
            then {
              policer ef-FIN-Policer-Profile;
              forwarding-class ef-FIN-class;
            }
          }
          term Network-Control {
            from {
              traffic-class 192; # 192 is the 110000 traffic class.
            }
            then {
              forwarding-class nc-CONTROL-class; # This is network control traffic.
            }
          }
          term Data {
            then forwarding-class be-DATA-class; # The rest is data.
          }
        }
      }
    }
    interfaces { # Router 1 interfaces.
      so-0/0/1 { # To servers.
        unit 0 {
          family inet {
            address 192.168.54.1/24;
          }
          family inet6 {
            filter {
              input mf-classifier;
            }
            address 0:0:FFFF:192.168.54.1/120;
          }
        }
      }
      so-0/1/1 { # Connected to R2.
        unit 0 {
          family inet {
            address 10.0.0.2/24;
          }
          family inet6 {
            address 0:0:FFFF:10.0.0.2/120;
```

```
        }
      }
    }
  }
}
```

Router 3

```
[edit]
class-of-service {
  classifiers { # Router 3 classifiers.
    dscp-ipv6 IPv6-classifier {
      import default; # Uses the DSCP default map.
      forwarding-class be-DATA-class {
        loss-priority high code-points 000001;
      }
      forwarding-class ef-FIN-class {
        loss-priority high code-points 101111;
      }
      forwarding-class af-AV-class {
        loss-priority high code-points 001100;
      }
      forwarding-class nc-CONTROL-class {
        loss-priority high code-points 110001;
      }
    }
  }
  drop-profiles { # Router 3 drop profiles.
    af-AV-normal {
      interpolate {
        fill-level [95 100];
        drop-probability [0 100];
      }
    }
    af-AV-with-PLP {
      interpolate {
        fill-level [60 70 80 90 95];
        drop-probability [80 90 95 97 100];
      }
    }
  }
  forwarding-classes { # Router 3 forwarding classes.
    queue 0 be-DATA-class;
    queue 1 ef-FIN-class;
    queue 2 af-AV-class;
    queue 3 nc-CONTROL-class;
  }
  interfaces { # Router 3 class-of-service interfaces.
    so-2/0/1 { # To servers.
      scheduler-map diffserv-cos-map;
      unit 0 {
        classifiers {
          dscp-ipv6 IPv6-classifier;
        }
        rewrite-rules {
          dscp-ipv6 rewrite-IPv6-dscp;
        }
      }
```

```
}
rewrite-rules rewrite-IPv6-dscps { # Router 3 rewrite rules.
    forwarding-class be-DATA-class {
        loss-priority low code points 000000;
        loss-priority high code points 000001;
    }
    forwarding-class ef-FIN-class {
        loss-priority low code points 101110;
        loss-priority high code points 101111;
    }
    forwarding-class af-AV-class {
        loss-priority low code points 001010;
        loss-priority high code points 001100;
    }
    forwarding-class nc-CONTROL-class {
        loss-priority low code points 110000;
        loss-priority high code points 110001;
    }
}
scheduler-maps { # Router 3 scheduler map.
    diffserv-cos-map {
        forwarding-class be-DATA-class scheduler be-DATA-scheduler;
        forwarding-class ef-FIN-class scheduler ef-FIN-scheduler;
        forwarding-class af-AV-class scheduler af-AV-scheduler;
        forwarding-class nc-CONTROL-class scheduler nc-CONTROL-scheduler;
    }
}
schedulers { # Router 3 schedulers.
    be-DATA-scheduler {
        transmit-rate percent 40;
        buffer-size percent 40;
        priority low;
    }
    ef-FIN-scheduler {
        transmit-rate percent 10;
        buffer-size percent 10;
        priority high;
    }
    af-AV-scheduler {
        transmit-rate percent 45;
        buffer-size percent 45;
        priority high;
        drop-profile-map loss-priority low protocol any drop-profile af-AV-normal;
        drop-profile-map loss-priority high protocol any drop-profile af-AV-with-PLP;
    }
    nc-CONTROL-scheduler {
        transmit-rate percent 5;
        buffer-size percent 5;
        priority low;
    }
}
firewall { # Router 3 firewall policer and filter.
    policer ef-FIN-Policer-Profile {
        if-exceeding {
            bandwidth-percent 10;
            burst-size-limit 2k;
```

```
    }
    then loss-priority high;
  }
  family inet6 {
    filter mf-classifier {
      filter-specific;
      term AV {
        from {
          destination-address {
            0:0:FFFF:172.16.79.11;
          }
        }
        then {
          loss-priority low;
          forwarding-class af-AV-class;
        }
      }
      term Finance {
        from {
          destination-address {
            O:0:FFFF:172.16.79.63;
          }
        }
        then {
          policer ef-FIN-Policer-Profile;
          forwarding-class ef-FIN-class;
        }
      }
      term Network-Control {
        from {
          traffic-class 192; # 192 is the 110000 traffic class.
        }
        then {
          forwarding-class nc-CONTROL-class; # This is network control traffic.
        }
      }
      term Data {
        then forwarding-class be-DATA-class; # The rest is data.
      }
    }
  }
}
interfaces { # Router 3 interfaces.
  so-2/0/0 { # To servers.
    unit 0 {
      family inet {
        address 1172.16.79.1/24;
      }
      family inet6 {
        filter {
          input mf-classifier;
        }
        address 0:0:FFFF:172.16.79.1/120;
      }
    }
  }
```

```
        so-2/0/1 { # to R2
          unit 0 {
            family inet {
              address 10.0.1.2/24;
            }
            family inet6 {
              address 0:0:FFFF:10.0.1.2/120;
            }
          }
        }
      }
    }
  }
```

Verifying Your Work

To verify that your CoS using IPv6 DiffServ configuration is correct, use the following commands:

- **show class-of-service classifier type dscp-ipv6**
- **show class-of-service rewrite-rule type dscp-ipv6**
- **show class-of-service interface**
- **show class-of-service forwarding-table classifier mapping**
- **show class-of-service forwarding-table rewrite-rule mapping**
- **show class-of-service scheduler-map** *scheduler-map-name*
- **show class-of-service forwarding-table scheduler-map**

The following section shows the output of these commands used with the configuration example.

DiffServ Classifiers

```
user@R1> show class-of-service classifier type dscp-ipv6
Classifier: dscp-ipv6-default, Code point type: dscp-ipv6, Index: 4
  Code point         Forwarding class                  Loss priority
  000000             be-DATA-class                     low
  000001             be-DATA-class                     low
  000010             be-DATA-class                     low
  000011             be-DATA-class                     low
  000100             be-DATA-class                     low
  000101             be-DATA-class                     low
  000110             be-DATA-class                     low
  000111             be-DATA-class                     low
  001000             be-DATA-class                     low
  001001             be-DATA-class                     low
  001010             af-AV-class                       low
  001011             be-DATA-class                     low
  001100             af-AV-class                       high
  001101             be-DATA-class                     low
  001110             af-AV-class                       high
  001111             be-DATA-class                     low
  010000             be-DATA-class                     low
  010001             be-DATA-class                     low
  010010             be-DATA-class                     low
  010011             be-DATA-class                     low
```

```
  010100              be-DATA-class                     low
  010101              be-DATA-class                     low
  010110              be-DATA-class                     low
  010111              be-DATA-class                     low
  011000              be-DATA-class                     low
  011001              be-DATA-class                     low
  011010              be-DATA-class                     low
  011011              be-DATA-class                     low
  011100              be-DATA-class                     low
  011101              be-DATA-class                     low
  011110              be-DATA-class                     low
  011111              be-DATA-class                     low
  100000              be-DATA-class                     low
  100001              be-DATA-class                     low
  100010              be-DATA-class                     low
  100011              be-DATA-class                     low
  100100              be-DATA-class                     low
  100101              be-DATA-class                     low
  100110              be-DATA-class                     low
  100111              be-DATA-class                     low
  101000              be-DATA-class                     low
  101001              be-DATA-class                     low
  101010              be-DATA-class                     low
  101011              be-DATA-class                     low
  101100              be-DATA-class                     low
  101101              be-DATA-class                     low
  101110              ef-FIN-class                      low
  101111              be-DATA-class                     low
  110000              nc-CONTROL-class                  low
  110001              be-DATA-class                     low
  110010              be-DATA-class                     low
  110011              be-DATA-class                     low
  110100              be-DATA-class                     low
  110101              be-DATA-class                     low
  110110              be-DATA-class                     low
  110111              be-DATA-class                     low
  111000              nc-CONTROL-class                  low
  111001              be-DATA-class                     low
  111010              be-DATA-class                     low
  111011              be-DATA-class                     low
  111100              be-DATA-class                     low
  111101              be-DATA-class                     low
  111110              be-DATA-class                     low
  111111              be-DATA-class                     low
Classifier: IPv6-classifier, Code point type: dscp-ipv6, Index: 18301
  Code point          Forwarding class                  Loss priority
  000000              be-DATA-class                     low
  000001              be-DATA-class                     high
  000010              be-DATA-class                     low
  000011              be-DATA-class                     low
  000100              be-DATA-class                     low
  000101              be-DATA-class                     low
  000110              be-DATA-class                     low
  000111              be-DATA-class                     low
  001000              be-DATA-class                     low
  001001              be-DATA-class                     low
  001010              af-AV-class                       low
  001011              be-DATA-class                     low
  001100              af-AV-class                       high
  001101              be-DATA-class                     low
  001110              af-AV-class                       high
```

```
  001111            be-DATA-class                 low
  010000            be-DATA-class                 low
  010001            be-DATA-class                 low
  010010            be-DATA-class                 low
  010011            be-DATA-class                 low
  010100            be-DATA-class                 low
  010101            be-DATA-class                 low
  010110            be-DATA-class                 low
  010111            be-DATA-class                 low
  011000            be-DATA-class                 low
  011001            be-DATA-class                 low
  011010            be-DATA-class                 low
  011011            be-DATA-class                 low
  011100            be-DATA-class                 low
  011101            be-DATA-class                 low
  011110            be-DATA-class                 low
  011111            be-DATA-class                 low
  100000            be-DATA-class                 low
  100001            be-DATA-class                 low
  100010            be-DATA-class                 low
  100011            be-DATA-class                 low
  100100            be-DATA-class                 low
  100101            be-DATA-class                 low
  100110            be-DATA-class                 low
  100111            be-DATA-class                 low
  101000            be-DATA-class                 low
  101001            be-DATA-class                 low
  101010            be-DATA-class                 low
  101011            be-DATA-class                 low
  101100            be-DATA-class                 low
  101101            be-DATA-class                 low
  101110            ef-FIN-class                  low
  101111            ef-FIN-class                  high
  110000            nc-CONTROL-class              low
  110001            nc-CONTROL-class              high
  110010            be-DATA-class                 low
  110011            be-DATA-class                 low
  110100            be-DATA-class                 low
  110101            be-DATA-class                 low
  110110            be-DATA-class                 low
  110111            be-DATA-class                 low
  111000            nc-CONTROL-class              low
  111001            be-DATA-class                 low
  111010            be-DATA-class                 low
  111011            be-DATA-class                 low
  111100            be-DATA-class                 low
  111101            be-DATA-class                 low
  111110            be-DATA-class                 low
  111111            be-DATA-class                 low
```

Rewrite Rules

```
user@R1> show class-of-service rewrite-rule type dscp-ipv6
Rewrite rule: dscp-ipv6-default, Code point type: dscp-ipv6, Index: 20
  Forwarding class                Loss priority       Code point
  be-DATA-class                   low                 000000
  be-DATA-class                   high                000000
  ef-FIN-class                    low                 101110
  ef-FIN-class                    high                101110
  af-AV-class                     low                 001010
  af-AV-class                     high                001100
  nc-CONTROL-class                low                 110000
  nc-CONTROL-class                high                111000
```

```
Rewrite rule: rewrite-IPv6-dscp, Code point type: dscp-ipv6, Index: 58077
  Forwarding class                Loss priority       Code point
  be-DATA-class                   low                 000000
  be-DATA-class                   high                000001
  ef-FIN-class                    low                 101110
  ef-FIN-class                    high                101111
  af-AV-class                     low                 001010
  af-AV-class                     high                001100
  nc-CONTROL-class                low                 110000
  nc-CONTROL-class                high                110001
```

Class-of-Service Interfaces

```
user@R1> show class-of-service interface
...
Physical interface: so-0/0/1, Index: 141
Queues supported: 4, Queues in use: 4
  Scheduler map: diffserv-cos-map, Index: -543019056
  Logical interface: so-0/0/1.0, Index: 68
    Object         Name                   Type                      Index
    Rewrite        rewrite-IPv6-dscp      dscp-ipv6                 58077
    Rewrite        exp-default            exp                          21
    Classifier     IPv6-classifier        dscp-ipv6                 18301
    Classifier     exp-default            exp                           5
...
Physical interface: so-0/1/1, Index: 144
Queues supported: 4, Queues in use: 4
  Scheduler map: <default>, Index: -113795564

  Logical interface: so-0/1/1.0, Index: 69
    Object         Name                   Type                      Index
    Rewrite        exp-default            exp                          21
    Classifier     exp-default            exp                           5
    Classifier     ipprec-compatibility   ip                            8
```

Classifier Mapping

```
user@R1> show class-of-service forwarding-table classifier mapping
                        Table Index/
Interface      Index      Q num      Table type
so-0/0/1.0        68      18301      IPv6 DSCP
so-0/1/1.0        69          8      IPv4 precedence
```

Rewrite Rule Mapping

```
user@R1> show class-of-service forwarding-table rewrite-rule mapping
Interface      Index   Table index  Type
so-0/1/1.0        68      58077     IPv6 DSCP
```

Scheduler Map

```
user@R1> show class-of-service scheduler-map diffserv-cos-map
Scheduler map: diffserv-cos-map, Index: 1094596010
  Scheduler: be-DATA-scheduler, Forwarding class: be-DATA-class, Index: 14343
    Transmit rate: 40 percent, Rate Limit: none, Buffer size: 40 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             non-TCP         1    <default-drop-profile>
      Low             TCP             1    <default-drop-profile>
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>
  Scheduler: ef-FIN-scheduler, Forwarding class: ef-FIN-class, Index: 21707
    Transmit rate: 10 percent, Rate Limit: none, Buffer size: 10 percent,
    Priority: high
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             non-TCP         1    <default-drop-profile>
```

```
      Low             TCP             1    <default-drop-profile>
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>
  Scheduler: af-AV-scheduler, Forwarding class: af-AV-class, Index: 51704
    Transmit rate: 45 percent, Rate Limit: none, Buffer size: 45 percent,
    Priority: high
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             non-TCP     61474    af-AV-normal
      Low             TCP         61474    af-AV-normal
      High            non-TCP     65199    af-AV-with-PLP
      High            TCP         65199    af-AV-with-PLP
  Scheduler: nc-CONTROL-scheduler, Forwarding class: nc-CONTROL-class, Index:
50404
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent,
    Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             non-TCP         1    <default-drop-profile>
      Low             TCP             1    <default-drop-profile>
      High            non-TCP         1    <default-drop-profile>
      High            TCP             1    <default-drop-profile>
```

```
user@R1> show class-of-service forwarding-table scheduler-map
...
Interface: so-0/0/1 (Index: 141, Map index: -543019056, Map type: FINAL,
Num of queues: 4):
  Entry 0 (Scheduler index: 14343, Queue #: 0):
    Tx rate: 0 Kb (40%), Buffer size: 40 percent
Priority low
    PLP high: 1, PLP low: 1, TCP PLP high: 1, TCP PLP low: 1
  Entry 1 (Scheduler index: 21707, Queue #: 1):
    Tx rate: 0 Kb (10%), Buffer size: 10 percent
Priority high
    PLP high: 1, PLP low: 1, TCP PLP high: 1, TCP PLP low: 1
  Entry 2 (Scheduler index: 51704, Queue #: 2):
    Tx rate: 0 Kb (45%), Buffer size: 45 percent
Priority high
    PLP high: 65199, PLP low: 61474, TCP PLP high: 65199, TCP PLP low: 61474
  Entry 3 (Scheduler index: 50404, Queue #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority low
    PLP high: 1, PLP low: 1, TCP PLP high: 1, TCP PLP low: 1
...
```

Related Documentation

- Class of Service Using IPv6 DiffServ
- Overview of Class of Service Using IPv6 DiffServ on page 3
- System Requirements for CoS with DiffServ for IPv6 on page 13
- Roadmap for Configuring CoS with IPv6 DiffServ on page 21

PART 4

Administration

CHAPTER 8

Commands

show class-of-service classifier

Syntax

show class-of-service classifier
<name *name*>
<type dscp | type dscp-ipv6 | type exp | type ieee-802.1 | type inet-precedence>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

For each class-of-service (CoS) classifier, display the mapping of code point value to forwarding class and loss priority.

Options

none—Display all classifiers.

name *name*—(Optional) Display named classifier.

type dscp—(Optional) Display all classifiers of the Differentiated Services code point (DSCP) type.

type dscp-ipv6—(Optional) Display all classifiers of the DSCP for IPv6 type.

type exp—(Optional) Display all classifiers of the MPLS experimental (EXP) type.

type ieee-802.1—(Optional) Display all classifiers of the ieee-802.1 type.

type inet-precedence—(Optional) Display all classifiers of the inet-precedence type.

Required Privilege Level

view

List of Sample Output

show class-of-service classifier type ieee-802.1 on page 53
show class-of-service classifier type ieee-802.1 (QFX Series) on page 53

Output Fields

Table 6 on page 52 describes the output fields for the **show class-of-service classifier** command. Output fields are listed in the approximate order in which they appear.

Table 6: show class-of-service classifier Output Fields

Field Name	Field Description
Classifier	Name of the classifier.
Code point type	Type of the classifier: **exp** (not on EX Series switch), **dscp**, **dscp-ipv6** (not on EX Series switch), **ieee-802.1**, or **inet-precedence**.
Index	Internal index of the classifier.
Code point	Code point value used for classification
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.

Table 6: show class-of-service classifier Output Fields *(continued)*

Field Name	Field Description
Loss priority	Loss priority value used for classification. For most platforms, the value is **high** or **low**. For some platforms, the value is **high**, **medium-high**, **medium-low**, or **low**.

Sample Output

show class-of-service classifier type ieee-802.1

```
user@host>  show class-of-service classifier type ieee-802.1
Classifier: ieee802.1-default, Code point type: ieee-802.1, Index: 3
Code Point         Forwarding Class                  Loss priority
  000              best-effort                         low
  001              best-effort                         high
  010              expedited-forwarding                low
  011              expedited-forwarding                high
  100              assured-forwarding                  low
  101              assured-forwarding                  medium-high
  110              network-control                     low
  111              network-control                     high

Classifier: users-ieee802.1, Code point type: ieee-802.1
  Code point         Forwarding class                    Loss priority
  100                expedited-forwarding                low
```

show class-of-service classifier type ieee-802.1 (QFX Series)

```
user@switch>  show class-of-service classifier type ieee-802.1
Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11
  Code point         Forwarding class                    Loss priority
  000                best-effort                         low
  001                best-effort                         low
  010                best-effort                         low
  011                fcoe                                low
  100                no-loss                             low
  101                best-effort                         low
  110                network-control                     low
  111                network-control                     low

Classifier: ieee-mcast, Code point type: ieee-802.1, Index: 46
  Code point         Forwarding class                    Loss priority
  000                mcast                               low
  001                mcast                               low
  010                mcast                               low
  011                mcast                               low
  100                mcast                               low
  101                mcast                               low
  110                mcast                               low
  111                mcast                               low
```

show class-of-service interface

Syntax show class-of-service interface
<*interface-name* | **detail** | **comprehensive**>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Forwarding class map information added in Junos OS Release 9.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Options **detail** and **comprehensive** introduced in Junos OS Release 11.4.

Description Display the logical and physical interface associations for the classifier, rewrite rules, and scheduler map objects.

Options

comprehensive—(M Series, MX Series, and T Series routers) (Optional) Display comprehensive quality-of-service (QoS) information about all physical and logical interfaces.

detail—(M Series, MX Series, and T Series routers) (Optional) Display QoS and CoS information based on the interface.

If the **interface** *interface-name* is a physical interface, the output includes:

- Brief QoS information about the physical interface
- Brief QoS information about the logical interface
- CoS information about the physical interface
- Brief information about filters or policers of the logical interface
- Brief CoS information about the logical interface

If the **interface** *interface-name* is a logical interface, the output includes:

- Brief QoS information about the logical interface
- Information about filters or policers for the logical interface
- CoS information about the logical interface

interface-name—(Optional) Display class-of-service (CoS) associations for the specified interface.

none—Display CoS associations for all physical and logical interfaces.

Required Privilege Level view

List of Sample Output

show class-of-service interface (Physical) on page 65
show class-of-service interface (Logical) on page 65
show class-of-service interface (Gigabit Ethernet) on page 65
show class-of-service interface (PPPoE Interface) on page 66
show class-of-service interface detail on page 66

show class-of-service interface comprehensive on page 67

Output Fields Table 7 on page 55 describes the output fields for the **show class-of-service interface** command. Output fields are listed in the approximate order in which they appear.

Table 7: show class-of-service interface Output Fields

Field Name	Field Description
Physical interface	Name of a physical interface.
Index	Index of this interface or the internal index of this object.
Dedicated Queues	Status of dedicated queues configured on an interface. Supported only on Trio MPC/MIC interfaces on MX Series routers.
Queues supported	Number of queues you can configure on the interface.
Queues in use	Number of queues currently configured.
Total non-default queues created	Number of queues created in addition to the default queues. Supported only on Trio MPC/MIC interfaces on MX Series routers.
Shaping rate	Maximum transmission rate on the physical interface. You can configure the shaping rate on the physical interface, or on the logical interface, but not on both. Therefore, the **Shaping rate** field is displayed for either the physical interface or the logical interface.
Scheduler map	Name of the output scheduler map associated with this interface.
Input shaping rate	For Gigabit Ethernet IQ2 PICs, maximum transmission rate on the input interface.
Input scheduler map	For Gigabit Ethernet IQ2 PICs, name of the input scheduler map associated with this interface.
Chassis scheduler map	Name of the scheduler map associated with the packet forwarding component queues.
Rewrite	Name and type of the rewrite rules associated with this interface.
Classifier	Name and type of classifiers associated with this interface.
Forwarding-class-map	Name of the forwarding map associated with this interface.
Congestion-notification	Congestion notification state, **enabled** or **disabled** (QFX Series only).
Logical interface	Name of a logical interface.
Object	Category of an object: **Classifier**, **Fragmentation-map** (for LSQ interfaces only), **Scheduler-map**, **Rewrite**, or **Translation Table** (for IQE PICs only).
Name	Name of an object.
Type	Type of an object: **dscp**, **dscp-ipv6**, **exp**, **ieee-802.1**, **ip**, or **inet-precedence**.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Link-level type	Encapsulation on the physical interface.
MTU	MTU size on the physical interface.
Speed	Speed at which the interface is running.
Loopback	Whether loopback is enabled and the type of loopback.
Source filtering	Whether source filtering is enabled or disabled.
Flow control	Whether flow control is enabled or disabled.
Auto-negotiation	(Gigabit Ethernet interfaces) Whether autonegotiation is enabled or disabled.
Remote-fault	(Gigabit Ethernet interfaces) Remote fault status. • **Online**—Autonegotiation is manually configured as online. • **Offline**—Autonegotiation is manually configured as offline.
Device flags	The **Device flags** field provides information about the physical device and displays one or more of the following values: • **Down**—Device has been administratively disabled. • **Hear-Own-Xmit**—Device receives its own transmissions. • **Link-Layer-Down**—The link-layer protocol has failed to connect with the remote endpoint. • **Loopback**—Device is in physical loopback. • **Loop-Detected**—The link layer has received frames that it sent, thereby detecting a physical loopback. • **No-Carrier**—On media that support carrier recognition, no carrier is currently detected. • **No-Multicast**—Device does not support multicast traffic. • **Present**—Device is physically present and recognized. • **Promiscuous**—Device is in promiscuous mode and recognizes frames addressed to all physical addresses on the media. • **Quench**—Transmission on the device is quenched because the output buffer is overflowing. • **Recv-All-Multicasts**—Device is in multicast promiscuous mode and therefore provides no multicast filtering. • **Running**—Device is active and enabled.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description

Interface flags	The **Interface flags** field provides information about the physical interface and displays one or more of the following values:
	• **Admin-Test**—Interface is in test mode and some sanity checking, such as loop detection, is disabled.
	• **Disabled**—Interface is administratively disabled.
	• **Down**—A hardware failure has occurred.
	• **Hardware-Down**—Interface is nonfunctional or incorrectly connected.
	• **Link-Layer-Down**—Interface keepalives have indicated that the link is incomplete.
	• **No-Multicast**—Interface does not support multicast traffic.
	• **No-receive No-transmit**—Passive monitor mode is configured on the interface.
	• **Point-To-Point**—Interface is point-to-point.
	• **Pop all MPLS labels from packets of depth**—MPLS labels are removed as packets arrive on an interface that has the **pop-all-labels** statement configured. The depth value can be one of the following:
	  ◦ **1**—Takes effect for incoming packets with one label only.
	  ◦ **2**—Takes effect for incoming packets with two labels only.
	  ◦ **[1 2]**—Takes effect for incoming packets with either one or two labels.
	• **Promiscuous**—Interface is in promiscuous mode and recognizes frames addressed to all physical addresses.
	• **Recv-All-Multicasts**—Interface is in multicast promiscuous mode and provides no multicast filtering.
	• **SNMP-Traps**—SNMP trap notifications are enabled.
	• **Up**—Interface is enabled and operational.

Flags	The **Logical interface flags** field provides information about the logical interface and displays one or more of the following values: • **ACFC Encapsulation**—Address control field Compression (ACFC) encapsulation is enabled (negotiated successfully with a peer). • **Device-down**—Device has been administratively disabled. • **Disabled**—Interface is administratively disabled. • **Down**—A hardware failure has occurred. • **Clear-DF-Bit**—GRE tunnel or IPsec tunnel is configured to clear the Don't Fragment (DF) bit. • **Hardware-Down**—Interface protocol initialization failed to complete successfully. • **PFC**—Protocol field compression is enabled for the PPP session. • **Point-To-Point**—Interface is point-to-point. • **SNMP-Traps**—SNMP trap notifications are enabled. • **Up**—Interface is enabled and operational.
Encapsulation	Encapsulation on the logical interface.
Admin	Administrative state of the interface (**Up** or **Down**)
Link	Status of physical link (**Up** or **Down**).
Proto	Protocol configured on the interface.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Input Filter	Names of any firewall filters to be evaluated when packets are received on the interface, including any filters attached through activation of dynamic service.
Output Filter	Names of any firewall filters to be evaluated when packets are transmitted on the interface, including any filters attached through activation of dynamic service.
Link flags	Provides information about the physical link and displays one or more of the following values: • **ACFC**—Address control field compression is configured. The Point-to-Point Protocol (PPP) session negotiates the ACFC option. • **Give-Up**—Link protocol does not continue connection attempts after repeated failures. • **Loose-LCP**—PPP does not use the Link Control Protocol (LCP) to indicate whether the link protocol is operational. • **Loose-LMI**—Frame Relay does not use the Local Management Interface (LMI) to indicate whether the link protocol is operational. • **Loose-NCP**—PPP does not use the Network Control Protocol (NCP) to indicate whether the device is operational. • **Keepalives**—Link protocol keepalives are enabled. • **No-Keepalives**—Link protocol keepalives are disabled. • **PFC**—Protocol field compression is configured. The PPP session negotiates the PFC option.
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.
CoS queues	Number of CoS queues configured.
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped: *year-month-day hour:minute:second:timezone* (*hour:minute:second* ago)**. For example, **Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).**
Statistics last cleared	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.
IPv6 transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Input errors	Input errors on the interface. The labels are explained in the following list: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Giants**—Number of frames received that are larger than the giant threshold. • **Bucket Drops**—Drops resulting from the traffic load exceeding the interface transmit or receive leaky bucket configuration. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • **L3 incompletes**—Number of incoming packets discarded because they failed Layer 3 (usually IPv4) sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. Layer 3 incomplete errors can be ignored by configuring the **ignore-l3-incompletes** statement. • **L2 channel errors**—Number of times the software did not find a valid logical interface for an incoming frame. • **L2 mismatch timeouts**—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable. • **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces. • **HS link FIFO overflows**—Number of FIFO overflows on the high-speed links between the ASICs responsible for handling the router interfaces.
Output errors	Output errors on the interface. The labels are explained in the following list: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC is malfunctioning. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Aged packets**—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware. • **HS link FIFO underflows**—Number of FIFO underflows on the high-speed links between the ASICs responsible for handling the router interfaces. • **MTU errors**—Number of packets whose size exceeds the MTU of the interface.
Egress queues	Total number of egress queues supported on the specified interface.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Queue counters	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.
SONET alarms **SONET defects**	(SONET) SONET media-specific alarms and defects that prevent the interface from passing packets. When a defect persists for a certain period, it is promoted to an alarm. Based on the router configuration, an alarm can ring the red or yellow alarm bell on the router or light the red or yellow alarm LED on the craft interface. See these fields for possible alarms and defects: **SONET PHY**, **SONET section**, **SONET line**, and **SONET path**.
SONET PHY	Counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET PHY** field has the following subfields: • **PLL Lock**—Phase-locked loop • **PHY Light**—Loss of optical signal
SONET section	Counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET section** field has the following subfields: • **BIP-B1**—Bit interleaved parity for SONET section overhead • **SEF**—Severely errored framing • **LOS**—Loss of signal • **LOF**—Loss of frame • **ES-S**—Errored seconds (section) • **SES-S**—Severely errored seconds (section) • **SEFS-S**—Severely errored framing seconds (section)

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
SONET line	Active alarms and defects, plus counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET line** field has the following subfields: • **BIP-B2**—Bit interleaved parity for SONET line overhead • **REI-L**—Remote error indication (near-end line) • **RDI-L**—Remote defect indication (near-end line) • **AIS-L**—Alarm indication signal (near-end line) • **BERR-SF**—Bit error rate fault (signal failure) • **BERR-SD**—Bit error rate defect (signal degradation) • **ES-L**—Errored seconds (near-end line) • **SES-L**—Severely errored seconds (near-end line) • **UAS-L**—Unavailable seconds (near-end line) • **ES-LFE**—Errored seconds (far-end line) • **SES-LFE**—Severely errored seconds (far-end line) • **UAS-LFE**—Unavailable seconds (far-end line)
SONET path	Active alarms and defects, plus counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET path** field has the following subfields: • **BIP-B3**—Bit interleaved parity for SONET section overhead • **REI-P**—Remote error indication • **LOP-P**—Loss of pointer (path) • **AIS-P**—Path alarm indication signal • **RDI-P**—Path remote defect indication • **UNEQ-P**—Path unequipped • **PLM-P**—Path payload (signal) label mismatch • **ES-P**—Errored seconds (near-end STS path) • **SES-P**—Severely errored seconds (near-end STS path) • **UAS-P**—Unavailable seconds (near-end STS path) • **ES-PFE**—Errored seconds (far-end STS path) • **SES-PFE**—Severely errored seconds (far-end STS path) • **UAS-PFE**—Unavailable seconds (far-end STS path)

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Received SONET overhead **Transmitted SONET overhead**	Values of the received and transmitted SONET overhead: • **C2**—Signal label. Allocated to identify the construction and content of the STS-level SPE and for PDI-P. • **F1**—Section user channel byte. This byte is set aside for the purposes of users. • **K1** and **K2**—These bytes are allocated for APS signaling for the protection of the multiplex section. • **J0**—Section trace. This byte is defined for STS-1 number 1 of an STS-*N* signal. Used to transmit a 1-byte fixed-length string or a 16-byte message so that a receiving terminal in a section can verify its continued connection to the intended transmitter. • **S1**—Synchronization status. The S1 byte is located in the first STS-1 number of an STS-*N* signal. • **Z3** and **Z4**—Allocated for future use.
Received path trace **Transmitted path trace**	SONET/SDH interfaces allow path trace bytes to be sent inband across the SONET/SDH link. Juniper Networks and other router manufacturers use these bytes to help diagnose misconfigurations and network errors by setting the transmitted path trace message so that it contains the system hostname and name of the physical interface. The received path trace value is the message received from the router at the other end of the fiber. The transmitted path trace value is the message that this router transmits.
HDLC configuration	Information about the HDLC configuration. • **Policing bucket**—Configured state of the receiving policer. • **Shaping bucket**—Configured state of the transmitting shaper. • **Giant threshold**—Giant threshold programmed into the hardware. • **Runt threshold**—Runt threshold programmed into the hardware.
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number. • **PLP byte**—Packet Level Protocol byte.
CoS information	Information about the CoS queue for the physical interface. • **CoS transmit queue**—Queue number and its associated user-configured forwarding class name. • **Bandwidth %**—Percentage of bandwidth allocated to the queue. • **Bandwidth bps**—Bandwidth allocated to the queue (in bps). • **Buffer %**—Percentage of buffer space allocated to the queue. • **Buffer usec**—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time. • **Priority**—Queue priority: **low** or **high**. • **Limit**—Displayed if rate limiting is configured for the queue. Possible values are **none** and **exact**. If **exact** is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If **none** is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.
Forwarding classes	Total number of forwarding classes supported on the specified interface.
Egress queues	Total number of egress queues supported on the specified interface.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Queue	Queue number.
Forwarding classes	Forwarding class name.
Queued Packets	Number of packets queued to this queue.
Queued Bytes	Number of bytes queued to this queue. The byte counts vary by PIC type.
Transmitted Packets	Number of packets transmitted by this queue. When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (displayed under the **Packet Forwarding Engine Chassis Queues** field) shows the prefragmentation values.
Transmitted Bytes	Number of bytes transmitted by this queue. The byte counts vary by PIC type.
Tail-dropped packets	Number of packets dropped because of tail drop.

RED-dropped packets	Number of packets dropped because of random early detection (RED).
	• (M Series and T Series routers only) On M320 and M120 routers and the T Series routers, the total number of dropped packets is displayed. On all other M Series routers, the output classifies dropped packets into the following categories:
	  • **Low, non-TCP**—Number of low-loss priority non-TCP packets dropped because of RED.
	  • **Low, TCP**—Number of low-loss priority TCP packets dropped because of RED.
	  • **High, non-TCP**—Number of high-loss priority non-TCP packets dropped because of RED.
	  • **High, TCP**—Number of high-loss priority TCP packets dropped because of RED.
	• (MX Series routers with enhanced DPCs, and T Series routers with enhanced FPCs only) The output classifies dropped packets into the following categories:
	  • **Low**—Number of low-loss priority packets dropped because of RED.
	  • **Medium-low**—Number of medium-low loss priority packets dropped because of RED.
	  • **Medium-high**—Number of medium-high loss priority packets dropped because of RED.
	  • **High**—Number of high-loss priority packets dropped because of RED.

RED-dropped bytes	Number of bytes dropped because of RED. The byte counts vary by PIC type.
	• (M Series and T Series routers only) On M320 and M120 routers and the T Series routers, only the total number of dropped bytes is displayed. On all other M Series routers, the output classifies dropped bytes into the following categories:
	  • **Low, non-TCP**—Number of low-loss priority non-TCP bytes dropped because of RED.
	  • **Low, TCP**—Number of low-loss priority TCP bytes dropped because of RED.
	  • **High, non-TCP**—Number of high-loss priority non-TCP bytes dropped because of RED.
	  • **High, TCP**—Number of high-loss priority TCP bytes dropped because of RED.

Transmit rate	Configured transmit rate of the scheduler. The rate is a percentage of the total interface bandwidth.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Rate Limit	Rate limiting configuration of the queue. Possible values are : • **None**—No rate limit. • **exact**—Queue transmits at the configured rate.
Buffer size	Delay buffer size in the queue.
Priority	Scheduling priority configured as **low** or **high**.
Excess Priority	Priority of the excess bandwidth traffic on a scheduler: **low**, **medium-low**, **medium-high**, **high**, or **none**.
Drop profiles	Display the assignment of drop profiles. • **Loss priority**—Packet loss priority for drop profile assignment. • **Protocol**—Transport protocol for drop profile assignment. • **Index**—Index of the indicated object. Objects that have indexes in this output include schedulers and drop profiles. • **Name**—Name of the drop profile. • **Type**—Type of the drop profile: **discrete** or **interpolated**. • **Fill Level**—Percentage fullness of a queue. • **Drop probability**—Drop probability at this fill level.
Excess Priority	Priority of the excess bandwidth traffic on a scheduler.
Drop profiles	Display the assignment of drop profiles. • **Loss priority**—Packet loss priority for drop profile assignment. • **Protocol**—Transport protocol for drop profile assignment. • **Index**—Index of the indicated object. Objects that have indexes in this output include schedulers and drop profiles. • **Name**—Name of the drop profile. • **Type**—Type of the drop profile: **discrete** or **interpolated**. • **Fill Level**—Percentage fullness of a queue. • **Drop probability**—Drop probability at this fill level.

Table 7: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description

Adjustment information	Display the assignment of shaping-rate adjustments on a scheduler node or queue.
	• **Adjusting application**—Application that is performing the shaping-rate adjustment.
	  ◦ The adjusting application can appear as **ancp LS-0**, which is the Junos OS Access Node Control Profile process (**ancpd**) that performs shaping-rate adjustments on schedule nodes.
	  ◦ The adjusting application can also appear as **pppoe**, which adjusts the shaping-rate and overhead-accounting class-of-service attributes on dynamic subscriber interfaces in a broadband access network based on access line parameters in Point-to-Point Protocol over Ethernet (PPPoE) Tags [TR-101]. This feature is supported on MPC/MIC interfaces on MX Series routers. The shaping rate is based on the actual-data-rate-downstream attribute. The overhead accounting value is based on the access-loop-encapsulation attribute and specifies whether the access loop uses Ethernet (frame mode) or ATM (cell mode).
	• **Adjustment type**—Type of adjustment: **absolute** or **delta**.
	• **Configured shaping rate**—Shaping rate configured for the scheduler node or queue.
	• **Adjustment value**—Value of adjusted shaping rate.
	• **Adjustment mode**—Level of shaping-rate adjustment performed: **node** or **queue**.

Sample Output

show class-of-service interface (Physical)

```
user@host> show class-of-service interface so-0/2/3
Physical interface: so-0/2/3, Index: 135
Queues supported: 8, Queues in use: 4
Total non-default queues created: 4
  Scheduler map: <default>, Index: 2032638653

  Logical interface: fe-0/0/1.0, Index: 68, Dedicated Queues: no
    Shaping rate: 32000
    Object                  Name                    Type           Index
    Scheduler-map           <default>                               27
    Rewrite                 exp-default             exp             21
    Classifier              exp-default             exp             5
    Classifier              ipprec-compatibility    ip              8
    Forwarding-class-map    exp-default             exp             5
```

show class-of-service interface (Logical)

```
user@host> show class-of-service interface so-0/2/3.0
Logical interface: so-0/2/3.0, Index: 68, Dedicated Queues: no
    Shaping rate: 32000
    Object                  Name                    Type            Index
    Scheduler-map           <default>                               27
    Rewrite                 exp-default             exp             21
    Classifier              exp-default             exp             5
    Classifier              ipprec-compatibility    ip              8
    Forwarding-class-map    exp-default             exp             5
```

show class-of-service interface (Gigabit Ethernet)

```
user@host> show class-of-service interface ge-6/2/0
Physical interface: ge-6/2/0, Index: 175
Queues supported: 4, Queues in use: 4
  Scheduler map: <default>, Index: 2
  Input scheduler map: <default>, Index: 3
  Chassis scheduler map: <default-chassis>, Index: 4
```

show class-of-service interface (PPPoE Interface)

```
user@host> show class-of-service interface pp0.1
Logical interface: pp0.1, Index: 85
    Object                 Name                    Type           Index
    Traffic-control-profile tcp-pppoe.o.pp0.1      Output         2726446535
    Classifier             ipprec-compatibility    ip             13

    Adjusting application: PPPoE
      Adjustment type: absolute
      Adjustment value: 5000000
      Adjustment overhead-accounting mode: cell
      Adjustment target: node
```

show class-of-service interface detail

```
user@host> show class-of-service interface ge-0/3/0 detail

Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000

  Physical interface: ge-0/3/0, Index: 138
  Queues supported: 4, Queues in use: 5
  Shaping rate: 50000 bps
  Scheduler map: interface-schedular-map, Index: 58414
  Input shaping rate: 10000 bps
  Input scheduler map: schedular-map, Index: 15103
  Chassis scheduler map: <default-chassis>, Index: 4
  Congestion-notification: Disabled

  Logical interface ge-0/3/0.0
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    inet
    mpls
Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.0      up    up   inet
                           mpls
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.0      up    up   inet
                           mpls

  Logical interface: ge-0/3/0.0, Index: 68
    Object                 Name                    Type               Index
    Rewrite                exp-default             exp (mpls-any)       33
    Classifier             exp-default             exp                  10
    Classifier             ipprec-compatibility    ip                   13


  Logical interface ge-0/3/0.1
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    inet
Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.1      up    up   inet
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.1      up    up   inet

  Logical interface: ge-0/3/0.1, Index: 69
    Object                 Name                    Type             Index
    Classifier             ipprec-compatibility    ip                13
```

show class-of-service interface comprehensive

```
user@host> show class-of-service interface so-1/3/0 comprehensive
Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Interface index: 138, SNMP ifIndex: 601, Generation: 141
  Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled, Flow
control: Enabled,
  Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  CoS queues     : 4 supported, 4 maximum usable queues
  Schedulers     : 256
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:14:f6:f4:b4:5d, Hardware address: 00:14:f6:f4:b4:5d
  Last flapped   : 2010-09-07 06:35:22 PDT (15:14:42 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
   IPv6 total statistics:
    Input  bytes  :                  0
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Ingress traffic statistics at Packet Forwarding Engine:
   Input  bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Drop   bytes  :                   0                   0 bps
   Drop   packets:                   0                   0 pps
  Label-switched interface (LSI) traffic statistics:
   Input  bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 5, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Ingress queues: 4 supported, 5 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 af3                            0                   0                   0

    1 af2                            0                   0                   0

    2 ef2                            0                   0                   0

    3 ef1                            0                   0                   0

  Egress queues: 4 supported, 5 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 af3                            0                   0                   0

    1 af2                            0                   0                   0

    2 ef2                            0                   0                   0

    3 ef1                            0                   0                   0
```

```
  Active alarms  : None
  Active defects : None
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
  Filter statistics:
    Input packet count                       0
    Input packet rejects                     0
    Input DA rejects                         0
    Input SA rejects                         0
    Output packet count                                       0
    Output packet pad count                                   0
    Output packet error count                                 0
    CAM destination filters: 0, CAM source filters: 0
  Autonegotiation information:
    Negotiation status: Complete
    Link partner:
       Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote fault:
 OK
    Local resolution:
      Flow control: Symmetric, Remote fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    2 ef2                    39          19500     0            120     high
none
    Direction : Input
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    0 af3                    30           3000    45              0      low
none

Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Interface index: 138, SNMP ifIndex: 601
Forwarding classes: 16 supported, 5 in use
Ingress queues: 4 supported, 5 in use
Queue: 0, Forwarding classes: af3
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                    0 bps
```

```
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: af2
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: ef2
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: ef1
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Forwarding classes: 16 supported, 5 in use
Egress queues: 4 supported, 5 in use
Queue: 0, Forwarding classes: af3
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                    0                    0 pps
    RL-dropped bytes     :                    0                    0 bps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: af2
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                    0                    0 pps
    RL-dropped bytes     :                    0                    0 bps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: ef2
  Queued:
```

```
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                     0                     0 pps
    RL-dropped bytes     :                     0                     0 bps
    RED-dropped packets  :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
Queue: 3, Forwarding classes: ef1
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                     0                     0 pps
    RL-dropped bytes     :                     0                     0 bps
    RED-dropped packets  :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps

Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 5 in use
Queue: 0, Forwarding classes: af3
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  : Not Available
    RED-dropped bytes    : Not Available
Queue: 1, Forwarding classes: af2
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  : Not Available
    RED-dropped bytes    : Not Available
Queue: 2, Forwarding classes: ef2
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  : Not Available
    RED-dropped bytes    : Not Available
Queue: 3, Forwarding classes: ef1
  Queued:
    Packets              :                108546                     0 pps
    Bytes                :              12754752                   376 bps
  Transmitted:
    Packets              :                108546                     0 pps
```

```
    Bytes                :              12754752                    376 bps
    Tail-dropped packets :                     0                      0 pps
    RED-dropped packets  : Not Available
    RED-dropped bytes    : Not Available

Physical interface: ge-0/3/0, Index: 138
Queues supported: 4, Queues in use: 5
  Shaping rate: 50000 bps

Scheduler map: interface-schedular-map, Index: 58414

  Scheduler: ef2, Forwarding class: ef2, Index: 39155
    Transmit rate: 39 percent, Rate Limit: none, Buffer size: 120 us, Buffer
Limit: none, Priority: high
    Excess Priority: unspecified
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
  Input shaping rate: 10000 bps
  Input scheduler map: schedular-map

Scheduler map: schedular-map, Index: 15103

  Scheduler: af3, Forwarding class: af3, Index: 35058
    Transmit rate: 30 percent, Rate Limit: none, Buffer size: 45 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: unspecified
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         40582    green
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any         18928    yellow
Drop profile: green, Type: discrete, Index: 40582
  Fill level    Drop probability
          50                   0
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: yellow, Type: discrete, Index: 18928
  Fill level    Drop probability
          50                   0
```

```
        100                 100
  Chassis scheduler map: < default-drop-profile>
Scheduler map: < default-drop-profile>, Index: 4

  Scheduler: < default-drop-profile>, Forwarding class: af3, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100

  Scheduler: < default-drop-profile>, Forwarding class: af2, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100

  Scheduler: < default-drop-profile>, Forwarding class: ef2, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
```

```
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100

  Scheduler: < default-drop-profile>, Forwarding class: ef1, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: , Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
  Congestion-notification: Disabled
Forwarding class                      ID      Queue  Restricted queue  Fabric
priority  Policing priority
  af3                                  0       0          0             low
          normal
  af2                                  1       1          1             low
          normal
  ef2                                  2       2          2             high
          normal
  ef1                                  3       3          3             high
          normal
  af1                                  4       4          0             low
          normal

  Logical interface ge-0/3/0.0 (Index 68) (SNMP ifIndex 152) (Generation 159)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
```

```
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol inet, MTU: 1500, Generation: 172, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Input Filters: filter-in-ge-0/3/0.0-i,
      Policer: Input: p1-ge-0/3/0.0-inet-i
    Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 173, Route table: 0

      Flags: Is-Primary
      Output Filters: exp-filter,,,,,

  Logical interface ge-0/3/0.0 (Index 68) (SNMP ifIndex 152)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Input packets : 0
    Output packets: 0

Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.0      up    up   inet  filter-in-ge-0/3/0.0-i
                           mpls                       exp-filter
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.0      up    up
                           inet  p1-ge-0/3/0.0-inet-i
                           mpls

Filter: filter-in-ge-0/3/0.0-i
Counters:
Name                                                Bytes              Packets
count-filter-in-ge-0/3/0.0-i                            0                    0

Filter: exp-filter
Counters:
Name                                                Bytes              Packets
count-exp-seven-match                                   0                    0
count-exp-zero-match                                    0                    0
Policers:
Name                                               Packets
p1-ge-0/3/0.0-inet-i                                    0


  Logical interface: ge-0/3/0.0, Index: 68
    Object                 Name                   Type                    Index

    Rewrite                exp-default            exp (mpls-any)             33

Rewrite rule: exp-default, Code point type: exp, Index: 33
  Forwarding class                    Loss priority      Code point
  af3                                 low                000
  af3                                 high               001
  af2                                 low                010
  af2                                 high               011
  ef2                                 low                100
  ef2                                 high               101
  ef1                                 low                110
  ef1                                 high               111
    Object                 Name                   Type                    Index

    Classifier             exp-default            exp                        10

Classifier: exp-default, Code point type: exp, Index: 10
```

```
  Code point         Forwarding class                    Loss priority
  000                af3                                 low
  001                af3                                 high
  010                af2                                 low
  011                af2                                 high
  100                ef2                                 low
  101                ef2                                 high
  110                ef1                                 low
  111                ef1                                 high
    Object                 Name                   Type                    Index

    Classifier             ipprec-compatibility   ip                        13

Classifier: ipprec-compatibility, Code point type: inet-precedence, Index: 13
  Code point         Forwarding class                    Loss priority
  000                af3                                 low
  001                af3                                 high
  010                af3                                 low
  011                af3                                 high
  100                af3                                 low
  101                af3                                 high
  110                ef1                                 low
  111                ef1                                 high
Forwarding class                        ID      Queue  Restricted queue  Fabric
priority  Policing priority
  af3                                    0       0          0             low
            normal
  af2                                    1       1          1             low
            normal
  ef2                                    2       2          2             high
            normal
  ef1                                    3       3          3             high
            normal
  af1                                    4       4          0             low
            normal

  Logical interface ge-0/3/0.1 (Index 69) (SNMP ifIndex 154) (Generation 160)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                  0 bps
     Output bytes  :                   0                  0 bps
     Input  packets:                   0                  0 pps
     Output packets:                   0                  0 pps
    Protocol inet, MTU: 1500, Generation: 174, Route table: 0
      Flags: Sendbcast-pkt-to-re

  Logical interface ge-0/3/0.1 (Index 69) (SNMP ifIndex 154)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Input packets : 0
    Output packets: 0
```

```
Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.1      up    up   mpls
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.1      up    up
                           mpls

  Logical interface: ge-0/3/0.1, Index: 69
    Object                  Name                    Type                    Index

    Classifier              ipprec-compatibility    ip                         13

Classifier: ipprec-compatibility, Code point type: inet-precedence, Index: 13
  Code point         Forwarding class                    Loss priority
  000                af3                                 low
  001                af3                                 high
  010                af3                                 low
  011                af3                                 high
  100                af3                                 low
  101                af3                                 high
  110                ef1                                 low
  111                ef1                                 high
Forwarding class                      ID      Queue  Restricted queue  Fabric
priority  Policing priority
  af3                                  0       0          0             low
            normal
  af2                                  1       1          1             low
            normal
  ef2                                  2       2          2             high
            normal
  ef1                                  3       3          3             high
            normal
  af1                                  4       4          0             low
            normal
```

show class-of-service forwarding-table classifier mapping

Syntax show class-of-service forwarding-table classifier mapping

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For each logical interface, display either the table index of the classifier for a given code point type or the queue number (if it is a fixed classification) in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table classifier mapping on page 77

Output Fields Table 8 on page 77 describes the output fields for the **show class-of-service forwarding-table classifier mapping** command. Output fields are listed in the approximate order in which they appear.

Table 8: show class-of-service forwarding-table classifier mapping Output Fields

Field Name	Field Description
Table index/ Q num	If the table type is **Fixed**, the number of the queue to which the interface is mapped. For all other types, this value is the classifier index number.
Interface	Name of the logical interface.
Index	Logical interface index.
Table type	Type of code points in the table: **DSCP**, **EXP** (not on the QFX Series), **IEEE 802.1**, **IPv4 precedence** (not on the QFX Series), or **IPv6 DSCP** (not on the QFX Series).

Sample Output

show class-of-service forwarding-table classifier mapping

```
user@host> show class-of-service forwarding-table classifier mapping
                          Table index/
Interface      Index        Q num      Table type
so-5/0/0.0        10        62436      DSCP
so-0/1/0.0        11        62436      DSCP
so-0/2/0.0        12            1      Fixed
so-0/2/1.0        13        62436      DSCP
so-0/2/1.0        13        62437      IEEE 802.1
so-0/2/2.0        14        62436      DSCP
so-0/2/2.0        14        62438      IPv4 precedence
```

show class-of-service forwarding-table rewrite-rule mapping

Syntax show class-of-service forwarding-table rewrite-rule mapping

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For each logical interface, display the table identifier of the rewrite rule map for each code point type.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table rewrite-rule mapping on page 78

Output Fields Table 9 on page 78 describes the output fields for the **show class-of-service forwarding-table rewrite-rule mapping** command. Output fields are listed in the approximate order in which they appear.

Table 9: show class-of-service forwarding-table rewrite-rule mapping Output Fields

Field Name	Field Description
Interface	Name of the logical interface.
Index	Logical interface index.
Table index	Rewrite table index.
Type	Type of classifier: **DSCP**, **EXP** (not on the QFX Series), **EXP-PUSH-3** (not on the QFX Series), **EXP-SWAP-PUSH-2** (not on the QFX Series),**Frame-Relay DE** (J Series routers only), **IEEE 802.1**, **IPv4 precedence** (not on the QFX Series), **IPv6 DSCP** (not on the QFX Series), or **Fixed**.

Sample Output

show class-of-service forwarding-table rewrite-rule mapping

```
user@host> show class-of-service forwarding-table rewrite-rule mapping
Interface       Index   Table index  Type
so-5/0/0.0         10       3753  DSCP
so-0/1/0.0         11       3753  DSCP
so-0/2/0.0         12       3753  DSCP
so-0/2/1.0         13       3753  DSCP
so-0/2/2.0         14       3753  DSCP
so-0/2/3.0         15       3753  DSCP
```

show class-of-service forwarding-table scheduler-map

Syntax show class-of-service forwarding-table scheduler-map

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For each physical interface, display the scheduler map information as it exists in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table scheduler-map on page 80

Output Fields Table 10 on page 79 describes the output fields for the **show class-of-service forwarding-table scheduler-map** command. Output fields are listed in the approximate order in which they appear.

Table 10: show class-of-service forwarding-table scheduler-map Output Fields

Field Name	Field Description
Interface	Name of the physical interface.
Index	Physical interface index.
Map index	Scheduler map index.
Num of queues	Number of queues defined in this scheduler map.
Entry	Number of this entry in the scheduler map.
Scheduler index	Scheduler policy index.
Forwarding-class #	Forwarding class number to which this entry is applied.
Tx rate	Configured transmit rate of the scheduler (in bps). The rate is a percentage of the total interface bandwidth, or the keyword **remainder**, which indicates that the scheduler receives the remaining bandwidth of the interface.
Max buffer delay	Amount of transmit delay (in milliseconds) or buffer size of the queue. This amount is a percentage of the total interface buffer allocation or the keyword **remainder**, which indicates that the buffer is sized according to what remains after other scheduler buffer allocations.
Priority	• **high**—Queue priority is high. • **low**—Queue priority is low.
PLP high	Drop profile index for a high packet loss priority profile.

Table 10: show class-of-service forwarding-table scheduler-map Output Fields *(continued)*

Field Name	Field Description
PLP low	Drop profile index for a low packet loss priority profile.
PLP medium-high	Drop profile index for a medium-high packet loss priority profile.
PLP medium-low	Drop profile index for a medium-low packet loss priority profile.
TCP PLP high	Drop profile index for a high TCP packet loss priority profile.
TCP PLP low	Drop profile index for a low TCP packet loss priority profile.
Policy is exact	If this line appears in the output, exact rate limiting is enabled. Otherwise, no rate limiting is enabled.

Sample Output

show class-of-service forwarding-table scheduler-map

```
user@host> show class-of-service forwarding-table scheduler-map
Interface: so-5/0/0 (Index: 9, Map index: 17638, Num of queues: 2):
  Entry 0 (Scheduler index: 6090, Forwarding-class #: 0):
    Tx rate: 0 Kb (30%), Max buffer delay: 39 bytes (0%)
    Priority low
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low:8742
    Policy is exact
  Entry 1 (Scheduler index: 38372, Forwarding-class #: 1):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (40%), Max buffer delay: 68 bytes (0%)
    Priority high
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742

Interface: at-6/1/0 (Index: 10, Map index: 17638, Num of queues: 2):
  Entry 0 (Scheduler index: 6090, Forwarding-class #: 0):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (30%), Max buffer delay: 39 bytes (0%)
    Priority high
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742
  Entry 1 (Scheduler index: 38372, Forwarding-class #: 1):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (40%), Max buffer delay: 68 bytes (0%)
    Priority low
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742
```

show class-of-service rewrite-rule

Syntax

show class-of-service rewrite-rule
<name *name*>
<type *type*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the mapping of forwarding classes and loss priority to code point values.

Options

none—Display all rewrite rules.

name *name*—(Optional) Display the specified rewrite rule.

type *type*—(Optional) Display the rewrite rule of the specified type. The rewrite rule type can be one of the following:

- **dscp**—For IPv4 traffic.
- **dscp-ipv6**—For IPv6 traffic.
- **exp**—For MPLS traffic.
- **frame-relay-de**—(J Series routers only) For Frame Relay traffic.
- **ieee-802.1**—For Layer 2 traffic.
- **inet-precedence**—For IPv4 traffic.

Required Privilege Level

view

List of Sample Output

show class-of-service rewrite-rule type dscp on page 82
show class-of-service rewrite-rule type dscp (QFX Series) on page 82

Output Fields

Table 11 on page 81 describes the output fields for the **show class-of-service rewrite-rule** command. Output fields are listed in the approximate order in which they appear.

Table 11: show class-of-service rewrite-rule Output Fields

Field Name	Field Description
Rewrite rule	Name of the rewrite rule.
Code point type	Type of rewrite rule: **dscp**, **dscp-ipv6**, **exp**, **frame-relay-de**, or **inet-precedence**.
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router or switch.
Index	Internal index for this particular rewrite rule.
Loss priority	Loss priority for rewriting.

Table 11: show class-of-service rewrite-rule Output Fields *(continued)*

Field Name	Field Description
Code point	Code point value to rewrite.

Sample Output

show class-of-service rewrite-rule type dscp

```
user@host> show class-of-service rewrite-rule type dscp
Rewrite rule: dscp-default, Code point type: dscp
  Forwarding class                  Loss priority       Code point
  gold                              high                000000
  silver                            low                 110000
  silver                            high                111000
  bronze                            low                 001010
  bronze                            high                001100
  lead                              high                101110

Rewrite rule: abc-dscp-rewrite, Code point type: dscp, Index: 3245
Forwarding class                  Loss priority       Code point
  gold                              low                 000111
  gold                              high                001010
  silver                            low                 110000
  silver                            high                111000
  bronze                            high                001100
  lead                              low                 101110
  lead                              high                110111
```

Sample Output

show class-of-service rewrite-rule type dscp (QFX Series)

```
user@host> show class-of-service rewrite-rule type dscp
Rewrite rule: dscp-default, Code point type: dscp, Index: 31
  Forwarding class                  Loss priority       Code point
  best-effort                       low                 000000
  best-effort                       high                000000
  fcoe                              low                 101110
  fcoe                              high                101110
  no-loss                           low                 001010
  no-loss                           high                001100
  network-control                   low                 110000
  network-control                   high                111000
```

show class-of-service scheduler-map

Syntax show class-of-service scheduler-map
<*name*>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the mapping of schedulers to forwarding classes and a summary of scheduler parameters for each entry.

Options **none**—Display all scheduler maps.

name—(Optional) Display a summary of scheduler parameters for each forwarding class to which the named scheduler is assigned.

Required Privilege Level view

List of Sample Output show class-of-service scheduler-map on page 84

Output Fields Table 12 on page 83 describes the output fields for the **show class-of-service scheduler-map** command. Output fields are listed in the approximate order in which they appear.

Table 12: show class-of-service scheduler-map Output Fields

Field Name	Field Description
Scheduler map	Name of the scheduler map.
Index	Index of the indicated object. Objects having indexes in this output include scheduler maps, schedulers, and drop profiles.
Scheduler	Name of the scheduler.
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.
Transmit rate	Configured transmit rate of the scheduler (in bps). The rate is a percentage of the total interface bandwidth, or the keyword **remainder**, which indicates that the scheduler receives the remaining bandwidth of the interface.
Rate Limit	Rate limiting configuration of the queue. Possible values are **none**, meaning no rate limiting, and **exact**, meaning the queue only transmits at the configured rate.
Maximum buffer delay	Amount of transmit delay (in milliseconds) or the buffer size of the queue. The buffer size is shown as a percentage of the total interface buffer allocation, or by the keyword **remainder** to indicate that the buffer is sized according to what remains after other scheduler buffer allocations.
Priority	Scheduling priority: **low** or **high**.

Table 12: show class-of-service scheduler-map Output Fields *(continued)*

Field Name	Field Description
Excess priority	Priority of excess bandwidth: **low**, **medium-low**, **medium-high**, **high**, or **none**.
Adjust minimum	Minimum shaping rate for an adjusted queue, in bps.
Adjust percent	Bandwidth adjustment applied to a queue, in percent.
Drop profiles	Table displaying the assignment of drop profiles by name and index to a given loss priority and protocol pair.
Loss priority	Packet loss priority for drop profile assignment.
Protocol	Transport protocol for drop profile assignment.
Name	Name of the drop profile.

Sample Output

show class-of-service scheduler-map

```
user@host> show class-of-service scheduler-map
Scheduler map: dd-scheduler-map, Index: 84

  Scheduler: aa-scheduler, Index: 8721, Forwarding class: aa-forwarding-class
   Transmit rate: 30 percent, Rate Limit: none, Maximum buffer delay: 39 ms,
   Priority: high
   Drop profiles:
    Loss priority   Protocol    Index    Name
     Low            non-TCP     8724     aa-drop-profile
     Low            TCP         9874     bb-drop-profile
     High           non-TCP     8833     cc-drop-profile
     High           TCP         8484     dd-drop-profile

  Scheduler: bb-scheduler, Forwarding class: aa-forwarding-class
   Transmit rate: 40 percent, Rate limit: none, Maximum buffer delay: 68 ms,
   Priority: high
   Drop profiles:
    Loss priority   Protocol    Index    Name
     Low            non-TCP     8724     aa-drop-profile
     Low            TCP         9874     bb-drop-profile
     High           non-TCP     8833     cc-drop-profile
     High           TCP         8484     dd-drop-profile
```

PART 5

Index

Index