

## Chapter 12

# Configuring Tricolor Marking

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

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

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

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

TCM is not bound by a green-yellow-red coloring convention. Packets are usually marked with low, medium, or high PLP bit configurations based on color, so both TCM schemes extend the functionality of class-of-service (CoS) traffic policing by providing three levels of drop precedence (loss priority) instead of the two normally available in port-level policers. Both single-rate and two-rate TCM schemes can operate in two modes:

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



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

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

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## Supported Platforms for Tricolor Marking

In the JUNOS software implementation, you can configure four loss priorities (sometimes called *four-color marking*) instead of three. The software marks loss priorities as high, medium-high, medium-low, and low. This allows you to provision even more granular service-level agreements (SLAs) across the DiffServ domain.

TCM is supported on the following routing platforms:

- T-series and M320 platforms with Enhanced II Flexible PIC Concentrators (FPCs)
- T640 platforms with Enhanced Scaling FPC4

The platforms that support TCM interoperate with other platforms, as shown in Table 29.

**Table 29: TCM Platform Interoperation**

Packet Sent from Other Platforms	Received by Platforms that Support TCM
low	low
high	medium-high
Packet Sent from Platforms that Support TCM	Received by Other Platforms
low	low
medium-low	low
medium-high	high
high	high

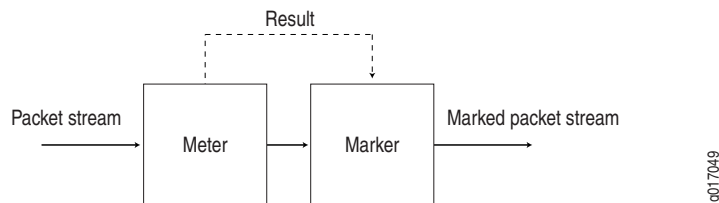
You can monitor how packets are marked by issuing the `show class-of-service forwarding-table classifier` command:

```
user@host> show class-of-service forwarding-table classifier
Classifier table index: 33166, # entries: 8, Table type: IEEE 802.1
Entry #   Code point   Queue #   PLP
  0         000           1         2 <---- medium-low
  1         001           2         2
  2         010           2         1 <---- high
  3         011           1         1
  4         100           2         3 <---- medium-high
  5         101           1         3
  6         110           1         0 <---- low
  7         111           2         0
```

## Tricolor Marking Architecture

Policers provide two functions: metering and marking. The policer meters each packet and passes the packet and the metering result to the marker, as shown in Figure 11.

**Figure 11: Flow of Tricolor Marking Policer Operation**



The meter operates in two modes. In the color-blind mode, the meter treats the packet stream as uncolored. Any preset loss priorities are ignored. In the color-aware mode, the meter inspects the packet loss priority (PLP) field, which has been set by an upstream device as PLP high, medium-high, medium-low, or low; in other words, the PLP field has already been set by a behavior aggregate (BA) or multifield (MF) classifier. The marker changes the PLP of each incoming IP packet according to the results of the meter. For more information, see “Two-Rate Tricolor Marking, Color-Aware Mode” on page 183.



**NOTE:** This chapter emphasizes configuration and use of TCM policers. For more information about configuring and using two-color policers (“policers”), see the *JUNOS Policy Framework Configuration Guide*.

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

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

For information about how to use marking policers with BA and MF classifiers, see “Setting the PLP with a BA Classifier” on page 190 and “Setting the PLP with a Multifield Classifier” on page 191.

## Configuring Tricolor Marking

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

```
[edit class-of-service]
tri-color;
classifiers {
  (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) classifier-name {
    import (classifier-name | default);
    forwarding-class class-name {
      loss-priority (low | medium-low | medium-high | high) {
        code-points [ aliases ] [ 6-bit-patterns ];
      }
    }
  }
}
rewrite-rules {
  (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) rewrite-name {
    import (rewrite-name | default);
    forwarding-class class-name {
      loss-priority (low | medium-low | medium-high | high)
        code-point (alias | bits);
    }
  }
}
schedulers {
  scheduler-name {
    drop-profile-map loss-priority (any | low | medium-low | medium-high | high)
      protocol any drop-profile profile-name;
  }
}

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

```

}
filter filter-name {
  <family family> {
    term rule-name {
      then {
        three-color-policer
          (single-rate | two-rate) policer-name;
      }
    }
  }
}
}

```

## Tricolor Marking Limitations

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The following limitations apply to TCM:

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

## Color-Blind and Color-Aware Single-Rate Tricolor Marking

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

### Single-Rate Tricolor Marking, Color-Blind Mode

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

In color-blind mode, packets that exceed the CBS but are below the EBS are marked yellow (medium-high). Packets that exceed the EBS are marked red (high), as shown in Table 32.

**Table 30: Color-Blind Mode TCM Color-to-PLP Mapping**

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

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

```

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

```

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

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

### Single-Rate Tricolor Marking, Color-Aware Mode

In color-aware mode, the metering treatment the packet receives depends on its classification. Metering can increase a packet’s preassigned PLP, but cannot decrease it, as shown in Table 31.

**Table 31: Color-Aware Mode TCM PLP Mapping**

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

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

#### Incoming PLP Low

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

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

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

### Incoming PLP Medium-Low

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

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

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

### Incoming PLP Medium-High

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

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

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

### Incoming PLP High

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

## Color-Blind and Color-Aware Two-Rate Tricolor Marking

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

### Two-Rate Tricolor Marking, Color-Blind Mode

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

In color-blind mode, packets that exceed the CBS but are below the PIR are marked yellow (medium-high). Packets that exceed the PIR are marked red (high), as shown in Table 32.

**Table 32: Color-Blind Mode TCM Color-to-PLP Mapping**

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

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

```

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

```

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

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

## Two-Rate Tricolor Marking, Color-Aware Mode

In color-aware mode, the metering treatment the packet receives depends on its classification. Metering can increase a packet's preassigned PLP, but cannot decrease it, as shown in Table 33.

**Table 33: Color-Aware Mode TCM Mapping**

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

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

### Incoming PLP Low

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

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

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

### Incoming PLP Medium-Low

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

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

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

### Incoming PLP Medium-High

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

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

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

### Incoming PLP High

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

## Enabling Tricolor Marking

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By default, TCM is not enabled. To enable TCM, include the `tri-color` statement at the `[edit class-of-service]` hierarchy level:

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

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

## Configuring a Tricolor Marking Policer

---

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

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

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

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

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

- low
- medium-low
- medium-high
- high

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

- low
- medium-high
- high

Table 34 describes all the configurable TCM statements.

**Table 34: Tricolor Marking Policer Statements**

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

## Applying a Tricolor Marking Policer to a Firewall Filter

---

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

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

You can include this statement at the following hierarchy levels:

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

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

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

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

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

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

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

```

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

```

For more information about applying policers to firewall filters, see the *JUNOS Policy Framework Configuration Guide*.

### Applying a Firewall Filter Tricolor Marking Policer to an Interface

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

```

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

```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-routers *logical-router-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

The filter name that you reference should have an attached tricolor marking policer, as shown in “Applying a Tricolor Marking Policer to a Firewall Filter” on page 187.

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

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

```

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

```

### Applying a Layer 2 Policer to a Gigabit Ethernet Interface

To rate-limit traffic by attaching a policer to Gigabit Ethernet interface, include the `layer2-policer` statement with the direction, type, and name of the policer:

```

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

```

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

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

### Examples: Applying Layer 2 Policers to a Gigabit Ethernet Interface

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

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

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

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

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

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

### Setting the PLP with a BA Classifier

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

```
[edit class-of-service]
classifiers {
  (dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence) classifier-name {
    import (classifier-name | default);
    forwarding-class class-name {
      loss-priority (low | medium-low | medium-high | high) {
        code-points [ aliases ] [ 6-bit-patterns ];
      }
    }
  }
}
```

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

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

```
class-of-service {
  classifiers {
    dscp dscp-cl {
      forwarding-class assured-forwarding {
        loss-priority medium-low {
          code-points 101110;
        }
      }
    }
  }
}
```

To use this classifier, you must configure the settings for the **assured-forwarding** forwarding class at the [edit class-of-service forwarding-classes queue *queue-number* assured-forwarding] hierarchy level. For more information, see “Configuring Forwarding Classes” on page 85.

## Setting the PLP with a Multifield Classifier

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

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

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

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

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

```

firewall {
  family inet {
    filter classify-customers {
      term isp1-customers {
        from {
          source-address 10.1.1.0/24;
          source-address 10.1.2.0/24;
        }
        then {
          loss-priority medium-high;
          forwarding-class expedited-forwarding;
        }
      }
    }
  }
}

```

To use this classifier, you must configure the settings for the `expedited-forwarding` forwarding class at the `[edit class-of-service forwarding-classes queue queue-number expedited-forwarding]` hierarchy level. For more information, see “Configuring Forwarding Classes” on page 85.

## Associating the PLP with a Drop-Profile Map

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

To configure the PLP for the drop-profile map, include the following statements at the `[edit class-of-service]` hierarchy level:

```

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

```

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

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

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

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

To use this drop-profile map, you must configure the settings for the `dp` drop profile at the `[edit class-of-service drop-profiles dp]` hierarchy level. For more information, see “Configuring RED Drop Profiles” on page 111.

## Associating the PLP with a Rewrite Rule

---

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

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

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

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

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

To use this classifier, you must configure the settings for the `assured-forwarding` forwarding class at the `[edit class-of-service forwarding-classes queue queue-number assured-forwarding]` hierarchy level. For more information, see “Configuring Forwarding Classes” on page 85.

## Verifying Your Configuration

---

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

- `show class-of-service`
- `show interfaces interface-name extensive`
- `show interfaces queue interface-name`

For information about these commands, see the *JUNOS Interfaces Command Reference* and *JUNOS System Basics and Services Command Reference*.

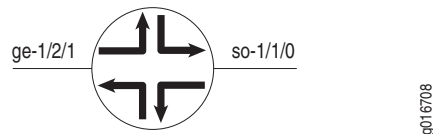
## Example: Configuring Two-Rate Tricolor Marking

Configure a two-rate tricolor marking policer on an input Gigabit Ethernet interface.

Traffic enters the Gigabit Ethernet interface and exits a SONET/SDH OC12 interface. Oversubscription occurs when you send line-rate traffic from the Gigabit Ethernet interface out the OC-12 interface.

Figure 12 shows the sample topology.

**Figure 12: Tricolor Marking Sample Topology**



### Input Interface

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

```

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

```

```
}

```

## Output Interface

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

```
class-of-service {
  drop-profiles {
    low-tcm {
      fill-level 80 drop-probability 100;
    }
    med-tcm {
      fill-level 40 drop-probability 100;
    }
    high-tcm {
      fill-level 10 drop-probability 100;
    }
  }
  tri-color;
  interfaces {
    so-1/1/0 {
      scheduler-map tcm-sched;
    }
  }
  scheduler-maps {
    tcm-sched {
      forwarding-class queue-0 scheduler q0-sched;
      forwarding-class queue-3 scheduler q3-sched;
    }
  }
  schedulers {
    q0-sched {
      transmit-rate percent 50;
      buffer-size percent 50;
      drop-profile-map loss-priority low protocol any drop-profile low-tcm;
      drop-profile-map loss-priority medium-high protocol any
        drop-profile med-tcm;
      drop-profile-map loss-priority high protocol any drop-profile high-tcm;
    }
    q3-sched {
      transmit-rate percent 50;
      buffer-size percent 50;
    }
  }
}

```

**Medium-Low Loss Priority**

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

```

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

firewall {
  three-color-policer trTCM {
    two-rate {
      color-blind;
      committed-information-rate 400m;
      committed-burst-size 100m;
      peak-information-rate 1g;
      peak-burst-size 500m;
    }
  }
  policer 4PLP {
    if-exceeding {
      bandwidth-limit 40k;
      burst-size-limit 4k;
    }
    then loss-priority medium-low;
  }
  family inet {
    filter 4PLP {
      term 0 {
        from {
          precedence 1;
        }
        then loss-priority medium-low;
      }
    }
    filter filter_trTCM {
      term default {
        then {
          three-color-policer {
            two-rate trTCM;
          }
        }
      }
    }
  }
}

```

```
}
```