QoS: Percentage-Based and Time-Based Policing Parameters

Percentage-Based and Time-Based options for the **police** policy map class configuration command are introduced as Modular Quality of Service Command Line Interface (MQC) commands so that you can reuse policy maps across different interfaces of different rates. The QoS: Percentage-Based and Time-Based Policing feature allows you to configure traffic policing or shaping on the basis of a *percentage* of bandwidth available on the interface. This feature also allows you to specify the committed burst (bc) size and the extended burst (be) size used for configuring traffic policing in milliseconds (ms).

Feature History for the QoS: Percentage-Based and Time-Based Policing Feature

Release	Modification
12.2(13)T	This feature was introduced.
12.0(28)S	The feature was integrated into Cisco IOS Release 12.0(28)S. This feature is based on the Percentage-Based Policing and Shaping feature introduced with Cisco IOS Release 12.3(13)T. The option of specifying committed burst (bc) and excess burst (be) sizes in milliseconds was added.
12.2(27)SBA	The feature was integrated into Cisco IOS Release 12.2(27)SBA.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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Contents

Restrictions for Percentage-Based and Time-Based Policing Parameters

The QoS: Percentage-Based and Time-Based Policing feature is supported only on the following Cisco 12000 Series Line Cards:

Supported Cisco 12000 Series Internet Services Engine (E3) Line Cards

- CHOC12/DS1-IR-SC=
  1-Port Channelized OC-12/STM-4 (DS1/E1) ISE Line Card
- CHOC48/DS3-SR-SC=
  1-Port Channelized OC-48/STM-16 (DS3/E3, OC-3c/STM-1c, OC-12c/STM-4c) POS/SDH ISE Line Card
- 4CHOC12/DS3-I-SCB=
  4-Port Channelized OC-12/STM-4 (DS3/E3, OC-3c/STM-1c) POS/SDH ISE Line Card
- 16OC3X/POS-I-LC-B=, 16OC3X/POS-M-MJ-B=
  16-Port OC-3c/STM-1c POS/SDH ISE Line Card
- 4OC12X/ATM-MM-SC=, 4OC12X/ATM-IR-SC=
  4-Port OC-12c/STM-4c ATM ISE Line Cards
- 4GE-SFP-LC=
  4-Port Gigabit Ethernet ISE Line Card

Supported Cisco 12000 Series Engine 4 Plus (E4+) Line Cards

- OC192E/POS-VSR=, OC192E/POS-SR-SC=, OC192E/POS-IR-SC=, OC192E/POS-LR-SC=
  1-Port OC-192c/STM-64c POS/SDH ES Line Cards
- 4OC48E/POS-LR-SC=, 4OC48E/POS-SR-SC=
  4-Port OC-48c/STM-16c POS/SDH ES Line Card
- EPA-GE/FE-BBRD=, EPA-3GE-SX/LH-LC=
  1-Port Gigabit Ethernet Line Cards
- 1X10GE-LR-SC=, 1x10GE-ER-SC=
  1-Port 10-Gigabit Ethernet Line Cards

Information About Percentage-Based and Time-Based Policing Parameters

To configure Percentage-Based policing, you need to understand the following concepts:

Percentage-Based Policing Benefits

Increased Flexibility and Ease-of-Use

This feature provides the ability to configure traffic policing and traffic shaping on the basis of a *percentage* of bandwidth available on an interface, and it allows you to specify burst sizes in milliseconds. Configuring traffic policing and traffic shaping in this manner enables you to use the same policy map for multiple interfaces with differing amounts of bandwidth. That is, you do not have to recalculate the bandwidth for each interface or configure a different policy map for each type of interface.

Defining Class and Policy Maps for Percentage-Based Policing

To configure the Percentage-Based Policing feature, you must define a traffic class, configure a policy map, and then attach that policy map to the appropriate interface. These three tasks can be accomplished by using the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC).

The MQC is a command-line interface that allows you to define traffic classes, create and configure traffic policies (policy maps), and then attach these traffic policies to interfaces.

In the MQC, the **class-map** command is used to define a traffic class (which is then associated with a traffic policy). The purpose of a traffic class is to classify traffic.

The MQC consists of the following three processes:

- Defining a traffic class with the **class-map** command.
- Creating a traffic policy by associating the traffic class with one or more QoS features (using the **policy-map** command).
- Attaching the traffic policy to the interface with the **service-policy** command.

A traffic class contains three major elements: a name, a series of match commands, and, if more than one **match** command exists in the traffic class, an instruction on how to evaluate these **match** commands (that is, match-all or match-any). The traffic class is named in the **class-map** command line; for example, if you enter the **class-map cisco** command while configuring the traffic class in the CLI, the traffic class would be named “cisco.”

The **match** commands are used to specify various criteria for classifying packets. Packets are checked to determine whether they match the criteria specified in the **match** commands. If a packet matches the specified criteria, that packet is considered a member of the class and is forwarded according to the QoS specifications set in the traffic policy. Packets that fail to meet any of the matching criteria are classified as members of the default traffic class.

Traffic Regulation Mechanisms and Bandwidth Percentages

Cisco IOS quality of service (QoS) offers two kinds of traffic regulation mechanisms—traffic policing and traffic shaping. A traffic policer typically drops traffic that violates a specific rate. A traffic shaper typically delays excess traffic using a buffer to hold packets and shapes the flow when the data rate to a queue is higher than expected.

Traffic policing and traffic shaping can work in tandem and can be configured in a class map. Class maps organize data packets into specific categories ("classes") that can, in turn, receive a user-defined QoS treatment when used in policy maps (sometimes referred to as "service policies").

Before this feature, traffic policing and traffic shaping were configured on the basis of a user-specified amount of bandwidth available on the interface. Policy maps were then configured on the basis of that specific amount of bandwidth, meaning that separate policy maps were required for each interface.

This feature provides the ability to configure traffic policing and traffic shaping on the basis of a *percentage* of bandwidth available on the interface. Configuring traffic policing and traffic shaping in this manner enables customers to use the same policy map for multiple interfaces with differing amounts of bandwidth.

Configuring traffic policing and shaping on the basis of a percentage of bandwidth is accomplished by using the **police** (percent) and **shape** (percent) commands. For more information about these commands, see the "Command Reference" section later in this document.

Specifying Burst Size in Milliseconds Option

The purpose of the burst parameters (**bc** and **be**) is to drop packets gradually, as is done with Weighted Random Early Detection (WRED), and to avoid tail drop. Setting sufficiently high burst values helps to ensure good throughput.

This feature allows you the option of specifying the committed burst (bc) size and the extended burst (be) as milliseconds (ms) of the class bandwidth when you configure traffic policing. The number of milliseconds is used to calculate the number of bytes that will be used by the QoS: Percentage-Based and Time-Based Policing Parameters feature.

Specifying these burst sizes in milliseconds is accomplished by using the **bc** and **be** keywords (and their associated arguments) of the **police** (percent) and **shape** (percent) commands.

For more information about these commands, see the "Command Reference" section later in this document.

Cisco 12000 Series Line Card Information

This section tabulates policing feature support for Cisco 12000 Series line cards in the following sections:

- Cisco 12000 Series Line Card with Internet Services Engine (E3) Policing Feature Matrix, page 5
- Cisco 12000 Series Line Card with Engine 4 Plus (E4+) Policing Feature Matrix, page 6

Cisco 12000 Series Line Card with Internet Services Engine (E3) Policing Feature Matrix

Percentage-Based and Time-Based policing is supported on ingress and egress interfaces. Policing can be configured on main, channelized, AToM, and subinterfaces. Table 1 shows supported line cards with their policing features.

Table 1 Policing Feature Support for Cisco 12000 Series ISE (E3) Line Cards

Line Card	Main Interface	Subinterface	AToM Interface (Egress Only)	Hierarchical Policy Support
1-Port Channelized OC-12/STM-4 (DS1/E1) ISE	Single-rate 2-color policing	Single-rate 2-color policing	Dual-rate 3-color policing	• On egress only • Not supported on FR-DLCI
1-Port Channelized OC-48/STM-16 (DS3/E3, OC-3c/STM-1c, OC-12c/STM-4c) POS/SDH ISE	Single-rate 2-color policing	Single-rate 2-color policing	Dual-rate 3-color policing	On egress only for main and subinterfaces[1]
4-Port Channelized OC-12/STM-4 (DS3/E3, OC-3c/STM-1c) POS/SDH ISE	Single-rate 2-color policing	Single-rate 2-color policing	Dual-rate 3-color policing	On egress only for main and subinterfaces[1]
16-Port OC-3c/STM-1c POS/SDH ISE Line Card	Single-rate 2-color policing	Single rate 2-color policing	Dual-rate 3-color policing	On egress only for main and subinterfaces[1]
4-Port OC-12c/STM-4c ATM ISE	Single-rate 2-color policing on the configured VC/VP [2]	Single-rate 2-color policing on the configured VC/VP	Not supported	Not supported
4-Port Gigabit Ethernet ISE Line Card	Single-rate 2-color policing	Single-rate 2-color policing	Single-rate 2-color policing	On ingress and egress for both main and subinterfaces

1. For subinterfaces, only a dummy parent policy is allowed for hierarchical policies. Bandwidth must be configured on subinterfaces with the **interface bandwidth** interface configuration command, because these line cards cannot shape the subinterface.
2. The **policy-map** global configuration command can be configured only for VC/VP and not on the main interface or sub interface.

Cisco 12000 Series Line Card with Engine 4 Plus (E4+) Policing Feature Matrix

Table 2 shows supported line cards with their policing features.

Table 2 Policing Feature Support for Cisco 12000 Engine 4 Plus (E4+) Line Cards

Line Card	Main Interface	Subinterface	AToM Interface (Egress Only)	Hierarchical Policy Support
1-Port OC-192c/STM-64c POS/SDH ES	Single-rate 2-color policing	Not supported	Not supported	Not supported
4-Port OC-48c/STM-16c POS/SDH ES	Single-rate 2-color policing	Not supported	Not supported	Not supported
1-Port Gigabit Ethernet	Single-rate 2-color policing	Not supported	Not supported	Not supported
1-Port 10-Gigabit Ethernet	Single-rate 2-color policing	Not supported	Not supported	Not supported

How to Configure Percentage-Based and Time-Based Policing

See the following sections for configuration tasks for the Percentage-Based Policing and Shaping feature. Each task in the list is identified as either required or optional.

- Configuring a Class and Policy Map, page 6 (required)
- Attaching the Policy Map to an Interface, page 7 (required)
- Verifying the Configuration, page 9 (optional)

Configuring a Class and Policy Map

A class map is used to organize traffic into specific categories or classes. These categories or classes of traffic are associated with a traffic policy or policy map. In turn, the policy map is used in conjunction with the class map to apply a specific QoS feature to the traffic. In this instance, the QoS feature of Percentage-Based policing will be applied.

To configure a class map and associate the class map with a specific policy map, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-name*
4. **class** {*class-name* | **class-default**}
5. **police cir percent** *percentage* [*burst-in-ms*] [**bc** *conform-burst-in-msec* **ms**] [**be** *peak-burst-in-msec* **ms**] [**pir percent** *percent*]
6. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables higher privilege levels, such as privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**policy-map** *policy-name* **Example:** `Router (config)# policy-map policy1`	Specifies the name of the policy map to be created. Enters policy-map configuration mode. • Enter the policy map name.
Step 4	**class** {*class-name* | **class-default**} **Example:** `Router(config-pmap)# class class1`	Specifies the class so that you can configure or modify its policy. Enters policy-map class configuration mode. • Enter the class name or specify the default class (class-default).
Step 5	**police cir percent** *percentage* [*burst-in-ms*] [**bc** *conform-burst-in-msec* **ms**] [**be** *peak-burst-in-msec* **ms**] [**pir percent** *percent*] **Example:** `Router(config-pmap-c)# police cir percent 20 bc 300 ms be 400 ms pir percent 40`	Configures traffic policing on the basis of the specified bandwidth percentage and optional burst sizes. Enters policy-map class police configuration mode. • Enter the bandwidth percentage and optional burst sizes.
Step 6	**exit** **Example:** `Router(config-pmap-c-police)# exit`	Exits policy-map class police configuration mode.

Attaching the Policy Map to an Interface

After a policy map is created, the next step is to attach the policy map to an interface. Policy maps can be attached to either the input or output direction of the interface.

Note Depending on the needs of your network, you may need to attach the policy map to a subinterface, an ATM PVC, a Frame Relay DLCI, or other type of interface.

To attach the policy map to an interface, perform the following steps.

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **interface** *type number*
4. **pvc** [*name*] *vpi*/*vci* [**ilmi** | **qsaal** | **smds**]
5. **service-policy** {**input** | **output**} *policy-map-name*
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables higher privilege levels, such as privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config-if)# interface s4/0`	Configures an interface or subinterface type and enters interface configuration mode. • Enter the interface type number.
Step 4	**pvc** [*name*] *vpi*/*vci* [**ilmi** | **qsaal** | **smds**] **Example:** `Router(config-if)# pvc cisco 0/16 ilmi`	(Optional) Creates or assigns a name to an ATM PVC and specifies the encapsulation type on an ATM PVC. Enters ATM VC configuration mode. **Note** This step is required only if you are attaching the policy map to an ATM PVC. If you are not attaching the policy map to an ATM PVC, skip this step and proceed with Step 5.

	Command or Action	Purpose
Step 5	**service-policy** {**input** | **output**} *policy-map-name* **Example:** `Router(config-if)# service-policy input policy1`	Specifies the name of the policy map to be attached to the input *or* output direction of the interface. **Note** Policy maps can be configured on ingress or egress routers. They can also be attached in the input or output direction of an interface. The direction (input or output) and the router (ingress or egress) to which the policy map should be attached varies according your network configuration. When using the **service-policy** command to attach the policy map to an interface, be sure to choose the router and the interface direction that are appropriate for your network configuration. • Enter the policy map name.
Step 6	**exit** **Example:** `Router(config-if)# exit`	(Optional) Exits interface configuration mode.

Verifying the Configuration

This task allows you to verify that you created the configuration you intended and that the feature is functioning correctly.

To verify the configuration, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **show class-map** [*class-map-name*]

   or

   show policy-map interface *interface-name*
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables higher privilege levels, such as privileged EXEC mode. • Enter your password if prompted.
Step 2	**show class-map** [*class-map-name*] **Example:** `Router# show class-map class1`	Displays all information about a class map, including the match criterion. • Enter the class map name.
	or	
	show policy-map interface *interface-name* **Example:** `Router# show policy-map interface s4/0`	Displays the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface. • Enter the interface name.
Step 3	**exit** **Example:** `Router# exit`	(Optional) Exits EXEC mode.

Troubleshooting Tips

The commands in the "Verifying the Configuration" section allow you to verify that you achieved the intended configuration and that the feature is functioning correctly. If, after using the **show** commands listed above, you find that the configuration is not correct or the feature is not functioning as expected, perform these operations:

If the configuration is not the one you intended, perform the procedures that follow.

- Use the **show running-config** command and analyze the output of the command.
- If the policy map does not appear in the output of the **show running-config** command, enable the **logging console** command.
- Attach the policy map to the interface again.

If the packets are not being matched correctly (for example, the packet counters are not incrementing correctly), complete the following procedures:

- Run the **show policy-map** command and analyze the output of the command.
- Run the **show running-config** command and analyze the output of the command.
- Use the **show policy-map interface** command and analyze the output of the command. Check the the following findings:
  - If a policy map applies queueing and the packets are matching the correct class, but you see unexpected results, compare the number of the packets in the queue with the number of the packets matched.
  - If the interface is congested and only a small number of the packets are being matched, check the tuning of the transmission (tx) ring, and evaluate whether the queueing is happening on the tx ring. To do this, use the **show controllers** command, and look at the value of the tx count in the output of the command.

Configuration Examples for Percentage-Based and Time-Based Policing

This section provides the following configuration examples:

- Specifying Traffic Policing on the Basis of a Bandwidth Percentage: Example, page 11
- Verifying the Configuration: Example, page 12

Specifying Traffic Policing on the Basis of a Bandwidth Percentage: Example

The following example configures traffic policing using a committed information rate (CIR) and a peak information rate (PIR) on the basis of a percentage of bandwidth. In this example, a CIR of 20 percent and a PIR of 40 percent have been specified. Additionally, optional **bc** and **be** values (300 ms and 400 ms, respectively) have been specified.

```
Router> enable
Router# configure terminal
Router (config)# policy-map policy1
Router(config-pmap)# class class1
Router(config-pmap-c)# police cir percent 20 bc 300 ms be 400 ms pir percent 40
Router(config-pmap-c-police)# exit
```

After the policy map and class maps are configured, the policy map is attached to the interface, as shown in the following example.

```
Router> enable
Router# configure terminal
Router(config-if)# interface s4/0
Router(config-if)# service-policy input policy1
Router(config-if)# exit
```

Verifying the Configuration: Example

This section contains sample output from the **show policy-map** command and the **show policy-map interface** command. The output from these commands can be used to verify and monitor the feature configuration on your network.

The following is sample output from the **show policy-map** command. This sample output displays the contents of a policy map called "policy1." In policy 1, traffic policing on the basis of a committed information rate (CIR) of 20 percent has been configured, and the **bc** and **be** values have been specified in milliseconds. As part of the traffic policing configuration, optional conform, exceed, and violate actions have been specified.

```
Router# show policy-map policy1
  Policy Map policy1
    Class class1
     police cir percent 20 bc 300 ms pir percent 40 be 400 ms
       conform-action transmit
       exceed-action drop
       violate-action drop
```

The following is sample output from the **show policy-map interface** command. This sample displays the statistics for the serial 2/0 interface on which traffic policing has been enabled. The committed burst (bc) and excess burst (be) are specified in milliseconds (ms).

```
Router# show policy-map interface s2/0
 Serial2/0

  Service-policy output: policy1 (1050)

    Class-map: class1 (match-all) (1051/1)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip precedence 0  (1052)
      police:
          cir 20 % bc 300 ms
          cir 409500 bps, bc 15360 bytes
          pir 40 % be 400 ms
          pir 819000 bps, be 40960 bytes
        conformed 0 packets, 0 bytes; actions:
          transmit
        exceeded 0 packets, 0 bytes; actions:
          drop
        violated 0 packets, 0 bytes; actions:
          drop
        conformed 0 bps, exceed 0 bps, violate 0 bps

    Class-map: class-default (match-any) (1054/0)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any  (1055)
        0 packets, 0 bytes
        5 minute rate 0 bps
```

In this example, the CIR and PIR are displayed in bits per second (bps), and both the committed burst (bc) and excess burst (be) are displayed in bits.

The CIR, PIR **bc**, and **be** values are calculated on the basis of the formulas described below.

Formula for Calculating the CIR

When calculating the CIR, the following formula is used:

Total bits per second = Specified CIR percentage (as shown in the output of the **show policy-map** command) * bandwidth (BW) of the interface (as shown in the output of the **show interfaces** command)

On the serial 2/0 interface, the bandwidth (BW) is 2,048 kbps. To see the bandwidth of the interface, use the **show interfaces** command. A sample is shown below:

```
Router # show interfaces s2/0
Serial2/0 is administratively down, line protocol is down
  Hardware is M4T
  MTU 1500 bytes, BW 2048 Kbit, DLY 20000 usec, rely 255/255, load 1/255
```

The following values are used for calculating the CIR:

20% * 2,048 kbps = 409600 bps

Formula for Calculating the PIR

When calculating the PIR, the following formula is used:

Total bits per second = Specified PIR percentage (as shown in the output of the **show policy-map** command) * bandwidth (BW) of the interface (as shown in the output of the **show interfaces** command)

On the serial 2/0 interface, the bandwidth (BW) is 2,048 Kbps. To see the bandwidth of the interface, use the **show interfaces** command. A sample is shown below:

```
Router # show interfaces s2/0
Serial2/0 is administratively down, line protocol is down
  Hardware is M4T
  MTU 1500 bytes, BW 2048 Kbit, DLY 20000 usec, rely 255/255, load 1/255
```

The following values are used for calculating the PIR.

40% * 2,048 kbps = 819,200 bps

Note Discrepancies between this total and the total shown in the output of the **show policy-map interface** command can be attributed to a rounding calculation or to differences associated with the specific interface configuration.

Formula for Calculating the Committed Burst (bc)

When calculating the **bc**, the following formula is used:

Total number of bytes = The **bc** in milliseconds (as shown in the **show policy-map** command) * the CIR in bits per seconds

The following values are used for calculating the bc:

300 ms * 409,600 bps = 15,360 bytes

Formula for Calculating the Excess Burst (be)

When calculating the **be**, the following formula is used:

Total number of bytes = The **be** in milliseconds (as shown in the **show policy-map** command) * the PIR in bits per seconds

The following values are used for calculating the **be**:

400 ms * 819,200 bps = 40,960 bytes

Additional References

The following sections provide references related to the QoS: Percentage-Based and Time-Based Policing feature.

Related Documents

Related Topic	Document Title
Quality of Service (QoS) commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*, Release 12.3T
Modular QoS Command-Line Interface (CLI) (MQC)	*Cisco IOS Quality of Service Solutions Configuration Guide*
Information about attaching policy maps to interfaces	*Cisco IOS Quality of Service Solutions Configuration Guide*
Traffic shaping	*Cisco IOS Quality of Service Solutions Configuration Guide*
Traffic policing	*Cisco IOS Quality of Service Solutions Configuration Guide*
dCEF	*Cisco IOS Switching Services Configuration Guide*
Commands related to dCEF	*Cisco IOS Switching Services Command Reference*, Release 12.3T

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
No new or modified MIBS are supported by this feature, and support for existing standards has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
• RFC 2697	*A Single Rate Three Color Marker*
• RFC 2698	*A Two Rate Three Color Marker*

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

Command Reference

This section documents only modified commands.

- **police (percent)**
- **shape (percent)**
- **show policy-map**
- **show policy-map interface**

police (percent)

To configure traffic policing on the basis of a percentage of bandwidth available on an interface, use the **police** command in policy-map class configuration mode. To remove traffic policing from the configuration, use the **no** form of this command.

police cir percent *percentage* [*burst-in-msec*] [**bc** *conform-burst-in-msec* **ms**] [**be** *peak-burst-in-msec* **ms**] [**pir percent** *percentage*]

no police cir percent *percentage* [*burst-in-msec*] [**bc** *conform-burst-in-msec* **ms**] [**be** *peak-burst-in-msec* **ms**] [**pir percent** *percentage*]

Syntax Description

cir	Committed information rate. Indicates that the CIR will be used for policing traffic.
percent	Specifies that percent of bandwidth will be used for calculating the CIR.
percentage	Specifies the bandwidth percentage. Valid range is a number from 1 to 100.
burst-in-msec	(Optional) Burst in milliseconds. Valid range is a number from 1 to 2000.
bc	(Optional) Conform burst (bc) size used by the first token bucket for policing traffic.
conform-burst-in-msec	(Optional) Specifies the bc value in milliseconds (ms). Valid range is a number from 1 to 2000.
ms	(Optional) Indicates that the burst value is specified in milliseconds.
be	(Optional) Peak burst (be) size used by the second token bucket for policing traffic.
peak-burst-in-msec	(Optional) Specifies the be size in ms. Valid range is a number from 1 to 2000.
pir	(Optional) Peak information rate. Indicates that the pir will be used for policing traffic.
percent	(Optional) Specifies that a percentage of bandwidth will be used for calculating the pir.

Defaults

The default bc and be is 4 ms.

Command Modes

Policy-map class configuration

Command History

Release	Modification
11.1 CC	The **rate-limit** command was introduced.
12.0(5)XE	This **police** command, which was closely related to the **rate-limit** command, was introduced.
12.1(1)E	This command was integrated into Cisco IOS Release 12.2(1)E.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T.

Release	Modification
12.2(13)T	This command was modified for the Percentage-Based Policing and Shaping feature.
12.0(28)S	The command was integrated into Cisco IOS Release 12.0(28)S.
12.2(27)SB	The command was integrated into Cisco IOS Release 12.2(27)SB.

Usage Guidelines

This command calculates the cir and pir on the basis of a percentage of the maximum amount of bandwidth available on the interface. When a policy map is attached to the interface, the equivalent cir and pir values in bits per second (bps) are calculated on the basis of the interface bandwidth and the percent value entered with this command. The **show policy-map interface** command can then be used to verify the bps rate calculated.

The calculated cir and pir bps rates must be in the range of 8000 and 2000000000 bps. If the rates are outside this range, the associated policy map cannot be attached to the interface. If the interface bandwidth changes (for example, more is added), the bps values of the cir and the pir are recalculated on the basis of the revised amount of bandwidth. If the cir and pir percentages are changed after the policy map is attached to the interface, the bps values of the cir and pir are recalculated.

Conform Burst and Peak Burst Sizes in Milliseconds

This command also allows you to specify the values for the conform burst size and the peak burst size in milliseconds. If you want bandwidth to be calculated as a percentage, the conform burst size and the peak burst size must be specified in milliseconds (ms).

Hierarchical Policy Maps

Policy maps can be configured in two-level (nested) hierarchies; a top (or “parent”) level and a secondary (or “child”) level. The **police** (percent) command can be configured for use in either a parent or child policy map.

Notes About Bandwidth and Hierarchical Policy Maps

The **police** (percent) command uses the maximum rate of bandwidth available as the reference point for calculating the bandwidth percentage. When the **police** (percent) command is configured in a child policy map, the **police** (percent) command uses the bandwidth amount specified in the next higher-level policy (in this case, the parent policy map). If the parent policy map does not specify the maximum bandwidth rate available, the **police** (percent) command uses the maximum bandwidth rate available on the next higher level (in this case, the physical interface, the highest point in the hierarchy) as the reference point. The **police** (percent) command always looks to the next higher level for the bandwidth reference point. The following sample configuration illustrates this point:

```
Policymap parent_policy
 class parent
  shape average 512000
  service-policy child_policy

Policymap child_policy
 class normal_type
  police cir percent 30
```

In this sample configuration, there are two hierarchical policies; one called parent_policy and one called child_policy. In the policy map called child_policy, the police command has been configured in the class called normal_type. In this class, the percentage specified by for the **police** (percent) command is

30 percent. The command will use 512 kbps, the peak rate, as the bandwidth reference point for class parent in the parent_policy. The **police** (percent) command will use 512 kbps as the basis for calculating the cir rate (512 kbps * 30 percent).

```
interface serial 4/0
 service-policy output parent_policy

Policymap parent_policy
 class parent
  bandwidth 512
  service-policy child_policy
```

In the above example, there is one policy map called parent_policy. In this policy map, a peak rate has not been specified. The **bandwidth** command has been used, but this command does not represent the maximum rate of bandwidth available. Therefore, the **police** (percent) command will look to the next higher level (in this case Serial interface 4/0) to get the bandwidth reference point. Assuming the bandwidth of the Series interface s4/0 is 1.5 Mbps, the **police** (percent) command will use 1.5 Mbps as the basis for calculating the cir rate (1500000 * 30 percent).

How Bandwidth Is Calculated

The **police** (percent) command is often used in conjunction with the **bandwidth** and **priority** commands. The **bandwidth** and **priority** commands can be used to calculate the total amount of bandwidth available on an entity (for example, a physical interface). When the **bandwidth** and **priority** commands calculate the total amount of bandwidth available on an entity, the following guidelines are invoked:

- If the entity is a physical interface, the total bandwidth is the bandwidth on the physical interface.
- If the entity is a shaped ATM permanent virtual circuit (PVC), the total bandwidth is calculated as follows:
  - For a variable bit rate (VBR) virtual circuit (VC), the sustained cell rate (SCR) is used in the calculation.
  - For an available bit rate (ABR) VC, the minimum cell rate (MCR) is used in the calculation.

For more information on bandwidth allocation, refer to the"Congestion Management Overview" chapter in the *Cisco IOS Quality of Service Solutions Configuration Guide.*

Examples

The following example configures traffic policing using a CIR and a PIR on the basis of a percentage of bandwidth. In this example, a CIR of 20 percent and a PIR of 40 percent have been specified. Additionally, an optional bc value and be value (300 ms and 400 ms, respectively) have been specified.

```
Router> enable
Router# configure terminal
Router (config)# policy-map policy1
Router(config-pmap)# class class1
Router(config-pmap-c)# police cir percent 20 bc 300 ms be 400 ms pir percent 40
Router(config-pmap-c-police)# exit
```

After the policy map and class maps are configured, the policy map is attached to interface as shown in the following example.

```
Router> enable
Router# configure terminal
Router(config-if)# interface s4/0
Router(config-if)# service-policy input policy1
Router(config-if)# exit
```

Related Commands

Command	Description
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
service-policy	Attaches a policy map to an input interface or VC, or an output interface or VC, to be used as the service policy for that interface or VC.
shape (percent)	Specifies average or peak rate traffic shaping on the basis of a percentage of bandwidth available on an interface.
show policy-map	Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.
show policy-map interface	Displays the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface.

shape (percent)

To specify average or peak rate traffic shaping on the basis of a percentage of bandwidth available on an interface, use the **shape** command in policy-map class configuration mode. To remove traffic shaping, use the **no** form of this command.

shape {**average** | **peak**} **percent** *percentage* [*sustained-burst-in-msec* **ms**] [**be** *excess-burst-in-msec* **ms**] [**bc** *committed-burst-in-msec* **ms**]

no shape {**average** | **peak**} **percent** *percentage* [*sustained-burst-in-msec* **ms**] [**be** *excess-burst-in-msec* **ms**] [**bc** *committed-burst-in-msec* **ms**]

Syntax Description

average	Specifies average rate traffic shaping.
peak	Specifies peak rate traffic shaping.
percent	Specifies that percent of bandwidth will be used for either the average rate or peak rate traffic shaping.
percentage	Specifies the bandwidth percentage. Valid range is a number from 1 to 100.
sustained-burst-in-msec	(Optional) Sustained burst size used by the first token bucket for policing traffic. Valid range is a number from 4 to 200.
ms	(Optional) Indicates that the burst value is specified in milliseconds.
be	(Optional) Excess burst (be) size used by the second token bucket for policing traffic.
excess-burst-in-msec	(Optional) Specifies the be size in ms. Valid range is a number from 0 to 200.
bc	(Optional) Committed burst (bc) size used by the first token bucket for policing traffic.
committed-burst-in-msec	(Optional) Specifies the bc value in milliseconds (ms). Valid range is a number from 1 to 2000.

Defaults

The default bc and be is 4 ms.

Command Modes

Policy-map class configuration

Command History

Release	Modification
12.1(2)T	This command was introduced.
12.2(13)T	This command was modified for the Percentage-Based Policing and Shaping feature.
12.0(28)S	The command was integrated into Cisco IOS Release 12.0(28)S.
12.2(27)SB	The command was integrated into Cisco IOS Release 12.2(27)SB.

Usage Guidelines

This command calculates the committed information rate (CIR) on the basis of a percentage of the available bandwidth on the interface. Once a policy map is attached to the interface, the equivalent cir value in bits per second (bps) is calculated on the basis of the interface bandwidth and the percent value entered with this command. The **show policy-map interface** command can then be used to verify the cir bps value calculated.

The calculated cir bps rate must be in the range of 8000 and 154400000 bps. If the rate is less than 8000 bps, the associated policy map cannot be attached to the interface. If the interface bandwidth changes (for example, more is added), the cir bps values are recalculated on the basis of the revised amount of bandwidth. If the cir percentage is changed after the policy map is attached to the interface, the bps value of the cir is recalculated.

Conform Burst and Peak Burst Sizes in Milliseconds

This command also allows you to specify the values for the conform burst size and the peak burst size in milliseconds. If you want bandwidth to be calculated as a percentage, the conform burst size and the peak burst size must be specified in milliseconds (ms).

Hierarchical Policy Maps

The **shape** (percent) command, when used in "child" (hierarchical) policy maps, is not supported on the Cisco 7500, the Cisco 7200, or lower series routers. Therefore, the **shape** (percent) command cannot be configured for use in hierarchical policy maps on these routers.

How Bandwidth Is Calculated

The **shape** (percent) command is often used in conjunction with the **bandwidth** and **priority** commands. The **bandwidth** and **priority** commands can be used to calculate the total amount of bandwidth available on an entity (for example, a physical interface). When the **bandwidth** and **priority** commands calculate the total amount of bandwidth available on an entity, the following guidelines are invoked:

- If the entity is a physical interface, the total bandwidth is the bandwidth on the physical interface.
- If the entity is a shaped ATM permanent virtual circuit (PVC), the total bandwidth is calculated as follows:
  - For a variable bit rate (VBR) virtual circuit (VC), the sustained cell rate (SCR) is used in the calculation.
  - For an available bit rate (ABR) VC, the minimum cell rate (MCR) is used in the calculation.

For more information on bandwidth allocation, refer to the "Congestion Management Overview" chapter in the *Cisco IOS Quality of Service Solutions Configuration Guide.*

Examples

The following example configures traffic shaping using an average shaping rate on the basis of a percentage of bandwidth. In this example, 25 percent of the bandwidth has been specified. Additionally, an optional be value and bc value (300 ms and 400 ms, respectively) have been specified.

```
Router> enable
Router# configure terminal
Router (config)# policy-map policy1
Router(config-pmap)# class class1
Router(config-pmap-c)# shape average percent 25 20 ms be 300 ms bc 400 ms
Router(config-pmap-c)# exit
```

After the policy map and class maps are configured, the policy map is attached to interface as shown in the following example.

```
Router> enable
Router# configure terminal
Router(config)# interface s4/0
Router(config-if)# service-policy input policy1
Router(config-if)# exit
```

Related Commands

Command	Description
bandwidth	Specifies or modifies the bandwidth allocated for a class belonging to a policy map.
class (policy-map)	Specifies the name of the class whose policy you want to create or change, and the default class (commonly known as the class-default class) before you configure its policy.
police (percent)	Configures traffic policing on the basis of a percentage of bandwidth available on an interface.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
priority	Gives priority to a class of traffic belonging to a policy map.
service-policy	Attaches a policy map to an input interface or VC, or an output interface or VC, to be used as the service policy for that interface or VC.
shape max-buffers	Specifies the maximum number of buffers allowed on shaping queues.

show policy-map

To display the configuration of all classes for a specified service policy map or all classes for all existing policy maps, use the **show policy-map** command in EXEC mode.

show policy-map [*policy-map*]

Syntax Description

policy-map	(Optional) Name of the service policy map whose complete configuration is to be displayed.

Defaults

All existing policy map configurations are displayed.

Command Modes

EXEC

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE.
12.0(7)S	This command was integrated into Cisco IOS Release 12.0(7)S.
12.1(1)E	This command was integrated into Cisco IOS Release 12.1(1)E.
12.2(13)T	The output of this command was modified for the Percentage-Based Policing and Shaping feature and includes the bandwidth percentage used when calculating traffic policing and shaping.
12.0(28)S	The output of this command was modified for the QoS: Percentage-Based Policing feature to display the committed (conform) burst (bc) and excess (peak) burst (be) sizes in milliseconds (ms).
12.2(27)SB	This command was integrated into Cisco IOS Release 12.2(27)SB.

Usage Guidelines

The **show policy-map** command displays the configuration of a service policy map created using the **policy-map** command. You can use the **show policy-map** command to display all class configurations comprising any existing service policy map, whether or not that service policy map has been attached to an interface.

Examples

The following is sample output from the **show policy-map** command. This sample output displays the contents of a policy map called “policy1.” In policy 1, traffic policing on the basis of a committed information rate (CIR) of 20 percent has been configured, and the bc and be have been specified in milliseconds. As part of the traffic policing configuration, optional conform, exceed, and violate actions have been specified.

```
Router# show policy-map policy1
  Policy Map policy1
    Class class1
     police cir percent 20 bc 300 ms pir percent 40 be 400 ms
```

```
conform-action transmit
exceed-action drop
violate-action drop
```

Table 3 describes the significant fields shown in the display.

Table 3 show policy-map Field Descriptions

Field	Description
Policy Map	Name of policy map displayed.
Class	Name of class configured in policy map displayed.
police	Indicates that traffic policing on the basis of specified percentage of bandwidth has been enabled. The committed burst (bc) and excess burst (be) sizes have been specified in milliseconds (ms), and optional conform, exceed, and violate actions have been specified.

Related Commands

Command	Description
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
show policy-map class	Displays the configuration for the specified class of the specified policy map.
show policy-map interface	Displays the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface.

show policy-map interface

To display the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific permanent virtual circuit (PVC) on the interface, use the **show policy-map interface** command in EXEC mode.

show policy-map interface *interface-name* [**vc** [*vpi/*] *vci*][**dlci** *dlci*] [**input** | **output**]

Syntax Description

interface-name	Name of the interface or subinterface whose policy configuration is to be displayed.
vc	(Optional) For ATM interfaces only, shows the policy configuration for a specified PVC. The name can be up to 16 characters long.
vpi/	(Optional) ATM network virtual path identifier (VPI) for this PVC. On the Cisco 7200 and 7500 series routers, this value ranges from 0 to 255. The absence of both the forward slash (*/*) and a *vpi* value defaults the *vpi* value to 0. If this value is omitted, information for all virtual circuits (VCs) on the specified ATM interface or subinterface is displayed. The *vpi* and *vci* arguments cannot both be set to 0; if one is 0, the other cannot be 0.
vci	(Optional) ATM network virtual channel identifier (VCI) for this PVC. This value ranges from 0 to 1 less than the maximum value set for this interface by the **atm vc-per-vp** command. Typically, the lower values 0 to 31 are reserved for specific traffic (F4 Operation, Administration, and Maintenance (OAM), switched virtual circuit (SVC) signaling, Integrated Local Management Interface (ILMI), and so on) and should not be used. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has local significance only. The *vpi* and *vci* arguments cannot both be set to 0; if one is 0, the other cannot be 0.
dlci	(Optional) Indicates a specific PVC for which policy configuration will be displayed.
dlci	(Optional) Specific data-link connection identifier (DLCI) number used on the interface. Policy configuration for the corresponding PVC will be displayed when a DLCI is specified.
input	(Optional) Indicates that the statistics for the attached input policy will be displayed.
output	(Optional) Indicates that the statistics for the attached output policy will be displayed.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE.
12.0(7)S	This command was integrated into Cisco IOS Release 12.0(7)S.
12.1(1)E	This command was integrated into Cisco IOS Release 12.1(1)E.
12.1(2)T	This command was modified to display information about the policy for all Frame Relay PVCs on the interface, or, if a DLCI is specified, the policy for that specific PVC. This command was also modified to display the total number of packets marked by the QoS set action.
12.1(3)T	This command was modified to display per-class accounting statistics.
12.2(4)T	This command was modified to display burst parameters and associated actions.
12.2(8)T	This command was modified to display the multiple actions configured for packets conforming to, exceeding, or violating a specific rate.
12.0(28)S	The output of this command was modified for the QoS: Percentage-Based Policing feature to include milliseconds when calculating the committed (conform) burst (bc) and excess (peak) burst (be) sizes.
12.2(27)SB	This command was integrated into Cisco IOS Release 12.2(27)SB.

Usage Guidelines

The **show policy-map interface** command displays the configuration for classes on the specified interface or the specified PVC only if a service policy has been attached to the interface or the PVC.

Examples

The following is sample output from the **show policy-map interface** command. This sample displays the statistics for the serial 2/0 interface on which traffic policing has been enabled. The committed (conform) burst (bc) and excess (peak) burst (be) are specified in milliseconds (ms).

```
Router# show policy-map interface s2/0
 Serial2/0

  Service-policy output: policy1 (1050)

    Class-map: class1 (match-all) (1051/1)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip precedence 0  (1052)
      police:
          cir 20 % bc 300 ms
          cir 409500 bps, bc 15360 bytes
          pir 40 % be 400 ms
          pir 819000 bps, be 40960 bytes
        conformed 0 packets, 0 bytes; actions:
          transmit
        exceeded 0 packets, 0 bytes; actions:
          drop
        violated 0 packets, 0 bytes; actions:
          drop
        conformed 0 bps, exceed 0 bps, violate 0 bps

    Class-map: class-default (match-any) (1054/0)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
```

```
    Match: any  (1055)
      0 packets, 0 bytes
      5 minute rate 0 bps
```

In this example, the CIR and PIR are displayed in bps, and both the committed burst (bc) and excess burst (be) are displayed in bits.

The CIR, PIR bc, and be are calculated on the basis of the formulas described below.

Formula for Calculating the CIR

When calculating the CIR, the following formula is used:

- CIR percentage specified (as shown in the output of the **show policy-map** command) * bandwidth (BW) of the interface (as shown in the output of the **show interfaces** command) = total bits per second

According to the output of the **show interfaces** command for the serial 2/0 interface, the interface has a bandwidth (BW) of 2048 kbps.

```
Router # show interfaces s2/0
Serial2/0 is administratively down, line protocol is down
  Hardware is M4T
  MTU 1500 bytes, BW 2048 Kbit, DLY 20000 usec, rely 255/255, load 1/255
```

The following values are used for calculating the CIR:

20 % * 2048 kbps = 409600 bps

Formula for Calculating the PIR

When calculating the PIR, the following formula is used:

- PIR percentage specified (as shown in the output of the **show policy-map** command) * bandwidth (BW) of the interface (as shown in the output of the **show interfaces** command) = total bits per second

According to the output of the **show interfaces** command for the serial 2/0 interface, the interface has a bandwidth (BW) of 2048 kbps.

```
Router # show interfaces s2/0
Serial2/0 is administratively down, line protocol is down
  Hardware is M4T
  MTU 1500 bytes, BW 2048 Kbit, DLY 20000 usec, rely 255/255, load 1/255
```

The following values are used for calculating the PIR:

40 % * 2048 kbps = 819200 bps

Note Discrepancies between this total and the total shown in the output of the **show policy-map interface** command can be attributed to a rounding calculation or to differences associated with the specific interface configuration.

Formula for Calculating the Committed Burst (bc)

When calculating the bc, the following formula is used:

- The bc in milliseconds (as shown in the **show policy-map** command) * the CIR in bits per seconds = total number bytes

The following values are used for calculating the bc:

300 ms * 409600 bps = 15360 bytes

Formula for Calculating the Excess Burst (be)

When calculating the bc and the be, the following formula is used:

- The be in milliseconds (as shown in the **show policy-map** command) * the PIR in bits per seconds = total number bytes

The following values are used for calculating the be:

400 ms * 819200 bps = 40960 bytes

Table 4 describes the significant fields shown in the display.

Table 4 show policy-map interface Field Descriptions[1]

Field	Description
Service-policy output	Name of the output service policy applied to the specified interface or VC.
Class-map	Class of traffic being displayed. Output is displayed for each configured class in the policy. The choice for implementing class matches (for example, match-all or match-any) can also appear next to the traffic class.
packets and bytes	Number of packets (also shown in bytes) identified as belonging to the class of traffic being displayed.
offered rate	Rate, in kbps, of packets coming in to the class.
drop rate	Rate, in kbps, at which packets are dropped from the class. The drop rate is calculated by subtracting the number of successfully transmitted packets from the offered rate.
Match	Match criteria specified for the class of traffic. Choices include criteria such as the Layer 3 packet length, IP precedence, IP differentiated services code point (DSCP) value, Multiprotocol Label Switching (MPLS) experimental value, access groups, and quality of service (QoS) groups. For more information about the variety of match criteria options that are available, refer to the "Configuring the Modular Quality of Service Command-Line Interface" chapter of the *Cisco IOS Quality of Service Solutions Configuration Guide*.
police	Indicates that traffic policing has been enabled. Display includes the CIR, PIR (in both a percentage of bandwidth and in bps) and the bc and be in bytes and milliseconds. Also displays the optional conform, exceed, and violate actions, if any, and the statistics associated with these optional actions.

1. A number in parentheses may appear next to the service-policy output name, class-map name, and match criteria information. The number is for Cisco internal use only and can be disregarded.

Related Commands

Command	Description
police (percent)	Configures traffic policing on the basis of a percentage of bandwidth available on an interfaces.
shape (percent)	Specifies average or peak rate traffic shaping on the basis of a percentage of bandwidth available on an interface.
show frame-relay pvc	Displays statistics about PVCs for Frame Relay interfaces.
show interfaces	Displays statistics for all interfaces configured on the router or access server.
show policy-map	Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.
show policy-map class	Displays the configuration for the specified class of the specified policy map.