QoS: Percentage-Based Shaping

First Published: December 4, 2006
Last Updated: June 23, 2010

The QoS: Percentage-Based Shaping feature allows you to configure traffic policing and traffic shaping on the basis of a *percentage* of bandwidth available on the interface. This feature also allows you to specify the committed (conform) burst (bc) size and the excess (peak) burst (be) size (used for configuring traffic shaping) in milliseconds (ms). Configuring traffic shaping in this manner enables you to use the same policy map for multiple interfaces with differing amounts of bandwidth.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for QoS: Percentage-Based Shaping" section on page 12.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS and Catalyst OS software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Contents

Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

Prerequisites for QoS: Percentage-Based Shaping

- For input traffic policing on a Cisco 7500 series router, verify that distributed Cisco Express Forwarding (dCEF) is enabled on the interface on which traffic policing is configured.
- For output traffic policing on a Cisco 7500 series router, ensure that the incoming traffic is dCEF-switched. Traffic policing cannot be used on the switching path unless dCEF switching is enabled.

Restrictions for QoS: Percentage-Based Shaping

The **shape** (percent) command, when used in "child" (nested) 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 nested policy maps on these routers.

Information About QoS: Percentage-Based Shaping

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

- Benefits for QoS: Percentage-Based Shaping, page 2
- Defining Class and Policy Maps for QoS: Percentage-Based Shaping, page 2
- Traffic Regulation Mechanisms and Bandwidth Percentages, page 3
- Specifying Burst Size in Milliseconds Option, page 3

Benefits for QoS: Percentage-Based Shaping

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 QoS: Percentage-Based Shaping

To configure the QoS: Percentage-Based Shaping 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 shaping and traffic policing 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 *Cisco IOS Quality of Service Solutions Command Reference*.

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 (conform) burst (bc) size and the excess (peak) burst (be) as milliseconds (ms) of the class bandwidth when you configure traffic shaping. The number of milliseconds is used to calculate the number of bytes to be used by the QoS: Percentage-Based Shaping 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 *Cisco IOS Quality of Service Solutions Command Reference.*

How to Configure QoS: Percentage-Based Shaping

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

- Configuring a Class and Policy Map, page 4 (required)
- Attaching the Policy Map to an Interface, page 5 (required)
- Verifying the Configuration, page 7 (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 shaping 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. **shape** {**average** | **peak**} **percent** *percentage* [*sustained-burst-in-msec* **ms**] [**be** *excess-burst-in-msec* **ms**] [**bc** *committed-burst-in-msec* **ms**]
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
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 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	**shape** {**average** | **peak**} **percent** *percentage* [*sustained-burst-in-msec* **ms**] [**be** *excess-burst-in-msec* **ms**] [**bc** *committed-burst-in-msec* **ms**] **Example:** `Router(config-pmap-c)# shape average percent 25 20 ms be 300 ms bc 400 ms`	Configures either average or peak rate traffic shaping on the basis of the specified bandwidth percentage and the optional burst sizes. • Enter the bandwidth percentage and optional burst sizes.
Step 6	**end** **Example:** `Router(config-pmap-c)# end`	Exits policy-map class 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. **end**

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)# interface serial4/0`	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.
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. **Note** Traffic shaping is supported on service policies attached to output interfaces or output VCs only. • Enter the policy map name.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits interface configuration mode.

Verifying the Configuration

To verify the configuration, use one or more of the **show** commands listed in the following steps.

SUMMARY STEPS

1. **enable**
2. **show class-map** [*class-map-name*]
3. **show policy-map interface** *type number*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables 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 class map name.
Step 3	**show policy-map interface** *interface-name* **Example:** `Router# show policy-map interface serial4/0`	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 type and number.
Step 4	**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, complete the following procedures:

1. Use the **show running-config** command and analyze the output of the command.
2. If the policy map does not appear in the output of the **show running-config** command, enable the **logging console** command.
3. 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:

1. Run the **show policy-map** command and analyze the output of the command.
2. Run the **show running-config** command and analyze the output of the command.
3. Use the **show policy-map interface** command and analyze the output of the command. Check the the following findings:
   a. 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.
   b. 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 QoS: Percentage-Based Shaping

This section provides the following configuration examples:

- Specifying Traffic Shaping on the Basis of a Bandwidth Percentage: Example, page 8
- Verifying the Configuration: Example, page 9

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

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)# end
```

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 serial4/0
Router(config-if)# service-policy input policy1
Router(config-if)# end
```

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 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 "policy3." In policy 3, average rate traffic shaping on the basis of an committed information rate (CIR) of 30 percent has been configured, and the bc and be have been specified in milliseconds.

```
Router# show policy-map

  Policy Map policy3
    Class class-default
      Average Rate Traffic Shaping
      cir 30% bc 10 (msec) be 10 (msec)
```

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 average rate traffic shaping has been enabled.

```
Router# show policy-map interface serial2/0

 Serial2/0

  Service-policy output: policy3 (1032)

    Class-map: class-default (match-any) (1033/0)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any  (1034)
        0 packets, 0 bytes
        5 minute rate 0 bps
      Queueing
      queue limit 64 packets
      (queue depth/total drops/no-buffer drops) 0/0/0
      (pkts queued/bytes queued) 0/0
      shape (average) cir 614400 bc 6144 be 6144
      target shape rate 614400
```

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

The CIR, 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

On the serial 2/0 interface, the bandwidth (BW) is 2048 kbps. To see the bandwidth of the interface, use the **show interfaces** command. A sample is shown below:

```
Router # show interfaces serial2/0

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
```

Therefore, the following values are used in the formula:

30% * 2048 kbps = 614400 bps

Formula for Calculating the Committed Burst (bc) and the Excess Burst (be)

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

- The bc (or be) in milliseconds (as shown in the **show policy-map** command) * the CIR in kilobytes (as shown in the **show policy-map** command) / 1000 = total number of bits

Therefore, the following values are used in the formula:

10 ms * 614400 bps = 6144 bits

Additional References

The following sections provide references related to the QoS: Percentage-Based Shaping feature.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
Modular QoS Command-Line Interface (CLI) (MQC) information about attaching policy maps to interfaces	"Applying QoS Features Using the MQC" module
Traffic shaping concepts and overview	"Policing and Shaping Overview" module
Traffic policing	"Traffic Policing" module
CEF and dCEF	"Cisco Express Forwarding Features Roadmap" module
Commands related to CEF and dCEF	*Cisco IOS IP Switching Command Reference*

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 MIBs 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
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Command Reference

The following commands are introduced or modified in the feature or features documented in this module. For information about these commands, see the *Cisco IOS Quality of Service Solutions Command Reference* at http://www.cisco.com/en/US/docs/ios/qos/command/reference/qos_book.html. For information about all Cisco IOS commands, use the Command Lookup Tool at http://tools.cisco.com/Support/CLILookup or the *Cisco IOS Master Command List, All Releases*, at http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html.

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

Feature Information for QoS: Percentage-Based Shaping

Table 1 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note Table 1 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 1 Feature Information for QoS: Percentage-Based Shaping

Feature Name	Releases	Feature Information
QoS: Percentage-Based Shaping	12.2(13)T 12.0(28)S 12.2(28)SB 12.2(31)SB2	The QoS: Percentage-Based Shaping feature allows you to configure traffic policing and traffic shaping on the basis of a *percentage* of bandwidth available on the interface. This feature also allows you to specify the committed (conform) burst (bc) size and the excess (peak) burst (be) size (used for configuring traffic shaping) in milliseconds (ms). Configuring traffic shaping in this manner enables you to use the same policy map for multiple interfaces with differing amounts of bandwidth. In Release 12.2(13)T, this feature was introduced. In Release 12.0(28)S, the option of specifying committed (conform) burst (bc) and excess (peak) burst (be) sizes in milliseconds was added. In Release 12.2(28)SB, this feature was integrated in Cisco IOS Release 12.2(28)SB. In Release 12.2(31)SB2, this feature was introduced on the PRE3 for Cisco 10000 Series Routers. The following commands were introduced or modified: **police (percent)**, **shape (percent)**, **show policy-map**, **show policy-map interface**.