

QoS Percentage-Based Shaping

The QoS: Percentage-Based Shaping feature allows you to configure 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.

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Information About QoS Percentage-Based Shaping

Benefits for QoS Percentage-Based Shaping

This feature provides the ability to configure 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 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.

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.

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 XE 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.

Burst Size Specified in Milliseconds Option

The purpose of the burst parameters (bc and be) is to specify the amount of traffic to anticipate under normal operating conditions before traffic is dropped or delayed. 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 **shape** (percent) command.

How to Configure QoS Percentage-Based Shaping

Configuring a Class and Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-name*
4. **class** {*class-name*| **class-default**}
5. **shape** {**average** | **peak**} **percent** *percentage* [**be** *excess-burst-in-msec* **ms**] [**bc** *committed-burst-in-msec* **ms**]
6. **end**

DETAILED STEPS

Procedure

	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.
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	**shape** {**average**	**peak**} **percent** *percentage* [**be** *excess-burst-in-msec* **ms**] [**bc** *committed-burst-in-msec* **ms**] **Example:**	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.

	Command or Action	Purpose
	`Router(config-pmap-c)# shape average percent 25 be 300 ms bc 400 ms`	
Step 6	**end** **Example:** `Router(config-pmap-c)# end`	Exits policy-map class configuration mode.

Attaching the Policy Map to an Interface

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

Procedure

	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 serial4/0/0`
		Configures an interface (or subinterface) type and enters interface configuration mode.
		• Enter the interface type number.
		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.

	Command or Action	Purpose
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`
	Example:
		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 QoS Percentage-Based Shaping Configuration

SUMMARY STEPS

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

DETAILED STEPS

Procedure

	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 serial4/0/0`
		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 privileged EXEC mode.

Troubleshooting Tips

The commands in the Verifying the QoS Percentage-Based Shaping Configuration, on page 5 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

Example Specifying Traffic Shaping on the Basis of a Bandwidth Percentage

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 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 serial4/0/0
Router(config-if)#

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

Example Verifying the QoS Percentage-Based Shaping Configuration

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 serial2/0/0
 Serial2/0/0
  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 serial2/0/0
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

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

Standards

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

MIBs

MIB	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 XE Software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

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

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for QoS Percentage-Based Shaping

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 1: Feature Information for QoS: Percentage-Based Shaping