

Regulating Packet Flow on a Per-Class Basis Using Class-Based Traffic Shaping

Packet flow on a network can be regulated using a traffic shaping mechanism. One such traffic shaping mechanism is a Cisco feature called Class-Based Traffic Shaping. Class-Based Traffic Shaping allows you to regulate the flow of packets (on a per-traffic-class basis) going out an interface, matching the packet flow to the speed of the interface. This module describes the concepts and tasks related to configuring Class-Based Traffic Shaping.

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Prerequisites for Configuring Class-Based Traffic Shaping

Be familiar with the concepts in the "Regulating Packet Flow Using Traffic Shaping" module.

Use Feature Navigator to determine if the platform in use supports Class-Based Traffic Shaping. Access Cisco Feature Navigator at http://www.cisco.com/go/fn .

Distributed Cisco Express Forwarding (dCEF) must be enabled if the customer is using a Versatile Interface Processor (VIP) on the router.

A policy map and a class map must be created first using the Modular Quality of Service (QoS) Command-Line Interface (MQC).

Restrictions for Configuring Class-Based Traffic Shaping

Adaptive traffic shaping for Frame Relay networks is supported for Frame Relay networks only.

Class-Based Traffic Shaping applies to outbound traffic only.

Class-Based Traffic Shaping does not support the following commands:

- **traffic-shape adaptive**
- **traffic shape fecn-adaptive**
- **traffic-shape group**
- **traffic-shape rate**

Information About Class-Based Traffic Shaping

Class-Based Traffic Shaping Functionality

Class-Based Traffic Shaping is a traffic shaping mechanism (also known as a "traffic shaper"). A traffic shaper typically delays excess traffic using a buffer, or queueing mechanism, to hold packets and shape the flow when the data rate of the source is higher than expected. It holds and shapes traffic to a particular bit rate by using the token bucket mechanism. For more information about token buckets and traffic shaping, see the "Regulating Packet Flow Using Traffic Shaping" module.

Class-Based Traffic Shaping is the Cisco-recommended traffic shaping mechanism.

Note Class-Based Traffic Shaping should be used instead of what was previously referred to as Distributed Traffic Shaping (DTS). Class-Based Traffic Shaping can and should be used on the Cisco 7500 series router with a VIP2-40, VIP2-50, or greater processor.

Using the Class-Based Traffic Shaping, you can perform the following tasks:

- Configure traffic shaping on a per-traffic-class basis. It allows you to fine-tune traffic shaping for one or more classes and it allows you to configure traffic shaping on a more granular level.
- Specify average rate or peak rate traffic shaping. Specifying peak rate shaping allows you to make better use of available bandwidth by allowing more data than the configured traffic shaping rate to be sent if the bandwidth is available.
- Configure traffic shaping in a hierarchical policy map structure. That is, traffic shaping is configured in a primary-level (parent) policy map and other QoS features (for instance, CBWFQ and traffic policing) can be configured in the secondary-level (child) policy maps. For more information, see the Hierarchical Policy Map Structure of Class-Based Traffic Shaping, on page 3.

Benefits of Class-Based Traffic Shaping

All of the benefits associated with traffic shaping also apply to Class-Based Traffic Shaping, but on a more granular level. For information about the benefits of traffic shaping, see the "Regulating Packet Flow Using Traffic Shaping" module.

Hierarchical Policy Map Structure of Class-Based Traffic Shaping

With the Class-Based Traffic Shaping mechanism, traffic shaping can be configured in a hierarchical policy map structure; that is, traffic shaping is enabled in a primary-level (parent) policy map and other QoS features used with traffic shaping, such as CBWFQ and traffic policing, can be enabled in a secondary-level (child) policy map.

Traffic shaping is enabled by using the **shape** command (and specifying a rate) in a policy map. When traffic shaping is enabled, one the following actions occur:

- Packets exceeding the specified rate are placed in a queue using an appropriate queueing mechanism.
- Packets conforming to the specified rate are transmitted.

When packets are placed in a queue, the default queueing mechanism used is weighted fair queueing (WFQ). However, with Class-Based Traffic Shaping, class-based WFQ (CBWFQ) can be configured as an alternative queueing mechanism.

CBWFQ allows you to fine-tune the way traffic is placed in a queue. For instance, you can specify that all voice traffic be placed in a high-priority queue and all traffic from a specific class be placed in a lower-priority queue.

If you want to use CBWFQ with the Class-Based Traffic Shaping mechanism, the following conditions must be met:

- A secondary-level (child) policy map *must* be created. This secondary-level (child) policy map is then used to configure CBWFQ by enabling the **bandwidth** command.
- Traffic shaping *must* be configured in the primary-level (parent) policy map.



Note CBWFQ is supported in both the primary-level (parent) policy map and the secondary-level (child) policy map. However, to use CBWFQ at the secondary-level (child) policy map, traffic shaping *must* be configured in the primary-level (parent) policy map.

The following sample configuration illustrates how the Class-Based Traffic Shaping mechanism is configured in a hierarchical policy map structure:

```
enable
configure terminal
 policy-map policy_parent        ! This is the primary-level policy map.
  class class-default
   shape average 1000000         ! This enables traffic shaping.
   service-policy policy_child   ! This associates the policy maps.
```

Traffic shaping must be configured in the primary-level (parent) policy map. With this configuration, WFQ is used as the default queueing mechanism for placing all the traffic in a queue.

In the following secondary-level (child) policy map, the alternative queueing mechanism CBWFQ is configured:

```
enable
configure terminal
 policy-map policy_child     ! This is the secondary-level policy map.
```

```
class class-default
 bandwidth percent 50      ! This enables CBWFQ.
```

In the secondary-level (child) policy map, additional QoS features used with traffic shaping (for example, CBWFQ and traffic policing) are typically configured. For Class-Based Traffic Shaping, the only two QoS features supported at the secondary-level (child) policy map are CBWFQ and traffic policing.

How to Configure Class-Based Traffic Shaping

Configuring Class-Based Traffic Shaping in a Primary-Level Policy Map

Traffic shaping is configured in a policy map. Policy maps determine the specific quality of service (QoS) feature that will be applied to traffic on a network. In this module, the QoS feature being applied is traffic shaping.

Traffic shaping is configured in the primary-level (parent) policy map in the hierarchy.

Before you begin

Before configuring traffic shaping, you must use the MQC to create a policy map and a class map.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **shape** [**average** | **peak**] *mean-rate* [*burst-size*] [*excess-burst-size*]
6. **service-policy** *policy-map-name*
7. **end**
8. **show policy-map**
9. **show policy-map interface** *type number*
10. **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	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Router# configure terminal`	
Step 3	**policy-map** *policy-map-name* **Example:** `Router(config)# policy-map policy_parent`	Specifies the name of the policy map created earlier and enters policy-map configuration mode. See Prerequisites for Configuring Class-Based Traffic Shaping, on page 1 for more information. • Enter the policy map name.
Step 4	**class** {*class-name* | **class-default**} **Example:** `Router(config-pmap)# class class-default`	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. • Enter the name of the class or enter the **class-default**keyword.
Step 5	**shape** [**average** | **peak**] *mean-rate* [*burst-size*] [*excess-burst-size*] **Example:** `Router(config-pmap-c)# shape average 1000000`	Shapes traffic according to the keyword and rate specified. • Enter the keyword and rate.
Step 6	**service-policy** *policy-map-name* **Example:** `Router(config-pmap-c)# service-policy policy_child`	Uses a service policy as a QoS policy within a policy map (called a hierarchical service policy). • Enter the policy map name.
Step 7	**end** **Example:** `Router(config-pmap-c)# end`	Returns to privileged EXEC mode.
Step 8	**show policy-map** **Example:** `Router# show policy-map`	(Optional) Displays all configured policy maps.

Step 9	**show policy-map interface** *type number*
	Example:
	`Router#`
	`show policy-map interface serial4/0`
		(Optional) 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 10	**exit** **Example:** `Router# exit`	(Optional) Exits privileged EXEC mode.

What to Do Next

To configure a secondary-level (child) policy map in the hierarchical policy map structure (an optional task), proceed with the instructions in Configuring the Secondary-Level Policy Map.

Configuring the Secondary-Level Policy Map

Note CBWFQ is supported in both the primary-level (parent) policy map and the secondary-level (child) policy map. However, to use CBWFQ in the secondary-level (child) policy map, traffic shaping *must* be configured in the primary-level (parent) policy map. For more information about CBWFQ in a secondary-level (child) policy map, see the Hierarchical Policy Map Structure of Class-Based Traffic Shaping, on page 3.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **bandwidth** {*bandwidth-kbps* | **remaining percent** *percentage* | **percent** *percentage*}
6. **end**
7. **show policy-map**
8. **show policy-map interface** *type number*
9. **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	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**policy-map** *policy-map-name* **Example:** `Router(config)# policy-map policy1`	Specifies the name of the policy map created earlier and enters policy-map configuration mode. See Prerequisites for Configuring Class-Based Traffic Shaping, on page 1 for more information. Enter the policy map name.

	Command or Action	Purpose
Step 4	**class** {*class-name* | **class-default**} **Example:** `Router(config-pmap)# class class-default`	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. • Enter the name of the class or enter the **class-default** keyword.
Step 5	**bandwidth** {*bandwidth-kbps* | **remaining percent** *percentage* | **percent** *percentage*} **Example:** `Router(config-pmap-c)# bandwidth percent 50` **Example:**	Specifies or modifies the bandwidth allocated for a class belonging to a policy map. • Enter the amount of bandwidth as a number of kbps, a relative percentage of bandwidth, or an absolute amount of bandwidth. **Note** The **bandwidth** command used here is only an example of a QoS feature than can be configured. The **bandwidth** command configures CBWFQ. You could also use the **police** command to configure traffic policing.
Step 6	**end** **Example:** `Router(config-pmap-c)# end`	Returns to privileged EXEC mode.
Step 7	**show policy-map** **Example:** `Router# show policy-map`	(Optional) Displays all configured policy maps.

Step 8	**show policy-map interface** *type number*
	Example:
	`Router#`
	`show policy-map interface serial4/0`
		(Optional) 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 9	**exit** **Example:** `Router# exit`	(Optional) Exits privileged EXEC mode.

Configuration Examples for Class-Based Traffic Shaping

Example Class-Based Traffic Shaping Configuration

The following is an example of Class-Based Traffic Shaping configured in a hierarchical policy map structure. In this example, two policy maps have been created; the primary-level (parent) policy map called

"policy_parent," and a secondary-level (child) policy map called "policy_child." Traffic shaping is configured in the policy_parent policy map, and CBWFQ has been configured in the policy_child policy map.

The **service-policy** command associates the two policy maps in the hierarchical policy map structure.

```
enable
configure terminal
 policy-map policy_parent
  class class-default
   shape average 1000000         ! This enables traffic shaping.
   service-policy policy_child   ! This associates the policy maps.
   exit
  exit
 policy-map policy_child
  class class-default
   bandwidth percent 50   ! This enables CBWFQ.
   end
```

Where to Go Next

To configure Generic Traffic Shaping (GTS), see the "Regulating Packet Flow on a Per-Interface Basis Using Generic Traffic Shaping" module.

To configure Frame Relay Traffic Shaping (FRTS), see the "MQC-Based Frame Relay Traffic Shaping" module.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
Packet classification	"Classifying Network Traffic" module
MQC, policy maps, class maps, and hierarchical policy maps	"Applying QoS Features Using the MQC" module
CBWFQ and other queueing mechanisms	"Configuring Weighted Fair Queueing" module
Overview information about using traffic shaping to regulate packet flow on a network	"Regulating Packet Flow Using Traffic Shaping" module
GTS	"Regulating Packet Flow on a Per-Interface Basis Using Generic Traffic Shaping" module
FRTS	"MQC-Based Frame Relay Traffic Shaping" module

Standards

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

MIBs

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	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

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

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 Class-Based Traffic 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 Class-Based Traffic Shaping

Feature Name	Software Releases	Feature Configuration Information
Distributed Traffic Shaping	12.2(8)T	Distributed Traffic Shaping (DTS) is a legacy method for regulating the flow of packets going out an interface. Class-Based Traffic Shaping should be used instead of (DTS).
Generic Traffic Shaping (GTS)	15.0(1)S	The GTS feature was integrated into the Cisco IOS Release 15.0(1)S release.