QoS Bandwidth Estimation

The QoS Bandwidth Estimation feature uses Corvil Bandwidth technology to allow you as a network manager to determine the bandwidth requirements to achieve user-specified quality of service (QoS) targets for networked applications.

Feature History for QoS Bandwidth Estimation

Release	Modification
12.3(14)T	This feature was introduced.

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

Prerequisites for QoS Bandwidth Estimation

- Before using this feature, configure a class map and a policy map using the modular quality of service (QoS) command-line interface (CLI) (MQC), and specify the appropriate match criteria.
- This feature requires the purchase of a Cisco IOS software feature license. The right to use this feature is not included in the base Cisco IOS software license for the software image.

Restrictions for QoS Bandwidth Estimation

This feature supports policy maps that are attached to interfaces in an output direction only.

Information About QoS Bandwidth Estimation

To use the QoS Bandwidth Estimation feature, you need to understand the following concepts:

- Feature Overview of QoS Bandwidth Estimation, page 2
- Benefits of QoS Bandwidth Estimation, page 4

Feature Overview of QoS Bandwidth Estimation

Allocating adequate bandwidth is key to assuring the network performance required for applications. However, allocating too much bandwidth can be costly. The QoS Bandwidth Estimation feature in Cisco IOS software uses Corvil Bandwidth technology to allow you as a network manager to determine the bandwidth requirements to achieve user-specified quality of service (QoS) targets for networked applications.

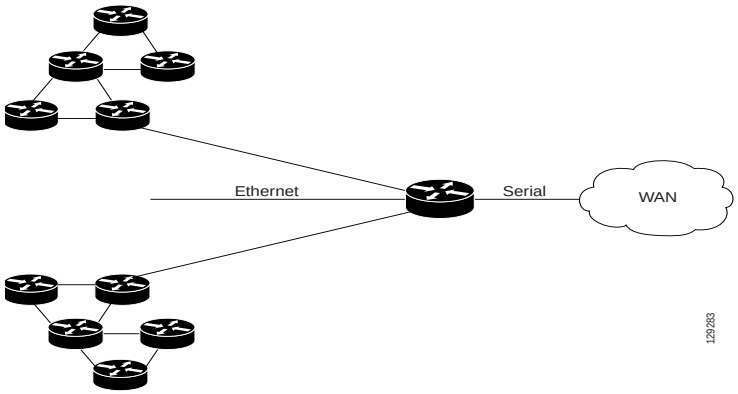
Corvil Bandwidth can determine the minimum bandwidth required to deliver traffic within customer-specified QoS targets with statistical reliability. From a network management perspective, an application's QoS requirements are characterized with respect to its sensitivity to packet loss and delay. Corvil Bandwidth provides a way to specify limits for delay and packet loss, and get a tight estimate of the minimum bandwidth essential to achieve desired application performance.

Corvil Bandwidth achieves its results by taking very short timescale (8- millisecond) snapshots of traffic and summarizing them in traffic descriptors that place very low overhead on the router because each descriptor has fewer than 300 bytes. These traffic descriptors record the exceptional events (bursts) and are input to the Corvil Bandwidth algorithm to calculate the minimum bandwidth required to deliver the user-specified QoS target for the observed traffic. (The QoS target is specified in terms of sensitivity to traffic delay and packet loss. For example, voice over IP (VoIP) traffic is very sensitive to both, whereas e-mail file transfer is sensitive to neither.)

As a result, turning on Corvil Bandwidth in the router allows you to obtain bandwidth values that can be used directly to configure the existing Cisco IOS QoS mechanisms on the router to achieve the required application performance as efficiently as possible.

For example, in Figure 1, Corvil Bandwidth is enabled on the router so that the serial interface can deliver the WAN traffic within the customer-specified QoS targets with statistical reliability.

Figure 1 Sample Topology Using QoS Bandwidth Estimation



Applying Corvil Bandwidth

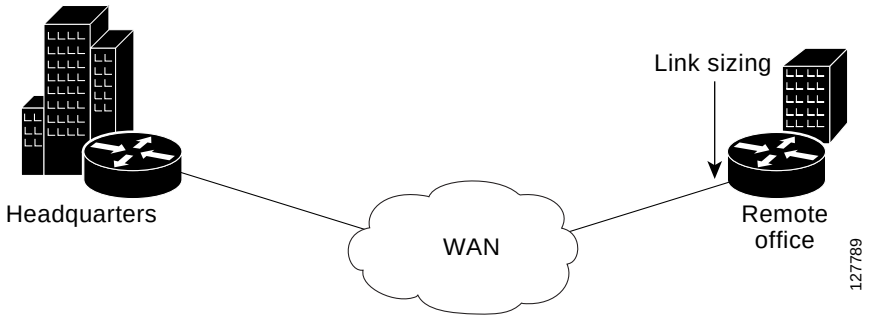
The following sections describe how Corvil Bandwidth can be implemented:

- Link Sizing, page 3
- Bandwidth Allocations by Traffic Class, page 3

Link Sizing

To use Corvil Bandwidth to establish the overall bandwidth requirement for a link, you start with QoS targets appropriate for the speed of the link and for the applications being carried on the link (Figure 2). The QoS targets are achieved as long as the link capacity is greater than or equal to the computed Corvil Bandwidth value.

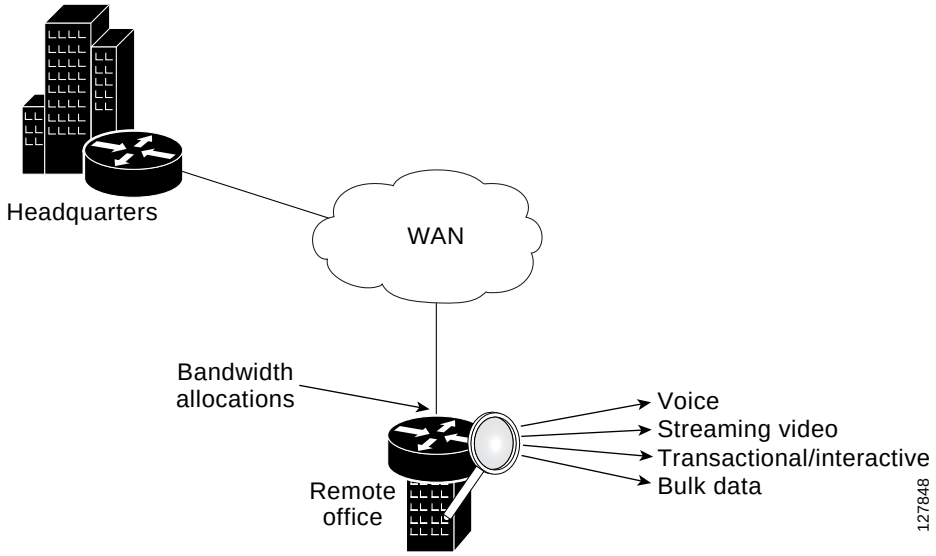
Figure 2 Link Sizing



Bandwidth Allocations by Traffic Class

Corvil Bandwidth can be used to size bandwidth allocations for individual traffic classes defined via the MQC (Figure 3). You specify the QoS target for a traffic class, and Corvil Bandwidth reports the minimum amount of bandwidth that must be allocated to meet that target. The Corvil Bandwidth value can be used directly in the corresponding MQC policy. (The bandwidth allocation is not changed automatically.)

Figure 3 Bandwidth Allocations



Benefits of QoS Bandwidth Estimation

Table 1 shows the features and benefits of QoS Bandwidth Estimation using Corvil Bandwidth technology.

Table 1 QoS Bandwidth Estimation

Feature	Benefits
User-specified packet loss and delay targets	• Establishment of service-level objectives for the desired performance of networked applications • Elimination of operational overhead and guesswork in bandwidth provisioning and QoS configuration • Potentially significant bandwidth cost savings while meeting QoS requirements • Increased capability and flexibility to offer bandwidth-on-demand types of services
Frequent fine-grain traffic measurements	• More accurate calculation of bandwidth requirements • Greater ability to meet more stringent QoS targets
Support for multiple traffic classes on an interface	• Individually specified QoS targets for each traffic class (class map) to calculate Corvil Bandwidth values
Corvil Bandwidth integrated with MQC	• Results available by traffic class • Bandwidth adjustment enabled in the corresponding MQC-based policy
Corvil Bandwidth results reported in kbps	• Results directly applied via Cisco IOS MQC **bandwidth** command and to link-rate sizing

Table 1 QoS Bandwidth Estimation (continued)

Feature	Benefits
Corvil Bandwidth results available in class-based QoS MIB	• Integrated with Simple Network Management Protocol (SNMP)-based performance management tools
Low resource consumption on router	• Efficient to use, adding little additional processing or memory requirements
Available on any router interface	• Applicable to serial, T1/E1, FastEthernet, and other interfaces as well as ATM virtual circuits (VCs), Frame Relay permanent virtual circuits (PVCs), multilink bundle interfaces, and virtual LAN (VLAN) subinterfaces

How to Configure QoS Bandwidth Estimation

This section contains the following procedures:

- Generating a Bandwidth Estimate, page 6 (required)
- Attaching the Policy Map to an Interface, page 8 (required)
- Verifying the Configuration, page 9 (optional)

Generating a Bandwidth Estimate

Perform the following task to generate a bandwidth estimate.

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. **estimate bandwidth drop-one-in** *n* **delay-one-in** *n* **milliseconds** *n*
7. **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.

Step 3	`policy-map` *policy-map-name* **Example:** `Router(config)# policy-map my-policy`	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 my-class`	Specifies the class so that you can configure or modify its policy. Enters policy-map class configuration mode. • Enter the class name or use the **class-default** keyword.

	Command or Action	Purpose
Step 5	**bandwidth** [*bandwidth-kbps* | **remaining percent** *percentage* | **percent** *percentage*] **Example:** `Router(config-pmap-c)# bandwidth percent 20`	Specifies or modifies the bandwidth allocated for a class belonging to a policy map. • Enter the bandwidth to be set or modified.
Step 6	**estimate bandwidth** [**drop-one-in** *n*] [**delay-one-in** *n* **milliseconds** *n*] **Example:** `Router(config-pmap-c)# estimate bandwidth drop-one-in 100 delay-one-in 100 milliseconds 50`	(Optional) Estimates the bandwidth needed per traffic class for given quality of service (QoS) targets based on traffic data. • Enter values for the packet loss target, the delay target, and the delay threshold.
Step 7	**end** **Example:** `Router(config-pmap-c)# end`	(Optional) Exits policy-map class configuration mode.

Attaching the Policy Map to an Interface

Perform the following task to attach the policy map to an interface.

Restrictions

This feature supports policy maps attached to an interface in the output direction only.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [*name-tag*]
4. **service-policy** {**input** | **output**} *policy-map-name*
5. **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.
Step 3	**interface** *type number* [*name-tag*] **Example:** `Router(config)# interface f0/1`	Configures the interface type specified and enters interface configuration mode. • Enter interface type.
Step 4	**service-policy** {**input** | **output**} *policy-map-name* **Example:** `Router(config-if)# service-policy output my-policy`	Specifies the name of the policy map to be attached to the input direction of the interface. **Note** You can configure policy maps on ingress or egress routers and attach them 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 to your network configuration. For this feature, only the output direction is supported. • Enter the **output** keyword followed by the policy map name.
Step 5	**end** **Example:** `Router(config-if)# end`	(Optional) Exits interface configuration mode.

Verifying the Configuration

Perform the following task to verify that bandwidth estimates have been generated.

SUMMARY STEPS

1. **enable**
2. **show policy-map interface** *interface-name* [**vc** [*vpi/*] *vci*][**dlci** *dlci*] [**input** | **output**]
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show policy-map interface** *interface-name* [**vc** [*vpi/*] *vci*] [**dlci** *dlci*] [**input** | **output**] **Example:** `Router# show policy-map interface f0/1`	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	**end** **Example:** `Router# end`	(Optional) Exits privileged EXEC mode.

Configuration Examples for QoS Bandwidth Estimation

This section contains the following configuration examples:

- Generating Bandwidth Estimates for QoS Targets: Example, page 10
- Attaching the Policy Map to an Interface: Example, page 10
- Verifying the Configuration: Example, page 10

Generating Bandwidth Estimates for QoS Targets: Example

In the following example, a policy map and a traffic class are configured. Then bandwidth estimates for QoS targets including packet loss rate, delay time and probability, and timeframe in milliseconds are configured.

```
Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.

Router(config)# policy-map my-policy
Router(config-pmap)# class my-class
Router(config-pmap-c)# bandwidth percent 20
Router(config-pmap-c)# estimate bandwidth drop-one-in 100 delay-one-in 100 milliseconds 50
Router(config-pmap-c)# end
```

Attaching the Policy Map to an Interface: Example

The following example shows the policy map named my-policy being attached to the FastEthernet 0/1 interface in the output direction:

```
Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.

Router(config)# interface f0/1
Router(config-if)# service-policy output my-policy
Router(config-if)# end
```

Verifying the Configuration: Example

The following example from the **show policy-map interface** command verifies that the policy map named my-policy is attached to the FastEthernet 0/1 interface in the output direction and bandwidth estimates have been created:

```
Router# show policy-map interface f0/1
 FastEthernet0/1

  Service-policy output: my-policy

    Class-map: icmp (match-all)
      199 packets, 22686 bytes
      30 second offered rate 0 bps, drop rate 0 bps
      Match: access-group 101
      Bandwidth Estimation:
        Quality-of-Service targets:
          drop no more than one packet in 1000 (Packet loss < 0.10%)
```

```
      delay no more than one packet in 100 by 40 (or more) milliseconds
        (Confidence: 99.0000%)
    Corvil Bandwidth: 1 kbits/sec

Class-map: class-default (match-any)
  112 packets, 14227 bytes
  30 second offered rate 0 bps, drop rate 0 bps
  Match: any
  Bandwidth Estimation:
    Quality-of-Service targets:
      <none specified, falling back to drop no more than one packet in 500
    Corvil Bandwidth: 1 kbits/sec
```

Additional References

The following sections provide references related to the QoS Bandwidth Estimation 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*, Release 12.3 T
MQC	*Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.3

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
• CISCO-CLASS-BASED-QOS-MIB • CISCO-CLASS-BASED-QOS-CAPABILITY-MIB	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
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of 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/techsupport

Command Reference

This section documents new and modified commands.

New Commands

- **estimate bandwidth**

Modified Commands

- **show policy-map interface**

estimate bandwidth

To estimate the bandwidth needed per traffic class for given quality of service (QoS) targets based on traffic data, use the **estimate bandwidth** command in policy-map class configuration mode. To disable the estimated bandwidth processing, use the **no** form of this command.

estimate bandwidth [**drop-one-in** *n*] [**delay-one-in** *n* **milliseconds** *n*]

no estimate bandwidth

Syntax Description

drop-one-in *n*	(Optional) The packet loss rate; for example, a value of 999 means drop no more than one packet out of 999. The range for *n* is 50 to1000000 packets.
delay-one-in *n* **milliseconds** *n*	(Optional) The packet delay time and probability; the range for *n* is 50 to 1000000 packets. The delay threshold; the range for *n* is 8 to 1000 milliseconds.

Defaults

Disabled

Command Modes

Policy-map class configuration

Command History

Release	Modification
12.3(14)T	This command was introduced.

Usage Guidelines

Use the **estimate bandwidth** command to specify the target drop probability, the delay time and probability, and the timeframe.

If you specify a delay time, you must also specify a delay threshold.

If you issue the **estimate bandwidth** command with no keywords, the default target is drop < 2%, which is the same as entering **estimate bandwidth drop-one-in 500**.

Examples

In the following example, the QoS targets are drop no more than one packet in 100, and delay no more than one packet in 100 by more than 50 milliseconds:

```
Router(config-pmap-c)# estimate bandwidth drop-one-in 100 delay-one-in 100 milliseconds 50
```

Related Commands

Command	Description
bandwidth (policy-map class)	Specifies or modifies the bandwidth allocated for a class belonging to a policy map.

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 privileged 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 *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 that a specific PVC for which policy configuration will be displayed.
dlci	(Optional) A 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

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.

Command Modes

Privileged 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 quality of service (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 for two-rate traffic policing. It now can display burst parameters and associated actions.
12.2(8)T	The command was modified for the Policer Enhancement — Multiple Actions feature and the WRED — Explicit Congestion Notification (ECN) feature.
12.2(13)T	The following modifications were made: • This command was modified for the Percentage-Based Policing and Shaping feature. • This command was modified for the Class-Based RTP and TCP Header Compression feature. • This command was modified as part of the Modular QoS CLI (MQC) Unconditional Packet Discard feature. Traffic classes in policy maps can now be configured to discard packets belonging to a specified class. • This command was modified to display the Frame Relay DLCI number as a criterion for matching traffic inside a class map. • This command was modified to display Layer 3 packet length as a criterion for matching traffic inside a class map. • This command was modified for the Enhanced Packet Marking feature. A mapping table (table map) can now be used to convert and propagate packet-marking values.
12.2(15)T	This command was modified to display Frame Relay voice-adaptive traffic-shaping information.
12.0(28)S	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.
12.3(14)T	This command was modified to display bandwidth estimation parameters.

Usage Guidelines

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

You can use the *interface-name* argument to display output for a PVC only for enhanced ATM port adapters (PA-A3) that support per-VC queueing.

The counters displayed after the **show policy-map interface** command is entered are updated only if congestion is present on the interface.

The **show policy-map interface** command displays policy information about Frame Relay PVCs only if Frame Relay Traffic Shaping (FRTS) is enabled on the interface.

The **show policy-map interface** command displays ECN marking information only if ECN is enabled on the interface.

Examples

This section provides sample output from a typical **show policy-map interface** command. Depending upon the interface in use and the options enabled, the output you see may vary slightly from the ones shown below. See Table 2 for an explanation of the significant fields that commonly appear in the command output.

The following sample output from the **show policy-map interface** command displays the statistics for the serial 3/1 interface, to which a service policy called “mypolicy” (configured as shown below) is attached.

```
policy-map mypolicy
  class voice
    priority 128
  class gold
   bandwidth 100
  class silver
   bandwidth 80
   random-detect

Router# show policy-map output interface serial3/1

 Serial3/1

  Service-policy output: mypolicy

    Class-map: voice (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip precedence 5
      Weighted Fair Queueing
        Strict Priority
        Output Queue: Conversation 264
        Bandwidth 128 (kbps) Burst 3200 (Bytes)
        (pkts matched/bytes matched) 0/0
        (total drops/bytes drops) 0/0

    Class-map: gold (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip precedence 2
      Weighted Fair Queueing
        Output Queue: Conversation 265
        Bandwidth 100 (kbps) Max Threshold 64 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: silver (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip precedence 1
      Weighted Fair Queueing
        Output Queue: Conversation 266
        Bandwidth 80 (kbps)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0
         exponential weight: 9
```

```
         mean queue depth: 0

class     Transmitted       Random drop      Tail drop    Minimum Maximum  Mark
          pkts/bytes        pkts/bytes       pkts/bytes    thresh  thresh  prob
0             0/0               0/0              0/0          20      40  1/10
1             0/0               0/0              0/0          22      40  1/10
2             0/0               0/0              0/0          24      40  1/10
3             0/0               0/0              0/0          26      40  1/10
4             0/0               0/0              0/0          28      40  1/10
5             0/0               0/0              0/0          30      40  1/10
6             0/0               0/0              0/0          32      40  1/10
7             0/0               0/0              0/0          34      40  1/10
rsvp          0/0               0/0              0/0          36      40  1/10

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

The following sample output from the **show policy-map interface** command displays the statistics for the serial 3/2 interface, to which a service policy called p1 (configured as shown below) is attached. Traffic shaping has been enabled on this interface.

```
policy-map p1
  class c1
   shape average 320000

Router# show policy-map output interface serial3/2

 Serial3/2

  Service-policy output: p1

    Class-map: c1 (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip precedence 0
      Traffic Shaping
        Target    Byte   Sustain   Excess    Interval  Increment Adapt
        Rate      Limit  bits/int  bits/int  (ms)      (bytes)   Active
        320000    2000   8000      8000      25        1000      -

        Queue     Packets   Bytes     Packets   Bytes     Shaping
        Depth                         Delayed   Delayed   Active
        0         0         0         0         0         no

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

Table 2 describes the significant fields shown in the displays. The fields in the table are grouped according to the relevant QoS feature.

Table 2 show policy-map interface Field Descriptions [1]

Field	Description
Fields Associated with Classes or Service Policies	
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. **Note** If the packets are compressed over an outgoing interface, the improved packet rate achieved by packet compression is not reflected in the offered rate. Also, if the packets are classified *before* they enter a combination of tunnels (for example, a generic routing encapsulation (GRE) tunnel and an IP Security (IPSec) tunnel), the offered rate does not include all the extra overhead associated with tunnel encapsulation in general. Depending on the configuration, the offered rate may include no overhead, may include the overhead for only *one* tunnel encapsulation, or may include the overhead for *all* tunnel encapsulations. In most of the GRE and IPSec tunnel configurations, the offered rate includes the overhead for GRE tunnel encapsulation only.
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 IP precedence, IP differentiated services code point (DSCP) value, Multiprotocol Label Switching (MPLS) experimental (EXP) value, access groups, and QoS groups. For more information about the variety of match criteria options available, refer to the chapter "Configuring the Modular Quality of Service Command-Line Interface" in the *Cisco IOS Quality of Service Solutions Configuration Guide*.
Fields Associated with Queueing (if Enabled)	
Output Queue	The weighted fair queueing (WFQ) conversation to which this class of traffic is allocated.
Bandwidth	Bandwidth, in either kbps or percentage, configured for this class and the burst size.
pkts matched/bytes matched	Number of packets (also shown in bytes) matching this class that were placed in the queue. This number reflects the total number of matching packets queued at any time. Packets matching this class are queued only when congestion exists. If packets match the class but are never queued because the network was not congested, those packets are not included in this total. However, if process switching is in use, the number of packets is always incremented even if the network is not congested.
depth/total drops/no-buffer drops	Number of packets discarded for this class. No-buffer indicates that no memory buffer exists to service the packet.

Table 2 show policy-map interface Field Descriptions [1] (continued)

Field	Description
Fields Associated with Weighted Random Early Detection (WRED) (if Enabled)	
exponential weight	Exponent used in the average queue size calculation for a WRED parameter group.
mean queue depth	Average queue depth based on the actual queue depth on the interface and the exponential weighting constant. It is a fluctuating average. The minimum and maximum thresholds are compared against this value to determine drop decisions.
class	IP precedence level.
Transmitted pkts/bytes	Number of packets (also shown in bytes) passed through WRED and not dropped by WRED. **Note** If there is insufficient memory in the buffer to accommodate the packet, the packet can be dropped *after* the packet passes through WRED. Packets dropped because of insufficient memory in the buffer (sometimes referred to as "no-buffer drops") are not taken into account by the WRED packet counter.
Random drop pkts/bytes	Number of packets (also shown in bytes) randomly dropped when the mean queue depth is between the minimum threshold value and the maximum threshold value for the specified IP precedence level.
Tail drop pkts/bytes	Number of packets dropped when the mean queue depth is greater than the maximum threshold value for the specified IP precedence level.
Minimum thresh	Minimum threshold. Minimum WRED threshold in number of packets.
Maximum thresh	Maximum threshold. Maximum WRED threshold in number of packets.
Mark prob	Mark probability. Fraction of packets dropped when the average queue depth is at the maximum threshold.
Fields Associated with Traffic Shaping (if Enabled)	
Target Rate	Rate used for shaping traffic.
Byte Limit	Maximum number of bytes that can be transmitted per interval. Calculated as follows: ((Bc+Be) /8) x 1
Sustain bits/int	Committed burst (Bc) rate.
Excess bits/int	Excess burst (Be) rate.
Interval (ms)	Time interval value in milliseconds (ms).
Increment (bytes)	Number of credits (in bytes) received in the token bucket of the traffic shaper during each time interval.

Table 2 show policy-map interface Field Descriptions [1] (continued)

Field	Description
Queue Depth	Current queue depth of the traffic shaper.
Packets	Total number of packets that have entered the traffic shaper system.
Bytes	Total number of bytes that have entered the traffic shaper system.
Packets Delayed	Total number of packets delayed in the queue of the traffic shaper before being transmitted.
Bytes Delayed	Total number of bytes delayed in the queue of the traffic shaper before being transmitted.
Shaping Active	Indicates whether the traffic shaper is active. For example, if a traffic shaper is active, and the traffic being sent exceeds the traffic shaping rate, a “yes” appears in this field.

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.

Frame Relay Voice-Adaptive Traffic-Shaping show policy interface Command Example

The following sample output shows that Frame Relay voice-adaptive traffic shaping is currently active and has 29 seconds left on the deactivation timer. With traffic shaping active and the deactivation time set, this means that the current sending rate on DLCI 201 is minCIR, but if no voice packets are detected for 29 seconds, the sending rate will increase to CIR.

```
Router# show policy interface Serial3/1.1

 Serial3/1.1:DLCI 201 -

  Service-policy output:MQC-SHAPE-LLQ1

    Class-map:class-default (match-any)
      1434 packets, 148751 bytes
      30 second offered rate 14000 bps, drop rate 0 bps
      Match:any
      Traffic Shaping
           Target/Average   Byte   Sustain   Excess    Interval  Increment
             Rate           Limit  bits/int  bits/int  (ms)      (bytes)
            63000/63000     1890   7560      7560      120       945

        Adapt  Queue     Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                         Delayed   Delayed   Active
        BECN   0         1434      162991    26        2704      yes
        Voice Adaptive Shaping active, time left 29 secs
```

Table 3 describes the significant fields shown in the display. Significant fields that are not described in Table 3 are described in Table 2, “show policy-map interface Field Descriptions.”

Table 3 show policy-map interface Field Descriptions—Configured for Frame Relay Voice-Adaptive Traffic Shaping

Field	Description
Voice Adaptive Shaping active/inactive	Indicates whether Frame Relay voice-adaptive traffic shaping is active or inactive.
time left	Number of seconds left on the Frame Relay voice-adaptive traffic shaping deactivation timer.

Two-Rate Traffic Policing show policy-map interface Command Example

The following is sample output from the **show policy-map interface** command when two-rate traffic policing has been configured. In the example below, 1.25 Mbps of traffic is sent (“offered”) to a policer class.

```
Router# show policy-map interface serial3/0

 Serial3/0

  Service-policy output: policy1

   Class-map: police (match all)
    148803 packets, 36605538 bytes
    30 second offered rate 1249000 bps, drop rate 249000 bps
    Match: access-group 101
    police:
     cir 500000 bps, conform-burst 10000, pir 1000000, peak-burst 100000
     conformed 59538 packets, 14646348 bytes; action: transmit
     exceeded 59538 packets, 14646348 bytes; action: set-prec-transmit 2
     violated 29731 packets, 7313826 bytes; action: drop
     conformed 499000 bps, exceed 500000 bps violate 249000 bps
   Class-map: class-default (match-any)
    19 packets, 1990 bytes
    30 seconds offered rate 0 bps, drop rate 0 bps
    Match: any
```

The two-rate traffic policer marks 500 kbps of traffic as conforming, 500 kbps of traffic as exceeding, and 250 kbps of traffic as violating the specified rate. Packets marked as conforming will be sent as is, and packets marked as exceeding will be marked with IP Precedence 2 and then sent. Packets marked as violating the specified rate are dropped.

Table 4 describes the significant fields shown in the display.

Table 4 show policy-map interface Field Descriptions—Configured for Two-Rate Traffic Policing

Field	Description
police	Indicates that the **police** command has been configured to enable traffic policing. Also, displays the specified CIR, conform burst size, peak information rate (PIR), and peak burst size used for marking packets.
conformed	Displays the action to be taken on packets conforming to a specified rate. Displays the number of packets and bytes on which the action was taken.
exceeded	Displays the action to be taken on packets exceeding a specified rate. Displays the number of packets and bytes on which the action was taken.
violated	Displays the action to be taken on packets violating a specified rate. Displays the number of packets and bytes on which the action was taken.

Multiple Traffic Policing Actions show policy-map interface Command Example

The following is sample output from the **show policy-map** command when the Policer Enhancement — Multiple Actions feature has been configured. The sample output from the **show policy-map interface** command displays the statistics for the serial 3/2 interface, to which a service policy called “police” (configured as shown below) is attached.

```
policy-map police
  class class-default
   police cir 1000000 pir 2000000
     conform-action transmit
     exceed-action set-prec-transmit 4
     exceed-action set-frde-transmit
     violate-action set-prec-transmit 2
     violate-action set-frde-transmit

Router# show policy-map interface serial3/2

Serial3/2: DLCI 100 -

Service-policy output: police

    Class-map: class-default (match-any)
      172984 packets, 42553700 bytes
      5 minute offered rate 960000 bps, drop rate 277000 bps
      Match: any
     police:
         cir 1000000 bps, bc 31250 bytes, pir 2000000 bps, be 31250 bytes
       conformed 59679 packets, 14680670 bytes; actions:
         transmit
exceeded 59549 packets, 14649054 bytes; actions:
         set-prec-transmit 4
         set-frde-transmit
       violated 53758 packets, 13224468 bytes; actions:
         set-prec-transmit 2
         set-frde-transmit
       conformed 340000 bps, exceed 341000 bps, violate 314000 bps
```

The sample output from **show policy-map interface** command shows the following:

- 59679 packets were marked as conforming packets (that is, packets conforming to the CIR) and were transmitted unaltered.
- 59549 packets were marked as exceeding packets (that is, packets exceeding the CIR but not exceeding the PIR). Therefore, the IP Precedence value of these packets was changed to an IP Precedence level of 4, the discard eligibility (DE) bit was set to 1, and the packets were transmitted with these changes.
- 53758 packets were marked as violating packets (that is, exceeding the PIR). Therefore, the IP Precedence value of these packets was changed to an IP Precedence level of 2, the DE bit was set to 1, and the packets were transmitted with these changes.

Note Actions are specified by using the *action* argument of the **police** command. For more information about the available actions, see the **police** command reference page.

Table 5 describes the significant fields shown in the display.

Table 5 show policy-map interface Field Descriptions—Configured for Multiple Traffic Policing Actions

Field	Description
police	Indicates that the **police** command has been configured to enable traffic policing. Also, displays the specified CIR, conform burst size (BC), PIR, and peak burst size (BE) used for marking packets.
conformed, packets, bytes, actions	Displays the number of packets (also shown in bytes) marked as conforming to a specified rate and the actions taken on the packet. If there are multiple actions, each action is listed separately.
exceeded, packets, bytes, actions	Displays the number of packets (also shown in bytes) marked as exceeding a specified rate and the actions taken on the packet. If there are multiple actions, each action is listed separately.
violated, packets, bytes, actions	Displays the number of packets (also shown in bytes) marked as violating a specified rate and the actions taken on the packet. If there are multiple actions, each action is listed separately.

Explicit Congestion Notification show policy-map interface Command Example

The following is sample output from the **show policy-map interface** command when the WRED — Explicit Congestion Notification (ECN) feature has been configured. The words “explicit congestion notification” included in the output indicate that ECN has been enabled.

```
Router# show policy-map interface Serial4/1

 Serial4/1

  Service-policy output:policy_ecn
        Class-map:prec1 (match-all)
          1000 packets, 125000 bytes
          30 second offered rate 14000 bps, drop rate 5000 bps
          Match:ip precedence 1
          Weighted Fair Queueing
            Output Queue:Conversation 42
            Bandwidth 20 (%)
            Bandwidth 100 (kbps)
            (pkts matched/bytes matched) 989/123625
```

```
   (depth/total drops/no-buffer drops) 0/455/0
        exponential weight:9
        explicit congestion notification
        mean queue depth:0

class   Transmitted  Random drop  Tail drop   Minimum     Maximum     Mark
        pkts/bytes   pkts/bytes    pkts/bytes threshold   threshold   probability
  0       0/0          0/0          0/0          20          40         1/10
  1     545/68125      0/0          0/0          22          40         1/10
  2       0/0          0/0          0/0          24          40         1/10
  3       0/0          0/0          0/0          26          40         1/10
  4       0/0          0/0          0/0          28          40         1/10
  5       0/0          0/0          0/0          30          40         1/10
  6       0/0          0/0          0/0          32          40         1/10
  7       0/0          0/0          0/0          34          40         1/10
rsvp      0/0          0/0          0/0          36          40         1/10
class   ECN Mark
        pkts/bytes
  0      0/0
  1     43/5375
  2      0/0
  3      0/0
  4      0/0
  5      0/0
  6      0/0
  7      0/0
rsvp     0/0
```

Table 6 describes the significant fields shown in the display.

Table 6 show policy-map interface Field Descriptions—Configured for ECN

Field	Description
explicit congestion notification	Indication that Explicit Congestion Notification is enabled.
mean queue depth	Average queue depth based on the actual queue depth on the interface and the exponential weighting constant. It is a moving average. The minimum and maximum thresholds are compared against this value to determine drop decisions.
class	IP precedence value.
Transmitted pkts/bytes	Number of packets (also shown in bytes) passed through WRED and not dropped by WRED. **Note** If there is insufficient memory in the buffer to accommodate the packet, the packet can be dropped *after* the packet passes through WRED. Packets dropped because of insufficient memory in the buffer (sometimes referred to as “no-buffer drops”) are not taken into account by the WRED packet counter.
Random drop pkts/bytes	Number of packets (also shown in bytes) randomly dropped when the mean queue depth is between the minimum threshold value and the maximum threshold value for the specified IP precedence value.
Tail drop pkts/bytes	Number of packets dropped when the mean queue depth is greater than the maximum threshold value for the specified IP precedence value.
Minimum threshold	Minimum WRED threshold in number of packets.

Table 6 show policy-map interface Field Descriptions—Configured for ECN (continued)

Field	Description
Maximum threshold	Maximum WRED threshold in number of packets.
Mark probability	Fraction of packets dropped when the average queue depth is at the maximum threshold.
ECN Mark pkts/bytes	Number of packets (also shown in bytes) marked by ECN.

Class-Based RTP and TCP Header Compression show policy-map interface Command Example

The following sample output from the **show policy-map interface** command shows the RTP header compression has been configured for a class called “prec2” in the policy map called “p1”.

The **show policy-map interface** command output displays the type of header compression configured (RTP), the interface to which the policy map called “p1” is attached (Serial 4/1), the total number of packets, the number of packets compressed, the number of packets saved, the number of packets sent, and the rate at which the packets were compressed (in bits per second (bps)).

In this example, User Datagram Protocol (UDP)/RTP header compressions have been configured, and the compression statistics are included at the end of the display.

```
Router# show policy-map interface Serial4/1

Serial4/1

Service-policy output:p1

    Class-map:class-default (match-any)
      1005 packets, 64320 bytes
      30 second offered rate 16000 bps, drop rate 0 bps
      Match:any
compress:
          header ip rtp
          UDP/RTP Compression:
          Sent:1000 total, 999 compressed,
                41957 bytes saved, 17983 bytes sent
                3.33 efficiency improvement factor
                99% hit ratio, five minute miss rate 0 misses/sec, 0 max
                 rate 5000 bps
```

Table 7 describes the significant fields shown in the display.

Table 7 show policy-map interface Field Descriptions—Configured for Class-Based RTP and TCP Header Compression[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, bytes	Number of packets (also shown in bytes) identified as belonging to the class of traffic being displayed.

Table 7 show policy-map interface Field Descriptions—Configured for Class-Based RTP and TCP Header Compression[1] (continued)

Field	Description
offered rate	Rate, in kbps, of packets coming in to the class. **Note** If the packets are compressed over an outgoing interface, the improved packet rate achieved by packet compression is not reflected in the offered rate. Also, if the packets are classified *before* they enter a combination of tunnels (for example, a generic routing encapsulation (GRE) tunnel and an IP Security (IPSec) tunnel), the offered rate does not include all the extra overhead associated with tunnel encapsulation in general. Depending on the configuration, the offered rate may include no overhead, may include the overhead for only *one* tunnel encapsulation, or may include the overhead for *all* tunnel encapsulations. In most of the GRE and IPSec tunnel configurations, the offered rate includes the overhead for GRE tunnel encapsulation only.
UDP/RTP Compression	Indicates that RTP header compression has been configured for the class.
Sent total	Count of every packet sent, both compressed packets and full-header packets.
Sent compressed	Count of number of compressed packets sent.
bytes saved	Total number of bytes saved (that is, bytes not needing to be sent).
bytes sent	Total number of bytes sent for both compressed and full-header packets.
efficiency improvement factor	The percentage of increased bandwidth efficiency as a result of header compression. For example, with RTP streams, the efficiency improvement factor can be as much as 2.9 (or 290 percent).
hit ratio	Used mainly for troubleshooting purposes, this is the percentage of packets found in the context database. In most instances, this percentage should be high.
five minute miss rate	The number of new traffic flows found in the last five minutes.
misses/sec max	The average number of new traffic flows found per second, and the highest rate of new traffic flows to date.
rate	The actual traffic rate (in bits per second) after the packets are compressed.

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

Modular QoS CLI (MQC) Unconditional Packet Discard show policy-map interface Command Example

The following sample output from the **show policy-map interface** command displays the statistics for the Serial2/0 interface, to which a policy map called "policy1" is attached. The discarding action has been specified for all the packets belonging to a class called "c1." In this example, 32000 bps of traffic is sent ("offered") to the class and all of them are dropped. Therefore, the drop rate shows 32000 bps.

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

 Serial2/0

  Service-policy output: policy1

    Class-map: c1 (match-all)
       10184 packets, 1056436 bytes
       5 minute offered rate 32000 bps, drop rate 32000 bps
       Match: ip precedence 0
       drop
```

Table 8 describes the significant fields shown in the display.

Table 8 show policy-map interface Field Descriptions—Configured for MQC Unconditional Packet Discard[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, 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. **Note** If the packets are compressed over an outgoing interface, the improved packet rate achieved by packet compression is not reflected in the offered rate. Also, if the packets are classified *before* they enter a combination of tunnels (for example, a generic routing encapsulation (GRE) tunnel and an IP Security (IPSec) tunnel), the offered rate does not include all the extra overhead associated with tunnel encapsulation in general. Depending on the configuration, the offered rate may include no overhead, may include the overhead for only *one* tunnel encapsulation, or may include the overhead for *all* tunnel encapsulations. In most of the GRE and IPSec tunnel configurations, the offered rate includes the overhead for GRE tunnel encapsulation only.

Table 8 show policy-map interface Field Descriptions—Configured for MQC Unconditional Packet Discard[1] (continued)

Field	Description
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 DSCP value, MPLS experimental value, access groups, and QoS groups. For more information about the variety of match criteria options available, refer to the chapter "Configuring the Modular Quality of Service Command-Line Interface" in the *Cisco IOS Quality of Service Solutions Configuration Guide*.
drop	Indicates that the packet discarding action for all the packets belonging to the specified class has been configured.

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

Percentage-Based Policing and Shaping show policy-map interface Command Example

The following sample output from the **show policy-map interface** command shows traffic policing configured using a CIR based on a bandwidth of 20 percent. The CIR and committed burst (Bc) in milliseconds (ms) are included in the display.

```
Router# show policy-map interface Serial3/1

 Serial3/1

  Service-policy output: mypolicy

    Class-map: gold (match-any)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any
      police:
          cir 20 % bc 10 ms
          cir 2000000 bps, bc 2500 bytes
          pir 40 % be 20 ms
          pir 4000000 bps, be 10000 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
```

Table 9 describes the significant fields shown in the display.

Table 9 show policy-map interface Field Descriptions—Configured for Percentage-Based Policing and Shaping[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, 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. **Note** If the packets are compressed over an outgoing interface, the improved packet rate achieved by packet compression is not reflected in the offered rate. Also, if the packets are classified *before* they enter a combination of tunnels (for example, a generic routing encapsulation (GRE) tunnel and an IP Security (IPSec) tunnel), the offered rate does not include all the extra overhead associated with tunnel encapsulation in general. Depending on the configuration, the offered rate may include no overhead, may include the overhead for only *one* tunnel encapsulation, or may include the overhead for *all* tunnel encapsulations. In most of the GRE and IPSec tunnel configurations, the offered rate includes the overhead for GRE tunnel encapsulation only.
police	Indicates that traffic policing based on a percentage of bandwidth has been enabled. Also, displays the bandwidth percentage, the CIR, and the committed burst (Bc) size in ms.
conformed, actions	Displays the number of packets and bytes marked as conforming to the specified rates, and the action to be taken on those packets.
exceeded, actions	Displays the number of packets and bytes marked as exceeding the specified rates, and the action to be taken on those packets.

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

Traffic Shaping show policy-map interface Command Example

The following sample output from the **show policy-map interface** command (shown below) displays the statistics for the serial 3/2 interface. Traffic shaping has been enabled on this interface, and an average rate of 20 percent of the bandwidth has been specified.

```
Router# show policy-map interface Serial3/2

Serial3/2

  Service-policy output: p1

    Class-map: c1 (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any
      Traffic Shaping
        Target/Average      Byte   Sustain    Excess      Interval  Increment  Adapt
        Rate              Limit  bits/int  bits/int    (ms)     (bytes)   Active
         20 %                        10 (ms)    20 (ms)
        201500/201500       1952   7808       7808        38         976       -

        Queue     Packets   Bytes     Packets   Bytes     Shaping
        Depth                         Delayed   Delayed   Active
        0         0         0         0         0         no
```

Table 10 describes the significant fields shown in the display.

Table 10 show policy-map interface Field Descriptions—Configured for Percentage-Based Policing and Shaping (with Traffic Shaping Enabled)[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, 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. **Note** If the packets are compressed over an outgoing interface, the improved packet rate achieved by packet compression is not reflected in the offered rate. Also, if the packets are classified *before* they enter a combination of tunnels (for example, a generic routing encapsulation (GRE) tunnel and an IP Security (IPSec) tunnel), the offered rate does not include all the extra overhead associated with tunnel encapsulation in general. Depending on the configuration, the offered rate may include no overhead, may include the overhead for only *one* tunnel encapsulation, or may include the overhead for *all* tunnel encapsulations. In most of the GRE and IPSec tunnel configurations, the offered rate includes the overhead for GRE tunnel encapsulation only.
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.

Table 10 show policy-map interface Field Descriptions—Configured for Percentage-Based Policing and Shaping (with Traffic Shaping Enabled)[1] (continued)

Field	Description
Match	Match criteria specified for the class of traffic. Choices include criteria such as the Layer 3 packet length, IP precedence, IP DSCP value, 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 chapter "Configuring the Modular Quality of Service Command-Line Interface" in the *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.2.
Traffic Shaping	Indicates that traffic shaping based on a percentage of bandwidth has been enabled.
Target /Average Rate	Rate (percentage) used for shaping traffic and the number of packets meeting that rate.
Byte Limit	Maximum number of bytes that can be transmitted per interval. Calculated as follows: ((Bc+Be) /8) x 1
Sustain bits/int	Committed burst (Bc) rate.
Excess bits/int	Excess burst (Be) rate.
Interval (ms)	Time interval value in milliseconds (ms).
Increment (bytes)	Number of credits (in bytes) received in the token bucket of the traffic shaper during each time interval.
Adapt Active	Indicates whether adaptive shaping is enabled.
Queue Depth	Current queue depth of the traffic shaper.
Packets	Total number of packets that have entered the traffic shaper system.
Bytes	Total number of bytes that have entered the traffic shaper system.
Packets Delayed	Total number of packets delayed in the queue of the traffic shaper before being transmitted.
Bytes Delayed	Total number of bytes delayed in the queue of the traffic shaper before being transmitted.
Shaping Active	Indicates whether the traffic shaper is active. For example, if a traffic shaper is active, and the traffic being sent exceeds the traffic shaping rate, a "yes" appears in this field.

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.

Packet Classification Based on Layer 3 Packet Length show policy-map interface Command Example

The following sample output from the **show policy-map interface** command displays the packet statistics for the Ethernet4/1 interface, to which a service policy called "mypolicy" is attached. The Layer 3 packet length has been specified as a match criterion for the traffic in the class called "class1".

```
Router# show policy-map interface Ethernet4/1

 Ethernet4/1
```

```
Service-policy input: mypolicy

  Class-map: class1 (match-all)
     500 packets, 125000 bytes
     5 minute offered rate 4000 bps, drop rate 0 bps
     Match: packet length min 100 max 300
     QoS Set
       qos-group 20
         Packets marked 500
```

Table 11 describes the significant fields shown in the display.

Table 11 show policy-map interface Field Descriptions—Configured for Packet Classification Based on Layer 3 Packet Length[1]

Field	Description
Service-policy input	Name of the input 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, 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. **Note** If the packets are compressed over an outgoing interface, the improved packet rate achieved by packet compression is not reflected in the offered rate. Also, if the packets are classified *before* they enter a combination of tunnels (for example, a generic routing encapsulation (GRE) tunnel and an IP Security (IPSec) tunnel), the offered rate does not include all the extra overhead associated with tunnel encapsulation in general. Depending on the configuration, the offered rate may include no overhead, may include the overhead for only *one* tunnel encapsulation, or may include the overhead for *all* tunnel encapsulations. In most of the GRE and IPSec tunnel configurations, the offered rate includes the overhead for GRE tunnel encapsulation only.
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 DSCP value, MPLS experimental value, access groups, and QoS groups.
QoS Set, qos-group, Packets marked	Indicates that class-based packet marking based on the QoS group has been configured. Includes the qos-group number and the number of packets marked.

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

Enhanced Packet Marking show policy-map interface Command Example

The sample output from the **show table-map** command shows the contents of a table map called “map 1.” In “map1”, a “to–from” relationship has been established and a default value has been defined. The fields for establishing the “to–from” mappings are further defined by the policy map in which the table map will be configured. (Configuring a policy map is the next logical step after creating a table map.)

For instance, a precedence or DSCP value of 0 could be mapped to a class of service (CoS) value of 1, or vice versa, depending on the how the values are defined in the table map. Any values not explicitly defined in a “to–from” relationship will be set to a default value.

The following sample output from the **show table-map** command displays the contents of a table map called “map1”. In this table map, a packet-marking value of 0 is mapped to a packet-marking value of 1. All other packet-marking values are mapped to the default value 3.

```
Router# show table-map map1

 Table Map map1
 from 0 to 1
 default 3
```

Table 12 describes the fields shown in the display.

Table 12 show policy-map interface Field Descriptions—Configured for Enhanced Packet Marking

Field	Description
Table Map	The name of the table map being displayed.
from, to	The values of the “to–from” relationship established by the **table-map** (value mapping) command and further defined by the policy map in which the table map will be configured.
default	The default action to be used for any values not explicitly defined in a “to–from” relationship by the **table-map** (value mapping) command. If a default action is not specified in the table-map (value mapping) command, the default action is “copy”.

Traffic Policing show policy-map interface Command Example

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 serial2/0
 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 from the **show policy-map** command) * bandwidth (BW) of the interface (as shown in the output from the **show interfaces** command) = total bits per second

According to the output from 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 from the **show policy-map** command) * bandwidth (BW) of the interface (as shown in the output from the **show interfaces** command) = total bits per second

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

```
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
```

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 from 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 13 describes the significant fields shown in the display.

Table 13 show policy-map interface Field Descriptions

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.

Table 13 show policy-map interface Field Descriptions (continued)

Field	Description
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.

Bandwidth Estimation show policy-map interface Command Example

The following sample output from the **show policy-map interface** command displays statistics for the FastEthernet 0/1 interface on which bandwidth estimates for quality of service (QoS) targets have been generated.

The Bandwidth Estimation section indicates that bandwidth estimates for QoS targets have been defined. These targets include the packet loss rate, the packet delay rate, and the timeframe in milliseconds. Confidence refers to the drop-one-in value (as a percentage) of the targets. Corvil Bandwidth means the bandwidth estimate in kilobits per second.

When no drop or delay targets are specified, "none specified, falling back to drop no more than one packet in 500" appears in the output.

```
Router# show policy-map interface FastEthernet0/1
 FastEthernet0/1

  Service-policy output: my-policy

    Class-map: icmp (match-all)
      199 packets, 22686 bytes
      30 second offered rate 0 bps, drop rate 0 bps
      Match: access-group 101
      Bandwidth Estimation:
        Quality-of-Service targets:
          drop no more than one packet in 1000 (Packet loss < 0.10%)
          delay no more than one packet in 100 by 40 (or more) milliseconds
            (Confidence: 99.0000%)
        Corvil Bandwidth: 1 kbits/sec

    Class-map: class-default (match-any)
      112 packets, 14227 bytes
      30 second offered rate 0 bps, drop rate 0 bps
      Match: any
      Bandwidth Estimation:
        Quality-of-Service targets:
          <none specified, falling back to drop no more than one packet in 500
        Corvil Bandwidth: 1 kbits/sec
```

Related Commands

Command	Description
compression header ip	Configures RTP or TCP IP header compression for a specific class.
drop	Configures a traffic class to discard packets belonging to a specific class.
match fr-dlci	Specifies the Frame Relay DLCI number as a match criterion in a class map.
match packet length (class-map)	Specifies the length of the Layer 3 packet in the IP header as a match criterion in a class map.
police	Configures traffic policing.
police (percent)	Configures traffic policing based on a percentage of bandwidth available on an interface.
police (two rates)	Configures traffic policing using two rates, the CIR and the PIR.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
random-detect ecn	Enables ECN.
shape (percent)	Specifies average or peak rate traffic shaping based on 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 a 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.
show table-map	Displays the configuration of a specified table map or of all table maps.
table-map (value mapping)	Creates and configures a mapping table for mapping and converting one packet-marking value to another.

Glossary

Corvil Bandwidth—The optimum bandwidth that delivers predictability in QoS targets while maximizing the efficiency of the network.

CTD—Corvil traffic descriptor. A compact encoding of the distribution of bit and packet rates in a traffic aggregate over any given time window. CTDs summarize observed traffic and are input for the Corvil algorithm that calculates the minimum bandwidth required to deliver the user-specified QoS target for the observed traffic.

delay—The time taken from point-to-point in a network. Delay can be measured in either one-way or round-trip delay. See also latency

latency—The delay on a router between the time a device receives a packet and the time that packet is forwarded out the destination port.

packet—A logical grouping of information that includes a header containing control information and (usually) user data. Packets most often refer to network layer units of data.

policy map—Any defined rule that determines the use of resources within the network. A QoS policy map identifies the traffic class to which it applies and the instructions for one or more actions to take on that traffic.

QoS—quality of service. A measure of performance for a transmission system that reflects its transmission quality and service availability. Quality of service focuses on achieving appropriate network performance for networked applications; it is superior to best effort performance.

traffic class—Three elements used to classify traffic. They include: 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 the **match** commands.

Note Refer to *Internetworking Terms and Acronyms* for terms not included in this glossary.