QoS Bandwidth Estimation

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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.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported use the "Feature Information for QoS Bandwidth Estimation" section on page 11.

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

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Contents

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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 should 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 ensuring 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.

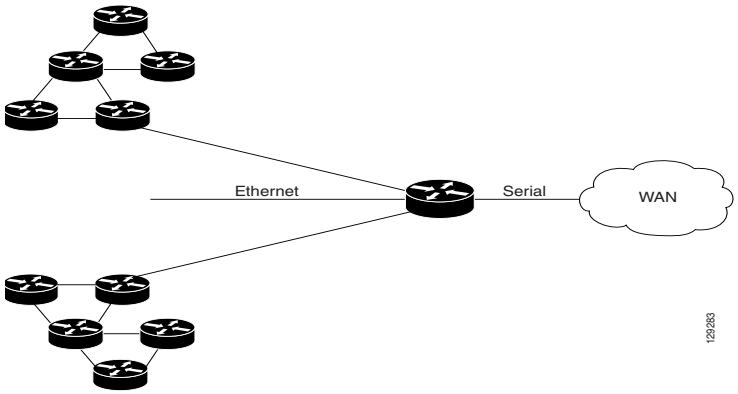
Corvil Bandwidth can determine the minimum bandwidth required to deliver traffic within customer-specified QoS targets with statistical reliability. From a network management perspective, an application's QoS requirements are characterized with respect to its sensitivity to delay and packet loss. Corvil 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

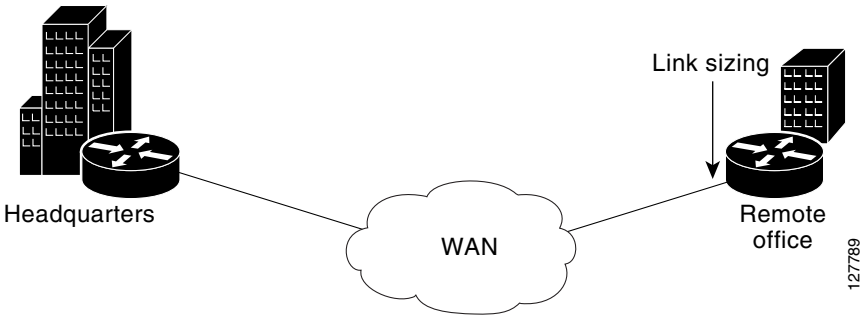
The following sections describe how Corvil Bandwidth can be implemented:

- 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.

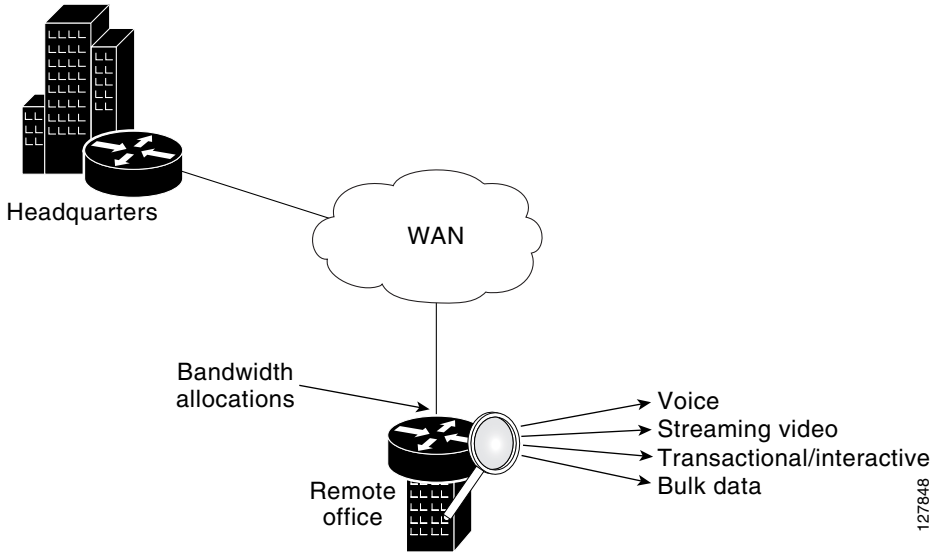
Figure 2 Link Sizing



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, Fast Ethernet, 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 5 (required)
- Attaching the Policy Map to an Interface, page 6 (required)
- Verifying the Configuration, page 7 (optional)

Generating a Bandwidth Estimate

To generate a bandwidth estimate, perform the following task.

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.
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

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

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 fastethernet0/1`	Configures the specified interface and enters interface configuration mode. • Enter interface type and number.
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 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 vary 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

To verify that bandwidth estimates have been generated, perform the following task.

SUMMARY STEPS

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

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show policy-map interface** *interface-name* [**vc** [*vpi*/]*vci*][**dlci** *dlci*][**input** | **output**] **Example:** `Router# show policy-map interface fastethernet0/1`	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	**exit** **Example:** `Router# exit`	(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 8
- Attaching the Policy Map to an Interface: Example, page 8
- Verifying the Configuration: Example, page 9

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
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 Fast Ethernet interface 0/1 in the output direction:

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

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 Fast Ethernet interface 0/1 in the output direction and that bandwidth estimates have been created:

```
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
```

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*
Information about attaching policy maps to interfaces using the MQC	"Applying QoS Features Using the MQC" module

Standards

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

MIBs

MIB	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

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

Feature Information for QoS Bandwidth Estimation

Table 2 lists the release history for this feature.

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

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Note Table 2 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 2 Feature Information for QoS Bandwidth Estimation

Feature Name	Releases	Feature Information
QoS Bandwidth Estimation	12.3(14)T	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. The following sections provide information about this feature: • Information About QoS Bandwidth Estimation, page 2 • How to Configure QoS Bandwidth Estimation, page 5 The following commands were introduced or modified by this feature: **estimate bandwidth, show policy-map interface**.

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.

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