



## **QoS: Bandwidth Estimation Configuration Guide, Cisco IOS Release 12.4**

### **Americas Headquarters**

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
<http://www.cisco.com>  
Tel: 408 526-4000  
800 553-NETS (6387)  
Fax: 408 527-0883

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED "AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: [www.cisco.com/go/trademarks](http://www.cisco.com/go/trademarks). Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

© 2011 Cisco Systems, Inc. All rights reserved.



## **CONTENTS**

<b>QoS Bandwidth Estimation</b>	<b>1</b>
Finding Feature Information	1
Prerequisites for QoS Bandwidth Estimation	1
Restrictions for QoS Bandwidth Estimation	1
Information About QoS Bandwidth Estimation	2
Feature Overview of QoS Bandwidth Estimation	2
Applying Corvil Bandwidth	3
Link Sizing	3
Bandwidth Allocations by Traffic Class	3
Benefits of QoS Bandwidth Estimation	4
How to Configure QoS Bandwidth Estimation	5
Generating a Bandwidth Estimate	5
Attaching the Policy Map to an Interface	6
Verifying the Configuration	8
Configuration Examples for QoS Bandwidth Estimation	8
Example Generating Bandwidth Estimates for QoS Targets	9
Example Attaching the Policy Map to an Interface	9
Example Verifying the Configuration	9
Additional References	10
Feature Information for QoS Bandwidth Estimation	11





# 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.

- [Finding Feature Information, page 1](#)
- [Prerequisites for QoS Bandwidth Estimation, page 1](#)
- [Restrictions for QoS Bandwidth Estimation, page 1](#)
- [Information About QoS Bandwidth Estimation, page 2](#)
- [How to Configure QoS Bandwidth Estimation, page 5](#)
- [Configuration Examples for QoS Bandwidth Estimation, page 8](#)
- [Additional References, page 10](#)
- [Feature Information for QoS Bandwidth Estimation, page 11](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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

## 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

- [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.

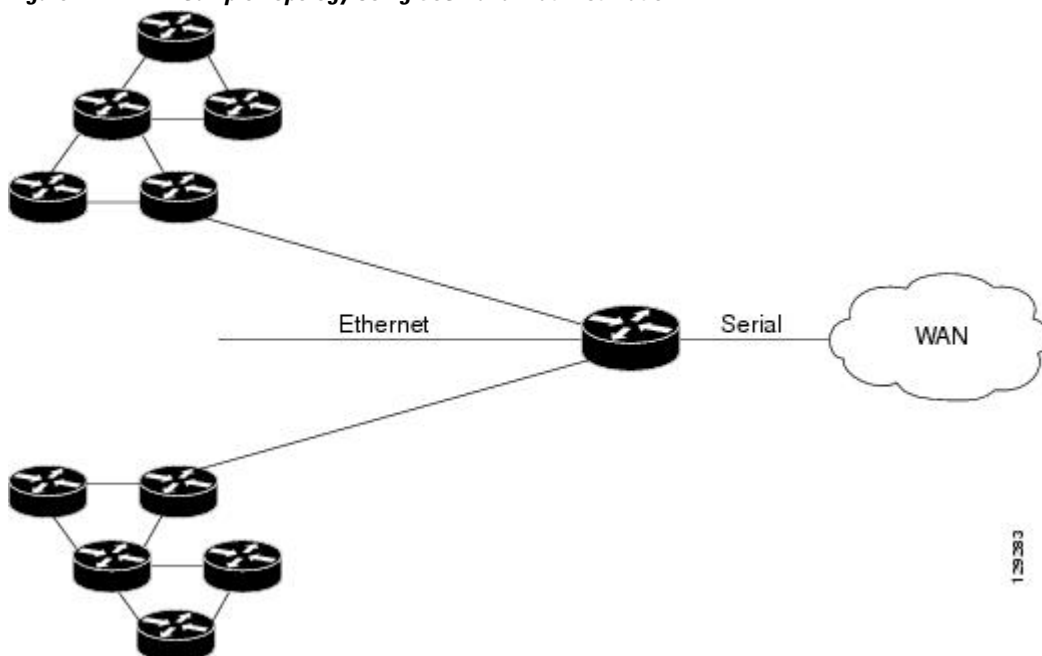
Corvil Bandwidth can determine the minimum bandwidth required to deliver traffic within customer-specified QoS targets with statistical reliability. From a network management perspective, an application's QoS requirements are characterized with respect to its sensitivity to delay and packet loss. Corvil 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 the figure below, 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, page 3](#)

## Applying Corvil Bandwidth

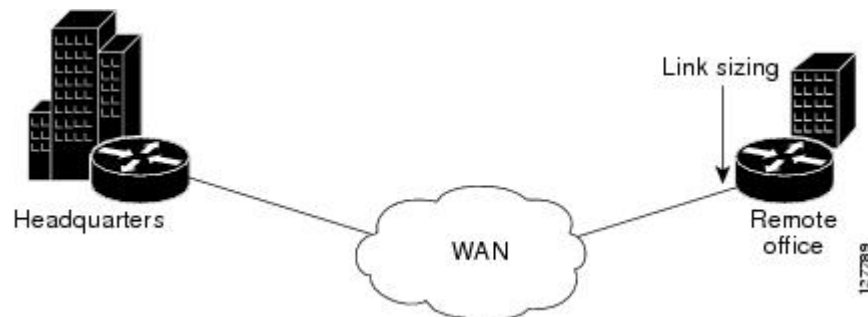
The following sections describe how Corvil Bandwidth can be implemented:

- [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 (see the figure below). The QoS targets are achieved as long as the link capacity is greater than or equal to the computed Corvil Bandwidth value.

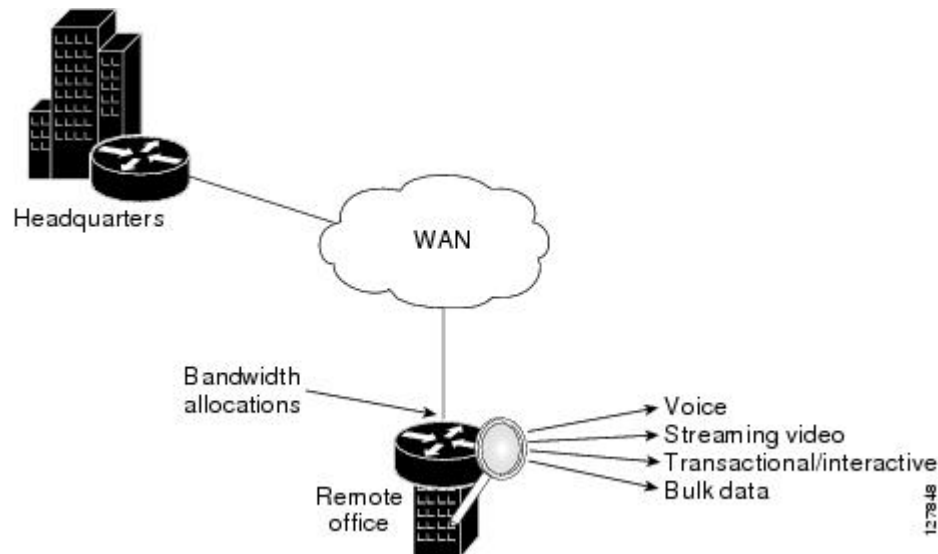
**Figure 2** *Link Sizing*



### Bandwidth Allocations by Traffic Class

Corvil Bandwidth can be used to size bandwidth allocations for individual traffic classes defined via the MQC (see the figure below). 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

The table below 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	<ul style="list-style-type: none"> <li>Establishment of service-level objectives for the desired performance of networked applications</li> <li>Elimination of operational overhead and guesswork in bandwidth provisioning and QoS configuration</li> <li>Potentially significant bandwidth cost savings while meeting QoS requirements</li> <li>Increased capability and flexibility to offer bandwidth-on-demand types of services</li> </ul>
Frequent fine-grain traffic measurements	<ul style="list-style-type: none"> <li>More accurate calculation of bandwidth requirements</li> <li>Greater ability to meet more stringent QoS targets</li> </ul>
Support for multiple traffic classes on an interface	<ul style="list-style-type: none"> <li>Individually specified QoS targets for each traffic class (class map) to calculate Corvil Bandwidth values</li> </ul>
Corvil Bandwidth integrated with MQC	<ul style="list-style-type: none"> <li>Results available by traffic class</li> <li>Bandwidth adjustment enabled in the corresponding MQC-based policy</li> </ul>
Corvil Bandwidth results reported in kbps	<ul style="list-style-type: none"> <li>Results directly applied via Cisco IOS MQC bandwidth command and to link-rate sizing</li> </ul>
Corvil Bandwidth results available in class-based QoS MIB	<ul style="list-style-type: none"> <li>Integrated with Simple Network Management Protocol (SNMP)-based performance management tools</li> </ul>
Low resource consumption on router	<ul style="list-style-type: none"> <li>Efficient to use, adding little additional processing or memory requirements</li> </ul>



Feature	Benefits
Available on any router interface	<ul style="list-style-type: none"> <li>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</li> </ul>

## How to Configure QoS Bandwidth Estimation

- [Generating a Bandwidth Estimate, page 5](#)
- [Attaching the Policy Map to an Interface, page 6](#)
- [Verifying the Configuration, page 8](#)

### Generating a Bandwidth Estimate

#### SUMMARY STEPS

- enable
- configure terminal
- policy-map *policy-map-name*
- class [*class-name* | **class-default**]
- bandwidth [*bandwidth-kbps* | **remaining percent** *percentage* | **percent** *percentage*]
- estimate bandwidth [**drop-one-in** *n*] [**delay-one-in** *n* **milliseconds** *n*]
- end

#### DETAILED STEPS

Command or Action	Purpose
<b>Step 1</b> enable  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b> configure terminal  <b>Example:</b> Router# configure terminal	Enters global configuration mode.

Command or Action	Purpose
<p><b>Step 3</b> <code>policy-map <i>policy-map-name</i></code></p> <p><b>Example:</b></p> <pre>Router(config)# policy-map my-policy</pre>	<p>Specifies the name of the policy map to be created. Enters policy-map configuration mode.</p> <ul style="list-style-type: none"> <li>Enter the policy-map name.</li> </ul>
<p><b>Step 4</b> <code>class [<i>class-name</i>   <b>class-default</b>]</code></p> <p><b>Example:</b></p> <pre>Router(config-pmap)# class my-class</pre>	<p>Specifies the class so that you can configure or modify its policy. Enters policy-map class configuration mode.</p> <ul style="list-style-type: none"> <li>Enter the class name or use the <b>class-default</b> keyword.</li> </ul>
<p><b>Step 5</b> <code>bandwidth [<i>bandwidth-kbps</i>   <b>remaining percent percentage</b>   <b>percent percentage</b>]</code></p> <p><b>Example:</b></p> <pre>Router(config-pmap-c)# bandwidth percent 20</pre>	<p>Specifies or modifies the bandwidth allocated for a class belonging to a policy map.</p> <ul style="list-style-type: none"> <li>Enter the bandwidth to be set or modified.</li> </ul>
<p><b>Step 6</b> <code>estimate bandwidth [<b>drop-one-in</b> <i>n</i>] [<b>delay-one-in</b> <i>n</i> <b>milliseconds</b> <i>n</i>]</code></p> <p><b>Example:</b></p> <pre>Router(config-pmap-c)# estimate bandwidth drop-one-in 100 delay-one-in 100 milliseconds 50</pre>	<p>(Optional) Estimates the bandwidth needed per traffic class for given quality of service (QoS) targets based on traffic data.</p> <ul style="list-style-type: none"> <li>Enter values for the packet loss target, the delay target, and the delay threshold.</li> </ul>
<p><b>Step 7</b> <code>end</code></p> <p><b>Example:</b></p> <pre>Router(config-pmap-c)# end</pre>	<p>(Optional) Exits policy-map class configuration mode.</p>

## Attaching the Policy Map to an Interface



### Note

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
<p><b>Step 1</b> <b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<p><b>Step 2</b> <b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<p><b>Step 3</b> <b>interface</b> <i>type number</i> [<i>name-tag</i>]</p> <p><b>Example:</b></p> <pre>Router(config)# interface fastethernet0/1</pre>	<p>Configures the specified interface and enters interface configuration mode.</p> <ul style="list-style-type: none"> <li>• Enter interface type and number.</li> </ul>
<p><b>Step 4</b> <b>service-policy</b> {<b>input</b> <b>output</b>} <i>policy-map-name</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# <b>service-policy output my-policy</b></pre>	<p>Specifies the name of the policy map to be attached to the interface.</p> <p><b>Note</b> 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.</p> <ul style="list-style-type: none"> <li>• Enter the <b>output</b> keyword followed by the policy map name.</li> </ul>
<p><b>Step 5</b> <b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# end</pre>	<p>(Optional) Exits interface configuration mode.</p>

## 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 dlc**][**input | output**]
3. **exit**

### DETAILED STEPS

Command or Action	Purpose
<p><b>Step 1</b> <b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<p><b>Step 2</b> <b>show policy-map interface</b> <i>interface-name</i> [<b>vc</b> [<i>vpi /vci</i>]][<b>dlci dlc</b>][<b>input   output</b>]</p> <p><b>Example:</b></p> <pre>Router# show policy-map interface fastethernet0/1</pre>	<p>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.</p> <ul style="list-style-type: none"> <li>• Enter the interface name.</li> </ul>
<p><b>Step 3</b> <b>exit</b></p> <p><b>Example:</b></p> <pre>Router# exit</pre>	<p>(Optional) Exits privileged EXEC mode.</p>

## Configuration Examples for QoS Bandwidth Estimation

- [Example Generating Bandwidth Estimates for QoS Targets, page 9](#)
- [Example Attaching the Policy Map to an Interface, page 9](#)
- [Example Verifying the Configuration, page 9](#)

## Example Generating Bandwidth Estimates for QoS Targets

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
```

## Example Attaching the Policy Map to an Interface

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
```

## Example Verifying the Configuration

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	<i>Cisco IOS Quality of Service Solutions Command Reference</i>
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
<ul style="list-style-type: none"> <li>CISCO-CLASS-BASED-QOS-MIB</li> <li>CISCO-CLASS-BASED-QOS-CAPABILITY-MIB</li> </ul>	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### RFCs

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

### Technical Assistance

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

## Feature Information for QoS Bandwidth Estimation

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

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

**Table 2** Feature Information for QoS Bandwidth Estimation

Feature Name	Releases	Feature Information
QoS Bandwidth Estimation	12.3(14)T	<p>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.</p> <p>The following commands were introduced or modified by this feature: <b>estimate bandwidth</b>, <b>show policy-map interface</b>.</p>

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: [www.cisco.com/go/trademarks](http://www.cisco.com/go/trademarks). Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams,

and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.