AutoQoS for the Enterprise

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The AutoQoS for the Enterprise feature automates the deployment of quality of service (QoS) policies in a general business environment, particularly for midsize companies and branch offices of larger companies. Existing QoS policies may be present during the first configuration phase of this feature, that is, during the Auto-Discovery (data collection) phase. However, any existing QoS policies must be removed before the AutoQoS-generated polices are applied during the second configuration phase of this feature.

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. An account on Cisco.com is not required.

Prerequisites for the AutoQoS for the Enterprise Feature

- Ensure that no QoS policies (service policies) are attached to the interface. This feature cannot be configured if a QoS policy is attached to the interface.
- To include Simple Network Management Protocol (SNMP) traps (monitored events), the SNMP server must be enabled.

- To apply the AutoQoS for the Enterprise feature, the interface must be supported by a Programmable Intelligent Services Accelerator (PISA).

Restrictions for the AutoQoS for the Enterprise Feature

General Restrictions

- The AutoQoS for the Enterprise feature is supported on the following interfaces, data-link connection identifiers (DLCIs), and permanent virtual circuits (PVCs) only:

  - Serial interfaces with PPP or High-Level Data Link Control (HDLC)
  - Frame Relay DLCIs in point-to-point subinterfaces only
  - ATM PVCs

The AutoQoS for the Enterprise feature is supported on low-speed and high-speed ATM PVCs in point-to-point subinterfaces.

Note An ATM PVC is classified as low speed if its bandwidth is less than or equal to 768 Kbps; an ATM PVC is classified as high speed if its bandwidth is greater than 768 Kpbs.

- - Frame Relay-to-ATM Interworking links

Serial Interface Restrictions

- For a serial interface with a low-speed link, Multilink PPP (MLP) is configured automatically. The serial interface must have an IP address. When MLP is configured, this IP address is removed and put on the MLP bundle. To ensure that the traffic goes through the low-speed link, the following conditions must be met:

  - The AutoQoS for the Enterprise feature must be configured at the both ends of the link.
  - The amount of bandwidth configured must be the same on both ends of the link.

Frame Relay DLCI Restrictions

- The AutoQoS for the Enterprise feature cannot be configured on a Frame Relay DLCI if a map class is attached to the DLCI.
- If a Frame Relay DLCI is already assigned to one subinterface, the AutoQoS for the Enterprise feature cannot be configured from a different subinterface.
- For low-speed Frame Relay DLCIs configured for use on Frame Relay-to-ATM networks, MLP over Frame Relay (MLPoFR) is configured automatically. The subinterface must have an IP address.

When MLPoFR is configured, this IP address is removed and put on the MLP bundle. The AutoQoS for the Enterprise feature must also be configured on the ATM side of the network.

- For low-speed Frame Relay DLCIs with Frame Relay-to-ATM Interworking, the AutoQoS for the Enterprise feature cannot be configured if a virtual template is already configured for the DLCI.

ATM PVC Restrictions

- For a low-speed ATM PVC, the AutoQoS for the Enterprise feature cannot be configured if a virtual template is already configured for the ATM PVC.
- For low-speed ATM PVCs, MLP over ATM (MLPoATM) is configured automatically. The subinterface must have an IP address.

When MLPoATM is configured, this IP address is removed and put on the MLP bundle. The AutoQoS for the Enterprise feature must also be configured on the ATM side of the network.

Cisco IOS Release 12.2(18)ZYA2 Restrictions

- Ingress QoS is not supported.
- AutoQoS is supported on L3 routed interfaces, but Auto QoS is not supported on L2 interfaces.
- Only the following commands are supported:

  - **auto discover qos**
  - **auto qos**

Information About the AutoQoS for the Enterprise Feature

Benefits of the AutoQoS for the Enterprise Feature

The key benefits of the AutoQoS for the Enterprise feature include the following:

- Customers can implement the QoS features required for voice, video, and data traffic without an in-depth knowledge of the following underlying technologies:

  - PPP
  - Frame Relay
  - ATM
  - Service policies
  - Link efficiency mechanisms (LEM), such as Link Fragmentation and Interleaving (LFI)
- The AutoQoS for the Enterprise feature simplifies QoS implementation and speeds up the provisioning of QoS technology over a Cisco network. It reduces human error and lowers training costs.
- The AutoQoS for the Enterprise feature creates class maps and policy maps on the basis of Cisco experience and "best practices" methodology.
- Customers can also use existing Cisco IOS commands to modify the configurations, automatically generated by the AutoQoS for the Enterprise feature, as needed to meet specific requirements.

Design Considerations

General QoS Requirements

- Recommended methods and values are configured to meet the QoS requirements for voice traffic.

- The AutoQoS for the Enterprise feature takes the interface type and bandwidth into consideration when implementing the following QoS features:

    ◦ Low latency queueing (LLQ) -- Priority Queueing (PQ)

The LLQ (specifically, PQ) is applied to the voice packets to meet the latency requirements.

- ◦ Compressed Real-Time Protocol (cRTP)

With cRTP, the 40-byte IP header of the voice packet is reduced from 2 to 4 bytes, thereby reducing voice bandwidth requirements. cRTP must be applied at both ends of a network link.

- ◦ LFI

LFI is used to reduce the jitter of voice packets by preventing voice packets from getting delayed behind large data packets in a queue. LFI must be applied at both ends of a network link.

Bandwidth Implications

The bandwidth of the serial interface determines the speed of the link. The speed of the link, in turn, determines the configurations generated by the AutoQoS for the Enterprise feature.

Note   Changing the bandwidth during configuring the AutoQoS for the Enterprise feature is not recommended.

The AutoQoS for the Enterprise feature uses the bandwidth that is allocated at the time the feature is configured. The AutoQoS for the Enterprise feature does not respond to changes made to bandwidth after the feature is configured.

For example, if the **auto qos** command is used to configure the AutoQoS for the Enterprise feature on an interface with 1000 Kbps, the AutoQoS for the Enterprise feature generates configurations for high-speed interfaces. However, if the bandwidth is later changed to 500 Kbps, the AutoQoS for the Enterprise feature will not use the lower bandwidth. The AutoQoS for the Enterprise feature retains the higher bandwidth and continues to use the generated configurations for high-speed interfaces.

To force the AutoQoS for the Enterprise feature to generate configurations for the low-speed interfaces, perform the following tasks:

1 Use the **no auto qos** command to remove the AutoQoS for the Enterprise feature.
2 Use the **no auto discovery qos** command to stop the Auto-Discovery (data collection) configuration phase.
3 Use the **auto discovery qos** command to resume the Auto-Discovery (data collection) phase.
4 Use the **auto qos** command to begin the AutoQoS template generation and installation configuration phase.

Fragmentation for Frame Relay Networks

For Frame Relay networks, fragmentation is configured using a delay of 10 milliseconds (ms) and a minimum fragment size of 60 bytes. This configuration ensures that the VoIP packets are not fragmented. However, when the G.711 coder-decoder (codec) is used on low-speed links, the fragment size configured by the AutoQoS for the Enterprise feature could be smaller than the size of the G.711 Voice over IP (VoIP) packet.

To solve this potential problem, choose one of the following:

- Change the fragment size to the required value.
- Change the size of the G.711 VoIP packet to a smaller value.

For example, if the AutoQoS for the Enterprise feature is configured on a Frame Relay DLCI with 128 Kbps, the fragment size configured by the AutoQoS for the Enterprise feature will be 160 bytes. The size of the G.711 VoIP packet will be 160 bytes, minus the bytes in the packet headers for the layers. The workaround is to either change the fragment size from 160 bytes to 220 bytes or change the size of the G. 711 VoIP packet from 160 bytes to 80 bytes.

Configuration Phases

The AutoQoS for the Enterprise feature consists of two configuration phases, completed in the following order:

- Auto-Discovery (data collection)

The Auto-Discovery phase uses network-based application recognition (NBAR)-based protocol discovery to detect the applications on the network and performs statistical analysis on the network traffic.
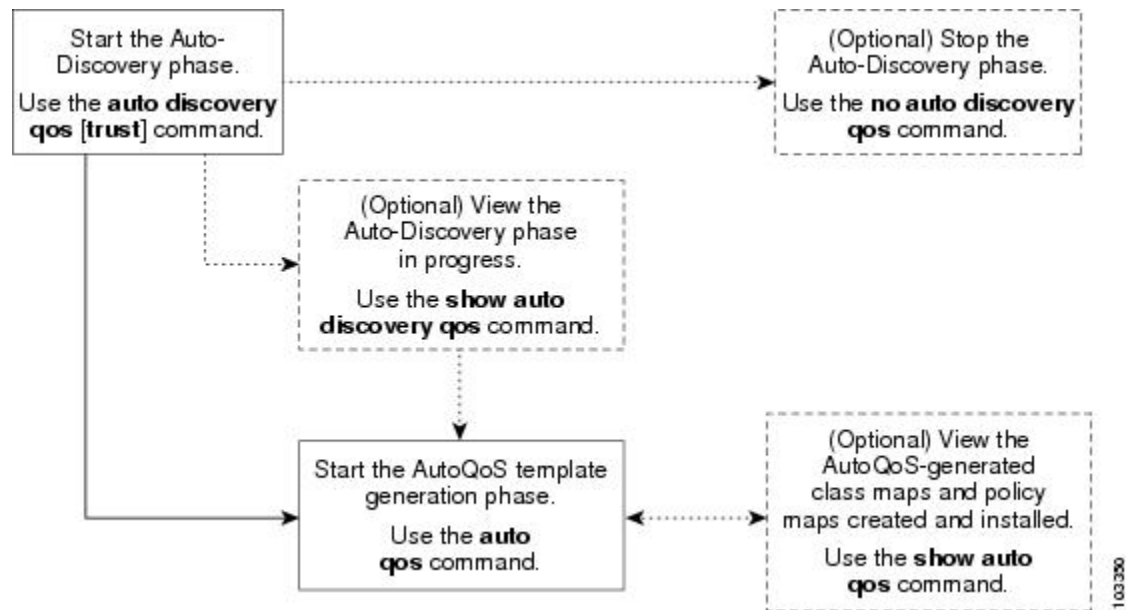
- AutoQoS template generation and installation

This phase generates templates from the data collected during the Auto-Discovery phase and installs the templates on the interface. Then these templates are used as the basis for creating the class maps and policy maps for your network. After the class maps and policy maps are created, they are then installed on the interface.

In Cisco IOS Release 12.2(18)ZYA2, when AutoQos is configured, a global macro is also applied to the interface to perform lan-queueing actions. This macro contains commands to configure bandwidth, queue limit, and thresholds based on the traffic type, its priority and its rate. This data is collected during the Auto-Discovery phase.

The figure below below illustrates the top-level processes for configuring the AutoQoS for Enterprise feature. The dotted lines indicate optional processes.

Figure 1   Top-Level Processes for Configuring the AutoQoS for the Enterprise Feature

First, start the Auto-Discovery (data collection) phase by using the **auto discovery qos** command. Note the following points about the Auto-Discovery phase:

- If you want to stop the Auto-Discovery phase, use the **no auto discovery qos** command. This command stops data collection and removes any data collection reports that have been generated.
- If you want to view the Auto-Discovery phase in progress, use the **show auto discovery qos** command. This command displays the results of the data collected during the Auto-Discovery phase.

Second, start the AutoQoS template generation phase by using the **auto qos** command. This phase generates templates from the data collected during the Auto-Discovery phase. It then uses those templates as the basis for creating and installing the class maps and policy maps for your network.

Note   After the **auto qos** command has finished creating and installing the templates, creating the class maps and policy maps, and installing the class maps and policy maps on the interface, you can view the class maps and policy maps by using the **show auto qos** command.

Detailed information about the Auto-Discovery phase and the AutoQoS template generation phase is provided below.

Auto-Discovery (Data Collection) Phase

The Auto-Discovery (data collection) phase uses NBAR to detect network applications as they arrive at an interface, collect data from the offered traffic, and perform statistical analysis.

The data collected should be a representative sampling of the volume and type of voice, video, and data on your network. Therefore, the amount of time devoted to data collection varies from network to network. Run the Auto-Discovery phase for as long as necessary. The length of time needed van vary, depending on the volume and nature of traffic on your network.

AutoQoS Template Generation and Installation Phase

This phase generates templates from the data collected during the Auto-Discovery phase and installs the templates on the interface. Then these templates are used as the basis for creating the class maps and policy maps for your network. After the class maps and policy maps are created, they are then installed on the interface.

During this phase, the AutoQoS for the Enterprise also assigns the appropriate bandwidth amounts and sets the appropriate scheduling parameters for the network traffic.

In Cisco IOS Release 12.2(18)ZYA2, a macro that contains mls qos commands to configure bandwidth, queue limit, and thresholds gets applied. To view these commands, use **show run interface** command. The commands will not be displayed as part of the **show auto qos**command.

AutoQos can be applied on an interface with input service policy applied, but no output service policy can be applied on the interface while applying AutoQos on it.

Class-Map Templates

The AutoQoS for the Enterprise feature creates a number of class-map templates, used for the following purposes:

- To classify applications and map them to classes for DiffServ per-hop behavior (PHB) mapping.
- To define the class-based QoS policy templates.

In Cisco IOS Release 12.2(18)ZYA2, the PISA MQC is limited to 8 filters per class-map. To accommodate this, additional AutoQos classes have been added to honour the 8 filter per class limitation. Transactional, Bulk, Scavanger and Management have been split.

AutoQoS Classes

The AutoQoS for the Enterprise feature defines 10 AutoQoS classes, designed to accommodate various enterprise applications. The table below lists the AutoQoS class name, the type of traffic defined for the class, and the differentiated services code point (DSCP) value for the type of traffic, if applicable.

Table 1   Class Definitions for the AutoQoS for the Enterprise Feature

AutoQoS Class Name	Traffic Type	DSCP Value
IP Routing	Network control traffic, such as routing protocols	CS6
Interactive Voice	Inactive voice-bearer traffic	EF
Interactive Video	Interactive video data traffic	AF41
Streaming Video	Streaming media traffic	CS4
Telephony Signaling	Telephony signaling and control traffic	CS3
Transactional/Interactive	Database applications transactional in nature	AF21
Network Management	Network management traffic	CS2
Bulk Data	Bulk data transfers; web traffic; general data service	AF11
Scavenger	Casual entertainment; rogue traffic; traffic in this category is given less-than-best-effort treatment	CS1
Best Effort	Default class; all non-critical traffic; HTTP; all miscellaneous traffic	0

These classes are used with the modular quality of service (QoS) command-line interface (MQC) to configure class maps, once the classification (match) criteria are determined. The match criteria can be configured using the appropriate **match protocol** commands.

These classes are also chosen to meet the scheduling requirement in compliance with the DiffServ recommendations. Each class will be associated with an egress (output) queue. The applications mapped to a class will be put into the same queue and receive the same (weighted) queueing scheduling.

Note The actual number of queues created corresponds to the number of applications (and then classes) discovered during AutoQoS-Discovery.

AutoQoS Classification Using NBAR

NBAR is the classification mechanism for the AutoQoS for the Enterprise feature. NBAR is a Cisco product that classifies network traffic using information about the application such as protocol type, URL, and dynamically assigned ports.

All the NBAR-supported applications are mapped to the AutoQoS classes described in the Class-Map Templates, page 6 section.

The AutoQoS for the Enterprise feature provides static default mapping rules used to build the AutoQoS class-map templates. The table below lists each AutoQoS class, the application to which it is mapped, and the Cisco IOS **match protocol** command used in a policy map to establish the mapping.

Table 2   AutoQoS Classes, Applications, and match protocol Command

AutoQoS Class	Application	match protocol Command
Interactive Voice	VoIP bearer	**match protocol rtp voice**
		match protocol cisco-phone
		match protocol vofr
Interactive Video 1	Video conference	**match protocol rtp video**
Telephony Signaling	Voice and video signaling and control	**match protocol rtcp**
		match protocol h323
Streaming Video	Streaming video	**match protocol cuseeme**
		match protocol netshow
		match protocol realaudio
		match protocol streamwork
		match protocol vdolive
Transactional/Interactive	Database	**match protocol sap**
		match protocol sqlnet
		match protocol sqlserver
		match protocol sqlexec
		match protocol citrix
		match protocol notes
		match protocol 1dap
		match protocol secure-1dap

AutoQoS Class	Application	match protocol Command
	Interactive sessions	**match protocol telnet**
		match protocol secure-telnet
		match protocol rtelnet
		match protocol xwindows
		match protocol ssh
		match protocol finger
		match protocol klogin
		match protocol kshell
		match protocol nickname
		match protocol vnc
		match protocol xdmcp
	Other enterprise applications	**match protocol novadigm**
		match protocol pcanywhere
		match protocol appleqtc
		match protocol cobra-iiop
		match protocol dicom
		match protocol fix
		match protocol ibm-db2
		match protocol hl7
		match protocol ora-srv
Bulk Data	File transfer	**match protocol ftp**
		match protocol secure-ftp
		match protocol nntp
		match protocol secure-ntp
		match protocol irc
		match protocol secure-irc
		match protocol tftp
		match protocol printer
Bulk Data (Continued)		**match protocol cifs**
		match protocol ipx
		match protocol microsoftds
		match protocol netbios
		match protocol winmx
		match protocol simap

AutoQoS Class	Application	match protocol Command
	Email and groupware	**match protocol exchange**
		match protocol smtp
		match protocol pop3
		match protocol secure-pop3
		match protocol mapi
Scavenger	Peer-to-peer file transfer	**match protocol napster**
		match protocol fastrack
		match protocol gnutella
		match protocol kazaa2
		match protocol bittorent
		match protocol edonkey
		match protocol directconnect

1. In Cisco IOS Release 12.2(18)ZYA2 on the Cisco Catalyst 6500 series switch that is equipped with a Supervisor 32/PISA telepresence-media and telepresence-control packets are classified under AutoQos Class Interactive Video.

The table below lists the best-effort AutoQoS class (Best Effort), the application category for this class, and the NBAR protocols associated with this class.

Table 3   Best Effort Class, Application Categories, and Associated NBAR Protocols

AutoQoS Class	Application Category	NBAR Protocols
Best Effort **Note** The class-default does not need a match statement in the policy map.	Known	http, secure-http, gopher, nfs, sunrpc, ntp, rcmd
	Unknown	All applications not identified by NBAR

Note NBAR allows new applications to be defined and added to the network by using different tools such as a Packet Description Language Module (PDLM). The AutoQoS class mapping can not be predetermined for these applications. Therefore, these new applications will be viewed as unknown and put into the AutoQoS default (that is, Best Effort) class.

The table below lists the AutoQoS network routing protocol class (IP Routing), the application category for this class, and the NBAR protocols associated with this class.

Table 4   *IP Routing Class, Application Categories, and Associated NBAR Protocols*

AutoQoS Class	Application Category	NBAR Protocols
IP Routing **Note** The Type of Service (ToS) byte is always marked as 0x11000000.	Network routing and signaling	All supported network routing and signaling protocols. The list of NBAR supported protocols includes bgp, eigrp, rip, rsvp.

The table below lists each AutoQoS management class (Network Management), the application to which it is mapped, and the Cisco IOS **match protocol**command used in a policy map to establish the mapping.

Table 5   *Network Management Class, Application Categories, and match protocol Command*

AutoQoS Class	Application Category	match protocol Command
Network Management	Network Management	**match protocol snmp**
		match protocol syslog
		match protocol systat
		match protocol dhcp
		match protocol dns
		match protocol ldap
		match protocol secure-ldap
		match protocol socks
		match protocol imap
		match protocol secure-imap
		match protocol kerberos
		match protocol tacacs
		match protocol daytime
		match protocol time
		match protocol npp
		match protocol echo
		match protocol isakmp
		match protocol clearcase
		match protocol lockd

These AutoQoS classes and mapping scheme are used as the basic building blocks for packet classification. If these classes and this mapping scheme are not correct for your particular network, you can change them using the standard Cisco IOS commands and the MQC.

Trusted Boundary

A trusted boundary is the location in the network where the QoS marking is established. AutoQoS can be enabled with the **trust** keyword of the **auto discovery qos** command when the data collection phase in enabled.

> **Note** In Cisco IOS Release 12.2(18)ZYA2 trusted boundary feature is not supported.

The AutoQoS classification for trusted marking will use DSCP match statements specified in the table below.

When a marking is trusted, the following DSCP values are used in the match statements in the policy maps.

Table 6   *DSCP Values in Match Statements for Trusted Boundaries*

AutoQoS Class	DSCP Values in Match Statements
IP Routing	**match ip dscp cs6**
Interactive Voice	**match ip dscp ef**
Interactive Video	**match ip dscp af41**
Streaming Video	**match ip dscp cs4**
Telephony Signaling	**match ip dscp cs3**
Transactional/Interactive	**match ip dscp af21**
Network Management	**match ip dscp cs2**
Bulk Data	**match ip dscp af11**
Scavenger	**match ip dscp cs1**

Policy-Map Templates

The policy-map templates created by the AutoQoS for the Enterprise feature are used to define the following three components:

- Queue scheduling
- Minimum guaranteed bandwidth
- Default Weighted Random Early Detection (WRED) for the applicable classes

These components are designed according to "best practice" recommendations and include QoS features for specific link types, such as low- and high-speed Frame Relay DLCIs.

How to Configure the AutoQoS for the Enterprise Feature

Enabling the Auto-Discovery Phase

Before using the **auto discovery qos** command at an interface or an ATM PVC, ensure that the following prerequisites have been met:

- Cisco Express Forwarding (CEF) must be enabled.
- If the interface or subinterface has a link speed of 768 kpbs or lower, configure the primary or secondary IP address of the interface by using the **ip address** command.
- For all interfaces or subinterfaces, configure the amount of bandwidth by using the **bandwidth** command. The amount of bandwidth allocated should be based on the link speed of the interface.
- For an ATM PVC, configure the variable bit rate (VBR) by using either the **vbr-nrt** command or the **vbr-rt** command or configure the constant bit rate (CBR) by using the **cbr** command.

Note

- The **auto discovery qos**command is not supported on subinterfaces.
- Do not change the bandwidth of the interface when using the **auto discovery qos**command.
- All previously attached policies must be removed from the interface.

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SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **bandwidth** *kilobits*
5. **vbr-nrt** *output-pcr output-scr output-mbs* [*input-pcr*] [*input-scr*] [*input-mbs*]
6. **vbr-rt** *peak-rate average-rate burst*
7. **cbr** *rate*
8. **pvc** [*name*] *vpi* / *vci* [**ces** | **ilmi** | **qsaal** | **smds**]
9. **ip address** *ip-address mask* [**secondary**]
10. **frame-relay interface-dlci** *dlci* **ietf** | **cisco**] [**voice-cir** *cir*] [**ppp** *virtual-template-name*
11. **auto discovery qos** [**trust**]
12. **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* **Example:** Router(config)# interface serial4/0	Configures an interface (or subinterface) type and enters interface configuration mode. • Enter the interface type number.
Step 4	**bandwidth** *kilobits* **Example:** Router(config-if)# bandwidth 1540 **Example:**	(Optional) Sets a bandwidth value for an interface. • Enter the bandwidth value in Kbps. **Note** This step applies only to interfaces and subinterfaces. It is not required for ATM PVCs.
Step 5	**vbr-nrt** *output-pcr output-scr output-mbs* [*input-pcr*] [*input-scr*] [*input-mbs*] **Example:** Router(config-if)# vbr-nrt 10000 5000 32 20000 10000 64 **Example:**	(Optional) Configures the variable bit rate-nonreal time (VBR-NRT) QoS and specifies the output peak cell rate (PCR), output sustainable cell rate (SCR), and output maximum burst cell size (MBS) for an ATM PVC, PVC range, switched virtual circuit (SVC), virtual circuit (VC) class, or VC bundle member. • Enter the output PCR, SCR, and MBS. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.

	Command or Action	Purpose
Step 6	**vbr-rt** *peak-rate average-rate burst* **Example:** Router(config-if)# vbr-rt 640 56 80	(Optional) Configures the real-time VBR for Voice over ATM connections. • Enter the peak information rate (PIR), the average information rate (AIR), and the burst size. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.
Step 7	**cbr** *rate* **Example:** Router(config-if-atm-vc)# cbr 56 **Example:**	(Optional) Configures the CBR for the ATM circuit emulation service (CES) for an ATM PVC. This command can be used in different modes, including ATM-VC configuration mode (for ATM PVCs and SVCs), ATM PVC range configuration mode (for an ATM PVC range), or ATM PVC-in-range configuration mode (for an individual PVC within a PVC range). • Enter the CBR. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.
Step 8	**pvc** [*name*] *vpi* / *vci* [**ces**	**ilmi**	**qsaal**	**smds**] **Example:** Router(config-if)# pvc 1/32 **Example:**	(Optional) Creates or assigns a name to an ATM PVC and specifies the encapsulation type on an ATM PVC. • Enter the ATM network virtual path identifier (VPI) and the ATM network virtual channel identifier (VCI) for the ATM PVC. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.
Step 9	**ip address** *ip-address mask* [**secondary**] **Example:** Router(config-if)# ip address 10.10.100.1 255.255.255.0	(Optional) Sets a primary or secondary IP address for an interface. **Note** Applies only to low-speed interfaces (that is, interfaces with link speeds of 768 Kbps or lower).

	Command or Action	Purpose
Step 10	**frame-relay interface-dlci** *dlci* **ietf** | **cisco**] [**voice-cir** *cir*] [**ppp** *virtual-template-name*	(Optional) Assigns a DLCI to a specified Frame Relay subinterface on the router or access server, or assigns a specific PVC to a DLCI, or applies a virtual template configuration for a PPP session.
	Example:	• Enter the DLCI number.
	Router(config-if)# frame-relay interface-dlci 100	**Note** This step applies only to Frame Relay interfaces (either low-speed or high-speed).
	Example:	
Step 11	**auto discovery qos** [**trust**]	• Configures the data discovery phase of the AutoQoS for the Enterprise feature.
	Example: Router(config-if)# auto discovery qos	**Note** The optional **trust** keyword indicates that the DSCP markings of the packet are trust (that is, relied on) for classification of the voice, video, and data traffic. For more information, see the Enabling the Auto-Discovery Phase, page 13.
Step 12	**end**	(Optional) Returns to privileged EXEC mode.
	Example: Router(config-if)# end	

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What to Do Next

Use the **auto qos** command to generate and install the AutoQoS templates. These templates are generated on the basis of the data collected in the Auto-Discovery phase, and will be used to create and install the corresponding class maps and policy maps.

Enabling the AutoQoS Template Generation and Installation Phase

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **bandwidth** *kilobits*
5. **vbr-nrt** *output-pcr output-scr output-mbs* [*input-pcr*] [*input-scr*] [*input-mbs*]
6. **vbr-rt** *peak-rate average-rate burst*
7. **cbr** *rate*
8. **pvc** [*name*] *vpi* / *vci* [**ces** | **ilmi** | **qsaal** | **smds**]
9. **ip address** *ip-address mask* [**secondary**]
10. **frame-relay interface-dlci** *dlci* [**ietf** | **cisco**] [**voice-cir** *cir*] [**ppp** *virtual-template-name*]
11. **auto qos**
12. **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*
	
	Example:
	
	`Router(config)#`
	
	`interface serial4/0`
		Configures an interface (or subinterface) type and enters interface configuration mode.
		
		• Enter the interface type number.

	Command or Action	Purpose
Step 4	**bandwidth** *kilobits* **Example:** Router(config-if)# bandwidth 1540 **Example:**	(Optional) Sets a bandwidth value for an interface. • Enter the bandwidth value in Kbps. **Note** This step applies only to interfaces and subinterfaces. It is not required for ATM PVCs.
Step 5	**vbr-nrt** *output-pcr output-scr output-mbs* [*input-pcr*] [*input-scr*] [*input-mbs*] **Example:** Router(config-if)# vbr-nrt 10000 5000 32 20000 10000 64 **Example:**	(Optional) Configures the VBR-NRT and specifies the output PCR, output SCR, and output MBS for an ATM PVC, PVC range, SVC, VC class, or VC bundle member. • Enter the output PCR, SCR, and MBS. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.
Step 6	**vbr-rt** *peak-rate average-rate burst* **Example:** Router(config-if)# vbr-rt 640 56 80	(Optional) Configures the real-time VBR for Voice over ATM connections. • Enter the PIR, the AIR, and the burst size. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.
Step 7	**cbr** *rate* **Example:** Router(config-if-atm-vc)# cbr 56 **Example:**	(Optional) Configures the CBR for the ATM CES for an ATM PVC. This command can be used in different modes, including ATM-VC configuration mode (for ATM PVCs and SVCs), ATM PVC range configuration mode (for an ATM PVC range), or ATM PVC-in-range configuration mode (for an individual PVC within a PVC range). • Enter the CBR. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.

	Command or Action	Purpose
Step 8	**pvc** [*name*] *vpi* **/** *vci* [**ces**	**ilmi**	**qsaal**	**smds**] **Example:** Router(config-if)# pvc 1/32 **Example:**	(Optional) Creates or assigns a name to an ATM PVC and specifies the encapsulation type on an ATM PVC. • Enter the ATM network VPI and the ATM network VCI for the ATM PVC. **Note** This step applies only to ATM PVCs. It is not required for interfaces or subinterfaces.
Step 9	**ip address** *ip-address mask* [**secondary**] **Example:** Router(config-if)# ip address 10.10.100.1 255.255.255.0	(Optional) Sets a primary or secondary IP address for an interface. **Note** Applies only to low-speed interfaces (that is, interfaces with link speeds of 768 Kbps or lower.)
Step 10	**frame-relay interface-dlci** *dlci* [**ietf**	**cisco**] [**voice-cir** *cir*] [**ppp** *virtual-template-name*] **Example:** Router(config-if)# frame-relay interface-dlci 100 **Example:**	(Optional) Assigns a DLCI to a specified Frame Relay subinterface on the router or access server, or assigns a specific PVC to a DLCI, or applies a virtual template configuration for a PPP session. • Enter the DLCI number. **Note** This step applies only to Frame Relay interfaces (either low-speed or high-speed).
Step 11	**auto qos** **Example:** Router(config-if)# auto qos	• Configures the Auto-Discovery (data discovery) phase of the AutoQoS for the Enterprise feature.
Step 12	**end** **Example:** Router(config-if)# end	(Optional) Returns to privileged EXEC mode.

Troubleshooting Tips

Below are answers to frequently asked questions (FAQs) and tips for troubleshooting situations that you may encounter when configuring or using the AutoQoS for the Enterprise feature.

Why can't I configure the AutoQoS for the Enterprise feature?

To configure the feature, CEF must be is enabled. Verify that CEF is enabled on your network.

Why isn't the AutoQoS for the Enterprise feature supported on my router?

The AutoQoS for the Enterprise feature is supported only on the IP Plus image for low-end platforms. Verify that you have the IP Plus image installed on your router.

Why are some of my QoS configurations still present after I disable the AutoQoS for the Enterprise feature?

You have to manually disable any QoS configurations that were modified by the AutoQoS for the Enterprise feature.

Why did my low-speed network link go down when I enabled the AutoQoS for the Enterprise feature?

Ensure that the AutoQoS for the Enterprise feature is enabled on *both* sides of the network link.

Why can't I establish an end-to-end connection on the Frame Relay link?

Check the bandwidth on both sides of the Frame Relay link. The bandwidth on both sides of the link *must be the same* ; otherwise a fragmentation size mismatch occurs, and a connection cannot be established.

Note   For more help, see the Troubleshooting Tips, page 20 section.

What to Do Next

If the policy maps and class maps created (on the basis of the templates generated by the AutoQoS for the Enterprise feature) do not meet the needs of your network, the policy maps and class maps can be modified using the appropriate Cisco IOS commands.

Note   Although you can modify the policy maps and class maps, they may not be removed properly when the AutoQoS for the Enterprise feature is disabled using the **no auto qos** command. You may have to manually remove any modified policy maps and class maps. For more information about the **no auto qos** command, see the Cisco IOS Quality of Service Solutions Command Reference.

Verifying the AutoQoS for the Enterprise Configuration

SUMMARY STEPS

1. **enable**
2. **show auto qos** [**interface** [*interface type*]]
3. and/or
4. **show auto discovery qos** [**interface** [*type number*]]
5. and/or
6. **show policy-map interface** [*type number*]
7. **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 auto qos** [**interface** [*interface type*]]
	
	Example:
	
	`Router#`
	`show auto qos interface serial4/0`
		(Optional) Displays the AutoQoS templates created for a specific interface or all interfaces.

Step 3	and/or	

Step 4	**show auto discovery qos** [**interface** [*type number*]]
	
	Example:
	
	`Router#`
	`show auto discovery qos interface`
	`serial4/0`
		(Optional) Displays the results of the data collected during the Auto-Discovery phase for a specific interface or all interfaces.

Step 5	and/or	

	Command or Action	Purpose
Step 6	**show policy-map interface** [*type number*] **Example:** Router# show policy-map interface serial4/0 **Example:**	(Optional) Displays the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface. • The packet statistics can be displayed for a specific interface, subinterface, PVC, or all interfaces, subinterfaces, or PVCs.
Step 7	**exit** **Example:** Router# exit	(Optional) Exits privileged EXEC mode.

Configuration Examples for the AutoQoS for the Enterprise Feature

Example Enabling the Auto-Discovery Phase

In the following example, the Auto-Discovery phase of the AutoQoS for the Enterprise feature has been enabled on serial interface 4/0 by using the **auto discovery qos**command. In this example, the bandwidth has been specified, although this is optional. With this configuration, data about the network traffic will be collected using NBAR-based protocol discovery and the traffic on the network will be analyzed.

```
Router> enable
Router# configure terminal
Router(config)#

interface seril4/0

Router(config-if)#

bandwidth 1540
Router(config-if)#

auto discovery qos

Router(config-if)#

end
```

Example Enabling the AutoQoS Template Generation Phase

In the following example, the template generation phase of the AutoQoS for the Enterprise feature has been enabled on serial interface 4/0 by using the **auto qos**command. In the template generation phase, class maps and policy maps are created (and installed) on the basis of the information collected during the Auto-Discovery phase conducted earlier.

```
Router> enable
Router# configure terminal
Router(config)#

interface serial4/0
Router(config-if)#

auto qos
Router(config-if)#

end
```

Example Verifying the AutoQoS for the Enterprise Configuration

The AutoQoS template generation phase of the AutoQoS for the Enterprise feature automatically generates templates that are, in turn, used to create policy maps and class maps. These policy maps and class maps configure the QoS features on your network.

The output of the **show auto discovery qos**command, the **show auto qos** command, and the **show policy-map interface**command can be used to verify the contents of the policy maps and class maps created by this AutoQoS for the Enterprise feature. The following section contains sample output for each of these commands.

The following is sample output from the **show auto discovery qos** command. This example displays the data collected during the Auto-Discovery (data discovery) phase.

```
Router# show auto discovery qos
Serial2/1.1
 AutoQoS Discovery enabled for applications
 Discovery up time: 55 minutes, 52 seconds
 AutoQoS Class information:
 Class VoIP:
  Recommended Minimum Bandwidth: 517 Kbps/50% (PeakRate).
  Detected applications and data:
  Application/      AverageRate      PeakRate         Total
  Protocol          (kbps/%)         (kbps/%)         (bytes)
  ----------        ----------       --------         ------------
  rtp audio         2/<1             517/50           703104
 Class Interactive Video:
  Recommended Minimum Bandwidth: 24 Kbps/2% (AverageRate).
  Detected applications and data:
  Application/      AverageRate      PeakRate         Total
  Protocol          (kbps/%)         (kbps/%)         (bytes)
  ----------        ----------       --------         ------------
  rtp video         24/2             5337/52          704574
 Class Control:
  Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate).
  Detected applications and data:
  Application/      AverageRate      PeakRate         Total
  Protocol          (kbps/%)         (kbps/%)         (bytes)
  ----------        ----------       --------         ------------
  h323              0/0              74/7             30212
  rtcp              0/0              7/<1             1540
 Class Streaming Video:
  Recommended Minimum Bandwidth: 3 Kbps/<1% (AverageRate).
  Detected applications and data:
  Application/      AverageRate      PeakRate         Total
```

```
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        -----------         --------            ------------
 cuseeme            3/<1                6148/60             99038
Class Transactional:
 Recommended Minimum Bandwidth: 1 Kbps/<1% (AverageRate).
 Detected applications and data:
 Application/       AverageRate         PeakRate            Total
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        -----------         --------            ------------
 sqlnet             1/<1                1706/16             40187
Class Bulk:
 Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate).
 Detected applications and data:
 Application/       AverageRate         PeakRate            Total
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        -----------         --------            ------------
 ftp                0/0                 313/30              74480
Class Scavenger:
 Recommended Minimum Bandwidth: 1 Kbps (AverageRate)/0% (fixed).
 Detected applications and data:
 Application/       AverageRate         PeakRate            Total
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        ---------           --------            ------------
 napster            1/<1                1429/13             33941
Class Management:
 Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate).
 Detected applications and data:
 Application/       AverageRate         PeakRate            Total
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        -----------         --------            ------------
 dhcp               0/0                 84/8                114480
 ldap               0/0                 169/16              55364
Class Routing:
 Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate).
 Detected applications and data:
 Application/       AverageRate         PeakRate            Total
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        -----------         --------            ------------
 icmp               0/0                 2/<1                300
Class Best Effort:
 Current Bandwidth Estimation: 350 Kbps/34% (AverageRate).
 Detected applications and data:
 Application/       AverageRate         PeakRate            Total
 Protocol           (kbps/%)            (kbps/%)            (bytes)
 -----------        -----------         --------            ------------
 unknowns           336/32              99457/97            949276
 http               14/1                15607/15            41945
```

The following is sample output from the **show auto qos** command. This example displays the templates created on the basis of the data collected during the data collection phase.

```
Router# show auto qos
 !
 policy-map AutoQoS-Policy-Se2/1.1
  class AutoQoS-Voice-Se2/1.1
   priority percent 50
   set dscp ef
  class AutoQoS-Inter-Video-Se2/1.1
   bandwidth remaining percent 10
   set dscp af41
  class AutoQoS-Stream-Video-Se2/1.1
   bandwidth remaining percent 1
   set dscp cs4
  class AutoQoS-Transactional-Se2/1.1
   bandwidth remaining percent 1
   set dscp af21
  class AutoQoS-Scavenger-Se2/1.1
   bandwidth remaining percent 1
   set dscp cs1
  class class-default
   fair-queue
 !
 policy-map AutoQoS-Policy-Se2/1.1-Parent
```

```
  class class-default
    shape average 1024000
    service-policy AutoQoS-Policy-Se2/1.1
!
class-map match-any AutoQoS-Stream-Video-Se2/1.1
 match protocol cuseeme
!
class-map match-any AutoQoS-Transactional-Se2/1.1
 match protocol sqlnet
!
class-map match-any AutoQoS-Voice-Se2/1.1
 match protocol rtp audio
!
class-map match-any AutoQoS-Scavenger-Se2/1.1
 match protocol napster
!
class-map match-any AutoQoS-Inter-Video-Se2/1.1
 match protocol rtp video
!
 rmon event 33333 log trap AutoQoS description "AutoQoS SNMP traps for Voice Drops" owner
AutoQoS
Serial2/1.1: DLCI 58 -
 !
 interface Serial2/1.1 point-to-point
  frame-relay interface-dlci 58
   class AutoQoS-FR-Serial2/1-58
 !
 map-class frame-relay AutoQoS-FR-Serial2/1-58
  frame-relay cir 1024000
  frame-relay bc 10240
  frame-relay be 0
  frame-relay mincir 1024000
  service-policy output AutoQoS-Policy-Se2/1.1-Parent
```

The following sample output from the **show policy-map interface** command displays the packet statistics of the classes (for all service policies) configured by the AutoQoS for the Enterprise feature on the serial 2/1/1 subinterface.

```
Router# show policy-map interface
 Serial2/1.1: DLCI 58 -
  Service-policy output: AutoQoS-Policy-Se2/1.1-Parent
    Class-map: class-default (match-any)
      725797 packets, 224584146 bytes
      5 minute offered rate 3468000 bps, drop rate 2605000 bps
      Match: any
      Traffic Shaping
           Target/Average   Byte   Sustain   Excess    Interval  Increment
             Rate           Limit  bits/int  bits/int  (ms)      (bytes)
           1024000/1024000  6400   25600     25600     25        3200
        Adapt  Queue    Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                        Delayed   Delayed   Active
        -      1000     268047    48786251  268032    48777309  yes
      Service-policy : AutoQoS-Policy-Se2/1.1
        Class-map: AutoQoS-Voice-Se2/1.1 (match-any)
          80596 packets, 5158144 bytes
          5 minute offered rate 105000 bps, drop rate 14000 bps
          Match: protocol rtp audio
            80596 packets, 5158144 bytes
            5 minute rate 105000 bps
          Queueing
            Strict Priority
            Output Queue: Conversation 72
            Bandwidth 70 (%)
            Bandwidth 716 (kbps) Burst 17900 (Bytes)
            (pkts matched/bytes matched) 82010/5248640
            (total drops/bytes drops) 12501/800064
          QoS Set
            dscp ef
              Packets marked 82010
        Class-map: AutoQoS-Inter-Video-Se2/1.1 (match-any)
          50669 packets, 42473594 bytes
          5 minute offered rate 692000 bps, drop rate 513000 bps
```

```
                      Match: protocol rtp video
                        50669 packets, 42473594 bytes
                        5 minute rate 692000 bps
                      Queueing
                        Output Queue: Conversation 73
                        Bandwidth remaining 10 (%) Max Threshold 64 (packets)
                        (pkts matched/bytes matched) 51558/43218807
                  (depth/total drops/no-buffer drops) 9/37454/7588
                      QoS Set
                        dscp af41
                          Packets marked 52193
                  Class-map: AutoQoS-Stream-Video-Se2/1.1 (match-any)
                    79843 packets, 30678725 bytes
                    5 minute offered rate 511000 bps, drop rate 428000 bps
                      Match: protocol cuseeme
                        79843 packets, 30678725 bytes
                        5 minute rate 511000 bps
                      Queueing
                        Output Queue: Conversation 74
                        Bandwidth remaining 1 (%) Max Threshold 64 (packets)
                        (pkts matched/bytes matched) 82381/31658370
                  (depth/total drops/no-buffer drops) 0/63889/7245
                      QoS Set
                        dscp cs4
                          Packets marked 82395
                  Class-map: AutoQoS-Transactional-Se2/1.1 (match-any)
                    77805 packets, 8511468 bytes
                    5 minute offered rate 157000 bps, drop rate 102000 bps
                      Match: protocol sqlnet
                        77805 packets, 8511468 bytes
                        5 minute rate 157000 bps
                      Queueing
                        Output Queue: Conversation 75
                        Bandwidth remaining 1 (%) Max Threshold 64 (packets)
                        (pkts matched/bytes matched) 80635/8820988
                  (depth/total drops/no-buffer drops) 64/50967/3296
                      QoS Set
                        dscp af21
                          Packets marked 80655
                  Class-map: AutoQoS-Scavenger-Se2/1.1 (match-any)
                    30723 packets, 7127736 bytes
                    5 minute offered rate 136000 bps, drop rate 84000 bps
                      Match: protocol napster
                        30723 packets, 7127736 bytes
                        5 minute rate 136000 bps
                      Queueing
                        Output Queue: Conversation 76
                        Bandwidth remaining 1 (%) Max Threshold 64 (packets)
                        (pkts matched/bytes matched) 31785/7373950
                  (depth/total drops/no-buffer drops) 0/16381/6160
                      QoS Set
                        dscp cs1
                          Packets marked 31955
                  Class-map: class-default (match-any)
                    406161 packets, 130634479 bytes
                    5 minute offered rate 2033000 bps, drop rate 1703000 bps
                      Match: any
                      Queueing
                        Flow Based Fair Queueing
                        Maximum Number of Hashed Queues 64
                  (total queued/total drops/no-buffer drops) 806/291482/13603
```

Additional References

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
NBAR	"Classifying Network Traffic Using NBAR" module
AutoQoS for voice over IP (VoIP)	"AutoQoS --VoIP" module
LFI and cRTP	"Header Compression" module
Packet classification	"Classifying Network Traffic" module
LLQ	"Configuring Weighted Fair Queueing" module
Service policies (policy maps)	"Applying QoS Features Using the MQC" module
Frame Relay and ATM commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Wide-Area Networking Command Reference*
Frame Relay configuration	"Configuring Frame Relay" module
MLPPP	"Configuring Media-Independent PPP and Multilink PPP" module
SNMP	"Configuring SNMP Support" module
CiscoWorks QoS Policy Manager (QPM)	Product information available online at Cisco.com

Standards

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

MIBs

MIB	MIBs Link
• CISCO-CLASS-BASED-QOS-MIB • CISCO-CLASS-BASED-QOS-CAPABILITY-MIB • CISCO-NBAR-PROTOCOL-DISCOVERY-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 by this feature, and support for existing standards has not been modified by this feature.	--

Technical Assistance

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

Feature Information for AutoQoS for the Enterprise

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

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

Table 7 *Feature Information for AutoQoS for the Enterprise*

Feature Name	Releases	Feature Information
AutoQos for the Enterprise	12.2(18)ZYA2 12.3(7)T	The AutoQoS for the Enterprise feature automates the deployment of quality of service (QoS) policies in a general business environment, particularly for midsize companies and branch offices of larger companies. In Release 12.3(7)T, this feature was introduced. In Release 12.2(18)ZYA2, support was added for the Cisco Catalyst 6500. The following commands were introduced or modified: **auto discovery qos, auto qos**, **show auto discovery qos**, **show auto qos**.