



Quality of Services Overview

This module explains quality of service (QoS) and the service models that embody it. It also suggests benefits can gain from using Cisco IOS QoS in your network. Then it focuses on the Cisco IOS QoS features and the technologies that implement them.

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What Is Quality of Service?

QoS refers to the ability of a network to provide improved service to selected network traffic over various underlying technologies including Frame Relay, ATM, Ethernet and 802.1 networks, SONET, and IP-routed networks. In particular, QoS features provide improved and more predictable network service by implementing the following services:

- Supporting guaranteed bandwidth
- Improving loss characteristics
- Avoiding and managing network congestion
- Shaping network traffic
- Setting traffic priorities across the network



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About QoS Architecture

You configure QoS features throughout a network to provide for end-to-end QoS delivery. The following three components are necessary to deliver QoS across a heterogeneous network:

- QoS within a single network element, which includes queuing, scheduling, and traffic shaping features.
- QoS signaling techniques for coordinating QoS for end-to-end delivery between network elements.
- QoS policing and management functions to control and administer end-to-end traffic across a network.

Not all QoS techniques are appropriate for all network routers. Because edge routers and backbone routers in a network do not necessarily perform the same operations, the QoS tasks that they perform might differ as well. To configure an IP network for real-time voice traffic, for example, you would need to consider the functions of both edge and backbone routers in the network and then select the appropriate QoS feature or features.

In general, edge routers perform the following QoS functions:

- Packet classification and marking
- Admission control
- Congestion management

In general, backbone routers perform the following QoS functions:

- Congestion management
- Congestion avoidance

Who Could Benefit from Using Cisco IOS QoS?

All networks can take advantage of aspects of QoS for optimum efficiency, whether the network is for a small corporation, an enterprise, or an Internet service provider (ISP). Different categories of networking users—such as major enterprises, network service providers, and small- and medium-sized businesses—have their own QoS requirements; in many areas, however, these requirements overlap. The Cisco IOS QoS features described in the “Cisco IOS QoS Features” section address these diverse and common needs.

Enterprise networks, for example, must provide end-to-end QoS solutions across the various platforms that comprise the network. Providing solutions for heterogeneous platforms often requires that you take a different QoS configuration approach for each technology. As enterprise networks carry more complex, mission-critical applications and experience increased traffic from web multimedia applications, QoS serves to prioritize this traffic to ensure that each application gets the service that it requires.

ISPs require assured scalability and performance. For example, ISPs that have long offered best-effort IP connectivity now also transfer voice, video, and other real-time critical application data. QoS answers the scalability and performance needs of these ISPs to distinguish different kinds of traffic, thereby enabling them to offer service differentiation to their customers.

In the small- and medium-sized business segment, managers are experiencing firsthand the rapid growth of business on the Internet. These business networks must also handle increasingly complex business applications. QoS lets the network handle the difficult task of utilizing an expensive WAN connection in the most efficient way for business applications.

Why Deploy Cisco IOS QoS?

The Cisco IOS QoS features enable networks to control and predictably service a variety of networked applications and traffic types. Implementing Cisco IOS QoS in your network has the following advantages:

- Control over resources. You have control over which resources (bandwidth, equipment, wide-area facilities, and so on) are being used. For example, you can limit bandwidth consumed over a backbone link by FTP transfers or give priority to an important database access.
- Tailored services. If you are an ISP, the control and visibility provided by QoS enables you to offer carefully tailored grades of service differentiation to your customers.
- Coexistence of mission-critical applications. Cisco IOS QoS features ensures following conditions:
 - That your WAN is used efficiently by mission-critical applications that are most important to your business.
 - That bandwidth and minimum delays required by time-sensitive multimedia and voice applications are available.
 - That other applications using the link get their fair service without interfering with mission-critical traffic.

Moreover, in implementing QoS features in your network, you put in place the foundation for a future fully integrated network.

End-to-End QoS Models

A service model, also called a level of service, describes a set of end-to-end QoS capabilities. End-to-end QoS is the ability of the network to deliver service required by specific network traffic from one end of the network to another. Cisco IOS QoS software supports three types of service models: best effort, integrated, and differentiated services.



Note

QoS models differ in how they enable applications to send data and in the ways in which the network attempts to deliver that data. For instance, one service model can be used for real-time applications, such as audio and video conferencing and IP telephony, while another service model can be used for file transfer and e-mail applications.

Consider the following factors when deciding which type of service to deploy in the network:

- The application or problem that you are trying to solve. Each of the three types of service—best effort, integrated, and differentiated—is appropriate for certain applications.
- The kind of capability that you want to allocate to your resources.
- Cost-benefit analysis. For example, the cost of implementing and deploying differentiated service is certain to be more expensive than the cost for a best-effort service.

The following sections describe the service models that are supported by features in Cisco IOS software:

- [Best-Effort Service](#)
- [Integrated Service](#)
- [Differentiated Service](#)

Best-Effort Service

Best effort is a single service model in which an application sends data whenever it must, in any quantity, and without requesting permission or first informing the network. For best-effort service, the network delivers data if it can, without any assurance of reliability, delay bounds, or throughput.

The Cisco IOS QoS feature that implements best-effort service is first-in, first-out (FIFO) queuing. Best-effort service is suitable for a wide range of networked applications such as general file transfers or e-mail.

Integrated Service

Integrated service is a multiple service model that can accommodate multiple QoS requirements. In this model the application requests a specific kind of service from the network before it sends data. The request is made by explicit signaling; the application informs the network of its traffic profile and requests a particular kind of service that can encompass its bandwidth and delay requirements. The application is expected to send data only after it gets a confirmation from the network. It is also expected to send data that lies within its described traffic profile.

The network performs admission control on the basis of information from the application and available network resources. It also commits to meeting the QoS requirements of the application as long as the traffic remains within the profile specifications. The network fulfills its commitment by maintaining per-flow state and then performing packet classification, policing, and intelligent queuing based on that state.

Cisco IOS QoS includes the following features that provide controlled load service, which is a kind of integrated service:

- The Resource Reservation Protocol (RSVP), which can be used by applications to signal their QoS requirements to the router.
- Intelligent queuing mechanisms, which can be used with RSVP to provide the following kinds of services:
 - Guaranteed rate service, which allows applications to reserve bandwidth to meet their requirements. For example, a Voice over IP (VoIP) application can reserve the required amount of bandwidth end-to-end using this kind of service. Cisco IOS QoS uses weighted fair queuing (WFQ) with RSVP to provide this kind of service.
 - Controlled load service, which allows applications to have low delay and high throughput even during times of congestion. For example, adaptive real-time applications, such as playback of a recorded conference, can use this kind of service. Cisco IOS QoS uses RSVP with Weighted Random Early Detection (WRED) to provide this kind of service.

Differentiated Service

Differentiated service is a multiple service model that can satisfy differing QoS requirements. However, unlike in the integrated service model, an application using differentiated service does not explicitly signal the router before sending data.

For differentiated service, the network tries to deliver a particular kind of service based on the QoS specified by each packet. This specification can occur in different ways, for example, using the IP Precedence bit settings in IP packets or source and destination addresses. The network uses the QoS specification to classify, mark, shape, and police traffic and to perform intelligent queuing.

The differentiated service model is used for several mission-critical applications and for providing end-to-end QoS. Typically, this service model is appropriate for aggregate flows because it performs a relatively coarse level of traffic classification.

Cisco IOS QoS includes the following features that support the differentiated service model:

- Committed access rate (CAR), which performs metering and policing of traffic, providing bandwidth management.
- Intelligent queuing schemes such as WRED and WFQ and their equivalent features on the Versatile Interface Processor (VIP), which are distributed WRED (DWRED) and distributed WFQ. These features can be used with CAR to deliver differentiated services.

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