



## Quality of Service Overview

---

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

To identify the hardware platform or software image information associated with a feature, use the Feature Navigator on Cisco.com to search for information about the feature or refer to the software release notes for a specific release. For more information, see the [“Identifying Supported Platforms”](#) section in the [“Using Cisco IOS Software”](#) chapter in this book.

## 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 providing the following services:

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

## 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 signalling 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 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, then select the appropriate QoS feature or features.

In general, edge routers perform the following QoS functions:

- Packet classification
- Admission control
- Configuration 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 business networking users—have their own QoS requirements; in many areas, however, these requirements overlap. The Cisco IOS QoS features described in the section “[Cisco QoS Features](#)” later in this chapter address these diverse and common needs.

Enterprise networks, for example, must provide end-to-end QoS solutions across the various platforms comprising 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 it requires.

ISPs require assured scalability and performance. For example, ISPs that long have 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 promotes the following features:

- 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 File Transfer Protocol (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 QoS features make certain of the 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 service models differ from one another in how they enable applications to send data and in the ways in which the network attempts to deliver that data. For instance, a different service model applies to real-time applications, such as audio and video conferencing and IP telephony, than a model that applies to 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 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 ability 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 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 FIFO queueing. 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 signalling; 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, based on 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 queueing 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 queueing 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 queueing (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 queueing.

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 packet classification through IP Precedence and QoS group settings. CAR performs metering and policing of traffic, providing bandwidth management.
- Intelligent queueing 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.

For more information on how to implement Differentiated Services using the components of Cisco IOS software, see the chapter “Implementing DiffServ for End-to-End Quality of Service Overview” in this book.

## Cisco QoS Features

The Cisco IOS QoS software provides the major features described in the following sections. Some of which have been previously mentioned, and all of them are briefly introduced in this chapter.

- [Classification](#)
- [Congestion Management](#)
- [Congestion Avoidance](#)
- [Policing and Shaping](#)
- [Signalling](#)
- [Link Efficiency Mechanisms](#)
- [QoS Solutions](#)
- [Modular QoS Command-Line Interface](#)
- [Security Device Manager](#)

The features listed are described more fully in the overview chapters of this book, which is organized into parts, one for each of the major features listed. Each book part contains an overview chapter and one or more configuration chapters.

## Classification

Packet classification features provide the capability to partition network traffic into multiple priority levels or classes of service. For example, by using the three precedence bits in the Type of service (ToS) field of the IP packet header—two of the values are reserved for other purposes—you can categorize packets into a limited set of up to six traffic classes. After you classify packets, you can utilize other QoS features to assign the appropriate traffic handling policies including congestion management, bandwidth allocation, and delay bounds for each traffic class.

Packets can also be classified by external sources, that is, by a customer or by a downstream network provider. You can either allow the network to accept the classification or override it and reclassify the packet according to a policy that you specify.

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.