



# Classifying VoIP Signaling and Media with DSCP for QoS

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## Feature History

Release	Modification
12.2(2)XB	This feature was introduced.
12.2(2)T	This feature was integrated into Cisco IOS Release 12.2(2)T.

This document describes the Classifying VoIP Signaling and Media with DSCP for QoS feature in Cisco IOS Release 12.2(2)T. It includes the following sections:

- [Feature Overview, page 1](#)
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## Feature Overview

The **ip precedence** command in dial-peer configuration mode, was originally designed to allow the prioritizing of H.323 traffic and the priority used, typically higher than that of IP data traffic. There was no means, however, for the end user to configure prioritization of H.245, H.225, and SIP signaling packets, which resulted in a delay when a call was set up over a congested network.

In order to provide finer tuning of priorities, the **ip precedence** command has been replaced by the **ip qos dscp** command. If a non zero value is specified for a particular type of traffic stream, this value is stored in the DSCP (Differentiated Services Code Point) before the gateway sends the packet out its WAN interface.

## About Differentiated Services

Differentiated Services (DiffServ) describes a set of end-to-end QoS (Quality of Service) 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 services, Integrated Services (IntServ), and Differentiated Services.

Differentiated Services is a multiple service model that can satisfy differing QoS requirements. With Differentiated Services, 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 6-bit DSCP setting 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.

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

## DS Field Definition

A replacement header field, called the DS field, is defined by Differentiated Services. The DS field supersedes the existing definitions of the IPv4 type of service (ToS) octet (RFC 791) and the IPv6 traffic class octet. Six bits of the DS field are used as the DSCP to select the Per Hop Behavior (PHB) at each interface. A currently unused (CU) 2-bit field is reserved for explicit congestion notification (ECN). The value of the CU bits is ignored by DS-compliant interfaces when determining the PHB to apply to a received packet.

## Per-Hop Behaviors

RFC 2475 defines PHB as the externally observable forwarding behavior applied at a DiffServ-compliant node to a DiffServ Behavior Aggregate (BA).

With the ability of the system to mark packets according to DSCP setting, collections of packets with the same DSCP setting and sent in a particular direction can be grouped into a BA. Packets from multiple sources or applications can belong to the same BA.

In other words, a PHB refers to the packet scheduling, queueing, policing, or shaping behavior of a node on any given packet belonging to a BA, as configured by a service level agreement (SLA) or a policy map.

The following sections describe the four available standard PHBs:

- Default PHB (as defined in RFC 2474).
- Class-Selector PHB (as defined in RFC 2474).
- Assured Forwarding (AFny) PHB (as defined in RFC 2597).
- Expedited Forwarding (EF) PHB (as defined in RFC 2598).

## Default PHB

The default PHB essentially specifies that a packet marked with a DSCP value of 000000 (recommended) receives the traditional best-effort service from a DS-compliant node (that is, a network node that complies with all of the core DiffServ requirements). Also, if a packet arrives at a DS-compliant node, and the DSCP value is not mapped to any other PHB, the packet will get mapped to the default PHB.

## Class-Selector PHB

To preserve backward-compatibility with any IP Precedence scheme currently in use on the network, DiffServ has defined a DSCP value in the form xxx000, where x is either 0 or 1. These DSCP values are called Class-Selector Code Points. (The DSCP value for a packet with default PHB 000000 is also called the Class-Selector Code Point.)

The PHB associated with a Class-Selector Code Point is a Class-Selector PHB. These Class-Selector PHBs retain most of the forwarding behavior as nodes that implement IP Precedence-based classification and forwarding.

For example, packets with a DSCP value of 110000 (the equivalent of the IP Precedence-based value of 110) have preferential forwarding treatment (for scheduling, queueing, and so on), as compared to packets with a DSCP value of 100000 (the equivalent of the IP Precedence-based value of 100). These Class-Selector PHBs ensure that DS-compliant nodes can coexist with IP Precedence-based nodes.

## Assured Forwarding PHB

Assured Forwarding PHB is nearly equivalent to Controlled Load Service available in the integrated services model. AFny PHB defines a method by which BAs can be given different forwarding assurances.

For example, network traffic can be divided into the following classes:

- Gold: Traffic in this category is allocated 50 percent of the available bandwidth.
- Silver: Traffic in this category is allocated 30 percent of the available bandwidth.
- Bronze: Traffic in this category is allocated 20 percent of the available bandwidth.

Further, the AFny PHB defines four AF classes: AF1, AF2, AF3, and AF4. Each class is assigned a specific amount of buffer space and interface bandwidth, according to the SLA with the service provider or policy map.

Within each AF class, you can specify three drop precedence (dP) values: 1, 2, and 3. Assured Forwarding PHB can be expressed as shown in the following example: AFny. In this example, n represents the AF class number (1, 2, or 3) and y represents the dP value (1, 2, or 3) within the AFn class.

In instances of network traffic congestion, if packets in a particular AF class (for example, AF1) need to be dropped, packets in the AF1 class will be dropped according to the following guideline:

$$dP(AFny) \geq dP(AFnz) \geq dP(AFnx)$$

where dP (AFny) is the probability that packets of the AFny class will be dropped. In other words, y denotes the dP within an AFn class.

In the following example, packets in the AF13 class will be dropped before packets in the AF12 class, which in turn will be dropped before packets in the AF11 class:

$$dP(AF13) \geq dP(AF12) \geq dP(AF11)$$

The dP method penalizes traffic flows within a particular BA that exceed the assigned bandwidth. Packets on these offending flows could be re-marked by a policer to a higher drop precedence.

An AFx class can be denoted by the DSCP value, xyzab0, where xyz can be 001, 010, 011, or 100, and ab represents the dP value.

Table 1 lists the DSCP value and corresponding dP value for each AF PHB class.

**Table 1 DSCP Values and Corresponding Drop Precedence Values for Each AF PHB Class**

Drop Precedence	Class 1	Class 2	Class 3	Class 4
Low drop precedence	001010	010010	011010	100010
Medium drop precedence	001100	010100	011100	100100
High drop precedence	001110	010110	011110	100110

## Expedited Forwarding PHB

Resource Reservation Protocol (RSVP), a component of the integrated services model, provides a Guaranteed Bandwidth Service. Applications such as Voice over IP (VoIP), video, and online trading programs require this kind of robust service. The EF PHB, a key ingredient of DiffServ, supplies this kind of robust service by providing low loss, low latency, low jitter, and assured bandwidth service.

EF can be implemented using priority queueing (PQ), along with rate-limiting on the class (or BA). When implemented in a DiffServ network, EF PHB provides a virtual leased line, or premium service. For optimal efficiency, however, EF PHB should be reserved for only the most critical applications because, in instances of traffic congestion, it is not feasible to treat all or most traffic as high priority.

EF PHB is ideally suited for applications such as VoIP that require low bandwidth, guaranteed bandwidth, low delay, and low jitter.

## Benefits

This DS-compliant CLI provides a means by which you can specify different priority levels for voice payload traffic and signaling traffic at the originating gateway.

## Restrictions

The default DSCP for voice is ef codepoint 101110 (RFC 2598) and the default DSCP for signaling is af31 codepoint 011010 (RFC 2597). Preferred settings are required for each type of traffic stream.

## Related Documents

- *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.2
- *Cisco IOS Quality of Service Solutions Command Reference*, Release 12.2
- *Implementing Quality of Service Policies with DSCP*

## Supported Platforms

- Cisco IAD2400 series

- Cisco 2600 series
- Cisco 3600 series
- Cisco 3700 series
- Cisco AS5300
- Cisco AS5400
- Cisco AS5800
- Cisco AS5850

#### Determining Platform Support Through Cisco Feature Navigator

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Cisco Feature Navigator is a web-based tool that enables you to determine which Cisco IOS software images support a specific set of features and which features are supported in a specific Cisco IOS image. You can search by feature or release. Under the release section, you can compare releases side by side to display both the features unique to each software release and the features in common.

To access Cisco Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to [cco-locksmith@cisco.com](mailto:cco-locksmith@cisco.com). An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions at <http://www.cisco.com/register>.

Cisco Feature Navigator is updated regularly when major Cisco IOS software releases and technology releases occur. For the most current information, go to the Cisco Feature Navigator home page at the following URL:

<http://www.cisco.com/go/fn>

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## Supported Standards, MIBs, and RFCs

#### Standards

None

#### MIBs

None

To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL:

<http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>

**RFCs**

- RFC 2474, *Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers*
- RFC 2475, *An Architecture for Differentiated Services*
- RFC 2597, *Assured Forwarding PHB Group*
- RFC 2598, *An Expedited Forwarding PHB*

## Prerequisites

Cisco IOS Release 12.2(2)XB or 12.2(2)T or a later release must be running.

## Configuration Tasks

See the following sections for configuration tasks for the Classifying VoIP Signaling and Media with Differentiated Services Code Point for QoS feature. Each task in the list is identified as either required or optional.

- [Configuring IP DSCP](#) (Optional)
- [Verifying IP DSCP Configuration](#) (Optional)

## Configuring IP DSCP

To configure IP DSCP precedence, use the following commands:

	Command	Purpose
Step 1	Router(config)# <b>dial-peer voice tag voip</b>	Enters dial-peer configuration mode and specifies VoIP voice encapsulation.
Step 2	Router(config-dial-peer)# <b>ip qos dscp</b> [ <i>number</i>   <i>set-af</i>   <i>set-cs</i>   <b>default</b>   <b>ef</b> ] [ <b>media</b>   <b>signaling</b> ]	Specifies IP DSCP. The optional keywords and arguments are as follows: <ul style="list-style-type: none"> <li>• <i>number</i>—DSCP value. Valid entries are from 0 to 63.</li> <li>• <i>set-af</i>—Sets DSCP to assured forwarding bit pattern. The recommended value is <b>af31</b>, which sets the DSCP to assured forwarding (af31) bit pattern 011010. For a complete list of acceptable values, see the "Command Reference" section.</li> <li>• <i>set-cs</i>—Sets DSCP to class-selector code point. For a complete list of acceptable values, see the "Command Reference" section.</li> <li>• <b>default</b>—Sets DSCP to default bit pattern 000000.</li> <li>• <b>ef</b>—Sets DSCP to expedited forwarding bit pattern 101110.</li> <li>• <b>media</b>—Applies DSCP to media payload packets.</li> <li>• <b>signaling</b>—Applies DSCP to signaling packets.</li> </ul>

## Verifying IP DSCP Configuration

To verify that IP DSCP is configured correctly, enter the **show running-config** privileged EXEC command to display the command settings for the router.

## Configuration Examples

The following displays the screen output using the **show running-config** command.

```
Router# show running-config

Building configuration...

Current configuration :1494 bytes
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname
!
no logging buffered
enable password
!
```



```
no ip address
no ip route-cache
no ip mroute-cache
!
ip classless
ip route 0.0.0.0 172.19.169.65
no ip http server
!
!
!
call rsvp-sync
!
mgcp
!
mgcp profile default
!
dial-peer voice 1 voip
  ip qos dscp cs1 media
!
dial-peer voice 2 voip
!
!
line con 0
  password #lwriter
line 1 48
  transport output lat pad telnet rlogin udptn v120 lapb-ta
line aux 0
line vty 0 4
  password #
  login
!
end
```

## Command Reference

This section documents the new **ip qos dscp** command. All other commands used with this feature are documented in the Cisco IOS Release 12.2 command reference publications.

## ip qos dscp

To set the DSCP for the quality of service, use the **ip qos dscp** command in dial-peer configuration mode. To disable DSCP, use the **no** form of this command.

**ip qos dscp** [*number* | *set-af* | *set-cs* | **default** | **ef**] [**media** | **signaling**]

**no ip qos dscp** [*number* | *set-af* | *set-cs* | **default** | **ef**] [**media** | **signaling**]

Syntax Description	
<i>number</i>	(Optional) DSCP value. Valid entries are from 0 to 63.
<i>set-af</i>	(Optional) Sets DSCP to assured forwarding bit pattern. Acceptable values are as follows: <ul style="list-style-type: none"> <li>• <b>af11</b>—bit pattern 001010</li> <li>• <b>af12</b>—bit pattern 001100</li> <li>• <b>af13</b>—bit pattern 001110</li> <li>• <b>af21</b>—bit pattern 010010</li> <li>• <b>af22</b>—bit pattern 010100</li> <li>• <b>af23</b>—bit pattern 010110</li> <li>• <b>af31</b>—bit pattern 011010</li> <li>• <b>af32</b>—bit pattern 011100</li> <li>• <b>af33</b>—bit pattern 011110</li> <li>• <b>af41</b>—bit pattern 100010</li> <li>• <b>af42</b>—bit pattern 100100</li> <li>• <b>af43</b>—bit pattern 100110</li> </ul>
<i>set-cs</i>	(Optional) Sets DSCP to class-selector code-point. Acceptable values are as follows: <ul style="list-style-type: none"> <li>• <b>cs1</b>—codepoint 1 (precedence 1)</li> <li>• <b>cs2</b>—codepoint 2 (precedence 2)</li> <li>• <b>cs3</b>—codepoint 3 (precedence 3)</li> <li>• <b>cs4</b>—codepoint 4 (precedence 4)</li> <li>• <b>cs5</b>—codepoint 5 (precedence 5)</li> <li>• <b>cs6</b>—codepoint 6 (precedence 6)</li> <li>• <b>cs7</b>—codepoint 7 (precedence 7)</li> </ul>
<b>default</b>	(Optional) Sets DSCP to default bit pattern 000000.
<b>ef</b>	(Optional) Sets DSCP to expedited forwarding bit pattern 101110.
<b>media</b>	(Optional) Applies DSCP to media payload packets.
<b>signaling</b>	(Optional) Applies DSCP to signaling packets.

### Defaults

DSCP is set to bit pattern 000000.

**Command Modes** Dial-peer configuration

Command History	Release	Modification
	12.2(2)XB	This command was introduced. It replaced the <b>ip precedence</b> (dial-peer) command.
	12.2(2)T	This command was integrated into Cisco IOS Release 12.2(2)T.

**Usage Guidelines** To configure voice and signaling traffic priorities, use the **ip qos dscp** command. Recommended values are **ip qos dscp ef media** and **ip qos dscp af31 signaling**.

**Examples** The following example specifies that DSCP is set to precedence 1 and is applied to media payload packets.

```
dial-peer voice 1 voip
 ip qos dscp cs1 media
```

Related Commands	Command	Description
	<b>call rsvp-sync</b>	Enables synchronization between RSVP signaling and the voice signaling protocol.
	<b>ip rsvp signalling dscp</b>	Specifies the DSCP to be used on all RSVP messages sent on an interface.

# Glossary

**CLI**—command-line interface. An interface that allows the user to interact with the operating system by entering commands and optional arguments.

**DSCP**—differentiated services code point. A 6-bit setting in IP packets or source and destination addresses.

**IP**—Internet Protocol. Network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security. Defined in RFC 791.

**QoS**—quality of service. Measure of performance for a transmission system that reflects its transmission quality and service availability.

**ToS**—type of service. An indication of how an upper-layer protocol requires a lower-layer protocol to treat its messages.

**VoIP**—Voice over IP. The capability to carry normal telephony-style voice over an IP-based internet with POTS-like functionality, reliability, and voice quality. VoIP enables a router to carry voice traffic (for example, telephone calls and faxes) over an IP network. In VoIP, the DSP segments the voice signal into frames, which then are coupled in groups of two and stored in voice packets. These voice packets are transported using IP in compliance with ITU-T specification H.323.

**WAN**—wide-area network. Data communications network that serves users across a broad geographic area and often uses transmission devices provided by common carriers. Frame Relay, SMDS, and X.25 are examples of WANs.