



## Configuring QoS

This chapter describes how to configure quality of service (QoS).



**Note**

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For complete syntax and usage information for the commands used in this chapter, refer to the *Catalyst 5000 Family Command Reference*.

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This chapter consists of these sections:

- [Understanding How QoS Works, page 15-1](#)
- [Hardware and Software Requirements, page 15-5](#)
- [QoS Default Configuration, page 15-6](#)
- [Configuring QoS, page 15-6](#)

## Understanding How QoS Works

These sections describe how QoS works:

- [Overview of QoS, page 15-1](#)
- [QoS Terminology, page 15-3](#)
- [Understanding Classification and Marking, page 15-3](#)
- [Understanding Scheduling, page 15-4](#)

## Overview of QoS

Networks operate on a best-effort delivery basis, which means that all traffic has equal priority and an equal chance of being delivered in a timely manner. When congestion occurs, all traffic has an equal chance of being dropped.

QoS selects network traffic, prioritizes it according to its relative importance, and provides priority-indexed treatment through congestion-avoidance techniques. Implementing QoS in your network makes network performance more predictable and bandwidth utilization more effective.

QoS classifies traffic by assigning priority-indexed IEEE 802.1p class of service (CoS) values to frames at supported ingress ports. On the Catalyst 5000 family switches, for IPv4 traffic destined for a router, QoS can classify packets that match an access-control entry (ACE) by setting the IP precedence bits (in the IP header) and CoS value in the frame header.

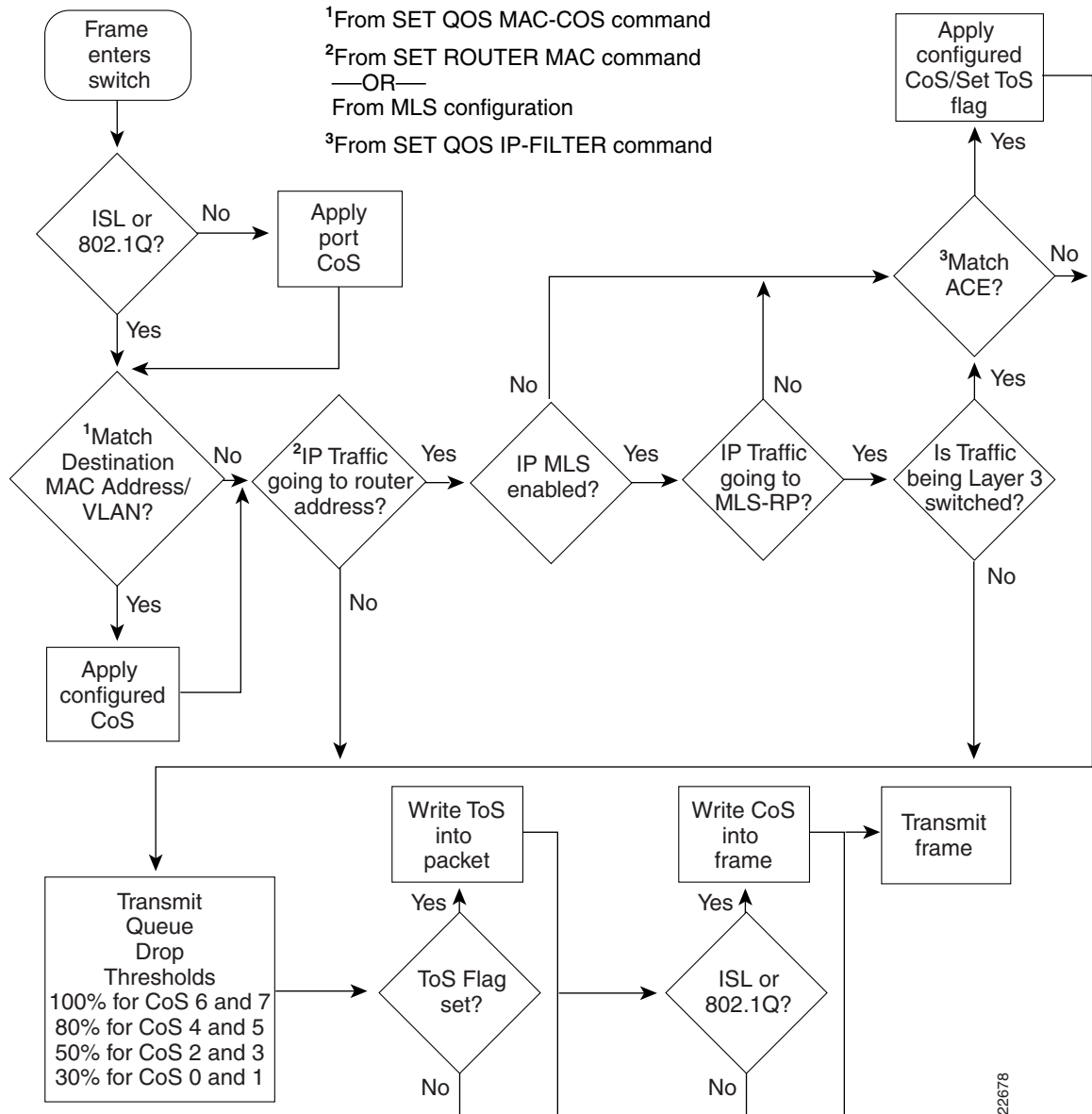
QoS implements scheduling on supported egress ports with transmit queue drop thresholds and multiple transmit queues that use the IEEE 802.1p CoS values to give preference to higher-priority traffic. Figure 15-1 shows how QoS affects the traffic flow through a Catalyst 5000 family switch.



**Note**

Use the **show port capabilities** command to determine if ports on a specific module support QoS as shown in Figure 15-1.

**Figure 15-1 Traffic Flow Through the Switch with QoS Enabled**



22678

## QoS Terminology

The following QoS terminology is used in this chapter:

- Labels—Values to prioritize traffic:

- Layer 2 class of service (CoS) values

Layer 2 Inter-Switch Link (ISL) frame headers have a 1-byte User field that carries an IEEE 802.1p CoS value in the three least significant bits. Layer 2 IEEE 802.1Q frame headers have a 2-byte Tag Control Information field that carries the CoS value in the three most significant bits (the User Priority bits). Other frame types cannot carry CoS values. CoS values range between zero (low priority) and seven (high priority).

- Layer 3 IP precedence values

The IP version 4 specification defines the three most significant bits of the 1-byte Type of Service (ToS) field as IP precedence, which is used to indicate priority. IP precedence values range between zero (low priority) and seven (high priority).

- Classification—Selection of traffic to be marked.
- Marking—Application of QoS labels to traffic.
- Scheduling—Assignment of traffic to a queue. QoS assigns traffic based on CoS values.
- Congestion avoidance—Process by which QoS reserves ingress and egress port capacity for traffic with high-priority CoS values.

QoS implements congestion avoidance with CoS value-based drop thresholds and transmit queues. A drop threshold is the percentage of buffer utilization at which traffic with a specified CoS value is dropped, leaving the buffer available for traffic with higher-priority CoS values. A transmit queue is a queue on the egress port where outgoing frames are stored before transmission. With multiple transmit queues, traffic with higher-priority CoS values can be placed in a reserved transmit queue.

- Policing—Process by which the switch limits the bandwidth consumed by a flow of traffic. Policing can mark or drop traffic.

## Understanding Classification and Marking

These sections describe the three supported methods of classification and marking:

- [Understanding Classification and Marking at the Ingress Port, page 15-3](#)
- [Understanding Classification and Marking Based on Destination, page 15-4](#)
- [Understanding Classification and Marking Based on an ACE, page 15-4](#)

### Understanding Classification and Marking at the Ingress Port

ISL or 802.1Q frames are not classified or marked at the ingress port; the existing CoS value is honored.

- When an ISL frame enters the switch through a supported ingress port, QoS accepts the three least significant bits in the User field as the CoS value.
- When an 802.1Q frame enters the switch through a supported ingress port, QoS accepts the User Priority bits as the CoS value.

On the Catalyst 5000 family switches, QoS classifies and marks all other frame types that enter the switch through a supported ingress port with the configured CoS value of the port (the default is zero).

## Understanding Classification and Marking Based on Destination

On the Catalyst 5000 family switches, QoS can rewrite the CoS value with a configurable value in frames destined for selected destination host Media Access Control (MAC) address and VLAN pairs (see the [“Mapping a CoS Value to a Host Destination MAC Address and VLAN Pair”](#) section on page 15-8). Destination-based marking overwrites any CoS value previously written, including port-based CoS values.

## Understanding Classification and Marking Based on an ACE

On the Catalyst 5000 family switches, for IPv4 traffic destined for a router, QoS can perform classification of traffic that matches the parameters in an access control entry (ACE) under the following conditions:

- If Multilayer Switching (MLS) is disabled, QoS can perform ACE-based classification of all traffic destined for a router. Specify router MAC addresses using the **set qos router-mac** command (see [“Configuring the Router MAC Address”](#) section on page 15-10).
- If MLS is enabled:
  - QoS can perform ACE-based classification of all traffic destined for a router other than the Multilayer Switching Route Processor (MLS-RP). Specify router MAC addresses using the **set qos router-mac** command.
  - For traffic destined for the MLS-RP, QoS can perform ACE-based classification only for traffic that is switched using MLS. ACE-based classification is performed at the switch egress port as the flow is being multilayer switched. QoS cannot perform ACE-based classification on traffic that the MLS-RP routes off the switch. QoS learns the address of the MLS-RP automatically when MLS is configured on the switch.

Use the **show mls entry qos** command to display information about the Layer 3-switched traffic on which QoS has performed ACE-based classification. QoS might take up to 1 second to start ACE-based classification of Layer 3-switched traffic.

If ACE-based classification occurs, QoS sets the IP precedence bits in the IP header to match the CoS value. ACE-based marking overwrites any CoS value previously written, including port-based and destination-based CoS values.

These parameters can be specified in an ACE:

- Layer 3 destination IP address and netmask
- Layer 3 source IP address and netmask
- Layer 4 protocol (**tcp**, **udp**, or **any**)
- Layer 4 destination port number (can be a wildcard)
- Layer 4 source port number (can be a wildcard)

For information on configuring ACEs, see the [“Creating an Access Control Entry”](#) section on page 15-9.

## Understanding Scheduling

On the Catalyst 5000 family switches, there is one non-user-configurable transmit queue and four user-configurable transmit queue drop thresholds for each port. These types of ports are specified using the **1q4t** keyword in QoS-related commands. QoS uses the transmit queue drop thresholds to schedule transmission of network traffic from the switch through supported egress ports.

By default, the four transmit queue drop thresholds function as follows:

- Threshold 1—Frames with CoS 0 or 1 are dropped when the transmit queue buffer is 30 percent full.
- Threshold 2—Frames with CoS 2 or 3 are dropped when the transmit queue buffer is 50 percent full.
- Threshold 3—Frames with CoS 4 or 5 are dropped when the transmit queue buffer is 80 percent full.
- Threshold 4—Frames with CoS 6 or 7 are dropped when the transmit queue buffer is 100 percent full.

**Note**

To configure the transmit queue drop threshold percentages, see the [“Configuring Transmit Queue Drop Thresholds” section on page 15-11](#). To configure the CoS values mapped to each threshold on the Catalyst 5000 family switches, see the [“Mapping CoS Values to Transmit Queues and Drop Thresholds” section on page 15-11](#). All **1q4t** ports in the switch use the same drop threshold configuration.

QoS uses the transmit queues to schedule transmission of network traffic from the switch through egress ports. By default, all traffic is assigned to queue 1 and threshold 1 when QoS is enabled. All traffic destined for a transmit queue, regardless of classification, is subject to tail drop when the queue is full (that is, frames at the end of the queue are dropped).

## Hardware and Software Requirements

QoS requires these software and hardware versions:

- Supervisor engine software release 5.1 or later
- Supervisor Engine II G or III G; or Supervisor Engine III with a NetFlow Feature Card II (NFFC II)
- One or more Ethernet switching modules that support QoS (QoS requires that traffic is received and transmitted on supported ports):
  - 4-port 10/100BASE-TX Fast EtherChannel uplink module (WS-U5537-FETX)
  - 4-port 100BASE-FX MMF MT-RJ Fast EtherChannel uplink module (WS-U5538-FEFX-MMF)
  - 24-port 10/100BASE-TX Fast Ethernet RJ-45 (WS-X5234-RJ45)
  - 24-port 100BASE-FX Fast Ethernet MT-RJ (WS-X5236-FX-MT)
  - 36-port 10/100BASE-TX Fast Ethernet Telco (WS-X5239-RJ21)

Use the **show port capabilities** command to determine the specific QoS support for a module.

# QoS Default Configuration

Table 15-1 shows the QoS default configuration.

**Table 15-1 QoS Default Configuration**

Feature	Default Value
QoS global enable state	Disabled
Port CoS value	0
Transmit queue drop threshold percentages	<ul style="list-style-type: none"> <li>• Threshold 1: 30%</li> <li>• Threshold 2: 50%</li> <li>• Threshold 3: 80%</li> <li>• Threshold 4: 100%</li> </ul>
CoS value-to-drop threshold mapping	<ul style="list-style-type: none"> <li>• Transmit queue drop threshold 1: CoS 0–1</li> <li>• Transmit queue drop threshold 2: CoS 2–3</li> <li>• Transmit queue drop threshold 3: CoS 4–5</li> <li>• Transmit queue drop threshold 4: CoS 6–7</li> </ul>
CoS value-to-transmit queue mapping	<ul style="list-style-type: none"> <li>• Transmit queue 1: CoS 0–7<sup>1</sup></li> </ul>

1. Non-user configurable

## Configuring QoS

These sections describe how to configure QoS:

- [Enabling QoS Globally, page 15-7](#)
- [Configuring the CoS Value for a Port, page 15-7](#)
- [Reverting to the Default Port CoS Value, page 15-8](#)
- [Mapping a CoS Value to a Host Destination MAC Address and VLAN Pair, page 15-8](#)
- [Creating an Access Control Entry, page 15-9](#)
- [Configuring the Router MAC Address, page 15-10](#)
- [Removing a Router Address, page 15-10](#)
- [Configuring Transmit Queue Drop Thresholds, page 15-11](#)
- [Mapping CoS Values to Transmit Queues and Drop Thresholds, page 15-11](#)
- [Reverting to the Default CoS-to-Transmit Queue and Drop Threshold Mapping, page 15-12](#)
- [Displaying QoS Statistics, page 15-12](#)
- [Displaying QoS Information, page 15-12](#)
- [Reverting to QoS Defaults, page 15-13](#)
- [Disabling QoS, page 15-14](#)
- [Configuring COPS Support, page 15-14](#)

**Note**

Enter QoS commands only when necessary because some QoS commands can disable and then reenable ports (which can cause spanning tree topology changes).

## Enabling QoS Globally

To enable QoS globally on the switch, perform this task in privileged mode:

Task	Command
Enable QoS on the switch.	<b>set qos enable</b>

This example shows how to enable QoS:

```
Console> (enable) set qos enable
QoS is enabled.
Console> (enable)
```

## Configuring the CoS Value for a Port

QoS assigns to unclassified frames received through a supported port the CoS value configured for that port. The default CoS value is zero.

To set the CoS value for a port, perform this task in privileged mode:

	Task	Command
<b>Step 1</b>	Set the CoS value for a port.	<b>set port qos mod/port cos cos-value</b>
<b>Step 2</b>	Verify the CoS value of the port.	<b>show port qos mod/port</b>

This example shows how to set CoS equal to 7 in all unclassified frames received through port 8/1 and verify the configuration:

```
Console> (enable) set port qos 8/1 cos 7
Port 8/1 qos cos set to 7
Console> (enable) show port qos 8/1
QoS is enabled on 8/1
Port 8/1 has 1 transmit queue with 4 drop thresholds (1q4t).
QoS setting in NVRAM:
Default CoS = 7
Run time setting of QoS:
Default CoS = 7
Console> (enable)
```

## Reverting to the Default Port CoS Value

To revert to the default CoS value for a port, perform this task in privileged mode:

	Task	Command
Step 1	Revert to the default CoS value for a port.	<b>clear port qos <i>mod/port</i> cos</b>
Step 2	Verify that the default CoS value was restored.	<b>show port qos <i>mod/port</i></b>

This example shows how to revert to the default CoS value for port 8/1 and verify the configuration:

```

Console> (enable) clear port qos 8/1 cos
Port 8/1 qos cos setting cleared.
Console> (enable) show port qos 8/1
QoS is enabled on 8/1
Port 8/1 has 1 transmit queue with 4 drop thresholds (1q4t).
QoS setting in NVRAM:
Default CoS = 0
Run time setting of QoS:
Default CoS = 0
Console> (enable)

```

## Mapping a CoS Value to a Host Destination MAC Address and VLAN Pair

To assign a CoS value to all frames destined for a particular host destination MAC address and VLAN number pair, perform this task in privileged mode:

	Task	Command
Step 1	Assign a CoS value to a host destination MAC address/VLAN number pair.	<b>set qos mac-cos <i>dest_MAC_addr</i> <i>VLAN</i> <i>cos_value</i></b>
Step 2	Verify the assigned CoS value.	<b>show qos mac-cos <i>dest_MAC_addr</i> [<i>VLAN</i>]</b> <b>show qos mac-cos all</b>

This example shows how to assign CoS 2 to a destination MAC address and VLAN number pair and verify the configuration:

```

Console> (enable) set qos mac-cos 00-40-0b-30-03-48 525 2
CoS 2 is assigned to 00-40-0b-30-03-48 vlan 525.
Console> (enable) show qos mac-cos 00-40-0b-30-03-48
VLAN  Dest MAC                CoS
----  -
525   00-40-0b-30-03-48         2
Console> (enable)

```

## Creating an Access Control Entry

Use the **set qos ip-filter** command to create access control entries (ACEs) with Layer 3 values or with both Layer 3 and 4 values.

The *dest\_addr/netmask* parameter is the destination IP address and netmask. The *src\_addr/netmask* parameter is the source IP address and netmask. The *cos* parameter range is 0 to 7. The address and netmask can specify a network, subnet, or host address.

Frames are compared to the ACEs sequentially. QoS uses the first match found. By default, ACEs are added to the end of the access control list. Use the optional **before ACE#** keyword and parameter to position an entry within the list. To display the access control list, enter the **show qos ip** command.

The *dst\_port* parameter is the Layer 4 destination port number. The *src\_port* parameter is the Layer 4 source port number. You can use zero as a wildcard for either or both port numbers.

To create an ACE, perform this task in privileged mode:

	Task	Command
Step 1	Create an ACE.	<pre>set qos ip-filter cos src_ip_addr_spec dest_ip_addr_spec [before ACE#   modify ACE#]  set qos ip-filter cos {tcp   udp   any} src_ip_addr_spec src_port dest_ip_addr_spec dest_port [before ACE#   modify ACE#]</pre>
Step 2	Verify the entry.	<b>show qos ip [runtime]</b>

This example shows how to create ACEs, and an ACE within the list, and verify the configuration:

```
Console> (enable) set qos ip 7 100.100.1.1 255.255.255.0 200.200.1.1 255.255.255.0
qos ip-filter is set successfully.
Console> (enable) show qos ip
There are 1 IP filter(s).
ACE# Dest IP/Mask                               Src IP/Mask
-----
  1 100.100.1.1/255.255.255.0                   200.200.1.1/255.255.255.0
    Protocol Dst Port Src Port CoS
    -----
    both      0      0      7

Console> (enable) set qos ip 4 tcp 120.100.1.1 255.255.255.0 47 210.210.1.1 255.255.255.0 23
qos ip-filter is set successfully.
Console> (enable) show qos ip
There are 2 IP filter(s).
ACE# Dest IP/Mask                               Src IP/Mask
-----
  1 100.100.1.1/255.255.255.0                   200.200.1.1/255.255.255.0
    Protocol Dst Port Src Port CoS
    -----
    both      0      0      7

  2 120.100.1.1/255.255.255.0                   210.210.1.1/255.255.255.0
    Protocol Dst Port Src Port CoS
    -----
    tcp       23      47      4

Console> (enable) set qos ip-filter 1 20.20.20.1 255.0.0.0 30.30.1. 255.0.0.0 before 1
qos ip-filter is set successfully.
Console> (enable) show qos ip
```

There are 3 IP filter(s).

```

ACE# Dest IP/Mask                               Src IP/Mask
-----
 1 20.20.20.1/255.0.0.0                       30.30.1.1/255.0.0.0
   Protocol Dst Port Src Port CoS
   -----
   both      0          0          1

 2 100.100.1.1/255.255.255.0                 200.200.1.1/255.255.255.0
   Protocol Dst Port Src Port CoS
   -----
   both      0          0          7

 3 120.100.1.1/255.255.255.0                 210.210.1.1/255.255.255.0
   Protocol Dst Port Src Port CoS
   -----
   tcp       23         47         4

```

## Configuring the Router MAC Address

To configure a router MAC address to use with QoS (except for MLS-RP), perform this task in privileged mode:

	Task	Command
Step 1	Configure a router for use with QoS.	<b>set qos router-mac</b> <i>MAC_addr</i> <i>vlan</i>
Step 2	Verify the configuration.	<b>show qos router-mac</b> [ <i>MAC_addr</i>   <i>vlan</i> ]

This example shows how to configure a router address in VLAN 2:

```

Console> (enable) set qos router-mac 00-40-0b-30-03-48 2
Router MAC/Vlan is set for QoS.
Console> (enable) show qos router-mac 00-40-0b-30-03-48
Number  MAC address          Vlan #
-----
      1  00-40-0b-30-03-48    2
Console> (enable)

```

## Removing a Router Address

To remove a router or all routers from the QoS configuration, perform this task in privileged mode:

	Task	Command
Step 1	Remove a router or all routers from the QoS configuration.	<b>clear qos router-mac</b> <i>MAC_addr</i> <i>vlan</i> <b>clear qos router-mac all</b>
Step 2	Verify the configuration.	<b>show qos router-mac</b>

This example shows how to clear a router address in VLAN 2:

```

Console> (enable) clear qos router-mac 00-40-0b-30-03-48 2
QoS Router MAC/Vlan(s) cleared.
Console> (enable)

```

## Configuring Transmit Queue Drop Thresholds

Use the **set qos wred-threshold** command to set the transmit queue drop thresholds.

The *port\_type* value is hardware dependent. Use the **show port capabilities** command to determine the *port\_type* for your hardware. The port type is defined by the number of transmit queues and the number of drop thresholds supported on the port. For example, the **1q4t** port type supports one transmit queue and four drop thresholds.

The *q#* value is the transmit queue number. The thresholds are specified as percentages, ranging from 1 to 100. A value of 10 indicates a threshold when the buffer is 10 percent full. The number of threshold percentages you can specify depends on the *port\_type*.

To configure the transmit queue drop thresholds on all ports in the switch, perform this task in privileged mode:

Task	Command
Set the transmit drop queue thresholds.	<b>set qos wred-threshold</b> <i>port_type</i> <b>tx queue</b> <i>q#</i> <i>threshold_percentage_values</i>

This example shows how to configure the transmit queue drop thresholds:

```
Console> (enable) set qos wred-threshold 1q4t tx queue 1 30 50 80 100
Transmit drop thresholds for queue 1 set at 30% 50% 80% 100%
Console> (enable)
```

## Mapping CoS Values to Transmit Queues and Drop Thresholds

Use the **set qos map** command to associate CoS values to transmit queue drop thresholds.

The *port\_type* value is hardware dependent. Use the **show port capabilities** command to determine the *port\_type* value for your hardware. The port type is defined by the number of transmit queues and the number of drop thresholds supported on the port. For example, the **1q4t** port type supports one transmit queue and four drop thresholds.

The *q#* value is the transmit queue number. The *threshold#* value is the drop threshold number for the specified queue.

The *cos\_list* value is the list of CoS values to map to the specified transmit queue and drop threshold.

To associate CoS values to a transmit queue and drop threshold, perform this task in privileged mode:

Task	Command
Associate a CoS value to a transmit queue and drop threshold.	<b>set qos map</b> <i>port_type</i> <i>q#</i> <i>threshold#</i> <b>cos</b> <i>cos_list</i>

This example shows how to assign the CoS values 4 through 7 to the first transmit queue and the second drop threshold for that queue on a **1q4t** port:

```
Console> (enable) set qos map 1q4t 1 2 cos 4-7
Qos tx priority queue and threshold mapped to cos successfully.
Console> (enable)
```

## Reverting to the Default CoS-to-Transmit Queue and Drop Threshold Mapping

Use the **clear qos map** command to revert to the default CoS-to-transmit queue and drop threshold mappings.

The *port\_type* value is hardware dependent. Use the **show port capabilities** command to determine the *port\_type* value for your hardware.

To revert to the default CoS-to-transmit queue and drop threshold mappings, perform this task in privileged mode:

Task	Command
Revert to default CoS-to-transmit queue and drop threshold mappings.	<b>clear qos map</b> <i>port_type</i>

This example shows how to return the CoS-to-transmit queue and drop threshold mappings to the default values on **1q4t** ports:

```
Console> (enable) clear qos map 1q4t
Qos map setting cleared.
Console> (enable)
```

## Displaying QoS Statistics

To display QoS statistics, perform this task in privileged mode:

Task	Command
Display QoS statistics.	<b>show qos statistics</b> [ <i>mod[/port]</i> ]

This example shows how to display QoS statistics for port 8/1:

```
Console> show qos statistics 8/1
On Transmit:Port 8/1 has 1 Queue(s) 4 Threshold(s)
Q # Threshold #:Packets dropped
-----
1 1:63551 pkts, 2:0 pkts, 3:0 pkts, 4:0 pkts
Console>
```

## Displaying QoS Information

To display QoS information, perform one of these tasks in privileged mode:

Task	Command
Display QoS information.	<b>show qos info</b> [ <i>runtime   config</i> ] <i>mod/port</i>
Display QoS information about the transmit queues.	<b>show qos info config</b> <i>port_type tx</i>

This example shows how to display the QoS information currently in NVRAM for port 8/1:

```

Console> show qos info runtime 8/1
Run time setting of QoS:
QoS is enabled
Port 8/1 has 1 transmit queue with 4 drop thresholds (1q4t).
Default CoS = 0
Queue and Threshold Mapping:
Queue Threshold CoS
-----
1      1          0 1
1      2          2 3
1      3          4 5
1      4          6 7
Tx WRED thresholds:
Queue #  Thresholds in percentage ( in abs values )
-----
1          14% (16380 bytes) 28% (32764 bytes) 57% (65532 bytes) 100% (131068 bytes)
Console> (enable)

```

This example shows how to display the QoS information for the transmit queue:

```

Console> (enable) show qos info config 1q4t tx
QoS setting in NVRAM for 1q4t transmit:
QoS is enabled
Queue and Threshold Mapping:
Queue Threshold CoS
-----
1      1          0 1
1      2          2 3
1      3          4 5
1      4          6 7
Tx WRED thresholds:
Queue #  Thresholds in percentage ( in abs values )
-----
1          14% 28% 57% 100%
Console> (enable)

```

## Reverting to QoS Defaults

To revert to QoS defaults, perform this task in privileged mode:

Task	Command
Revert to QoS defaults.	<b>clear qos config</b>

This example shows how to revert to QoS defaults:

```

Console> (enable) clear qos config
This command will disable QoS and take values back to factory default.
Do you want to continue (y/n) [n]? y
QoS config cleared.
Console> (enable)

```



### Note

Because QoS is disabled by default, when you revert to defaults, QoS is disabled.

## Disabling QoS

To disable QoS, perform this task in privileged mode:

Task	Command
Disable QoS on the switch.	<b>set qos disable</b>

This example shows how to disable QoS:

```
Console> (enable) set qos disable
QoS is disabled.
Console> (enable)
```

## Configuring COPS Support



### Note

QoS only supports the commands in this section when it is configured on a switch with a Layer 3 switching engine.

These sections describe configuring Common Open Policy Service (COPS) support:

- [Understanding QoS Policy, page 15-14](#)
- [Selecting COPS as the QoS Policy Source, page 15-15](#)
- [Selecting Locally Configured QoS Policy, page 15-15](#)
- [Configuring Roles, page 15-15](#)
- [Deleting Roles, page 15-16](#)
- [Configuring Policy Decision Point Servers, page 15-16](#)
- [Deleting the PDP Server Configuration, page 15-17](#)
- [Configuring the COPS Domain Name, page 15-17](#)
- [Deleting the COPS Domain Name, page 15-18](#)
- [Configuring the COPS Communications Parameters, page 15-18](#)
- [Displaying Download Policy, page 15-18](#)



### Note

Throughout this guide and all Catalyst 5000 family documents, the term *COPS* refers to COPS support as implemented on the Catalyst 5000 family switches.

## Understanding QoS Policy

The term *QoS policy* refers to the QoS values, such as how packets are classified and scheduled as they pass through the switch.

A valid QoS router MAC address must be configured for COPS to activate. Only the packets destined for the configured router will be classified. For more information on configuring the router MAC address, see “Configuring the Router MAC Address” on page 10.

## Selecting COPS as the QoS Policy Source

QoS uses locally configured QoS values as the default QoS policy source. To select COPS as the QoS policy source, perform this task in privileged mode:

	Task	Command
Step 1	Select COPS as the QoS policy source.	<b>set qos policy-source {local   cops}</b>
Step 2	Verify the QoS policy source.	<b>show qos policy-source</b>

This example shows how to select COPS as the QoS policy source:

```
Console> (enable) set qos policy-source cops
QoS policy source for the switch set to COPS.
Console> (enable) show qos policy-source
QoS policy source for the switch set to COPS.
QoS runtime policy source for the switch is local.
Console> (enable)
```

When you select COPS as the QoS policy source, the following values switch from locally configured values to received COPS values:

- Named and default ACL (list of ACEs) definitions
- CoS-to-queue assignments
- Threshold configuration

## Selecting Locally Configured QoS Policy

To select locally configured QoS policy, perform this task in privileged mode:

	Task	Command
Step 1	Select locally configured QoS policy.	<b>set qos policy-source {local   cops}</b>
Step 2	Verify the QoS policy source.	<b>show qos policy-source</b>

This example shows how to select locally configured QoS policy:

```
Console> (enable) set qos policy-source local
QoS policy source for the switch set to local.
Console> (enable) show qos policy-source
QoS policy source for the switch set to local.
Console> (enable)
```

## Configuring Roles

COPS does not configure ports using slot number and port number parameters. COPS uses *roles* that you create and assign to the switch.

A role is a name that describes the capability of ports (for example, *access* or *mod2\_1-4*). Only one role combination, with up to 64 roles, can be assigned per switch. You can assign more than one role name to a switch (for example, *mod2ports1-12* and *access*), with the limitation that the combined length of role names cannot exceed 255 characters.

The role name can be up to 31 characters long, and is not case-sensitive, but may include uppercase and lowercase letters, consisting of a–z and A–Z, and numbers 0–9, the dash character (-), the underscore character (\_), and the period character (.). Role names must start with an alphabetic character.

When you first assign a new role to a switch, the role is created.

To assign roles to a switch, perform this task in privileged mode:

	Task	Command
Step 1	Assign roles to a port ASIC.	<b>set cops roles</b> <i>role1</i> [ <i>role2</i> ] ...
Step 2	Verify the roles for the port.	<b>show cops roles</b>

This example shows how to assign two new roles to the switch:

```
Console> (enable) set cops roles backbone access
New role 'backbone' created.
New role 'access' created.
Roles added successfully.
Console> (enable)
```

## Deleting Roles

To delete a role (which removes it from all ports), perform this task in privileged mode:

	Task	Command
Step 1	Delete a role.	<b>clear cops</b> { <b>all-roles</b>   <b>roles</b> <i>role1</i> [ <i>role2</i> ] ...}
Step 2	Verify the roles for the port.	<b>show cops roles</b>

This example shows how to delete a role:

```
Console> (enable) clear cops roles backbone_port main_port
Roles cleared.
Console> (enable)
```

## Configuring Policy Decision Point Servers



### Note

COPS can use the same policy decision point (PDP) server.

COPS obtains QoS policy from a PDP server. You need to configure a primary PDP server and, optionally, a backup PDP server to obtain QoS policy.

To configure a PDP server, perform this task in privileged mode:

	Task	Command
Step 1	Configure a PDP server.	<b>set cops server</b> <i>ip_address</i> [ <i>port</i> ] [ <b>primary</b> ]
Step 2	Verify the PDP server configuration.	<b>show cops info</b>

The *ip\_address* parameter can be the IP address or name of the server.

The *port* parameter is the PDP server TCP port number.

The first *ip\_address* value specified is set as the primary server. If an additional *ip\_address* value is set as a COPS server, it becomes the secondary server, unless specified as primary. The previously entered *ip\_address* value becomes the secondary server.

This example shows how to configure a PDP server:

```
Console> (enable) set cops server my_server1 primary
my_server1 added to the COPS diff-serv server table as primary server.
my_server1 added to the COPS rsvp server table as primary server.
Console> (enable)
```

## Deleting the PDP Server Configuration

To delete the PDP server configuration, perform this task in privileged mode:

	Task	Command
Step 1	Delete the PDP server configuration.	<b>clear cops server</b> {all   <i>ip_address</i> }
Step 2	Verify the PDP server configuration.	<b>show cops info</b>

This example shows how to delete PDP server configuration:

```
Console> (enable) clear cops server all
All COPS diff-serv servers cleared.
All COPS rsvp servers cleared.
Console> (enable)
```

## Configuring the COPS Domain Name

PDP servers use a COPS domain name to communicate with policy enforcement point (PEP) devices, such as switches. To configure a COPS domain name for the switch, perform this task in privileged mode:

	Task	Command
Step 1	Configure the COPS domain name.	<b>set cops domain-name</b> <i>domain_name</i>
Step 2	Verify the COPS domain name.	<b>show cops info</b>

This example shows how to configure a COPS domain name:

```
Console> (enable) set cops domain-name my_domain
Domain name set to my_domain.
Console> (enable)
```

## Deleting the COPS Domain Name

To delete the COPS domain name, perform this task in privileged mode:

	Task	Command
Step 1	Delete the COPS domain name.	<b>clear cops domain-name</b>
Step 2	Verify the configuration.	<b>show cops info</b>

This example shows how to delete the COPS domain name:

```
Console> (enable) clear cops domain-name
Domain name cleared.
Console> (enable)
```

## Configuring the COPS Communications Parameters

To configure the parameters that COPS uses to communicate with the PDP server, perform this task in privileged mode:

	Task	Command
Step 1	Configure the parameters that COPS uses to communicate with the PDP server.	<b>set cops retry-interval</b> <i>initial increment maximum</i>
Step 2	Verify the configuration.	<b>show cops info</b>

Enter the parameters as a number of seconds in the range 0 to 65535. The value of the *initial* parameter plus the value of the *increment* parameter must not exceed the value of the *maximum* parameter.

This example shows how to configure the parameters that COPS uses to communicate with the PDP server:

```
Console> (enable) set cops retry-interval 15 1 30
Connection retry intervals set.
Console> (enable)
```

## Displaying Download Policy

To display the runtime policy for the switch, use the following commands:

Task	Command
• Display the QoS policy source information.	<b>show qos policy-source</b>
• Display the access control list.	<b>show qos ip [runtime]</b>
• Display QoS-related information for a specified port.	<b>show qos info [runtime]</b>
• Display the COPS policy tree information.	<b>show cops pib</b>

This example shows how to view the QoS policy source:

```
Console> show qos policy-source
QoS policy source for the switch set to local.
QoS runtime policy source for the switch is local.
Console>
```

This example shows how to display the access control list and its details when cops is disabled:

```
Console> (enable) show qos ip runtime
There are 1 IP filter(s).
ACE# Src IP and Mask                               Dest IP and Mask
-----
  1 171.33.22.7 0.0.0.255                          172.22.33.5 0.0.255.255
    Protocol Src Port Dst Port CoS Action
    -----
      any      0      0      3   -
Console> (enable)
```

This example shows how to display the current QoS runtime information for a port:

```
Console> show qos info runtime 8/1
Run time setting of QoS:
QoS is enabled
Port 8/1 has 1 transmit queue with 4 drop thresholds (1q4t).
Default CoS = 0
Queue and Threshold Mapping:
Queue Threshold CoS
-----
 1      1      0 1
 1      2      2 3
 1      3      4 5
 1      4      6 7
Tx WRED thresholds:
Queue # Thresholds in percentage ( in abs values )
-----
 1      14% (16380 bytes) 28% (32764 bytes) 57% (65532 bytes) 100% (131068 bytes)
Console>
```

This example shows how to display COPS policy tree information:

```
Console> show cops pib
PRC                               PRI   Attr Type          Value
-----
QosDevicePibIncarnationTable      1     0 Unsigned32 1
                                     1 DisplayStr  gllab-pc4.cisco.com
                                     2 OctetStr
30.30.30.30.30.30.30.30.39.34.37.32.37.35.35.35.31.30.36.31.23.30.39.34.37.32.37.35.35.35.
31.23.35.62.66.36.32.31.30.32.38.65.37.31.65.38.37.30.23.31.23
                                     3 Unsigned32 300
QosDeviceAttributeTable           1     0 Unsigned32 1
                                     1 DisplayStr
                                     2 IpAddress  172.20.55.31
QosInterfaceTypeTable             2     0 Unsigned32 2
                                     1 Integer    3
                                     2 DisplayStr  inputclass
                                     3 OctetStr   60.10.20
QosPolicerTable                   -     - - -
QosAggregateTable                 -     - - -
QosMacClassificationTable         -     - - -
QosIpAceTable                     5346  0 Unsigned32 5346
                                     1 IpAddress  0.0.0.7
                                     2 IpAddress  255.255.255.255
```

```
QosIfDropPreferenceTable      3642    0 Unsigned32 3642
                               1 DisplayStr inputclass
                               2 Integer    10
                               3 Integer    1
QosIfTailDropTable           -        - -          -
QosIfWeightsTable            -        - -          -
(display is truncated)
Console>
```