Cisco Nexus 1000V for VMware vSphere Quality of Service Configuration Guide, Release 5.x

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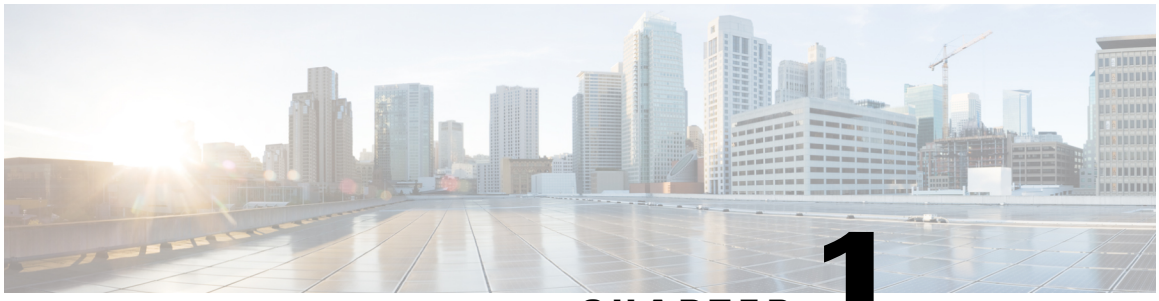


CHAPTER 1

Overview

This chapter contains the following sections:

Information About Quality of Service

You can use quality of service (QoS) to provide the most desirable flow of traffic through a network. QoS allows you to classify your network traffic, police and prioritize the traffic flow, and provide congestion avoidance. Traffic is processed based on how you classify it and the QoS policies that you put in place.

You can implement a QoS policy using the following steps:

1. Define a traffic class by using the **class-map** command. For more information, see Configuring QoS Classification, on page 7.
2. Create a traffic class by using the **policy-map** command. A traffic policy defines how specific traffic is to be acted upon to improve the quality of service. For more information, see Configuring QoS Marking Policies, on page 21.
3. Attach the traffic policy to an interface or port profile by using the **service-policy** command. For more information, see Creating Ingress and Egress Policies, on page 30.
4. Police the traffic. For more information, see Configuring QoS Policing, on page 35.

Traffic Classification and Marking

QoS classifies network traffic, uses or assigns QoS labels to indicate priority, makes the packets comply with the configured resource usage limits (polices the traffic and marks the traffic), and provides congestion avoidance where resource contention exists. The following table describes these processes.

QoS Method	Description	Command	Mechanism
Traffic Classifications	Groups network traffic based on defined criteria.	**match**	class maps
Traffic Marking	Modifies traffic attributes by matching the class.	**set**	policy maps

QoS Commands

QoS configuration commands are shown in the following table.

Command	Configuration	Description
class-map	Global configuration	Defines a class map that represents a class of traffic.
table-map	Global configuration	Defines a table map that represents a mapping from one set of field values to another set of field values. You can reference a table map from a policy map.
policy-map	Global configuration	Defines a policy map that represents a set of policies to be applied to a set of class maps. Policy maps can reference table maps.
match	Class map QoS configuration	Defines the criteria for a class map.
set	Policy map QoS configuration	Defines the action to be taken on the packet.

Command	Configuration	Description
service-policy	Interface or port profile configuration	Applies a specified policy map to input or output packets on interfaces configured as follows: • inherited from a port-profile • port-channel • Ethernet • vEthernet
police	Policy map class QoS configuration	Defines the rate at which data traffic is monitored.

Default QoS Behavior

QoS has no default behavior. Policing and prioritization of traffic are implemented only when you apply a policy map to an interface. When you are configuring QoS with an ACL, note that packets are processed as follows:

- QoS ingress processing follows ACL processing.
- QoS egress processing precedes ACL egress processing.

Supported RFCs

The following table lists RFCs that are supported by QoS.

Number	Title
RFC 2475	Architecture for Differentiated Services
RFC 2697	A Single Rate Three Color Marker
RFC 2698	A Dual Rate Three Color Marker
RFC 3289	Management Information Base for the Differentiated Services Architecture
RFC 3550	RTP: A Transport Protocol for Real-Time Applications

High Availability Requirements for QoS Features

QoS recovers its previous state after a software restart, and it is able to switch over from the active supervisor to the standby supervisor without a loss of state.

Commonly Used DSCP Values

You can mark both incoming and outgoing packets. The following commonly used DSCP values are described in RFC 2475.

DSCP Value	Decimal Value	Meaning	Drop Probability	Equivalent IP Precedence Values
101 110	46	High Priority Expedited Forwarding (EF)	N/A	101—Critical
000 000	0	Best effort	N/A	000—Routine
001 010	10	AF11	Low	001—Priority
001 100	12	AF12	Medium	001—Priority
001 110	14	AF13	High	001—Priority
010 010	18	AF21	Low	010—Immediate
010 100	20	AF22	Medium	010—Immediate
010 110	22	AF23	High	010—Immediate
011 010	26	AF31	Low	011—Flash
011 100	28	AF32	Medium	011—Flash
011 119	30	AF33	High	011—Flash
100 010	34	AF41	Low	100—Flash Override
100 100	36	AF42	Medium	100—Flash Override
100 110	38	AF43	High	100—Flash Override
001 000	8	CS1		1
010 000	16	CS2		2
011 000	24	CS3		3

DSCP Value	Decimal Value	Meaning	Drop Probability	Equivalent IP Precedence Values
100 000	32	CS4		4
101 000	40	CS5		5
110 000	48	CS6		6
111 000	56	CS7		7
000 000	0	Default		
101 110	46	EF		

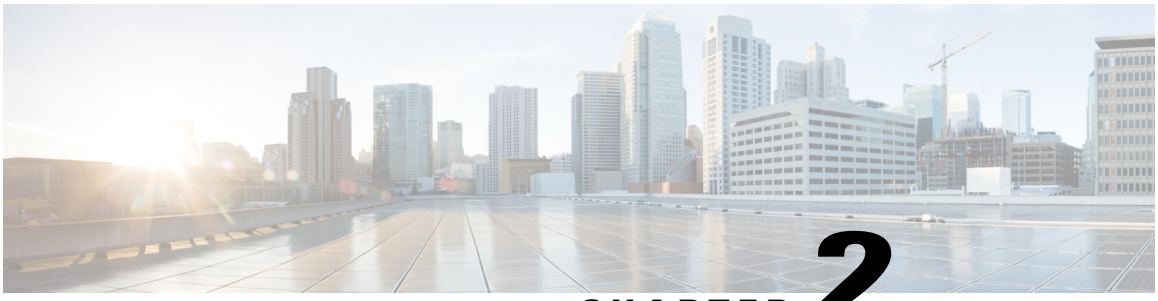
IP Precedence Values

The IP precedence values from least to most important are listed in the following table.

Value	Description
000 (0)	Routine or Best Effort
001 (1)	Priority
010 (2)	Immediate
011 (3)	Flash (mainly used for voice signaling or for video)
100 (4)	Flash Override
101 (5)	Critical (mainly used for voice RTP)
110 (6)	Internet
111 (7)	Network

QoS Configuration Limits

The configuration limits are documented in the *Cisco Nexus 1000V Resource Availability Reference*.



CHAPTER 2

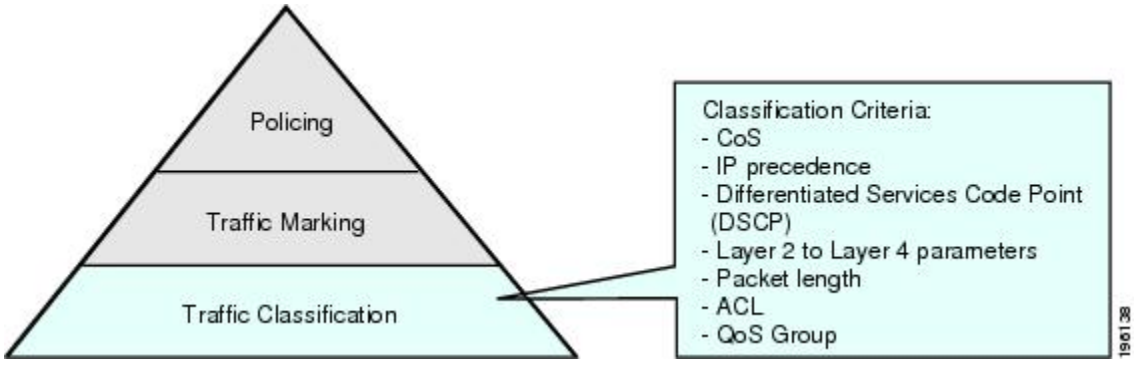
Configuring QoS Classification

This chapter contains the following sections:

Information About Traffic Classes

Traffic classes, or categories of traffic (packets) that are grouped on the basis of similarity of traffic, are called class maps. Classifying network traffic allows you to enable a quality of service (QoS) strategy in your network.

Figure 1: Criteria for Classifying Network Traffic



Identifying and categorizing network traffic into traffic classes (that is, classifying packets) enables you to handle different types of traffic by separating network traffic into different categories.

Classifying network traffic allows you to see the kinds of traffic you have and treat some types of traffic differently than others. Identifying and organizing network traffic allows you to allocate network resources to deliver the best performance for each type of traffic.

You can place network traffic with a specific IP precedence into one traffic class, while you place traffic with a specific differentiated services code point (DSCP) value into another traffic class. Each traffic class can be given a different QoS class, which you configure in a policy map later.

You define each class of traffic in a class map based upon criteria, such as the IP precedence or class of service (CoS). The allowable criteria for mapping classes of traffic is available and you can match the criteria to your traffic as follows:

- Matching all
- Matching or not matching one
- Matching or not matching multiple
- Matching or not matching another class map

Some of the criteria used in traffic class maps relates only to one direction of traffic—either ingress or egress. For example, the internal label QoS group has no meaning on ingress traffic because it has not yet been assigned a value.

Traffic that fails to match any traffic class in a QoS policy map is assigned to a default class of traffic called class-default. The class-default can be referenced in a QoS policy map to select this unmatched traffic.

Criteria for Mapping Classes

The allowable criteria for the mapping traffic classes are as follows:

Class Criteria	Description
CoS	Class of service (CoS) field in the IEEE 802.1Q header.
IP precedence	Precedence value within the type of service (ToS) byte of the IP header. For details, see the IP Precedence Values, on page 5 table.
Differentiated Services Code Point (DSCP)	DSCP value within the DIffServ field of the IP header. The standard DSCP values are listed in Commonly Used DSCP Values, on page 4.
QoS group	Locally significant QoS values that can be manipulated and matched within the system. The range is from 0 to 126.

Class Criteria	Description
Discard class	Locally significant values that can be matched and manipulated within the system. The range is from 0 to 63.
ACL	IP access control list (ACL) or MAC ACL name. If you configure the class to match-all and ACL as match-criteria, no other match criteria, except the packet length, can be specified. If you configure the class to match-any and ACL as match-criteria, you can also match ACLs and any other match criteria.
Packet length	Size range of Layer 3 packet lengths.
IP RTP	Applications that are using the Real-time Transport Protocol (RTP) are identified by UDP port number range.
Class map	Criteria that are specified in a named class-map object.

Prerequisites for Classification

You are logged in to the CLI in EXEC mode.

Guidelines and Limitations for QoS Classification

- You can specify a maximum of 32 match criteria in a class map.
- You can configure a maximum of 64 classes for use in a single policy map if no policers are configured.

Note Tunneled IP packets are not matched unless the tunneling protocol is also IP, and then the match applies to the outer IP header and not the encapsulated IP header.

Classifying Traffic

Classifying ACL Traffic

You can classify traffic by matching packets based on existing access control lists (ACLs).

Before You Begin

- QoS does not use the permit-deny functions of ACLs. The **permit** and **deny** ACL keywords are ignored when matching.
- QoS does not support the **not** form of this command.
- If you configure the class to match-all and ACL as match-criteria, no other match criteria, except the packet length, can be specified.
- If you configure the class to match-any and ACL as match-criteria, you can match ACLs and any other match criteria also.
- You are logged in to the CLI in EXEC mode.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match access-group name** *ac1-name*	Configures and saves the access group to match for this class in the running configuration. **Note** The **permit** and **deny** keywords are ignored when matching the ACL. The **not** form of this command is not supported.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to classify the ACL traffic:

```
switch# configure terminal
switch(config)# class-map class_acl
switch(config-cmap-qos)# match access-group name my_acl
switch(config-cmap-qos)# show class-map class_acl
Type qos class-maps
 ===================

   class-map type qos match-all class_acl
```

```
    match access-group name my_acl
switch(config-cmap-qos)# copy running-config startup-config
```

Classifying DSCP Traffic

You can classify traffic based on the DSCP value in the DiffServ field of the IP header. The standard DSCP values are found in the Commonly Used DSCP Values, on page 4 and IP Precedence Values, on page 5.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match [not] dscp** *dscp_list*	Configures the traffic class by matching packets that are based on *dscp-values*. The standard DSCP values are listed in the Commonly Used DSCP Values, on page 4 and IP Precedence Values, on page 5. Use the **not** keyword to match on values that do not match the specified range.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to classify DSCP traffic:

```
switch# configure terminal
switch(config)# class-map class_dscp
switch(config-cmap-qos)# match dscp af21 af32
switch(config-cmap-qos)# show class-map class_dscp
 Type qos class-maps
 ===================

   class-map type qos match-all class_dscp
     match dscp 18,28

switch(config-cmap-qos)# copy running-config startup-config
```

Configuring IP Precedence Classification

You can classify traffic based on the precedence value in the type of service (ToS) byte field of the IP header. Precedence values can be found in the Commonly Used DSCP Values, on page 4 and IP Precedence Values, on page 5 tables.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match [not] precedence** *values*	Configures the traffic class by matching packets that are based on *precedence-values* listed in the following table: **Value** / **Description** 000 (0) — Routine or Best Effort 001 (1) — Priority 010 (2) — Immediate 011 (3) — Flash (mainly used for voice signaling or for video) 100 (4) — Flash Override 101 (5) — Critical (mainly used for voice RTP) 110 (6) — Internet 111 (7) — Network Use the **not** keyword to match on values that do not match the specified range.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration.

	Command or Action	Purpose
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure the IP precedence classification:

```
switch# configure terminal
switch(config)# class-map class_ip_precedence
switch(config-cmap-qos)# match precedence 1-2, 5-7
switch(config-cmap-qos)# show class-map class_ip_precedence
 Type qos class-maps
 ===================

   class-map type qos match-all class_ip_precedence
     match precedence 1-2,5-7

switch(config-cmap-qos)# copy running-config startup-config
```

Configuring QoS Group Classification

You can classify traffic based on the QoS group internal label, which is not part of the packet payload or any packet header. You can set the value of the QoS group within a policy map using the **set qos-group** command as described in the Creating a QoS Group Policy, on page 28.

Note You match on the QoS group only in egress policies because its value is undefined until you set it in an ingress policy.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match [not] qos-group** *multi-range-qos-group-values*	Configures the traffic class by matching packets that are based on a list of QoS group values. Values can range from 0 to 126. The default QoS group value is 0. Use the **not** keyword to match on values that do not match the specified range.

	Command or Action	Purpose
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration for the specified traffic class name.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure QoS group classification:

```
switch# config terminal
switch(config)# class-map class_qos_group
switch(config-cmap-qos)# match qos-group 4, 80-90
switch(config-cmap-qos)# show class-map class_qos_group
Type qos class-maps
 ====================

   class-map type qos match-all class_qos_group
     match qos-group 4,80-90
switch(config-cmap-qos)# copy running-config startup-config
```

Configuring Discard Class Classification

You can classify traffic based on the value of the discard class internal label, which is not part of the packet payload or any packet header. You can set the value of the discard class within a policy map by using the **set discard-class** command as described in the Creating a Discard Class Policy, on page 29.

Note You match on the discard class only in egress policies because its value is undefined until you set it in an ingress policy.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.

	Command or Action	Purpose
Step 3	switch(config-cmap-qos)# **match [not] discard-class** *multi-range-discard-group-values*	Configures the traffic class by matching packets that are based on a list of discard-class values. Values can range from 0 to 63. The default discard class value is 0. Use the **not** keyword to match on values that do not match the specified range.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration for the specified traffic class name.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure discard class classification:

```
switch# configure terminal
switch(config)# class-map class_discard_class
switch(config-cmap-qos)# match discard-class 4, 60-62
switch(config-cmap-qos)# show class-map class-discard-class
Type qos class-maps
 ====================

   class-map type qos match-all class_dicard_class
     match discard-class 4,60-62
switch(config-cmap-qos)# copy running-config startup-config
```

Configuring Layer 3 Packet Length Classification

You can classify Layer 3 traffic based on various packet lengths.

Note This feature is designed for IP packets only.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.

	Command or Action	Purpose
Step 3	switch(config-cmap-qos)# **match [not] packet-length** *packet-length-list*	Configures the traffic class by matching packets that are based on various packet lengths. Values can range from 1 to 9198. Use the **not** keyword to match on values that do not match the specified range.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration for the specified traffic class name.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure Layer 3 packet length classification:

```
switch# configure terminal
switch(config)# class-map class_packet_length
switch(config-cmap-qos)# match packet length 2000
switch(config-cmap-qos)# show class-map class_packet_length
Type qos class-maps
 ====================

   class-map type qos match-all class_packet_length
     match packet length 2000
switch(config-cmap-qos)# copy running-config startup-config
```

Configuring CoS Classification

Traffic classification allows you to organize traffic (packets) into traffic classes or categories on the basis of whether the traffic matches the criteria that you specify. The values used to classify traffic are called match criteria. When you define a traffic class, you can specify multiple match criteria, you can choose to not match on a particular criterion, or you can determine the traffic class by matching any or all criteria.

You can classify traffic based on the class of service (CoS) in the IEEE 1Q header. This 3-bit field is defined in IEEE.802.1p to support QoS traffic classes. CoS refers to three bits in a 802.1Q header that is used to indicate the priority of the Ethernet frame as it passes through a switch network.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example,

	Command or Action	Purpose
		you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match** [**not**] **cos** *cos-list*	Configures the traffic class by matching packets that are based on a list of CoS values. Values can range from 0 to 7. Use the **not** keyword to match on values that do not match the specified range.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration for the specified traffic class name.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure CoS classification:

```
switch# configure terminal
switch(config)# class-map class_cos
switch(config-cmap-qos)# match cos 4, 5-6
switch(config-cmap-qos)# show class-map class-cos
Type qos class-maps
 ====================

   class-map type qos match-all class_cos
     match cos 4-6

switch(config-cmap-qos)# copy running-config startup-config
```

Configuring IP RTP Classification

The IP Real-time Transport Protocol (RTP) is a transport protocol for real-time applications that transmits data such as audio or video and is defined by RFC 3550. Although RTP does not use a common TCP or UDP port, you typically configure RTP to use ports 16384 to 32767. UDP communications use an even port and the next higher odd port is used for RTP Control Protocol (RTCP) communications.

You can configure classification based on UDP port ranges, which are likely to target applications using RTP.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example,

	Command or Action	Purpose
		you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match** [**not**] **ip rtp** *udp-port-values*	Configures the traffic class by matching packets that are based on the range of lower and upper UDP port numbers, which is likely to target applications using RTP. Values can range from 2000 to 65535. Use the **not** keyword to match on values that do not match the specified range.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration for the specified traffic class name.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure IP RTP classification:

```
switch# configure terminal
switch(config)# class-map class_rtp
switch(config-cmap-qos)# match ip rtp 2000-21000, 4000-4100
switch(config-cmap-qos)# show class-map class-rtp
Type qos class-maps
 ====================

   class-map type qos match-all class_rtp
     match ip rtp 2000-2100,4000-4100

switch(config-cmap-qos)# copy running-config startup-config
```

Configuring Class Map Classification

You can classify traffic based on the match criteria in another class map.

Before You Begin

- The referenced class map must be created prior to its reference.
- You can reference the same class map in multiple policies.
- You can configure only one level of nesting of class maps. You cannot reference a class map that references another class map.
- Before you delete a referenced class map, you should delete all references to that class map.
- To perform a logical OR with the class map that is specified in the **match class-map** command, use the **match-any** keyword. The **match-any** or **match-all** specification of the matched class map is ignored.
- To perform a logical AND with the class map that is specified in the **match class-map** command, use the **match-all** keyword. The **match-any** or **match-all** specification of the matched class map is ignored.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map** [**type qos**] [**match-any** | **match-all**] *class_map_name*	Places you into class map QoS configuration mode for the specified class map and configures and saves the map name in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-cmap-qos)# **match** [**not**] **class-map** *class_map_name*	Configures the traffic class by matching packets that are based on the match criteria in another class map. Because *match-all* is the default for the **class-map** command, the match criteria that is specified in class_map3 are ANDed with match criteria in class_class_map. Use the **not** keyword to find values that do not match the specified range. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters.
Step 4	switch(config-cmap-qos)# **show class-map** *class_map_name*	Displays the class map configuration.
Step 5	switch(config-cmap-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure the class map classification:

```
switch# configure terminal
switch(config)# class-map class_class_map
switch(config-cmap-qos)# match class-map class-map3
switch(config-cmap-qos)# show class-map class_class_map
Type qos class-maps
 ====================

   class-map type qos match-all class_class_map
     match class-map class-map

switch(config-cmap-qos)# show class-map class-map


 Type qos class-maps
 ====================

   class-map type qos match-all class-map
     match dscp 10,12

switch(config-cmap-qos)# copy running-config startup-config
```

Verifying the Classification Configuration

To verify the classification configuration, use the commands in the following table.

Command	Description
show class-map *name*	Displays the class map configuration for all class maps or for a specified class map.
show ip access-lists *name*	Displays all IPv4 access control lists (ACLs) or a specific IPv4 ACL.

Configuration Example for QoS Classification

This example shows how to configure classification for the class map named cmap1, which matches DSCP traffic AF21 and AF32:

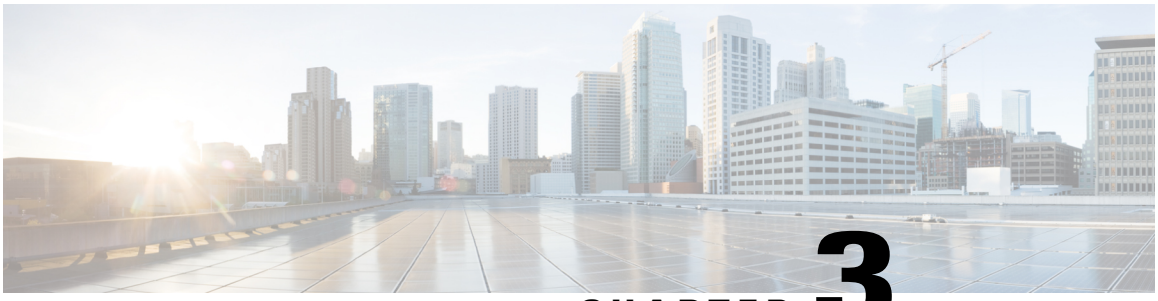
```
switch(config)# class-map type qos match-all cmap1
Type qos class-maps
 ====================

   class-map type qos match-all cmap1
     match dscp 18,28
switch(config-cmap-qos)# match dscp af21 af32
switch(config-cmap-qos)# exit
```

Note A Class-map that does not have any match criteria configured will not match any packets. The only exception to this rule is the default class-map (class-default).

Feature History for QoS Classification

This section provides the QoS Classification release history.

Feature Name	Release	Feature Information
QoS Classification	4.0.	This feature was introduced.



CHAPTER 3

Configuring QoS Marking Policies

This chapter contains the following sections:

Information About Policy Maps

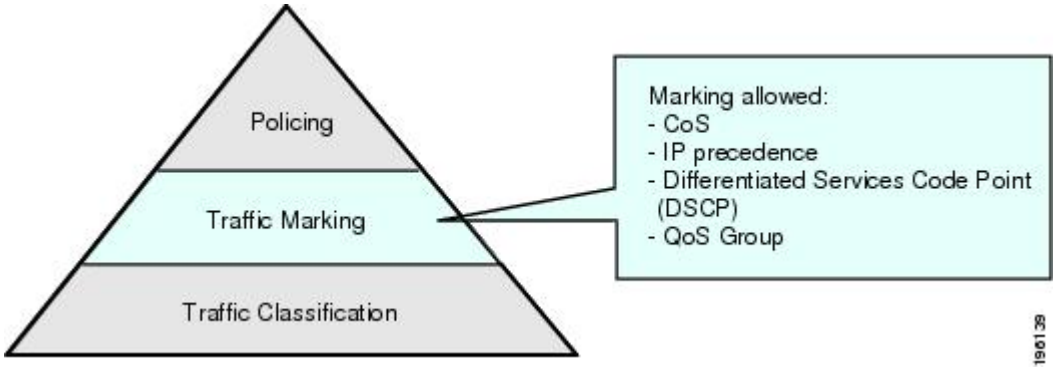
Policy maps prioritize network traffic by class. You create policy maps to define how to treat each class of traffic so that it is prioritized for the best quality of service.

Marking is a method that you use to modify the QoS fields of the incoming and outgoing packets. The QoS fields that you can mark are CoS in Layer 2, and IP precedence and Differentiated Service Code Point (DSCP) in Layer 3. The QoS group and discard class are two labels local to the system that you can assign intermediate marking values. You can use these two labels to determine the final values marked in a packet.

Service policies are specified using policy maps. Policy maps provide an ordered mapping of class maps to service levels. You can specify multiple class maps within a policy map, and map a class map to a high, medium, or low service level. The default priority is low. The policy map name is restricted to 63 alphanumeric characters.

The order of the class maps within a policy map is important to determine the order in which the frame is compared to class maps. The first matching class map has the corresponding priority marked in the frame.

Figure 2: Packet Fields Available for Marking



After you define your traffic classes, you can reference them in the policy map where you also define how they should be marked.

Criteria for Marking Fields

The following table lists fields that are available for marking.

Field	Description
DSCP	Layer 3 differentiated services code point (DSCP). **Note** If you change the DSCP value, you cannot change discard class values, and vice-versa.
IP Precedence	Layer 3 IP precedence. **Note** IP precedence uses only the lower 3 bits of the type of service (ToS) field. The device overwrites the first 3 bits of the ToS field to 0.
CoS	Layer 2 class of service (CoS).
QoS Group	Local QoS values that can be marked and matched as needed. The range is from 0 to 126.
Discard Class	Local QoS values that can be matched and marked as needed. The range is from 0 to 63. **Note** If you change the DSCP value, you cannot change discard class values, and vice-versa.
Table Maps	Method to use table maps for marking.

Unless noted as a restriction, you can mark both incoming and outgoing packets.

Prerequisites for QoS Marking Policies

Marking has the following prerequisites:

- You must have already classified your network traffic. For more information, see Configuring QoS Classification, on page 7.
- You are already logged in to the CLI in EXEC mode.

Guidelines and Limitations for QoS Marking Policies

- The **set cos** command is applicable only to 802.1Q interfaces. So, although you can use the **set cos** command on an ingress interface, the setting is only applied if a packet eventually egresses an 802.1Q compliant interface.
- For a single class, you can set operations on any two out of the following five fields: CoS, IP Precedence, DSCP, QoS Group, and Discard Class.
- You can use the **set qos-group** command only in ingress policies.
- You can use the **set discard-class** command only in ingress policies.

Creating QoS Marking Policies

Creating a DSCP Policy

You can create a policy that marks the DSCP value in the IP header packet to prioritize traffic in a particular class.

Before You Begin

- See the DSCP description in RFC 2475.
- You are logged in to the CLI in EXEC mode.
- If you use DSCP marking, you cannot use Discard Class marking. For more information, see Creating a Discard Class Policy, on page 29.
- You can mark the DSCP field as a numeric value between 0 and 63 or as one of the commonly used values listed in the Commonly Used DSCP Values, on page 4 and IP Precedence Values, on page 5.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.

	Command or Action	Purpose
Step 2	switch(config)# **policy-map** [**type qos**] [**match-first**] *policy-map-name*	Places you into policy map QoS configuration mode for the specified policy map and configures the map name in the running configuration. The *policy-map-name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-pmap)# **class** [**type qos**] {*class_map_name* |**class-default**}	Creates a reference to *class-map-name* and enters policy-map class QoS configuration mode for the specified class map. By default, the class is added to the end of the policy map. Changes are saved in the running configuration. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-insensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 4	switch (config-pmap-c-qos)# **set dscp** *value*	Defines the DSCP value that should be used in all IP headers for the specified class and saves it in the running configuration. You can use a numeric value from 1 to 60 or one of the standard values from Commonly Used DSCP Values, on page 4 and IP Precedence Values, on page 5. In the example below, the standard value of af31 is used.
Step 5	switch(config-pmap-c-qos)#**show policy-map** *policy-map-name*	Displays the policy map configuration for the specified map name. The *policy_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters.
Step 6	switch(config-pmap-c-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to create a DSCP policy:

```
switch# configure terminal
switch(config)# policy-map policy1
switch(config-pmap)# class class1
switch(config-pmap-c-qos)# set dscp af31
switch(config-pmap-c-qos)# show policy-map policy1
Type qos policy-maps
 ====================
```

```
 policy-map type qos policy1
   class  class1
     set dscp af31
switch(config-pmap-c-qos)# copy running-config startup-config
```

Creating an IP Precedence Policy

Before You Begin

- You are logged in to the CLI in EXEC mode.
- See the RFC 791 precedence values from least to most important in the table IP Precedence Values, on page 5.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map** [**type qos**] [**match-first**] *policy-map-name*	Places you into policy map QoS configuration mode for the specified policy map and configures the map name in the running configuration. The *policy-map-name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-pmap-qos)# **class** [**type qos**] {*class_map_name* |**class-default**}	Creates a reference to *class-map-name* and enters policy-map class QoS configuration mode for the specified class map. By default, the class is added to the end of the policy map. Changes are saved in the running configuration. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters.
Step 4	switch (config-pmap-c-qos)# **set precedence** *value*	Adds the precedence value that should be used in all IP headers for the specified class and saves it in the running configuration. You can use a numeric value from 0 to 7 as shown in the following table:

Value	Description
000 (0)	Routine or Best Effort
001 (1)	Priority

	Command or Action	Purpose
		<table><tr><th>Value</th><th>Description</th></tr><tr><td>010 (2)</td><td>Immediate</td></tr><tr><td>011 (3)</td><td>Flash (mainly used for voice signaling or for video)</td></tr><tr><td>100 (4)</td><td>Flash Override</td></tr><tr><td>101 (5)</td><td>Critical (mainly used for voice RTP)</td></tr><tr><td>110 (6)</td><td>Internet</td></tr><tr><td>111 (7)</td><td>Network</td></tr></table>
Step 5	switch(config-pmap-c-qos)# **show policy-map** *policy-map-name*	Displays the policy map configuration for the specified map name.
Step 6	switch(config-pmap-c-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to create an IP precedence policy:

```
switch# configure terminal
switch(config)# policy-map policy1
switch(config-pmap)# class class1
switch(config-pmap-c-qos)# set precedence 3
switch(config-pmap-c-qos)# show policy-map policy1
Type qos policy-maps
 ====================

 policy-map type qos policy1
   class  class1
     set prec 3
switch(config-pmap-c-qos)# copy running-config startup-config
```

Creating a Class of Service Policy

You can mark the CoS field in the IEEE 802.1Q header for all traffic in a specific class. If you mark this field in an ingress or egress policy, it will only be set when a packet egresses an IEEE 802.1Q-capable interface.

Before You Begin

- You are logged in to the CLI in EXEC mode.
- You can set CoS in ingress and egress policies.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map** [**type qos**] [**match-first**] *policy-map-name*	Places you into policy map QoS configuration mode for the specified policy map and configures the map name in the running configuration. The *policy-map-name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-pmap-qos)# **class** [**type qos**] {*class_map_name* | **class-default**}	Creates a reference to *class-map-name* and enters policy-map class QoS configuration mode for the specified class map. By default, the class is added to the end of the policy map. Changes are saved in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map.
Step 4	switch (config-pmap-c-qos)# **set cos** *cos-value*	Sets the CoS value to *cos-value*. The value can range from 0 to 7. You can use this command only in egress policies.
Step 5	switch(config-pmap-c-qos)# **show policy-map** *policy-map-name*	Displays the policy map configuration for the specified map name.
Step 6	switch(config-pmap-c-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to create a class of service policy:

```
switch# configure terminal
switch(config)# policy-map policy1
switch(config-pmap-qos)# class class1
switch(config-pmap-c-qos)# set cos 3
switch(config-pmap-c-qos)# show policy-map policy1

  Type qos policy-maps
 ====================

 policy-map type qos policy1
   class  class1
     set cos 3
switch(config-pmap-c-qos)#
```

Creating a QoS Group Policy

Before You Begin

- You are logged in to the CLI in EXEC mode.
- You can mark the QoS group value only in ingress policies.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map** [**type qos**] [**match-first**] *policy-map-name*	Places you into policy map QoS configuration mode for the specified policy map and configures the map name in the running configuration. The *policy-map-name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-pmap-qos)# **class** [**type qos**] {*class_map_name* | **class-default**}	Creates a reference to *class-map-name* and enters policy-map class QoS configuration mode for the specified class map. By default, the class is added to the end of the policy map. Changes are saved in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map.
Step 4	switch (config-pmap-c-qos)# **set qos-group** *qos-group-value*	Sets the QoS group value to qos-group-value. The value can range from 0 to 126.
Step 5	switch(config-pmap-c-qos)# **show policy-map** *policy-map-name*	Displays the policy map configuration for the specified map name.
Step 6	switch(config-pmap-c-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to create a QoS group policy:

```
switch# configure terminal
switch(config)# policy-map policy1
switch(config-pmap-qos)# class class1
switch(config-pmap-c-qos)# set qos-group 100
```

```
switch(config-pmap-c-qos)# show policy-map policy1
Type qos policy-maps
 ====================

 policy-map type qos policy1
   class  class1
     set qos-group 100
switch(config-pmap-c-qos)# copy running-config startup-config
```

Creating a Discard Class Policy

You can set a local internal label discard class policy.

Before You Begin

- If you configure a local internal label discard class policy, you cannot create a DSCP policy. For more information about DSCP policies, see the Creating a DSCP Policy, on page 23.
- You can set a discard class only in ingress policies.
- To reference the local discard class in a policy or in traffic classification, use the **match discard-class** command. For more information, see Configuring Discard Class Classification, on page 14.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map** [**type qos**] [**match-first**] *policy-map-name*	Places you into policy map QoS configuration mode for the specified policy map and configures the map name in the running configuration. The *policy-map-name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-pmap-qos)# **class** [**type qos**] {*class_map_name* |**class-default**}	Creates a reference to *class-map-name* and enters policy-map class QoS configuration mode for the specified class map. By default, the class is added to the end of the policy map. Changes are saved in the running configuration. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map.
Step 4	switch (config-pmap-c-qos)# **set discard-class** *discard-class-value*	Sets the discard-class value to *discard-class-value*. The value ranges from 0 to 63.

	Command or Action	Purpose
Step 5	switch(config-pmap-c-qos)# **show policy-map** *policy-map-name*	Displays the policy map configuration for the specified map name.
Step 6	switch(config-pmap-c-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to create a discard class policy:

```
switch# configure terminal
switch(config)# policy-map policy1
switch(config-pmap-qos)# class class1
switch(config-pmap-c-qos)# set discard-class 40
switch(config-pmap-c-qos)# show policy-map policy1
Type qos policy-maps
 ====================

 policy-map type qos policy1
   class  class1
     set discard-class 40
switch(config-pmap-c-qos)# copy running-config startup-config
```

Creating Ingress and Egress Policies

You can attach a policy map to an interface or a port profile so that the marking instructions are applied to the ingress or egress packets.

Before You Begin

- The interface or port profile have been created.
- The policy map that you want to use has been defined.

Note You can attach only one input policy and one output policy to an interface or port profile.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	Enter one of the following commands: • switch (config)# **interface** *type number* • switch (config)# **port-profile** *name*	Places you into configuration mode for the specified Ethernet or vEthernet interface or port profile.

	Command or Action	Purpose
Step 3	switch (config-if)# **service-policy** [**type qos**] {**input** | **output**} *policy-map-name* [**no stats**]	(Optional) Attaches a policy map name that will be added to the input or output packets of the interface or port profile. **Note** You can attach only one input policy and one output policy to an interface or port profile. The *policy_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters.
Step 4	switch(config-if)# **show policy-map** *policy-map-name*	(Optional) Displays the policy map configuration for the specified map name.
Step 5	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure an ingress policy on an Ethernet interface:

```
switch# configure terminal
switch(config-if)# interface port-channel 1
switch(config-if)# service-policy input policy1
switch(config-if)# show policy-map interface port-channel 1 input


Global statistics status :   enabled

port-channel1

 Service-policy (qos) input:   policy1
   policy statistics status:   enabled

   Class-map (qos):   class1 (match-all)
     283 packets
     Match: access-group testacl1
     Match: packet length 3-6000
     set dscp af31

switch(config-if)# copy running-config startup-config
```

This example shows how to configure an egress policy on a port profile:

```
switch# configure terminal
switch(config)# port-profile 2225-ephe
switch(config-port-prof)# service-policy output policy1
switch(config)# show policy-map interface vethernet 1

Global statistics status :   enabled

Vethernet1

 Service-policy (qos) output:   policy1
   policy statistics status:   enabled

   Class-map (qos):   class1 (match-all)
     0 packets
     Match: access-group testacl1
     Match: packet length 3-6000
     set dscp af31
```

```
switch(config-if)# copy running-config startup-config
```

Verifying the QoS Policy Configuration

Use one of the following commands to verify the configuration:

Command	Description
show policy-map [**type qos**] [**name** *policy_map_name*]	Displays the policy map configuration.
show policy-map interface *name*	Displays the policy applied on a interface with statistics.
show policy-map interface brief	Displays all the interfaces on which QoS policy is applied.
show running-config ipqos	Displays all configured class, policy maps, and interfaces.

Configuration Example for QoS Marking Policies

This example shows how to display a specific policy-map policy applied on a interface:

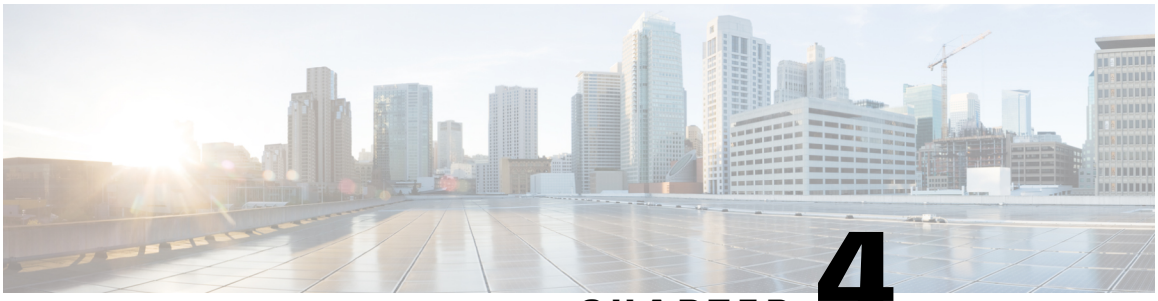
```
switch(config)# show policy-map policy1


  Type qos policy-maps
  ====================

  policy-map type qos policy1
    class  class1
      set dscp af31
switch(config)# sh class-map class1


  Type qos class-maps
  ===================

    class-map type qos match-all class1
      match access-group name testacl1
      match packet length 3-6000

switch(config)# int veth 1
switch(config-if)# service-policy ty qos input policy1
switch(config-if)# sh run int veth 1

!Command: show running-config interface Vethernet1


interface Vethernet1
  inherit port-profile 2225-ephe
  service-policy type qos input policy1
  description data-2-00-1, Network Adapter 2
  vmware dvport 416 dvswitch uuid "d8 39 0d 50 d2 4a 37 c2-4f 55 f5 b3 d2 fa f8 e9"
  vmware vm mac 0050.5681.443C

switch(config-if)# show policy-map interface vethernet 1


Global statistics status :   enabled
```

```
Vethernet1

  Service-policy (qos) input:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      0 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31


switch(config-if)# show policy-map interface brief


 Interface/VLAN [Status]:INP QOS       OUT QOS       INP QUE       OUT QUE
================================================================================
Vethernet1      [Active]:policy1
Vethernet2      [Active]:             policy1
Vethernet3      [Active]:             policy1
```

Feature History for QoS Marking Policies

This section provides the QoS marking policies release history.

Feature Name	Release	Feature Information
QoS Marking Policies	4.0	This feature was introduced.
QoS Marking Policies	4.0(4)SV1(2)	DSCP and Discard Class are no longer mutually exclusive. For a single class, you can set operations on any two out of the following five fields: CoS, IP Precedence, DSCP, QoS Group, and Discard Class.



CHAPTER 4

Configuring QoS Policing

This chapter contains the following sections:

Information About Policing

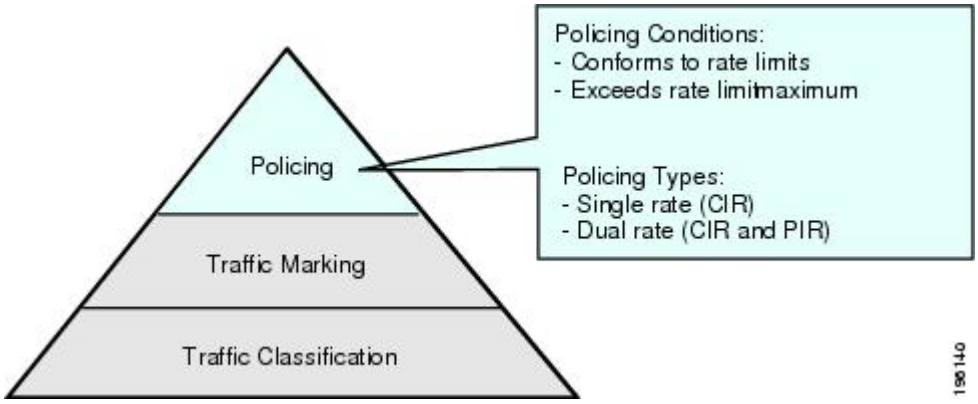
Policing is the monitoring of the data rates for a particular class of traffic. When the data rate exceeds user-configured values, marking or dropping of packets occurs immediately. Policing does not buffer the traffic, so transmission delay is not affected. When traffic exceeds the data rate, you instruct the system to either drop the packets or mark QoS fields in them. You can define single-rate, dual-rate, and color-aware policers.

Single-rate policers monitor the committed information rate (CIR) of traffic. Dual-rate policers monitor both the CIR and peak information rate (PIR) of traffic. In addition, the system monitors associated burst sizes. Three colors or conditions are determined by the policer for each packet depending on the data rate parameters supplied: conform (green), exceed (yellow), or violate (red).

You can configure only one action for each condition. For example, you might police for traffic in a class to conform to the data rate of 256,000 bits per second, with up to 200 millisecond bursts. The system would apply the conform action to traffic that falls within this rate, and it would apply the violate action to traffic that exceeds this rate.

Color-aware policers assume that traffic has been previously marked with a color. This information is then used in the actions taken by this type of policer. For more information about policies, see RFC 2697, RFC 2698, and RFC4115.

Figure 3: Policing Condition and Types



The following table lists the conditions that trigger actions by the policer depending on the defined data rate.

Table 1: Policer Actions for Exceed or Violate

Condition	Color	Description	Policer Action[1]
Conform	Green	The packet traffic data rate is within the defined boundaries.	The policer either transmits these packets as is or changes the value in the header (DSCP, precedence, or CoS) and then transmits these packets.
Exceed	Yellow	The packet traffic data rate exceeds the defined boundary.	The policer can drop or mark down these packets.
Violate	Red	The packet traffic data rate violates the defined boundaries.	The policer can drop or mark down these packets.

1 Only one policer action is allowed per condition.

Prerequisites for Policing

- You are logged on to the CLI in EXEC mode.

Guidelines and Limitations for QoS Policing

Each module polices independently, which might affect a policer that is applied to traffic distributed across more than one module, such as in the case of a port channel interface.

Configuring Policing

Police Command and Policer Types

Police Command Arguments

The type of policer that is created by the Cisco Nexus 1000V is based on a combination of the **police** command arguments.

Note Specify the identical value for **pir** and **cir** to configure 1-rate, 3-color policing.

Argument	Description
cir	Committed information rate (**cir**), or desired bandwidth, specified as a bit rate or a percentage of the link rate. Although a value for **cir** is required, the argument itself is optional. The range of values is from 1 to 80000000000; the range of policing values that are mathematically significant is 250 Kbps to 80 Gbps.
percent	Rate as a percentage of the interface rate. The range of values is from 1 to 100%.
bc	Indication of how much the **cir** can be exceeded, either as a bit rate or an amount of time at **cir**. The default is 200 milliseconds of traffic at the configured rate. The default data rate units are bytes, and the Gigabit per second (gbps) rate is not supported for this parameter.
pir	Peak information rate (**pir**), which is specified as a PIR bit rate or a percentage of the link rate. There is no default. The range of values is from 1 to 80000000000; the range of policing values that are mathematically significant is from 250 Kbps to 80 Gbps. The range of percentage values is from 1 to 100%.
be	Indication of how much the **pir** can be exceeded, either as a bit rate or an amount of time at **pir**. When the **bc** value is not specified, the default is 200 milliseconds of traffic at the configured rate. The default data rate units are bytes, and the Gigabit per second (gbps) rate is not supported for this parameter. **Note** You must specify a value for **pir** before the device displays this argument.

Argument	Description
conform	Single action to take if the traffic data rate is within bounds. The basic actions are transmit or one of the **set** commands listed in the table. The default is transmit.
exceed	Single action to take if the traffic data rate exceeds the specified boundaries. The basic actions are drop or markdown. The default is drop.
violate	Single action to take if the traffic data rate violates the configured rate values. The basic actions are drop or markdown. The default is drop.

Policer Types and Actions

Although all the arguments in the above table are optional, you must specify a value for **cir**. In this section, **cir** indicates the value but not necessarily the keyword itself. The combination of these arguments and the resulting policer types and actions are described in the following table.

Police Arguments Present	Policer Type	Policer Action
cir, but not **pir**, **be**, or **violate**	1-rate, 2-color	**≤ cir**, then **conform**; otherwise **violate**
cir and **pir**	1-rate, 3-color	**≤cir conform**; **≤ pirexceed**; else **violate** **Note** You must specify identical values for cir and pir.
cir and **pir**	2-rate, 3-color	**≤ cir**, then **conform**; **≤ pir**, then exceed; otherwise **violate**

Policer Action

You can take the following actions when the packet exceeds the parameters or violates the parameters:

Action	Description
drop	Drops the packet. This action is available only when the packet exceeds or violates the parameters.
set dscp dscp table {*cir-markdown-map* | *pir-markdown-map*}	Sets the specified fields from a table map and transmits the packet. For more information on the system-defined, or default table maps, see Configuring QoS Marking Policies, on page 21. This action is available only when the packet exceeds the parameters (use the *cir-markdown-map*) or violates the parameters (use the *pir-markdown-map*).

Action	Description
transmit	Transmits the packet. This action is available only when the packet conforms to the parameters.
set-prec-transmit	Sets the IP precedence field to a specified value and transmits the packet. This action is available only when the packet conforms to the parameters.
set-dscp-transmit	Sets the DSCP field to a specified value and transmits the packet. This action is available only when the packet conforms to the parameters.
set-cos-transmit	Sets the CoS field to a specified value and transmits the packet. This action is available only when the packet conforms to the parameters.
set-qos-transmit	Sets the QoS group internal label to the specified value and transmits the packet. This action can be used only in input policies and is available only when the packet conforms to the parameters.
set-discard-class-transmit	Sets the discard-class internal label to a specified value and transmits the packet. This action can be used only in ingress policies and is available only when the packet conforms to the parameters.

Police Command Data Rates

The policer can only drop or mark down packets that exceed or violate the specified parameters. For more information, see Configuring QoS Marking Policies, on page 21.

The **police** command uses the following data rates:

Table 2: Data Rates for the police Command

Rate	Description
bps	Bits per second (default)
kbps	1000 bits per seconds
mbps	1,000,000 bits per second
gbps	1,000,000,000 bits per second

Police Command Burst Sizes

The **police** command uses the following burst sizes:

Speed	Description
bytes	bytes
kbytes	1000 bytes
mbytes	1,000,000 bytes
ms	milliseconds
us	microseconds

Configuring Markdown Policing

Markdown policing is the setting of a QoS field in a packet when traffic exceeds or violates the policed data rates. You can configure markdown policing by using the **set** commands for conform described in Configuring Mark Down Policing.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map** [**type qos**] [**match-first**] *policy-map-name*	Places you into policy map QoS configuration mode for the specified policy map and configures the map name in the running configuration. The *policy-map-name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters. The map name must be unique across class-maps and policy-maps. For example, you cannot have a class-map and a policy-map with the same name of HR_Map.
Step 3	switch(config-pmap-qos)# **class** [**type qos**] {*class_map_name* |**class-default**}	Creates a reference to *class-map-name* and enters policy-map class QoS configuration mode for the specified class map. By default, the class is added to the end of the policy map. Changes are saved in the running configuration. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map. The *class_map_name* argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters.

	Command or Action	Purpose
Step 4	switch(config-pamp-c-qos)# **police**[**cir**] {*committed-rate* [*data-rate*] | **percent** *cir-link-percent*} [**bc** *committed-burst-rate* [*link-speed*]][**pir**] {*peak-rate* [*data-rate*] | **percent** *cir-link-percent*} [**be** *peak-burst-rate* [*link-speed*]] [**conform** action [**exceed** {**drop** | **set dscp dscp table** *cir-markdown-map*} [**violate** {**drop** | **set dscp dscp table** *pir-markdown-map*}]]}}	Polices **cir** in bits or as a percentage of the link rate. The **conform** action is taken if the data rate is **≤ cir**. If **be** and **pir** are not specified, all other traffic takes the **violate** action. If **be** or **violate** are specified, then the **exceed** action is taken if the data rate **≤ pir**, and the violate action is taken otherwise.
Step 5	switch(config-pamp-c-qos)# **show policy-map** [**type qos**] [*policy-map-name*]	(Optional) Displays information about all configured policy maps or a selected policy map of type QoS.
Step 6	switch(config-pmap-c-qos)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows a 1-rate, 3-color policer that transmits if the data rate is within 300 milliseconds of traffic at 256000 bps and how to mark down DSCP using the system-defined table map if the data rate is within 300 milliseconds of traffic at 256000 bps; and drops packets otherwise:

```
switch# configure terminal

switch(config)# policy-map pol1
switch(config-pmap-qos)# class class-default
switch(config-pmap-c-qos)# police cir 256000 bps conform transmit violate set dscp dscp
table pir-markdown-map
switch(config)# show policy-map pol1Type qos policy-maps
====================
policy-map type qos pol1
class class-default
police cir 256000 bps bc 200 ms conform transmit violate set dscp dscp table pir-markdown-map
switch(config)# show table-map pir-markdown-map
Table-map pir-markdown-map
default copy
from 10,12 to 14
from 18,20 to 22
from 26,28 to 30
from 34,36 to 38
```

Verifying the Policing Configuration

Use the following command to verify the configuration:

Command	Description
show policy-map	Displays information about policy maps and policing.

Configuration Example for QoS Policing

This example shows a 2 rate, 3 color policer that sets CoS to 4 if the data rate is within 300 kbps. It also shows how to mark down DSCP using the system-defined cir-markdown-map table map if the data rate is within 750 kbps and how to mark down DSCP using the system-defined pir-markdown-map table map if the data rate is greater 750 kbps:

```
switch(config)# policy-map ty qos 2rate3clr
switch(config-pmap-qos)# class  class1
switch(config-pmap-c-qos)# police cir 300 kbps pir 750 kbps conform set-cos-transmit 4
exceed set dscp dscp table cir-markdown-map violate set dscp dscp table pir-markdown-map

switch(config-pmap-c-qos)# show policy-map 2rate3clr


  Type qos policy-maps
  ====================

  policy-map type qos 2rate3clr
    class  class1
      police cir 300 kbps bc 200 ms pir 750 kbps be 200 ms conform set-cos-transmit 4 exceed
 set dscp dscp table cir-markdown-map violate set dscp dscp table pir-mar
kdown-map
```

This example shows a 1 rate, 2 color policer that transmits if the data rate is within 200 milliseconds of traffic at 600 kbps:

```
switch(config)# policy-map ty qos 1rate2clr
switch(config-pmap-qos)# class  class2
switch(config-pmap-c-qos)# police cir 600 kbps conform transmit violate drop
switch(config-pmap-c-qos)# show policy-map 1rate2clr


  Type qos policy-maps
  ====================

  policy-map type qos 1rate2clr
    class  class2
      police cir 600 kbps bc 200 ms conform transmit violate drop
switch(config-pmap-c-qos)#
```

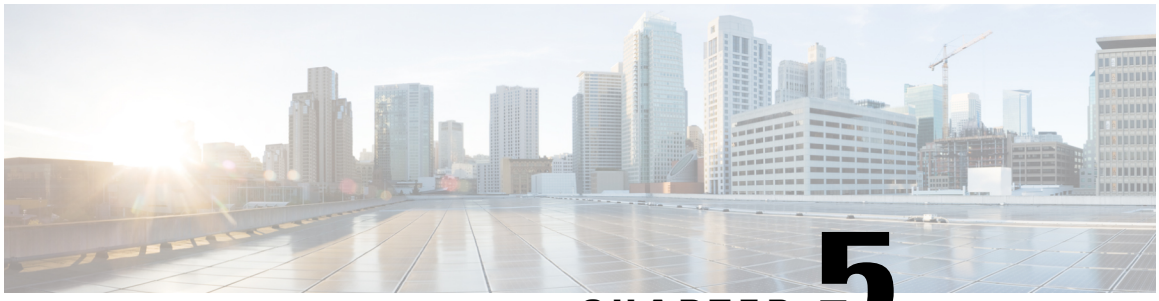
This example shows how to configure single-rate three-color policer that polices traffic at 4,000,000 bits per second and allows normal or committed bursts of 200 kbytes and excess bursts of 400 kbytes. The policer transmits traffic that conforms to the policing rate, marks down the DSCP using system-defined "cir-markdown-map" table map for traffic that exceeds the burst sizes, and drops traffic that violates the policing rate.

```
switch(config)# policy-map 1rate3clr
switch(config-pmap-qos)# class class1
switch(config-pmap-c-qos)# police cir 4 mbps bc 200 kbytes pir 4 mbps be 400 kbytes conform
 transmit exceed set dscp dscp table cir-markdown-map violate drop
switch(config-pmap-c-qos)# show policy-map 1rate3clr


  Type qos policy-maps
  ====================

  policy-map type qos 1rate3clr
    class  class1
      police cir 4 mbps bc 200 kbytes pir 4 mbps be 400 kbytes conform transmit exceed set
 dscp dscp table cir-markdown-map violate drop
```

Feature History for QoS Policing

This section provides the QoS policing release history.

Feature Name	Release	Feature Information
QoS Policing	4.0	This feature was introduced.



CHAPTER 5

Monitoring QoS Statistics

This chapter contains the following sections:

Information About QoS Statistics

Statistics are maintained for each policy, class action, and match criteria per interface. You can enable or disable the collection of statistics globally using the **[no] qos statistics** command. You can display statistics using the **show policy-map interface** command, and you can clear statistics based on an interface or policy map with the **clear qos statistics** command. Statistics are enabled by default and can be disabled globally.

Prerequisites for Monitoring QoS Statistics

You are logged in to the CLI in EXEC mode.

Enabling QoS Statistics

You can enable or disable QoS statistics for all interfaces on the device.

Note By default, QoS statistics are enabled.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **qos statistics**	Enables QoS statistics on all interfaces.
Step 3	switch(config)# **show policy-map interface**	(Optional) Displays the status of the global statistics and the configured policy maps on all interfaces.
Step 4	switch(config)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to enable QoS statistics:

```
switch# configure terminal
switch(config)# qos statistics
switch(config)# show policy-map interface
Global statistics status :   enabled

Vethernet1

  Service-policy (qos) input:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      1 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      1 packets

  Service-policy (qos) output:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      9 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      18645 packets

Vethernet2
```

```
  Service-policy (qos) output:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      18636 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      19191 packets

Vethernet3

  Service-policy (qos) output:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      9 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      18644 packets

Vethernet4

  Service-policy (qos) input:   1r2c
    policy statistics status:   enabled

    Class-map (qos):   mat-dscp0 (match-all)
      568738560 packets
      Match: dscp 0
      police cir 90 mbps bc 200 ms
        conformed 37578738384 bytes, 0 bps action: set-dscp-transmit 10
        violated 0 bytes, 0 bps action: drop

  Service-policy (qos) output:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      9 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      18642 packets
switch(config)# copy running-config startup-config
```

Displaying QoS Statistics

Before You Begin

You know the interface for which statistics are needed.

Note Statistics for individual interfaces are often the most useful.

Procedure

	Command or Action	Purpose
Step 1	switch# **show policy-map** [*policy-map-name* | **interface** [**brief** | **ethernet** *interface_number* | **output type qos** | **port-channel** *number* | **vethernet** *interface_number* | **input type qos**] | **type qos**]	Displays the specified statistics. To achieve the best result when your system has a large number of policies, use this command with specific arguments, such as specifying a particular interface or port channel. • Use the **interface** keyword with the following keywords to display the service policy on an interface: ◦ **brief—**Displays a brief report of all policies attached to interfaces. ◦ **ethernet—**Displays statistics for an Ethernet interface. ◦ **input type qos—**Displays statistics for QoS input policies. ◦ **output type qos—**Displays statistics for QoS output policies. ◦ **port-channel—**Displays statistics for a port channel interface. ◦ **vethernet—**Displays the statistics for a vEthernet interface. • Use the **type qos** keyword to display the type of policy map.

This example shows how to display QoS statistics:

```
switch (config)# show policy-map interface port-channel 1

Global statistics status :   enabled

port-channel1

  Service-policy (qos) input:   2rate3clr
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      14 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      police cir 300 kbps bc 200 ms pir 750 kbps be 200 ms
        conformed 1260 bytes, 4384 bps action: set-cos-transmit 4
        exceeded 0 bytes, 0 bps action: set dscp dscp table cir-markdown-map
        violated 0 bytes, 0 bps action: set dscp dscp table pir-markdown-map

switch(config-if)# show policy-map interface vethernet 1


Global statistics status :   enabled

Vethernet1

  Service-policy (qos) input:   policy1
```

```
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      1 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      1 packets

  Service-policy (qos) output:   policy1
    policy statistics status:   enabled

    Class-map (qos):   class1 (match-all)
      9 packets
      Match: access-group testacl1
      Match: packet length 3-6000
      set dscp af31

    Class-map (qos):   class-default (match-any)
      19074 packets
```

Clearing QoS Statistics

Procedure

	Command or Action	Purpose
Step 1	switch # **clear qos statistics** [**interface** {**ethernet** *interface_number* | **port-channel** number | **vethernet** *interface_number* | **output type qos** | **input type qos**}]	Clears the specified QoS statistics.

This example shows how to clear QoS statistics:

```
switch(config)# clear qos statistics interface port-channel 1
switch# show policy-map interface port-channel 1
Global statistics status : enabled
port-channel1
Service-policy (qos) input: 2rate3clr
policy statistics status: enabled
Class-map (qos): class1 (match-all)
0 packets
Match: access-group testacl1
Match: packet length 3-6000
police cir 300 kbps bc 200 ms pir 750 kbps be 200 ms
conformed 0 bytes, 0 bps action: set-cos-transmit 4
exceeded 0 bytes, 0 bps action: set dscp dscp table cir-markdown-map
violated 0 bytes, 0 bps action: set dscp dscp table pir-markdown-map
switch#
```

Configuration Example for QoS Statistics

This example shows how to display statistics for policy maps that are configured on interfaces:

```
switch(config)# show policy-map interface

Global statistics status :   enabled

Vethernet3
```

```
  Service-policy (qos) input:   new-policy
    policy statistics status:   enabled

    Class-map (qos):   class-default (match-any)
      59610700 packets
      set prec 5

Vethernet5

  Service-policy (qos) output:   new-policer
    policy statistics status:   enabled

    Class-map (qos):   new-class (match-all)
      344661013 packets
      Match: precedence 5
      police cir 900 mbps bc 200 ms
        conformed 505953339796 bytes, 899924196 bps action: transmit
        violated 12285218014 bytes, 22283000 bps action: drop
```

This example shows how to display the status of the global statistics and the configured policy maps on a specific interface:

```
switch(config)# show policy-map interface vethernet 3

Global statistics status :   enabled

Vethernet3

  Service-policy (qos) input:   policy-protoacl
    policy statistics status:   enabled

    Class-map (qos):   class-protoacl (match-any)
      132 packets
      Match: access-group protoacl
        132 packets
      set qos-group 100
```

Standards

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

MIBs

MIBS	MIBs Link
CISCO-PROCESS-MIB	To locate and download MIBs, go to the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

RFCs

No RFCs are supported by this feature.

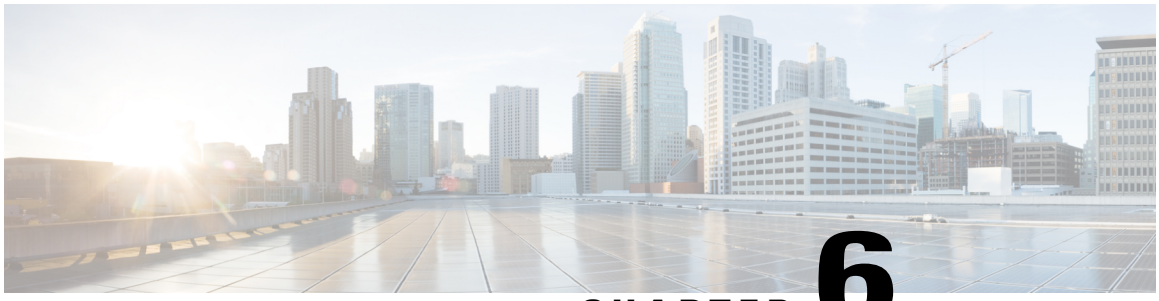
Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, contains 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/cisco/web/support/index.html

Feature History for QoS Statistics

This section provides the QoS statistics release history.

Feature Name	Release	Feature Information
QoS Statistics	4.0	This feature was introduced.



CHAPTER 6

Configuring Class Based Weighted Fair Queueing

This chapter contains the following sections:

Information About CBWFQ

This feature addresses the following goals:

- Queuing can ensure that any traffic class does not starve other traffic types.
- Respect the bandwidth guarantees for each traffic class.
- Optimize the utilization of the uplink bandwidth.

Class-based weighted fair queuing (CBWFQ) extends the standard weighted fair queuing (WFQ) functionality to provide user-defined traffic classes. For CBWFQ, you define traffic classes based on match criteria including protocols and CoS values. Packets that satisfy the match criteria for a class constitute the traffic for that class. A queue is reserved for each class, and traffic that belongs to a class is directed to the queue for that class.

Once a class has been defined according to its match criteria, you can assign its characteristics. To characterize a class, you assign a bandwidth. The bandwidth assigned to a class is the guaranteed bandwidth delivered to the class during congestion.

The traffic that does not match any of the configured classes is given best-effort treatment. Once a packet is classified, all of the standard mechanisms that can also be used to differentiate service among the classes apply.

For CBWFQ, the weight specified for the class becomes the weight of each packet that meets the match criteria of the class. Packets that arrive at the egress interface are classified according to the match criteria filters you define, and then each one is assigned the appropriate weight. The weight for a packet that belongs to a specific class is derived from the bandwidth that you assigned to the class when you configured it; the weight for a class is user-configurable.

After the weight for a packet is assigned, the packet is enqueued in the appropriate class queue. CBWFQ uses the weights assigned to the queued packets to ensure that the class queue is serviced fairly.

Configuring a class policy—configuring CBWFQ—has three processes:

- Defining traffic classes to specify the classification policy (class maps).

  This process determines how many types of packets are to be differentiated from one another.

- Associating policies—that is, class characteristics—with each traffic class (policy maps).

  This process entails configuration of policies to be applied to packets that belong to one of the classes that were previously defined through a class map. For this process, you configure a policy map that specifies the policy for each traffic class.

- Attaching policies to interfaces (service policies).

  Note A queuing policy map can be applied only on an uplink in the egress (outbound) direction.

  This process requires that you associate an existing policy map, or service policy, with an interface to apply the particular set of policies for the map to that interface.

Policy maps prioritize network traffic by class. You create policy maps to define how to treat each class of traffic so that it is prioritized for the best quality of service.

Licensing Requirement for CBWFQ

This feature does not require a license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for CBWFQ

You are already logged in to the CLI in EXEC mode.

Guidelines and Limitations

- A queuing policy can be applied only on an uplink interface in the egress (outbound) direction.
- Queuing is supported only on ESX or ESXi 5.0 or later hosts.
- For port-channel interfaces, queuing bandwidth applies on the member ports. The overall performance depends on how the vEthernet interfaces are pinned to member ports and the traffic pattern on the individual ports.

- We recommend that you reserve 10% bandwidth of the uplink for the control traffic.

Default Settings

Class-based weighted fair queuing is disabled by default.

Configuring CBWFQ

This feature allows you to differentiate traffic classes and provide appropriate bandwidth guarantees. You can use this procedure to configure class-based weighted fair queuing as follows:

- Create a queuing class map with protocol or CoS matching criteria.
- Create a queuing policy map and assign the class map to it.

Before You Begin

- You are logged in to the CLI in EXEC mode.
- You know whether you want the queuing class map to match the protocol or CoS.
- You know the bandwidth that you want to assign to each class of traffic.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **class-map type queuing** {**match-any** | **match-all**} *class-map-name*	Creates a CBWFQ class map and enters class map queuing mode for configuring the new class map. **match-any—**Use this option to apply this class map to a packet if it matches any of the matching criteria. **match-all—**Use this option to apply this class map to a packet if it matches all of the matching criteria. *class-map-name***—**Up to 40 alphanumeric characters in length and can include the hyphen and underscore characters.
Step 3	switch(config-cmap-que)# **match** {**cos** *id*} | {**protocol** *name*}	Defines whether you want packets for this class map to match the protocol, class of service, or both. • CoS is specified as a number from 0 to 7— Matches traffic based on the class of service (CoS) in the IEEE 802.1Q header, defined in IEEE 802.1p. CoS is encoded in the high order 3 bits of the VLAN ID Tag field and is referred to as user priority. • The following are predefined protocol matches:

	Command or Action	Purpose
		◦ n1k_control—Refers to the Cisco Nexus 1000V control traffic. ◦ n1k_mgmt—Refers to the Cisco Nexus 1000V management traffic directed to interface management 0. ◦ n1k_packet—Refers to the Cisco Nexus 1000V inband traffic. ◦ vmw_ft—Refers to the VMware fault tolerance traffic. ◦ vmw_iscsi—Refers to the iSCSI traffic. ◦ vmw_mgmt—Refers to the traffic directed to the service console of the ESX. ◦ vmw_nfs—Refers to the NFS traffic. ◦ vmw_vmotion—Refers to the VMotion traffic.
Step 4	switch(config-cmap-que)# **exit**	Exits class-map queuing configuration mode and returns you to global configuration mode.
Step 5	switch(config)# **policy-map type queuing** *name*	Creates a CBWFQ policy map and enters policy map queuing mode for configuring the new policy map.
Step 6	switch(config-pmap-que)# **class type queuing** *name*	Assigns a CBWFQ class to this policy map and enters policy map class queuing configuration mode.
Step 7	switch(config-pmap-c-que)# **bandwidth percent** *percentage*	Designates the minimum guaranteed bandwidth for this traffic class as a percentage of total available bandwidth.
Step 8	switch(config-pmap-c-que)# **exit**	Exits policy-map type queuing configuration mode and returns you to policy-map configuration mode.
Step 9	switch(config-pmap-que)# **exit**	Exits policy-map configuration mode and returns you to global configuration mod.
Step 10	switch(config)# **port-profile type ethernet** *name*	Creates a port profile and enters port profile configuration mode.
Step 11	switch(config-port-prof)# **service-policy type queuing output** *name*	Creates a service policy of type queuing.
Step 12	switch(config-port-prof)# **show policy-map interface**	Displays the status of the global statistics and the configured policy maps on all interfaces.
Step 13	switch(config-port-prof)# **copy running-config startup-config**	(Optional) Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure class-based weighted fair queuing:

```
switch# configure terminal
switch(config)# class-map type queuing queue_1
switch(config-cmap-que)# match protocol n1k_mgmt
switch(config-cmap-que)# match protocol n1k_control
switch(config-cmap-que)# match protocol vmw_vmotion
switch(config-cmap-que)# exit
switch(config)# policy-map type queuing qpol1
switch(config-pmap-que)# class type queuing queue_1
switch(config-pmap-c-que)# bandwidth percent 30
switch(config-pmap-c-que)# exit
switch(config-pmap-que)# exit
switch(config)# port-profile type ethernet uplink
switch(config-port-prof)# service-policy type queuing output qpol1
switch(config-port-prof)# sh policy-map interface


Global statistics status :   enabled

port-channel1

  Service-policy (queuing) output:   qpol1
    policy statistics status:   enabled

    Class-map (queuing):   queue_1 (match-all)
      Match: protocol n1k_mgmt
      Match: protocol n1k_control
      Match: protocol vmw_vmotion
      bandwidth percent 30
      queue dropped pkts : 0
      queue matched pkts : 39
      queue inrate bytes ( Kbits/sec )  : 0
      queue outrate bytes ( Kbits/sec ) : 0

port-channel2

  Service-policy (queuing) output:   qpol1
    policy statistics status:   enabled

    Class-map (queuing):   queue_1 (match-all)
      Match: protocol n1k_mgmt
      Match: protocol n1k_control
      Match: protocol vmw_vmotion
      bandwidth percent 30
      queue dropped pkts : 0
      queue matched pkts : 208
      queue inrate bytes ( Kbits/sec )  : 0
      queue outrate bytes ( Kbits/sec ) : 0

port-channel4

  Service-policy (queuing) output:   qpol1
    policy statistics status:   enabled

    Class-map (queuing):   queue_1 (match-all)
      Match: protocol n1k_mgmt
      Match: protocol n1k_control
      Match: protocol vmw_vmotion
      bandwidth percent 30
      queue dropped pkts : 0
      queue matched pkts : 054
      queue inrate bytes ( Kbits/sec )  : 0
      queue outrate bytes ( Kbits/sec ) : 0

switch(config)# copy running-config startup-config
```

Note In the Layer 3 mode of operation, both n1k_control and n1k_packet traffic are classified under the n1k_control protocol. The protocol vmw_iscsi can match only with the software iSCSI traffic and not the hardware iSCSI traffic. For any match for VMware protocol traffic, the vmknic that carries that traffic should be assigned to a port profile on the Cisco Nexus 1000V.

Verifying the CBWFQ Configuration

Use one of the following commands to verify the configuration:

Command	Description
show policy map type queuing *name*	Displays the queuing policy map configuration.
show class-map type queuing *name*	Displays the queuing class map configuration.
show policy-map interface	Displays the policy map interface configuration.
show running-config ipqos	Displays the QoS running configuration.

Show Policy Map Type Example

This example shows how to display the policy map type queuing for policy vmotion:

```
n1000v# show policy-map type queuing Policy-vmotion

  Type queuing policy-maps
  ========================

  policy-map type queuing Policy-vmotion
    class type queuing Match-vmotion
      bandwidth percent 50
```

Show Class Map Example

This example shows how to display the class map queuing for vmotion:

```
n1000v# show class-map type queuing Match-vmotion

  Type queuing class-maps
  ========================

  class-map type queuing match-any Match-vmotion
    match protocol vmw_vmotion
```

This example shows how to display class map type queuing CoS:

```
n1000v# show class-map type queuing Match-Cos

  Type queuing class-maps
  ========================

    class-map type queuing match-all Match-Cos
      match cos 5
```

Show Policy Map Interface Examples

This example shows how to display the policy map on the interface ethernet policy vmotion:

```
n1000v# show policy-map interface ethernet 3/3

Global statistics status :   disabled

Ethernet3/3

  Service-policy (queuing) output:   Policy-vmotion
    policy statistics status:   enabled

    Class-map (queuing):   Match-vmotion (match-any)
      Match: protocol vmw_vmotion
      bandwidth percent 50
```

This example shows how to display the service policy on the interface ethernet policy-CoS:

```
n1000v# show policy-map interface ethernet 3/3

Global statistics status :   disabled

Ethernet3/3

  Service-policy (queuing) output:   Policy-Cos
    policy statistics status:   enabled

    Class-map (queuing):   Match-Cos (match-all)
      Match: cos 5
      bandwidth percent 50
```

This example shows how to display the service policy on the interface port channel:

```
n1000v# show policy-map interface port-channel 1

Global statistics status :   disabled

port-channel1

  Service-policy (queuing) output:   Policy-vmotion
    policy statistics status:   enabled

    Class-map (queuing):   Match-vmotion (match-any)
      Match: protocol vmw_vmotion
      bandwidth percent 50
```

Configuration Examples for CBWFQ

This example shows how to allocate 50 percent of the bandwidth for VMotion traffic:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# class-map type queuing match-any Match-vmotion
switch(config-cmap-que)# match protocol vmw_vmotion
switch(config-cmap-que)# exit
switch(config)# policy-map type queuing Policy-vmotion
switch(config-pmap-que)# class type queuing Match-vmotion
switch(config-pmap-c-que)# bandwidth percent 50
switch(config-pmap-c-que)# exit
switch(config-pmap-que)# exit
switch(config)# interface ethernet 3/3
switch(config-if)# service-policy type queuing output Policy-vmotion
```

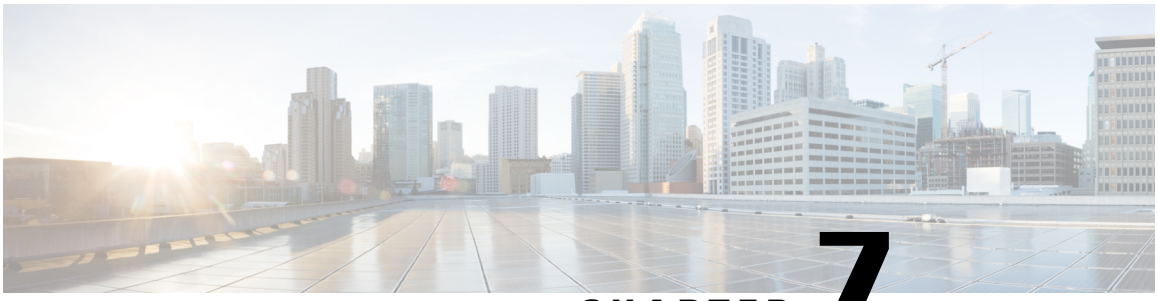
This example shows how to allocate 50 percent of bandwidth for traffic with a CoS value of 5:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
switch(config)# class-map type queuing match-all Match-Cos
switch(config-cmap-que)# match cos 5
switch(config-cmap-que)# exit
switch(config)# policy-map type queuing Policy-Cos
switch(config-pmap-que)# class type queuing Match-Cos
switch(config-pmap-c-que)# bandwidth percent 50
switch(config-pmap-c-que)# exit
switch(config-pmap-que)# exit
switch(config)# interface ethernet 3/3
switch(config-if)# service-policy type queuing output Policy-Cos
```

This example shows how to configure a policy map with multiple traffic classes:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# class-map type queuing match-any class-vmotion
switch(config-cmap-que)# match protocol vmw_vmotion
switch(config-cmap-que)# exit
switch(config)# class-map type queuing match-any class-cos-2
switch(config-cmap-que)# match cos 2
switch(config-cmap-que)# exit
switch(config)# policy-map type queuing policy-priority-vmotion
switch(config-pmap-que)# class type queuing class-vmotion
switch(config-pmap-c-que)# bandwidth percent 60
switch(config-pmap-c-que)# class type queuing class-cos-2
switch(config-pmap-c-que)# bandwidth percent 40
switch(config-pmap-c-que)# exit
switch(config-pmap-que)# exit
switch(config)# interface po1
switch(config-if)# service-policy type queuing output policy-priority-vmotion
switch(config-if)# show policy-map type queuing policy-priority-vmotion

  Type queuing policy-maps
  ========================

  policy-map type queuing policy-priority-vmotion
    class type queuing class-vmotion
      bandwidth percent 60
    class type queuing class-cos-2
      bandwidth percent 40

switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# interface po1
switch(config-if)# service-policy type queuing output policy-priority-vmotion

switch(config-if)# show policy-map interface po1

Global statistics status :   disabled

port-channel1

  Service-policy (queuing) output:   policy-priority-vmotion
    policy statistics status:   enabled

    Class-map (queuing):   class-vmotion (match-any)
      Match: protocol vmw_vmotion
      bandwidth percent 60

    Class-map (queuing):   class-cos-2 (match-any)
      Match: cos 2
      bandwidth percent 40
```



CHAPTER 7

QoS Configuration Limits

This chapter contains the following sections:

QoS Configuration Limits

The configuration limits are documented in the *Cisco Nexus 1000V Resource Availability Reference*.

QoS Configuration Limits