



# Configuring QoS Classification

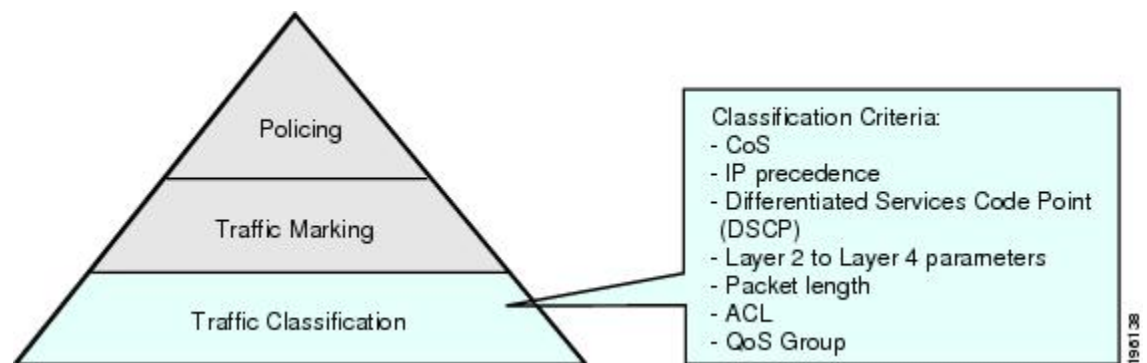
This chapter contains the following sections:

- [Information About Traffic Classes, page 1](#)
- [Criteria for Mapping Classes, page 2](#)
- [Prerequisites for Classification, page 3](#)
- [Guidelines and Limitations for QoS Classification, page 3](#)
- [Classifying Traffic, page 3](#)
- [Verifying the Classification Configuration, page 14](#)
- [Configuration Example for QoS Classification, page 14](#)
- [Feature History for QoS Classification, page 14](#)

## 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 <a href="#">IP Precedence Values</a> table.
Differentiated Services Code Point (DSCP)	DSCP value within the DiffServ field of the IP header. The standard DSCP values are listed in <a href="#">Commonly Used DSCP Values</a> .
QoS group	Locally significant QoS values that can be manipulated and matched within the system. The range is from 0 to 126.
Discard class	Locally significant values that can be matched and manipulated within the system. The range is from 0 to 63.

Class Criteria	Description
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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map</b> [type qos] [match-any   match-all] <i>class_map_name</i>	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 <i>class_map_name</i> 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.
<b>Step 3</b>	switch(config-cmap-qos)# <b>match access-group name</b> <i>acl-name</i>	Configures and saves the access group to match for this class in the running configuration.  <b>Note</b> The <b>permit</b> and <b>deny</b> keywords are ignored when matching the ACL.  The <b>not</b> form of this command is not supported.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map</b> <i>class_map_name</i>	Displays the class map configuration.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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](#) and [IP Precedence Values](#).

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map [type qos] [match-any   match-all] class_map_name</b>	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 <i>class_map_name</i> 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.
<b>Step 3</b>	switch(config-cmap-qos)# <b>match [not] dscp dscp_list</b>	Configures the traffic class by matching packets that are based on <i>dscp-values</i> . The standard DSCP values are listed in the <a href="#">Commonly Used DSCP Values</a> and <a href="#">IP Precedence Values</a> .  Use the <b>not</b> keyword to match on values that do not match the specified range.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map class_map_name</b>	Displays the class map configuration.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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](#) and [IP Precedence Values](#) tables.

### Procedure

	Command or Action	Purpose																		
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.																		
<b>Step 2</b>	switch(config)# <b>class-map</b> [ <b>type qos</b> ] [ <b>match-any</b>   <b>match-all</b> ] <i>class_map_name</i>	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 <i>class_map_name</i> 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.																		
<b>Step 3</b>	switch(config-cmap-qos)# <b>match</b> [ <b>not</b> ] <i>precedence values</i>	Configures the traffic class by matching packets that are based on <i>precedence-values</i> listed in the following table: <table border="1" data-bbox="824 993 1487 1591"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>000 (0)</td> <td>Routine or Best Effort</td> </tr> <tr> <td>001 (1)</td> <td>Priority</td> </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> </tbody> </table> <p>Use the <b>not</b> keyword to match on values that do not match the specified range.</p>	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
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<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map</b> <i>class_map_name</i>	Displays the class map configuration.																		

	Command or Action	Purpose
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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](#).



### 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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map [type qos] [match-any   match-all] class_map_name</b>	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 <i>class_map_name</i> 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.
<b>Step 3</b>	switch(config-cmap-qos)# <b>match [not] qos-group multi-range-qos-group-values</b>	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 <b>not</b> keyword to match on values that do not match the specified range.

	Command or Action	Purpose
<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map</b> <i>class_map_name</i>	Displays the class map configuration for the specified traffic class name.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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](#).



### 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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map</b> [type qos] [ <b>match-any</b>   <b>match-all</b> ] <i>class_map_name</i>	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 <i>class_map_name</i> 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
<b>Step 3</b>	switch(config-cmap-qos)# <b>match [not] discard-class</b> <i>multi-range-discard-group-values</i>	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 <b>not</b> keyword to match on values that do not match the specified range.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map</b> <i>class_map_name</i>	Displays the class map configuration for the specified traffic class name.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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_discard_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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map</b> [ <b>type qos</b> ] [ <b>match-any</b>   <b>match-all</b> ] <i>class_map_name</i>	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 <i>class_map_name</i> 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
<b>Step 3</b>	switch(config-cmap-qos)# <b>match [not] packet-length</b> <i>packet-length-list</i>	Configures the traffic class by matching packets that are based on various packet lengths. Values can range from 1 to 9198. Use the <b>not</b> keyword to match on values that do not match the specified range.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map</b> <i>class_map_name</i>	Displays the class map configuration for the specified traffic class name.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map [type qos] [match-any   match-all]</b> <i>class_map_name</i>	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 <i>class_map_name</i> 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.
<b>Step 3</b>	switch(config-cmap-qos)# <b>match</b> [ <b>not</b> ] <b>cos</b> <i>cos-list</i>	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 <b>not</b> keyword to match on values that do not match the specified range.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show</b> <b>class-map</b> <i>class_map_name</i>	Displays the class map configuration for the specified traffic class name.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy</b> <b>running-config startup-config</b>	(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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map</b> [ <b>type</b> <b>qos</b> ] [ <b>match-any</b>   <b>match-all</b> ] <i>class_map_name</i>	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 <i>class_map_name</i> 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.
<b>Step 3</b>	switch(config-cmap-qos)# <b>match</b> [ <b>not</b> ] <b>ip rtp udp-port-values</b>	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 <b>not</b> keyword to match on values that do not match the specified range.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show</b> <b>class-map class_map_name</b>	Displays the class map configuration for the specified traffic class name.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy</b> <b>running-config startup-config</b>	(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
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>class-map</b> [ <b>type qos</b> ] [ <b>match-any</b>   <b>match-all</b> ] <i>class_map_name</i>	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 <i>class_map_name</i> 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.
<b>Step 3</b>	switch(config-cmap-qos)# <b>match</b> [ <b>not</b> ] <b>class-map</b> <i>class_map_name</i>	Configures the traffic class by matching packets that are based on the match criteria in another class map. Because <i>match-all</i> is the default for the <b>class-map</b> command, the match criteria that is specified in <i>class_map3</i> are ANDed with match criteria in <i>class_class_map</i> . Use the <b>not</b> keyword to find values that do not match the specified range.  The <i>class_map_name</i> argument is a unique alphabetic string that can be up to 40 case-sensitive characters long, including hyphen (-) and underscore (_) characters.
<b>Step 4</b>	switch(config-cmap-qos)# <b>show class-map</b> <i>class_map_name</i>	Displays the class map configuration.
<b>Step 5</b>	switch(config-cmap-qos)# <b>copy running-config startup-config</b>	(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
<code>show class-map name</code>	Displays the class map configuration for all class maps or for a specified class map.
<code>show ip access-lists name</code>	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.