



Configuring Classification

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About Classification

Classification is the separation of packets into traffic classes. You configure the device to take a specific action on the specified classified traffic, such as policing or marking down, or other actions.

You can create class maps to represent each traffic class by matching packet characteristics with the classification criteria in the following table:

Table 1: Classification Criteria

Classification 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.
Differentiated Services Code Point (DSCP)	DSCP value within the DiffServ field of the IP header.
ACL	IP, IPv6, or MAC ACL name.
Packet length	Size range of Layer 3 packet lengths.

Classification Criteria	Description
IP RTP	Identify applications using Real-time Transport Protocol (RTP) by UDP port number range.

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.

**Note**

However, if you match on an ACL, no other match criteria, except the packet length, can be specified in a match-all class. In a match-any class, you can match on ACLs and any other match criteria.

Traffic that fails to match any 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.

You can reuse class maps when defining the QoS policies for different interfaces that process the same types of traffic.

Licensing Requirements for Classification

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	The QoS feature does not require license. Any feature not included in a license package is bundled with the NX-OS image and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the <i>Cisco NX-OS Licensing Guide</i> .

Prerequisites for Classification

Classification has the following prerequisites:

- You must be familiar with using modular QoS CLI.
- You are logged on to the device.

Guidelines and Limitations

Classification has the following configuration guidelines and limitations:

- You can specify a maximum of 1024 match criteria in a class map.
- You can configure a maximum of 128 classes for use in a single policy map.

- When you match on an ACL, the only other match you can specify is the Layer 3 packet length in a match-all class.
- The **match-all** option in the **class-map type qos match-all** command is not supported. The match criteria of this command becomes the same as in the **class-map type qos match-any** command. The **class-map type qos match-all** command yields the same results as the **class-map type qos match-any** command.
- You can classify traffic on Layer 2 ports based on either the port policy or VLAN policy of the incoming packet but not both. If both are present, the device acts on the port policy and ignores the VLAN policy.
- When a Cisco Nexus Fabric Extender (FEX) is connected and in use, data traffic should not be marked with a CoS value of 7. CoS 7 is reserved for control traffic transiting the Fabric Extender.
- FEX host interfaces (HIF) are supported by the FEX QoS policy.
 - The FEX QoS policy is applied to the hardware resources of the fabric port associated with the FEX HIF port and not directly to the FEX device.
 - The FEX QoS policy supports QoS TCAM carving that is available on ALE enabled devices.

Configuring Traffic Classes

Configuring ACL Classification

You can classify traffic by matching packets based on existing ACLs. The permit and deny ACL keywords are ignored in the matching. QoS does not use the permit-deny functions of ACLs. You can classify by either IPv4, IPv6, or MAC address.

SUMMARY STEPS

1. **configure terminal**
2. **class-map [type qos] [match-any | match-all] class-name**
3. **match access-group name acl-name**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] class-name Example: switch(config)# class-map class_acl	Creates or accesses the class map named class-name and enters class-map mode. The class map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters. (match-any is the default when no option is selected and multiple match statements are entered.)

	Command or Action	Purpose
Step 3	match access-group name <i>acl-name</i> Example: <pre>switch(config-cmap-qos)# match access-group name my_acl</pre>	Configures the traffic class by matching packets based on the <i>acl-name</i> . The permit and deny ACL keywords are ignored in the matching.

This example shows how to display the ACL class-map configuration:

```
switch# show class-map class_acl
```

Configuring DSCP Classification

You can classify traffic based on the DSCP value in the DiffServ field of the IP header. The standard DSCP values are listed in the following table:

Table 2: Standard DSCP Values

Value	List of DSCP Values
af11	AF11 dscp (001010)—decimal value 10
af12	AF12 dscp (001100)—decimal value 12
af13	AF13 dscp (001110)—decimal value 14
af21	AF21 dscp (010010)—decimal value 18
af22	AF22 dscp (010100)—decimal value 20
af23	AF23 dscp (010110)—decimal value 22
af31	AF31 dscp (011010)—decimal value 26
af32	AF40 dscp (011100)—decimal value 28
af33	AF33 dscp (011110)—decimal value 30
af41	AF41 dscp (100010)—decimal value 34
af42	AF42 dscp (100100)—decimal value 36
af43	AF43 dscp (100110)—decimal value 38
cs1	CS1 (precedence 1) dscp (001000)—decimal value 8
cs2	CS2 (precedence 2) dscp (010000)—decimal value 16

Value	List of DSCP Values
cs3	CS3 (precedence 3) dscp (011000)—decimal value 24
cs4	CS4 (precedence 4) dscp (100000)—decimal value 32
cs5	CS5 (precedence 5) dscp (101000)—decimal value 40
cs6	CS6 (precedence 6) dscp (110000)—decimal value 48
cs7	CS7 (precedence 7) dscp (111000)—decimal value 56
default	Default dscp (000000)—decimal value 0
ef	EF dscp (101110)—decimal value 46

SUMMARY STEPS

1. **configure terminal**
2. **class-map** [type qos] [match-any | match-all] *class-name*
3. **match** [not] dscp *dscp-values*
4. **exit**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] <i>class-name</i> Example: switch(config)# class-map class_dscp	Creates or accesses the class map named <i>class-name</i> and enters class-map mode. The class-map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters.
Step 3	match [not] dscp <i>dscp-values</i> Example: switch(config-cmap-qos)# match dscp af21, af32	Configures the traffic class by matching packets based on <i>dscp-values</i> . The standard DSCP values are shown in the following table. Use the not keyword to match on values that do not match the specified range.

	Command or Action	Purpose
Step 4	exit Example: <pre>switch(config-cmap-qos)# exit switch(config)#</pre>	Exits global class-map queuing mode and enters global configuration mode.
Step 5	copy running-config startup-config Example: <pre>switch(config)# copy running-config startup-config</pre>	(Optional) Saves the running configuration to the startup configuration.

This example shows how to display the DSCP class-map configuration:

```
switch# show class-map class_dscp
```

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. The precedence values are listed in the following:

Table 3: Precedence Values

Value	List of Precedence Values
0-7	IP precedence value
critical	Critical precedence (5)
flash	Flash precedence (3)
flash-override	Flash override precedence (4)
immediate	Immediate precedence (2)
internet	Internetwork control precedence (6)
network	Network control precedence (7)
priority	Priority precedence (1)
routine	Routine precedence (0)

SUMMARY STEPS

1. **configure terminal**
2. **class-map** [type qos] [match-any | match-all] *class-name*
3. **match** [not] precedence *precedence-values*
4. **exit**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] <i>class-name</i> Example: switch(config)# class-map class_ip_precedence	Creates or accesses the class map named <i>class-name</i> and then enters class-map mode. The class-map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters.
Step 3	match [not] precedence <i>precedence-values</i> Example: switch(config-cmap-qos)# match precedence 1-2, 5-7	Configures the traffic class by matching packets based on <i>precedence-values</i> . Values are shown in the following table. Use the not keyword to match on values that do not match the specified range.
Step 4	exit Example: switch(config-cmap-qos)# exit switch(config)#	Exits global class-map queuing mode and enters global configuration mode.
Step 5	copy running-config startup-config Example: switch(config)# copy running-config startup-config	(Optional) Saves the running configuration to the startup configuration.

This example shows how to display the IP precedence class-map configuration:

```
switch# show class-map class_ip_precedence
```

Configuring Protocol Classification

For Layer 3 protocol traffic, you can use the ACL classification match.

Table 4: match Command Protocol Arguments

Argument	Description
arp	Address Resolution Protocol (ARP)
bridging	Bridging
cdp	Cisco Discovery Protocol (CDP)
dhcp	Dynamic Host Configuration (DHCP)
isis	Intermediate system to intermediate system (IS-IS)

SUMMARY STEPS

1. **configure terminal**
2. **class-map [type qos] [match-any | match-all] class-name**
3. **match [not] protocol {arp | bridging | cdp | dhcp | isis}**
4. **exit**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] class-name Example: switch(config)# class-map class_protocol	Creates or accesses the class map named class-name and then enters class-map mode. The class-map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters.
Step 3	match [not] protocol {arp bridging cdp dhcp isis} Example: switch(config-cmap-qos)# match protocol isis	Configures the traffic class by matching packets based on the specified protocol. Use the not keyword to match on protocols that do not match the protocol specified.
Step 4	exit Example: switch(config-cmap-qos)# exit switch(config)#	Exits global class-map queuing mode and enters global configuration mode.

	Command or Action	Purpose
Step 5	copy running-config startup-config Example: <pre>switch(config)# copy running-config startup-config</pre>	(Optional) Saves the running configuration to the startup configuration.

This example shows how to display the protocol class-map configuration:

```
switch# show class-map class_protocol
```

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.

SUMMARY STEPS

1. **configure terminal**
2. **class-map [type qos] [match-any | match-all] class-name**
3. **match [not] packet length packet-length-list**
4. **exit**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] class-name Example: <pre>switch(config)# class-map class_packet_length</pre>	Creates or accesses the class map named class-name and then enters class-map mode. The class-map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters.
Step 3	match [not] packet length packet-length-list Example: <pre>switch(config-cmap-qos)# match packet length min 2000</pre>	Configures the traffic class by matching packets based on various packet lengths (bytes). Values can range from 1 to 9198. Use the not keyword to match on values that do not match the specified range.

	Command or Action	Purpose
Step 4	exit Example: <pre>switch(config-cmap-qos)# exit switch(config)#</pre>	Exits global class-map queuing mode and enters global configuration mode.
Step 5	copy running-config startup-config Example: <pre>switch(config)# copy running-config startup-config</pre>	(Optional) Saves the running configuration to the startup configuration.

This example shows how to display the packet length class-map configuration:

```
switch# show class-map class_packet_length
```

Configuring CoS Classification

You can classify traffic based on the class of service (CoS) in the IEEE 802.1Q header. This 3-bit field is defined in IEEE 802.1p to support QoS traffic classes. CoS is encoded in the high order 3 bits of the VLAN ID Tag field and is referred to as `user_priority`.

SUMMARY STEPS

1. **configure terminal**
2. **class-map [type qos] [match-any | match-all] class-name**
3. **match [not] cos cos-list**
4. **exit**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] class-name Example: <pre>switch(config)# class-map class_cos</pre>	Creates or accesses the class map named class-name and then enters class-map mode. The class-map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters.

	Command or Action	Purpose
Step 3	match [not] cos <i>cos-list</i> Example: <pre>switch(config-cmap-qos)# match cos 4,5-6</pre>	Configures the traffic class by matching packets based on the 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. Note When a Cisco Nexus Fabric Extender (FEX) is connected and in use, data traffic should not be marked with a CoS value of 7. CoS 7 is reserved for control traffic transiting the Fabric Extender.
Step 4	exit Example: <pre>switch(config-cmap-qos)# exit switch(config)#</pre>	Exits global class-map queuing mode and enters global configuration mode.
Step 5	copy running-config startup-config Example: <pre>switch(config)# copy running-config startup-config</pre>	(Optional) Saves the running configuration to the startup configuration.

This example shows how to display the CoS class-map configuration:

```
switch# show class-map class_cos
```

Configuring IP RTP Classification

The IP Real-time Transport Protocol (RTP) is a transport protocol for real-time applications that transmit 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 uses an even-numbered port and the next higher odd-numbered 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.

SUMMARY STEPS

1. **configure terminal**
2. **class-map [type qos] [match-any | match-all] *class-name***
3. **match [not] ip rtp *udp-port-value***
4. **exit**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	class-map [type qos] [match-any match-all] class-name Example: switch(config)# class-map class_rtp	Creates or accesses the class map named class-name and then enters class-map mode. The class-map name can contain alphabetic, hyphen, or underscore characters, and can be up to 40 characters.
Step 3	match [not] ip rtp udp-port-value Example: switch(config-cmap-qos)# match ip rtp 2000-2100, 4000-4100	Configures the traffic class by matching packets based on a 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	exit Example: switch(config-cmap-qos)# exit switch(config)#	Exits global class-map queuing mode and enters global configuration mode.
Step 5	copy running-config startup-config Example: switch(config)# copy running-config startup-config	(Optional) Saves the running configuration to the startup configuration.

This example shows how to display the RTP class-map configuration:

```
switch# show class-map class_rtp
```

Verifying the Classification Configuration

Use the **show class-map** command to verify the class-map configuration. This command displays all class maps.

Configuration Examples for Classification

The following example shows how to configure classification for two classes of traffic:

```
class-map class_dscp
match dscp af21, af32
exit
class-map class_cos
```

```
match cos 4, 5-6  
exit
```

