



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. |
| 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 a 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 Cisco NX-OS Licensing Guide . |

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 for Classification

Classification has the following guidelines and limitations:

- A QoS policy that references an ACL that contains a match on a source IPv6 address is not supported. Only matching on IPv4 source/destination and IPv6 destination is supported.
- A match on CoS/DSCP creates entries for IPv4/IPv6 which requires double the TCAM entries.
- Port-range matches are LOU expanded on ingress only.
- MAC address based match is not supported.
- RTP list not supported as match criteria in **class-map** for QoS classification.

- You cannot set both CoS and DSCP values for a class in a policy map.
- The **show** commands with the **internal** keyword are not supported.
- Matching the packets that are based on DSCP, CoS, or precedence in Cisco Nexus 3400-S switches, the TCAM entries for both IPv4 (single-wide is one entry) and IPv6 (double-wide are two entries) are installed in the hardware. For example, if you match DSCP 4, three entries are installed in the hardware, one entry for IPv4 and two entries for IPv6.
- You can specify a maximum of 512 match criteria in a class map.
- You can configure a maximum of 128 classes for use in a single policy map.
- Packet length classification is not supported.
- 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.
- Classification on VLANs is not supported.
- RTP classification is not supported.
- QoS classification policies are not supported under system QoS for Layer 2 switch ports. However, you can configure a QoS policy to classify the incoming traffic that is based on CoS/DSCP and map it to different queues. The QoS policy must be applied under all the interfaces that require the classification.
- MAC-based ACLs are not supported.

Configuring Traffic Classes

Configuring ACL Classification

You can classify traffic by matching packets based on an existing access control list (ACL). Traffic is classified by the criteria defined in the ACL. The permit and deny ACL keywords are ignored in the matching; even though a match criteria in the access-list has a deny action, it is still used for matching for this class.



Note Use the **class-map class_acl** command to display the ACL class-map configuration.

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: <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_acl</pre> | 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.) |
| Step 3 | match access-group name acl-name 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. |

Examples: Configuring ACL Classification

To prevent packets from being matched by the QoS class-map, you must explicitly specify the packets you want to match with permit statements. The *implicit* default deny statement at the end of the ACL will filter out the remainder. Any *explicit* deny statements configured inside the access list of a QoS class map will be ignored in the matching and treated as an explicit permit statement as shown in the examples below.

The following examples, A1, B1, and C1, all produce the same QoS matching results:

• A1

```
ip access-list extended A1
 permit ip 10.1.0.0 0.0.255.255 any
 permit ip 172.16.128.0 0.0.1.255 any
 permit ip 192.168.17.0 0.0.0.255 any
```

• B1

```
ip access-list extended B1
 permit ip 10.1.0.0 0.0.255.255 any
 deny ip 172.16.128.0 0.0.1.255 any /* deny is interpreted as a permit */
 permit ip 192.168.17.0 0.0.0.255 any
```

• C1

```
ip access-list extended C1
 deny ip 10.1.0.0 0.0.255.255 any /* deny is interpreted as a permit */
 deny ip 172.16.128.0 0.0.1.255 any /* deny is interpreted as a permit */
 deny ip 192.168.17.0 0.0.0.255 any /* deny is interpreted as a permit */
```

Adding an explicit DENY ALL at the end of a QoS matching ACL causes the QoS ACL to permit all traffic.

The following examples, D1 and E1, produce the same QoS matching results:

- D1

```
ip access-list extended D1
  permit ip 10.1.0.0 0.0.255.255 any
  permit ip 172.16.128.0 0.0.1.255 any
  permit ip 192.168.17.0 0.0.0.255 any
  deny ip 0.0.0.0 255.255.255.255 any /* deny is interpreted as a permit */
```



Note The last line in the example effectively becomes a PERMIT ALL statement and results in the QoS ACL to permit all packets.

- E1

```
ip access-list extended E1
  permit ip 0.0.0.0 255.255.255.255 any
```

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] class-name Example: switch(config)# class-map class_dscp | 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. |
| Step 3 | match [not] dscp dscp-values Example: switch(config-cmap-qos)# match dscp af21, af32 | Configures the traffic class by matching packets based on dscp-values. 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. |
| 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: | (Optional) Saves the running configuration to the startup configuration. |

| | Command or Action | Purpose |
|--|---|---------|
| | <code>switch(config)# copy running-config startup-config</code> | |

Example

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 | <code>configure terminal</code> Example: | Enters global configuration mode. |

| | Command or Action | Purpose |
|---------------|--|--|
| | switch# configure terminal switch(config)# | |
| Step 2 | class-map [type qos] [match-any match-all] class-name Example: switch(config)# class-map class_ip_precedence | 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] precedence precedence-values Example: switch(config-cmap-qos)# match precedence 1-2, 5-7 | Configures the traffic class by matching packets based on precedence-values. 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. |

Example

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: <pre>switch# configure terminal switch(config)#</pre> | Enters global configuration mode. |
| Step 2 | class-map [type qos] [match-any match-all] <i>class-name</i> Example: <pre>switch(config)# class-map class_protocol</pre> | 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] protocol {arp bridging cdp dhcp isis} Example: <pre>switch(config-cmap-qos)# match protocol isis</pre> | 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: <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. |

Example

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

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

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. |
| Step 3 | match [not] cos cos-list Example: <pre>switch(config-cmap-qos)# match cos 4,5-6</pre> | <p>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.</p> <p>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.</p> |
| 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. |

Example

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.



Note The Cisco Nexus 3400-S switches do not support RTP classification.

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: <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_rtp</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] ip rtp udp-port-value Example: <pre>switch(config-cmap-qos)# match ip rtp 2000-2100, 4000-4100</pre> | 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: <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. |

Example

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
```