Modular QoS Command Reference for Cisco 8000 Series Routers

First Published: 2020-03-01

Last Modified: 2024-03-27

CONTENTS

Preface

This preface contains these sections:

Changes to This Document

This table lists the technical changes made to this document since it was first released.

Table 1: Changes to This Document

Date	Summary
January 2022	Republished with documentation updates for Release 7.3.3 features.
June 2021	Republished with documentation updates for Release 7.3.16 features.
February 2021	Republished for Release 7.3.1.
October 2020	Republished for Release 7.2.12.
August 2020	Republished with documentation updates for Release 7.0.14 features.
March 2020	Initial release of this document.

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Congestion Avoidance Commands

bandwidth remaining

To specify how to allocate leftover bandwidth to various classes, use the **bandwidth remaining** command in policy map class configuration mode. To return to the system defaults, use the **no** form of this command.

bandwidth remaining [{**ratio** *ratio-value*}]
no bandwidth remaining [{**ratio** *ratio-value*}]

Syntax Description

ratio *ratio-value*	Specifies the amount of guaranteed bandwidth, based on a bandwidth ratio value. Range is 1 to 63 for main interfaces, and 1 to 255 for subinterfaces.

Command Default   No bandwidth is specified.

Command Modes   Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   Bandwidth, bandwidth remaining, and shaping commands can be configured together in the same class.

> **Note**   The **bandwidth remaining** command is supported only in the egress direction.

The available bandwidth is equally distributed among those queueing classes that do not have the remaining bandwidth explicitly configured.

The **bandwidth remaining** command is used to proportionally allocate bandwidth to the particular classes, but there is no reserved bandwidth capacity.

On egress, if the **bandwidth remaining** command is not present, then the bandwidth is shared equally among the configured queueing classes present in the policy-map.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how the remaining bandwidth is shared by classes class1 and class2 in a 20:80 ratio.

```
RP/0/RP0/CPU0:router(config)#policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)#class class1
RP/0/RP0/CPU0:router(config-pmap-c)#bandwidth remaining ratio 20
RP/0/RP0/CPU0:router(config-pmap-c)#exit
RP/0/RP0/CPU0:router(config-pmap)#class class2
RP/0/RP0/CPU0:router(config-pmap-c)#bandwidth remaining ratio 80
```

```
RP/0/RP0/CPU0:router(config-pmap-c)#exit
RP/0/RP0/CPU0:router(config-pmap)#exit
```

clear controller priority-flow-control statistics

To clear priority flow control statistics on an interface on a per-port or a per-traffic-class, per-port basis, use the **clear controller priority-flow-control statistics** command in XR EXEC mode.

clear controllers *interface-type* *interfacepath-id* **priority-flow-control** **statistics** **traffic-class** *tc*

Syntax Description

traffic class *tc* —Traffic class to be cleared

Command Default No default behavior or values

Command Modes XR EXEC mode

Command History

Release	Modification
Release 7.0.11	This command was introduced.

Usage Guidelines None

Example

This example shows a sample for the **clear controllers priority-flow-control statistics** command to clear statistics for traffic class 3:

```
Router#clear controller FourHundredGigE0/0/0/0 priority-flow-control statistics traffic-class
 3
```

clear controller priority-flow-control watchdog statistics

To clear priority flow control watchdog statistics on an interface on a per-port or a per-traffic-class, per-port basis, use **clear controller priority-flow-control watchdog-stats** command in XR EXEC mode.

clear controllers *interface-type* *interfacepath-id* **priority-flow-control** **watchdog-stats** **traffic-class** *tc*

Syntax Description

traffic class *tc* —Traffic class to be cleared	

Command Modes

XR EXEC mode

Command History

Release	Modification
Release 7.0.11	This command was introduced.

Usage Guidelines

None

Example

This example shows how to clear priority flow control watchdog statistics for traffic class 3 on a FourHundredGigE 0/0/0/0 interface.

```
Router#clear controller FourHundredGigE 0/0/0/0 priority-flow-control watchdog-stats
traffic-class 3
```

hw-module profile npu memory buffer-extended bandwidth-congestion-detection enable

To enable the ability to detect High Bandwidth Memory (HBM) congestion when you configure PFC in the buffer-extended mode, use the **hw-module profile npu memory buffer-extended bandwidth-congestion-detection enable** command in the XR Config mode.

To disable this feature, use the **no** form of this command.

hw-module profile npu memory buffer-extended location *lc* **bandwidth-congestion-detection enable**

Syntax Description	**location** *lc* —Line card location

Command Default   This feature is disabled by default.

Command Modes   XR Config mode

Command History

Release	Modification
Release 7.5.3	This command was introduced.

Usage Guidelines   No specific guidelines impact the use of this command.

Task ID

Task ID	Operation
qos	read, write

The following example shows how to enable the detection of HBM congestion when packets are egressing from an interface.

```
Router#config
Router(config)#hw-module profile npu buffer-extended location 0/6/CPU0
bandwidth-congestion-detection enable
Router(config)#commit
Router(config)#exit
```

hw-module profile npu memory buffer-extended bandwidth-congestion-protect enable

To enable triggering of global pause frames (X-off) whenever there's HBM congestion in the buffer-extended mode, use the **hw-module profile npu memory buffer-extended bandwidth-congestion-protect enable** command in the XR Config mode.

To disable this feature, use the **no** form of this command.

hw-module profile npu memory buffer-extended location *lc* **bandwidth-congestion-protect enable**

Syntax Description	**location** *lc* —Line card location

Command Default

This feature is disabled by default.

Command Modes

XR Config mode

Command History

Release	Modification
Release 7.5.4	This command was introduced.

Usage Guidelines

Configuring the **hw-module profile npu memory buffer-extended bandwidth-congestion-protect enable** command for line cards where you've configured headroom values exceeding 6144000 bytes could result in a commit error or the feature not being enabled.

You must reload the line card for the **hw-module profile npu memory buffer-extended bandwidth-congestion-protect enable** command to take effect.

Task ID

Task ID	Operation
qos	read, write

The following example shows how to enable the triggering of global pause frames (X-off) whenever there's HBM congestion.

```
Router#config
Router(config)#hw-module profile npu buffer-extended location 0/1/CPU0
bandwidth-congestion-protect enable
Router(config)#commit
```

hw-module profile priority-flow-control

To configure PFC threshold values, use the **hw-module profile priority-flow-control** command in XR Config mode. You can configure the values either in the **buffer-internal** mode or the **buffer-extended** mode. To return to the system defaults, use the **no** form of this command.

To disable this feature, use the no form of this command.

hw-module profile priority-flow-control **location** *lc* [**buffer-extended traffic-class** *value* **pause-threshold** *value unit* [**headroom** *value unit*] | **buffer-internal traffic-class** *value* **pause-threshold** *value unit* **headroom** *value unit* [**ecn** *value unit* | **max-threshold** *value unit* | **probability-percentage** *value unit*]]

For 88-LC0-36FH-M line cards:

hw-module profile priority-flow-control **location** *<lc>* [**buffer-extended traffic-class** *value* **pause-threshold** *value unit* [**headroom** *value unit*]]

Syntax Description		
location	*<lc>* —Line card location	
buffer-extended	**traffic-class** — value from 0 through 7	
	Sets PFC threshold values for long-reach PFC deployments. You can configure the following parameters using the **buffer-extended** option:	
	pause-threshold — pause-threshold for traffic class in ms or us and in KB or MB for 88-LC0-36FH-M line cards.	
	For 88-LC0-36FH-M line cards, also configure:	
	headroom —headroom for traffic class in KB or MB	
buffer-internal	**traffic-class** — value from 0 through 7	
	Sets PFC threshold values for short-reach PFC deployments. You can configure the following parameters using the **buffer-internal** option:	
	traffic-class — value from 0 through 7	
	pause-threshold — pause-threshold for traffic class in bytes	
	headroom — headroom for traffic class in bytes	
	ecn — Explicit Congestion Notification (ECN) threshold in bytes	
	From Release 7.3.6	
	max threshold— ECN maximum threshold value in bytes	
	probability-percentage — mark probability in percent	

Command Default

No default behavior or values.

Command Modes

XR Config

Command History	Release	Modification
	Release 7.0.11	This command was introduced.
	Release 7.3.1	This command isn't supported.
	Release 7.3.15	This command is supported.
	Release 7.3.16	The default PFC configuration functionality that autodetects PFC threshold values and configures them for the buffer-internal and buffer-extended modes, was introduced.
	Release 7.3.6	The options to configure ECN maximum threshold value and mark probability were added.

Usage Guidelines

- If you add a new traffic class and configure PFC threshold values for the first time on that traffic class, you must reload the line card.

- If you want to use the functionality to autodetect the PFC threshold values (using the default PFC configuration), delete the existing PFC configuration and then run the requisite command. You needn't reload the line card.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to configure the PFC threshold values using the buffer-internal mode.

```
RP/0/RP0/CPU0:router(config)#hw-module profile priority-flow-control location 0/1/CPU0
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-internal traffic-class 3 pause-threshold 403200
 bytes headroom 441600 bytes ecn 224640 bytes
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-internal traffic-class 4 pause-threshold 403200
 bytes headroom 441600 bytes ecn 224640 bytes

RP/0/RP0/CPU0:router(config-pfc-loc)#commit
```

This example shows how to configure the PFC threshold values using the buffer-extended mode.

```
RP/0/RP0/CPU0:router(config)#hw-module profile priority-flow-control location 0/6/0/1
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-extended traffic-class 3 pause-threshold 10 ms
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-extended traffic-class 4 pause-threshold 10 ms
RP/0/RP0/CPU0:router(config-pfc-loc)#commit
```

The default PFC configuration autodetects PFC threshold values and configures them for the buffer-internal and buffer-extended modes.

Configure the traffic class values for the buffer-internal and buffer-extended modes in the **hw-module profile priority-flow-control** command. Depending on the line card, the functionality configures the default threshold values.

For example, for buffer-internal mode on a line card, configure:

```
RP/0/RP0/CPU0:router(config)#hw-module profile priority-flow-control location 0/0/CPU0
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-internal traffic-class 3
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-internal traffic-class 4
RP/0/RP0/CPU0:router(config-pfc-loc)#exit
RP/0/RP0/CPU0:router(config-pfc-loc)#commit
```

For buffer-extended mode on a line card, configure:

```
RP/0/RP0/CPU0:router(config)#hw-module profile priority-flow-control location 0/2/CPU0
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-extended traffic-class 2
RP/0/RP0/CPU0:router(config-pfc-loc)#buffer-extended traffic-class 1
RP/0/RP0/CPU0:router(config-pfc-loc)#exit
RP/0/RP0/CPU0:router(config-pfc-loc)#commit
```

The following example shows how to configure PFC in buffer-internal mode with custom values for all parameters including **max-threshold** and **probability-percentage**.

```
Router(config)#hw-module profile priority-flow-control location 0/6/01
Router(config-pfc-loc)#buffer-internal traffic-class 3 pause-threshold 1574400 bytes headroom
 1651200 bytes ecn 629760 bytes max-threshold 1416960  bytes probability-percentage 50
Router(config-pfc-loc)#buffer-internal traffic-class 4 pause-threshold 1574400 bytes headroom
 1651200 bytes ecn 629760 bytes max-threshold 1416960  bytes probability-percentage 50
Router(config-pfc-loc)#commit
```

hw-module profile qos low-latency-mode

To enable the low latency mode for data-intensive operations, use the **hw-module profile qos low-latency-mode** command in the XR Config mode.

To disable this feature, use the **no** form of this command.

hw-module profile qos low-latency mode *value*

Syntax Description

hw-module profile qos low-latency-mode *value* —denotes the latency level	

Command Default

This feature is disabled by default.

Command Modes

XR Config mode

Command History

Release	Modification
Release 24.2.1	This command was introduced.

Usage Guidelines

Evaluate the impact of this feature across your existing configurations and operations. Since this feature has yet to be tested for all scenarios, ensure that you deploy it only after consulting your Cisco TAC team.

You must run all the fabric cards on your router for this feature to work.

Ensure that you don't configure QoS policies for subinterfaces.

Reload the router using the **hw-module location all reload** command for this configuration to take effect.

Task ID

Task ID	Operation
qos	read, write

The following example shows how to enable the low latency mode.

```
Router#config
Router(config)#hw-module profile qos low-latency-mode
Router(config)#commit
Router(config)#exit
Router#admin
sysadmin-router#hw-module location all reload
```

hw-module profile qos voq-mode

To configure the VOQ mode value or the fair VOQ mode value, use the hw-module profile qos voq-mode command in XR Config mode. To disable this mode, use the no form of the command. You can configure the normal VOQ mode value from 8 (default value) to 4 or conversely from 4 to 8.

hw-module profile qos voq-mode [**4** | **8** | **fair-4** | **fair-8**]

Syntax Description

4	Indicates the normal VOQ mode to configure to 4.
8	Indicates the normal VOQ mode to configure to 8.
fair-4	Indicates the fair VOQ mode to configure to fair-4.
fair-8	Indicates the fair VOQ mode to configure to fair-8.

Command Default The default normal VOQ mode value is 8.

Command Modes XR Config mode

Command History

Release	Modification
Release 7.0.12	This command was introduced.
Release 7.3.3	The option to configure fair VOQ mode was introduced.

Usage Guidelines The default normal VOQ mode value is 8. To change the value to 4, you must:

1. Configure **hw-module profile qos voq-mode** *4* and commit.

2. Remove the queuing service-policy from all interfaces including main interface, subinterface, and bundle.

3. Run **reload location all** to reload all nodes on your router.

Note Because this mode supports a maximum of four VOQs, egress policy matches only on queues 7, 6, 5, and 0.

After you commit the *hw-module* configuration, you **must** reload the chassis immediately before proceeding with any other operation. Else, existing configurations on the chassis may be affected, leading to unexpected behavior.

Task ID

Task ID	Operation
qos	read, write

The following example shows how to enable VOQ mode value 4 on the router.

```
RP/0/RP0/CPU0:router#config
RP/0/RP0/CPU0:router(config)#hw-module profile
RP/0/RP0/CPU0:router(config)#hw-module profile qos
RP/0/RP0/CPU0:router(config)#hw-module profile voq-mode 4
RP/0/RP0/CPU0:router(config)#commit
RP/0/RP0/CPU0:router#reload location all
```

The following example shows how to configure fair-4 VOQ mode:

```
RP/0/RP0/CPU0:router#config
RP/0/RP0/CPU0:router(config)#hw-module profile
RP/0/RP0/CPU0:router(config)#hw-module profile qos
RP/0/RP0/CPU0:router(config)#hw-module profile voq-mode fair-4
RP/0/RP0/CPU0:router(config)#commit
RP/0/RP0/CPU0:router#reload location all
```

hw-module voq-watchdog cardshut disable

To prevent the line cards from being shut down upon detecting stuck VOQs, use the **hw-module voq-watchdog cardshut disable** command in the XR Config mode.

hw-module voq-watchdog cardshut disable

Syntax Description   This command has no arguments or keywords.

Command Default   This feature is enabled by default.

Command Modes   XR Config mode

Command History

Release	Modification
Release 24.2.1	This command was introduced.

Usage Guidelines   No specific guidelines impact the use of this command.

Task ID

Task ID	Operation
qos	read, write

The following example shows how to disable the shutdown action on the line card upon detecting stuck VOQs.

```
Router#config
Router(config)#hw-module voq-watchdog cardshut disable
Router(config)#commit
```

hw-module voq-watchdog feature enable

To disable the Virtual Output Queue (VOQ) watchdog feature, use the **hw-module voq-watchdog feature enable** command in the XR Config mode.

hw-module voq-watchdog feature enable

Syntax Description   This command has no arguments or keywords.

Command Default   This feature is disabled by default.

Command Modes   XR Config mode

Command History

Release	Modification
Release 24.2.1	This command was introduced.

Usage Guidelines   No specific guidelines impact the use of this command.

Task ID

Task ID	Operation
qos	read, write

The following example shows how to enable the VOQ watchdog feature on your router.

```
Router#config
Router(config)#hw-module voq-watchdog feature enable
Router(config)#commit
Router(config)#exit
```

queue-limit

To specify or modify the maximum number of packets the queue can hold for a class policy configured in a policy map for each port, use the **queue-limit** command in policy map class configuration mode. To remove the queue packet limit from a class, use the **no** form of this command.

queue-limit *value* [*unit*] | *percent <1-100> | discard-class value <0-1> unit*
no queue-limit

Syntax Description		
value	Maximum threshold for tail drop in bytes. Range is from 1 to 4294967295.	
unit	(Optional) Units for the queue limit value. Values can be:	
	• **bytes** —bytes	
	• **kbytes** —kilobytes	
	• **mbytes** —megabytes	
	• **ms** —milliseconds	
	• **packets** —packets (default)	
	• **us** —microseconds	
	Note When the specified *units* is packets, packets are assumed to be 256 bytes in size.	
percent	(Optional) Allows you to specify queue limit thresholds as a percentage of the total buffer limit for each port. This makes your provisioning model simpler and makes it easier for you to adjust the queue burst limit, irrespective of the queue's service rate.	
discard-class	(Optional) Allows you to configure dual queue limit thresholds for high priority and low priority. This option was introduced in Release 7.0.12.	
	value	
	• **0** —higher priority flow	
	• **1** —lower priority flow	
	(Optional) Units for the queue limit value. Values can be:	
	• **bytes** —bytes	
	• **kbytes** —kilobytes	
	• **mbytes** —megabytes	
	• **ms** —milliseconds	
	• **packets** —packets (default)	
	• **us** —microseconds	

Command Default   The default value is 6 milliseconds for all queues including the high-priority queues.

Command Modes   Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   When configuring the **queue-limit** command, you must configure one of the following commands: **priority**, **shape average**, **bandwidth** or **bandwidth remaining**, except for the default class. The default value is 6 milliseconds for all queues including the high-priority queues.

The **queue-limit** command is supported only in the egress direction.

Packets satisfying the match criteria for a class accumulate in the queue reserved for the class until they are serviced by the scheduling mechanism. The **queue-limit** command defines the maximum threshold for a class. When that threshold is reached, enqueued packets to the class queue result in tail drop (packet drop). Tail drop is a congestion avoidance technique that drops packets when a virtual output queue is full, until congestion is eliminated.

Use the **show qos interface** command to display the queue limit and other QoS values.

Queue Limit Default Values

These default values are used when **queue-limit** is not configured in the class.

If QoS is configured and random-detect is configured when the **queue-limit** is configured in time units, the guaranteed service rate (for the non-priority class) or the interface rate (for the priority class) is used to compute the queue-limit.

Task ID

Task ID	Operations
qos	read, write

Examples   This example shows how to configure two queue limits, one for higher priority and the other for lower priority.:

```
RP/0/RP0/CPU0:router(config)#policy-map egress_pol_dql
RP/0/RP0/CPU0:router(config-pmap)# class tc7
RP/0/RP0/CPU0:router(config-pmap-c)#priority level 1
RP/0/RP0/CPU0:router(config-pmap-c)#queue-limit ?
<1-4294967295>  Max Threshold for tail drop
  discard-class   Discard Class based QLIMIT (upto 8 values)
  percent         Configure queue limit value in percentage

RP/0/RP0/CPU0:router(config-pmap-c)#queue-limit discard-class ?
<0-1>  Discard Class  value
RP/0/RP0/CPU0:router(config-pmap-c)#queue-limit discard-class 0 100 ?
bytes    Bytes
  kbytes   Kilobytes
  mbytes   Megabytes
  ms       Milliseconds
```

```
  packets  Packets (default)
  us       Microseconds
  <cr>
RP/0/RP0/CPU0:router(config-pmap-c)#queue-limit discard-class 0 100 mbytes
RP/0/RP0/CPU0:router(config-pmap-c)#queue-limit discard-class 1 50 mbytes
RP/0/RP0/CPU0:router(config-pmap-c)#commit
RP/0/RP0/CPU0:router(config-pmap-c)#end
```

random-detect

To enable random early detection (RED), use the **random-detect** command in policy map class configuration mode. To remove RED, use the **no** form of this command.

random-detect [[[**min-threshold** *value*] [**max-threshold** *value*] **probability** *percentage probability value*]] [**discard-class** *value*]

no random-detect

Syntax Description		
min-threshold *value*	Minimum threshold in number of packets. The value range of this argument is from 0 through 1073741823 in packets.	
	Note	On your router, the threshold numbers are converted into units of bytes (minimum: 6144, maximum: 390070272) and enforced.
max-threshold *value*	Maximum threshold in number of packets. The value range of this argument is from the value of the *min-threshold* argument through 1073741823. When the queue length exceeds the maximum threshold, RED drops all packets with the specified discard class value.	
	Note	On your router, the threshold numbers are converted into units of bytes (minimum: 6144, maximum: 390070272) and enforced.
units	(Optional) Units for the threshold values. Values can be: • **bytes**—bytes • **gbytes**—gigabytes • **kbytes**—kilobytes • **mbytes** —megabytes • **ms** —milliseconds • **packets** —packets (default) • **us** —microseconds	
probability *percentage probability value*	Configure WRED mark probability in percent. The value range of this argument is from 1 through 100.	
discard-class *value*	Discard-class based RED (up to 2 values, which is 0 and 1).	

Command Default Default unit for *max-threshold* and *min-threshold* is **packets**.

Command Modes Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Release	Modification
Release 7.3.16	The functionality to configure WRED mark probability in percent was introduced.

Usage Guidelines

The RED congestion avoidance technique takes advantage of the congestion control mechanism of TCP. By randomly dropping packets before periods of high congestion, RED tells the packet source to decrease its transmission rate. Assuming the packet source is using TCP, it decreases its transmission rate until all the packets reach their destination, indicating that the congestion is cleared. You can use RED as a way to cause TCP to slow transmission of packets. TCP not only pauses, but it also restarts quickly and adapts its transmission rate to the rate that the network can support.

RED distributes losses in time and maintains normally low queue depth while absorbing traffic bursts. When enabled on an interface, RED begins dropping packets when congestion occurs at a rate you select during configuration.

When time units are used, the guaranteed service rate is used to compute thresholds.

When the value of the *units* argument is packets, packets are assumed to be 256 bytes in size.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to enable RED using a minimum threshold value of 1000000 and a maximum threshold value of 2000000:

```
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# random-detect 1000000 2000000
```

service-policy (interface)

To attach a policy map to an input interface or output interface to be used as the service policy for that interface, use the **service-policy** command in the appropriate configuration mode. To remove a service policy from an input or output interface, use the **no** form of the command.

service-policy {**input** | **output**} *policy-map*
no service-policy {**input** | **output**} *policy-map*

Syntax Description		
input	Attaches the specified policy map to the input interface.	
output	Attaches the specified policy map to the output interface.	
policy-map	Name of a service policy map (created using the **policy-map** command) to be attached.	

Command Default

No service policy is specified.

Command Modes

Interface configuration.

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

You can attach a single policy map to one or more interfaces to specify the service policy for those interfaces. The class policies composing the policy map are then applied to packets that satisfy the class map match criteria for the class. To apply a new policy to an interface, you must remove the previous policy. A new policy cannot replace an existing policy.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows policy map policy2 applied to HundredGigE 0/0/0/0.

```
RP/0/RP0/CPU0:router(config)# class-map class2
RP/0/RP0/CPU0:router(config)# match precedence ipv4 2
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy2
RP/0/RP0/CPU0:router(config-pmap)# class-map class2
RP/0/RP0/CPU0:router(config-pmap-c)# set precedence 3
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# HundredGigE 0/0/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input policy2
```

This example shows policy map policy 1 applied to Bundle-Ether interface.

```
RP/0/RP0/CPU0:router(config)# interface Bundle-Ether1
RP/0/RP0/CPU0:router(config-if)# service-policy input policy1
RP/0/RP0/CPU0:router(config-if)# exit
```

service-policy (policy map class)

To use a service policy as a QoS policy within a policy map (called a *hierarchical service policy*), use the **service-policy** command in policy map class configuration mode. To disable a particular service policy as a QoS policy within a policy map, use the **no** form of this command.

service-policy [**type qos**] *policy-map-name*
no service-policy [**type qos**] *policy-map-name*

Syntax Description		
type qos	(Optional) Specifies a QoS service policy.
policy-map-name	Name of the predefined policy map to be used as a QoS policy. The name can be a maximum of 40 alphanumeric characters.

Command Default

No service policy is specified.

Type is QoS when not specified.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

The **service-policy (policy-map class)** command creates hierarchical service policies in policy-map class configuration mode.

This command is different from the **service-policy (interface)** command used in interface configuration mode.

The child policy is the previously defined service policy that is being associated with the class default of the parent policy-map. The new service policy using the preexisting service policy is the parent policy.

The **service-policy (policy-map class)** command has this restriction:

• The **priority** command can be used only in the child policy.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to create a hierarchical service policy in the service policy called parent:

```
RP/0/RP0/CPU0:router(config)# policy-map child
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# priority level 1
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit
```

```
RP/0/RP0/CPU0:router(config)# policy-map parent
RP/0/RP0/CPU0:router(config-pmap)# class class-default
RP/0/RP0/CPU0:router(config-pmap-c)# shape average 10000000
RP/0/RP0/CPU0:router(config-pmap-c)# service-policy child
```

shape average

To shape traffic to the indicated bit rate according to the algorithm specified, use the **shape average** command in policy map class configuration mode. To remove traffic shaping, use the **no** form of this command.

shape average {**percent** *percentage* | *rate* [*units*] | **per-thousand** *value* | **per-million** *value* }
no shape average

Syntax Description		
percent *percentage*	Specifies the interface bandwidth in percentage. Values can be from 1 to 100.
rate	Average shaping rate in the specified units. Values can be from 1 to 4294967295.
units	(Optional) Units for the bandwidth. Values can be: • **bps**—bits per second (default) • **gbps**—gigabits per second • **kbps**—kilobits per second • **mbps**—megabits per second
per-thousand *value*	Specifies shape rate as parts per thousand of the available bandwidth.
per-million *value*	Specifies shape rate as parts per million of the available bandwidth.

Command Default

units: **bps**

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

The **shape average** command is supported only in the egress direction.

When you use the **shape average** command, egress shaping is done at the Layer 1 level and includes the Layer 1 header in the rate calculation. If you have both shape and bandwidth configured for a class, ensure that the shape percent value is always greater than the percent value for bandwidth. For bundled interfaces, **shape average** can be configured only as a percentage.

The **priority** and **shape average** commands can be configured together in the same class.

Task ID

Task ID	Operations
qos	read, write

Examples

This example sets traffic shaping to 50 percent of the parent shaper rate milliseconds:

```
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# shape average percent 50
```

This example shows how to set traffic shaping to 100000 kbps:

```
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# shape average 100000 kbps
```

show controllers

To view Priority Flow Control (PFC) statistics, including PFC watchdog statistics, use the **show controllers** command in the XR EXEC mode.

show controllers { *interface* **priority-flow-control** [{ **statistics** | **watchdog-stats** }] | **all priority-flow-control** { **statistics** | **watchdog-stats** } **location all** }

Syntax Description

interface	Displays statistics for an interface.
all	Displays statistics for all interfaces.
priority-flow-control	Specifies PFC mechanism.
statistics	Displays PFC statistics for an interface or all interfaces.
	(Optional) For a specific interface.
watchdog-stats	Displays PFC watchdog statistics for an interface or all interfaces.
	(Optional) For a specific interface.
location all	Displays PFC statistics for all nodes.

Command Modes   XR EXEC mode

Command History

Release	Modification
Release 7.5.5	The **show controllers all priority-flow-control statistics location all** command form was added to display PFC statistics for all interfaces.
	The **show controllers all priority-flow-control watchdog-stats location all** command form was added to display PFC watchdog statistics for all interfaces.

Release	Modification
Release 7.5.4	For the **show controllers priority-flow-control watchdog-stats** command output, separate counters were added for total dropped packets and dropped packets.
	For the **show controllers priority-flow-control statistics**command, an additional counter for PFC Tx pause frames per traffic class was added.
Release 7.0.11	The **show controllers priority-flow-control statistics** and **show controllers priority-flow-control watchdog-stats** command forms were introduced.

Usage Guidelines

- From Release 7.5.5, you can view the PFC and PFC Watchdog statistics for all interfaces using the **show controllers all priority-flow-control statistics location all** and **show controllers all priority-flow-control watchdog-stats location all** commands, respectively.
- Running the **clear controller priority-flow-control watchdog-stats** command also clears the counters for the corresponding interfaces that the **show controllers all priority-flow-control watchdog-stats location all** command displays.
- Running the **clear controller priority-flow-control statistics** command also clears the counters for the corresponding interfaces that the **show controllers all priority-flow-control statistics location all** command displays.
- You can view PFC statistics and PFC Watchdog statistics per interface using the **show controllers priority-flow-control statistics** and **show controllers priority-flow-control watchdog-stats** commands, respectively.
- Use the **clear controller priority-flow-control statistics**and **clear controller priority-flow-control watchdog-stats** commands to clear PFC statistics and PFC watchdog statistics counters, respectively.

This example shows a sample output of the **show controllers priority-flow-control statistics** command:

```
Router# show controllers hundredGigE 0/0/0/0 priority-flow-control statistics

Priority flow control information for interface HundredGigE0/0/0/0:
Priority Flow Control:
    Total Rx PFC Frames: 0
    Total Tx PFC Frames: 1764273
    Rx Data Frames Dropped: 0
    CoS   Status  Rx Frames
    ---   ------  ----------
     0     Off       0
     1     Off       0
     2     Off       0
     3     Off       0
     4     Off       0
```

```
    5   Off     0
    6   Off     0
    7   Off     0
```

This example shows the sample output with counters for PFC Tx frames per traffic class.

```
Router# show controllers hundredGigE 0/0/0/4  priority-flow-control statistics

Priority flow control information for interface HundredGigE0/0/0/4:
Priority Flow Control:
    Total Rx PFC Frames: 0
    Total Tx PFC Frames: 4832680
    Rx Data Frames Dropped: 1442056 (possible overflow)
    CoS  Status  Rx Frames   Tx Frames
    ---  ------  ----------  ----------
     0   on          0           0
     1   on          0           0
     2   on          0           0
     3   on          0        2416374
     4   on          0        2416306
     5   on          0           0
     6   on          0           0
     7   on          0           0
```

This example shows the sample output of **show controllers hundredGigE 0/0/0/0 priority-flow-control watchdog-stats** command:

```
Router# show controllers hundredGigE 0/0/0/0 priority-flow-control watchdog-stats

Priority flow control information for interface HundredGigE0/0/0/0:

Priority flow control watchdog statistics:
SAR: Auto restore and shutdown
---------------------------------------------------------------------------------------------------
Traffic Class             :     0      1      2      3      4      5      6
     7
---------------------------------------------------------------------------------------------------
Watchdog Events           :     0      0      0      0      0      0      0
     0
Shutdown Events           :     0      0      0      0      0      0      0
     0
Auto Restore Events       :     0      0      0      0      0      0      0
     0
SAR Events                :     0      0      0      0      0      0      0
     0
SAR Instantaneous Events  :     0      0      0      0      0      0      0
     0
Total Dropped Packets     :     0      0      0      0      0      0      0
     0
```

From Release 7.5.4 onwards, the output includes separate counters for total dropped packets and dropped packets:

```
Router# show controllers hundredGigE 0/1/0/43 priority-flow-control watchdog-stats

Priority flow control information for interface HundredGigE0/1/0/43:

Priority flow control watchdog statistics:
SAR: Auto restore and shutdown
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
Traffic Class             :     0      1      2      3      4      5      6
```

```
        7
-\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\+-
Watchdog Events         :        0        0        0        3        3        0        0
        0
Shutdown Events         :        0        0        0        3        3        0        0
        0
Auto Restore Events     :        0        0        0        3        3        0        0
        0
SAR Events              :        0        0        0     3510     3510        0        0
        0
SAR Instantaneous Events :       0        0        0     1172     1172        0        0
        0
Total Dropped Packets   :        0        0        0 941505767 941488166        0        0
        0
Dropped Packets         :        0        0        0 314855466 314887161        0        0
        0
```

Disregard the SAR Events and SAR Instantaneous Events entries because those numbers have no bearing on your operations.

This example shows a sample output of the **show controllers all priority-flow-control statistics location all** command:

```
Router# show controllers all priority-flow-control statistics location all

    Interface             TC    Rx PFC  TxPFC  RxDropped

    FourHundredGigE0/0/0/0   0      0      0     NA
    FourHundredGigE0/0/0/0   7      0      0     NA
    FourHundredGigE0/0/0/0  all     0      0     0
    FourHundredGigE0/0/0/1   0      0      0     NA
    FourHundredGigE0/0/0/1   7      0      0     NA
    FourHundredGigE0/0/0/1  all     0      0     0
    FourHundredGigE0/0/0/2   0      0      0     NA
    FourHundredGigE0/0/0/2   7      0      0     NA
    FourHundredGigE0/0/0/2  all     0      0     0
    FourHundredGigE0/0/0/3   0      0      0     NA
```

This example shows the sample output of the **show controllers all priority-flow-control watchdog-stats location all** command:

```
Router# show controllers all priority-flow-control watchdog-stats location all

Interface           TC  Watchdog  Shutdown  Auto Restore  SAR      SAR Instantaneous
Total Dropped    Dropped
                        Events    Events    Events        Events   Events

FourHundredGigE0/0/0/0   0   0         0         0            0        0
0                0
FourHundredGigE0/0/0/0   7   0         0         0            0        0
0                0
FourHundredGigE0/0/0/1   0   0         0         0            0        0
0                0
FourHundredGigE0/0/0/1   7   0         0         0            0        0
0                0
FourHundredGigE0/0/0/2   0   0         0         0            0        0
0                0
FourHundredGigE0/0/0/2   7   0         0         0            0        0
0                0
FourHundredGigE0/0/0/3   0   0         0         0            0        0
```

```
0                    0
FourHundredGigE0/0/0/3   7   0           0           0           0           0
0                    0
FourHundredGigE0/0/0/4   0   0           0           0           0           0
0                    0
```

show controllers npu packet-memory

To display the High Bandwidth Memory (HBM) congestion state and the current current memory usage of Shared Memory System (SMS) and HBM, use the **show controllers npu packet-memory** command in the XR EXEC mode.

show controllers npu packet-memory [all | congestion | interface *type* **| usage {instance {** *number* **|** *all* **}| verbose}]**

Syntax Description		
all	Displays all details, including memory usage and congestion .
congestion	Displays Open Forwarding Abstraction (OFA) hardware congestion.
interface *type*	Displays the name of the IEEE 802.3 interfaces.
	For *type*, you can specify a specific interface or use **all** to specify all interfaces.
usage instance*number*	Displays information for the specific device instance number selected.
usage instance*all*	Displays information for all device instances
verbose	Displays information details, including timestamp in milliseconds.

Command Default   None

Command Modes   XR EXEC mode

Command History

Release	Modification
Release 7.5.5	Counters to view buffer availability for Shared Memory System (SMS) and High Bandwidth Memory (HBM) were added.
Release 7.5.3	This command was introduced.

Usage Guidelines   The **show controllers npu packet-memory** command is supported only when you:

- configure Priority Flow Control in the buffer-extended mode. (See **hw-module profile priority-flow-control**.)

- configure the **hw-module profile npu memory buffer-extended bandwidth-congestion-detection enable** command to detect HBM congestion.

For details on detecting HBM congestion, and detailed examples of **show controllers npu packet-memory**, see the *Modular QoS Configuration Guide for Cisco 8000 Series Routers*.

Task ID

Task ID	Operations
interface	read
cisco-support	read

From Release 7.5.5, you can also view details of the buffer available for SMS (**Buff-int-free Min WM**) and HBM (**Buff-ext-free Min WM**) when you run the **show controllers npu packet-memory usage instance all location all** command.

```
Router#show controller npu packet-memory usage instance all location all
HW memory Information For Location: 0/6/CPU0
```

Timestamp(msec)	Device	Buff-int Usage	Buff-int Max WM	Buff-ext Usage	Buff-ext Max WM	**Buff-int-free Min WM**	**Buff-ext-free Min WM**
Wed 2023-08-30 23:47:40.918 UTC	0	1518	6668	17154	17656	293394	982846
Wed 2023-08-30 23:47:41.918 UTC	0	1227	5631	16010	16427	293685	983990
Wed 2023-08-30 23:47:42.919 UTC	0	1398	8295	15041	15734	293514	984959
Wed 2023-08-30 23:47:43.919 UTC	0	1765	8892	14744	15678	293147	985256
Wed 2023-08-30 23:47:41.011 UTC	1	10380	12419	37532	38165	284532	962468
Wed 2023-08-30 23:47:42.011 UTC	1	10463	11977	37315	38326	284449	962685
Wed 2023-08-30 23:47:43.013 UTC	1	9145	12604	37714	38242	285767	962286
Wed 2023-08-30 23:47:44.013 UTC	1	10996	13272	37429	38051	283916	962571

Run the **show controllers npu packet-memory usage verbose instance all location all** to view memory usage details in SMS and HBM.

```
RP/0/RP0/CPU0:Router#show controllers npu packet-memory usage verbose instance all location
 all

HW memory Information For Location: 0/RP0/CPU0

* Option 'verbose' formatted data is for internal consumption.
```

Timestamp(msec)	Device	Buff-int Usage	Buff-int Max WM	Buff-ext Usage	Buff-ext Max WM
1663958881006	0	2455	2676	637	640
1663958882007	0	2461	2703	635	640
1663958883007	0	2364	2690	635	640
1663958884007	0	71603	75325	3183	18336
1663958885008	0	2458	2852	1275	1279
1663958886008	0	2484	2827	1275	1279

Run the **show controllers npu packet-memory congestion verbose instance all location all** command to view congestion details in SMS and HBM.

```
Router#show controllers npu packet-memory congestion verbose instance all location all
HW memory Information For Location: 0/RP0/CPU0
```

* Option 'verbose' formatted data is for internal consumption.

Timestamp(msec)	Event Type	Device	Slice	VOQ	VOQ-buff int-WM	Evicted-buff int-WM	Buff-int UC-WM	Buff-int Usage	Buff-int Max WM	Buff-ext Usage	Buff-ext Max WM
1663958550349	0	0	5	534	16011	63969	65451	70410	70410	34405	34405
1663958551101	1	0	5	534	0	0	900	2440	2440	0	0
1663958557354	0	0	5	534	16011	63984	65493	70573	70573	34408	34408
1663958558354	1	0	5	534	0	0	915	2455	2455	0	0
1663958564606	0	0	5	534	16011	64002	65520	70081	70081	34532	34532
1663958565356	1	0	5	534	0	0	915	2417	2417	0	0

show controllers npu packet-memory interface sq-buffer-usage

To display the source queue buffer usage information in the packet memory space, use the show controllers npu packet-memory **sq-buffer-usage** command in the XR EXEC mode.

show controllers npu packet-memory interface *type* **sq-buffer-usage [latest] location** *ID*

Syntax Description		
latest	Shows the latest information about priority flow control (PFC) source queue buffer usage at the specified NPU node/all nodes.
location *ID*	Specifies the node location. For *ID*, you can specify a specific node in the *rack/slot/module* notation or use **all** to specify all nodes.

Command Default

None

Command Modes

XR EXEC mode

Command History

Release	Modification
Release 24.1.1	This command was introduced.

Usage Guidelines

Displaying the source queue buffer usage in all ports at all locations is not supported.

Task ID

Task ID	Operations
interface	read
cisco-support	read

This example displays periodic information about the source queue buffer usage per port in the packet memory space

```
Router#show controllers npu packet-memory interface FourHundredGigE 0/0/0/23 sq-buffer-usage
 location 0/RP0/CPU0
Thu Feb  1 16:52:48.101 UTC


----------------------------------------------------------------------
Node ID: 0/RP0/CPU0
Source Queue Buffer Usage Info for interface(s) FourHundredGigE0_0_0_23

Intf          Intf        TC      buffer-usage      congestion-state
name          handle
              (hex)
----------------------------------------------------------------------
FH0/0/0/23   0x0f0001c8    3             0                  NO
FH0/0/0/23   0x0f0001c8    6             0                  NO
```

This example displays latest information about the source queue buffer usage per port in the packet memory space.

```
RP/0/RP0/CPU0:ios#show controllers npu packet-memory interface FourHundredGigE 0/0/0/23
sq-buffer-usage latest location 0/RP0/CPU0
Thu Feb  1 16:57:20.657 UTC


----------------------------------------------------------------------------
This option will affect system performance and should be used with caution.
Integration of this CLI with automation scripts is not recommended


----------------------------------------------------------------------------
Node ID: 0/RP0/CPU0
Source Queue Buffer Usage Info for interface(s) FourHundredGigE0_0_0_23

Intf           Intf          TC     buffer-usage     congestion-state
name           handle
               (hex)
----------------------------------------------------------------------------
FH0/0/0/23     0x0f0001c8    3          0                 NO
FH0/0/0/23     0x0f0001c8    6          0                 NO
```

This example displays periodic information about source queue buffer usage in all ports in the packet
memory space.

```
RP/0/RP0/CPU0:ios#show controllers npu packet-memory interface all sq-buffer-usage location
 0/RP0/CPU0
Thu Feb  1 17:04:40.472 UTC


----------------------------------------------------------------------------
Node ID: 0/RP0/CPU0
Source Queue Buffer Usage Info for interface(s) all

Intf           Intf          TC     buffer-usage     congestion-state
name           handle
               (hex)
----------------------------------------------------------------------------
Hu0/0/0/0      0x0f000130    3          0                 NO
Hu0/0/0/0      0x0f000130    6          0                 NO
Hu0/0/0/35     0x0f000138    3          0                 NO
Hu0/0/0/35     0x0f000138    6          0                 NO
Hu0/0/0/34     0x0f000140    3          0                 NO
Hu0/0/0/34     0x0f000140    6          0                 NO
Hu0/0/0/33     0x0f000148    3          0                 NO
Hu0/0/0/33     0x0f000148    6          0                 NO
Hu0/0/0/32     0x0f000150    3          0                 NO
Hu0/0/0/32     0x0f000150    6          0                 NO
Hu0/0/0/31     0x0f000158    3          0                 NO
Hu0/0/0/31     0x0f000158    6          0                 NO
Hu0/0/0/30     0x0f000160    3          0                 NO
Hu0/0/0/30     0x0f000160    6          0                 NO
Hu0/0/0/29     0x0f000168    3          0                 NO
Hu0/0/0/29     0x0f000168    6          0                 NO
Hu0/0/0/28     0x0f000170    3          0                 NO
Hu0/0/0/28     0x0f000170    6          0                 NO
Hu0/0/0/27     0x0f000178    3          0                 NO
Hu0/0/0/27     0x0f000178    6          0                 NO
Hu0/0/0/26     0x0f000180    3          0                 NO
Hu0/0/0/26     0x0f000180    6          0                 NO
Hu0/0/0/25     0x0f000188    3          0                 NO
Hu0/0/0/25     0x0f000188    6          0                 NO
Hu0/0/0/24     0x0f000190    3          0                 NO
Hu0/0/0/24     0x0f000190    6          0                 NO
Hu0/0/0/20     0x0f000198    3          0                 NO
Hu0/0/0/20     0x0f000198    6          0                 NO
Hu0/0/0/19     0x0f0001a0    3          0                 NO
Hu0/0/0/19     0x0f0001a0    6          0                 NO
```

```
Hu0/0/0/15    0x0f0001a8    3          0              NO
Hu0/0/0/15    0x0f0001a8    6          0              NO
Hu0/0/0/8     0x0f0001b0    3          0              NO
Hu0/0/0/8     0x0f0001b0    6          0              NO
Hu0/0/0/1     0x0f0001b8    3          0              NO
Hu0/0/0/1     0x0f0001b8    6          0              NO
FH0/0/0/2     0x0f0001c0    3          0              NO
```

This example displays latest information about the source queue buffer usage in all ports in the packet memory space.

```
RP/0/RP0/CPU0:ios#show controllers npu packet-memory interface all sq-buffer-usage latest
location 0/RP0/CPU0
Thu Feb  1 17:04:02.892 UTC


------------------------------------------------------------------------
This option will affect system performance and should be used with caution.
Integration of this CLI with automation scripts is not recommended


------------------------------------------------------------------------
Node ID: 0/RP0/CPU0
Source Queue Buffer Usage Info for interface(s) all

Intf          Intf         TC    buffer-usage    congestion-state
name          handle
              (hex)
------------------------------------------------------------------------
Hu0/0/0/0     0x0f000130    3          0              NO
Hu0/0/0/0     0x0f000130    6          0              NO
Hu0/0/0/35    0x0f000138    3          0              NO
Hu0/0/0/35    0x0f000138    6          0              NO
Hu0/0/0/34    0x0f000140    3          0              NO
Hu0/0/0/34    0x0f000140    6          0              NO
Hu0/0/0/33    0x0f000148    3          0              NO
Hu0/0/0/33    0x0f000148    6          0              NO
Hu0/0/0/32    0x0f000150    3          0              NO
Hu0/0/0/32    0x0f000150    6          0              NO
Hu0/0/0/31    0x0f000158    3          0              NO
Hu0/0/0/31    0x0f000158    6          0              NO
Hu0/0/0/30    0x0f000160    3          0              NO
Hu0/0/0/30    0x0f000160    6          0              NO
Hu0/0/0/29    0x0f000168    3          0              NO
Hu0/0/0/29    0x0f000168    6          0              NO
Hu0/0/0/28    0x0f000170    3          0              NO
Hu0/0/0/28    0x0f000170    6          0              NO
Hu0/0/0/27    0x0f000178    3          0              NO
Hu0/0/0/27    0x0f000178    6          0              NO
Hu0/0/0/26    0x0f000180    3          0              NO
Hu0/0/0/26    0x0f000180    6          0              NO
Hu0/0/0/25    0x0f000188    3          0              NO
Hu0/0/0/25    0x0f000188    6          0              NO
Hu0/0/0/24    0x0f000190    3          0              NO
Hu0/0/0/24    0x0f000190    6          0              NO
Hu0/0/0/20    0x0f000198    3          0              NO
Hu0/0/0/20    0x0f000198    6          0              NO
Hu0/0/0/19    0x0f0001a0    3          0              NO
Hu0/0/0/19    0x0f0001a0    6          0              NO
Hu0/0/0/15    0x0f0001a8    3          0              NO
Hu0/0/0/15    0x0f0001a8    6          0              NO
Hu0/0/0/8     0x0f0001b0    3          0              NO
 --More--
```

Note If there is no traffic and congestion in the system when the snapshot is taken , the value of *buffer-usage* is 0 and *congestion-state* is NO. If there is traffic and congestion at the egress interface, the values of *buffer-usage* and *congestion-state* are as highlighted below:

```
RP/0/RP0/CPU0:ios#show controllers npu packet-memory interface fourHundredGigE 0/0/0/4
sq-buffer-usage latest location 0/RP0/CPU0
Fri Aug 25 04:09:25.447 UTC


------------------------------------------------------------------------
Node ID: 0/RP0/CPU0
Source Queue Buffer Usage Info for interface(s) FourHundredGigE0_0_0_4

Intf           Intf          TC       buffer-usage        congestion-state
name           handle
               (hex)
------------------------------------------------------------------------
FH0/0/0/4    0x0f000130      2            0                    NO
FH0/0/0/4    0x0f000130      3           8319                  YES
FH0/0/0/4    0x0f000130      4            0                    NO
FH0/0/0/4    0x0f000130      6            0                    NO
```

Displaying the source queue buffer usage in all ports at all locations is not supported.

These examples throw the 'Operation not supported' error in an attempt to display periodic/latest information about the source queue buffer usage in all ports at all locations.

```
RP/0/RP0/CPU0:ios#show controllers npu packet-memory interface all sq-buffer-usage location
 all
Thu Feb  1 17:13:35.010 UTC
Operation not supported on this location: all

RP/0/RP0/CPU0:ios#show controllers npu packet-memory interface all sq-buffer-usage latest
location all
Thu Feb  1 17:14:50.261 UTC
Operation not supported on this location: all
```

show controllers npu priority-flow-control

To display the current status and configured thresholds in a hardware module configuration, use **show controllers npu priority-flow-control** command in XR EXEC mode.

show controllers npu priority-flow-control *<loc>*

Command Default	No default behavior or values
Command Modes	XR EXEC mode

Command History

Release	Modification
Release 7.5.4	The output added values for ECN maximum threshold value and mark probability.
Release 7.0.11	This command was introduced.

Usage Guidelines   None

Example

This example shows sample output of `show controllers npu priority-flow-control loc 0/0/CPU0` command:

```
RP/0/RP1/CPU0:router#show controllers npu priority-flow-control loc 0/0/CPU0
Mon Oct 12 14:35:17.531 UTC

Location:    0/0/CPU0
PFC:         Enabled
TC    Pause-threshold    Resume-Threshold    Headroom
-------------------------------------------------------
3      403200 bytes        40320 bytes        441600 bytes
4      403200 bytes        40320 bytes        441600 bytes
RP/0/RP1/CPU0:router#
```

This example shows the sample output with custom values for all parameters including **max-threshold** and **probability-percentage**.

```
Router#show controllers npu priority-flow-control location all

Location:              0/6/CPU0
PFC:                   Enabled
PFC Mode:              buffer-internal
TC    Pause-threshold    Headroom        ECN            ECN-MAX         Prob-per
--------------------------------------------------------------------------------
3    1574400 bytes      1651200 bytes   629760 bytes   1416960 bytes   50
4    1574400 bytes      1651200 bytes   629760 bytes   1416960 bytes   50
```

show hw-module bandwidth-congestion-protect

To view the current status of global pause frames (X-off) in case of High Bandwidth Memory (HBM) congestion, use the **show hw-module bandwidth-congestion-protect** command in XR EXEC mode.

show hw-module bandwidth-congestion-protect location *lc*

Syntax Description	**location** *lc* —Line card location

Command Default   No default behavior or values

Command Modes   XR EXEC mode

Command History

Release	Modification
Release 7.5.4	This command was introduced.

Usage Guidelines

• Use this command to view the status of the global pause frame (X-off) configuration after you configure the **hw-module profile npu memory buffer-extended bandwidth-congestion-protect enable** command.

• The table lists the various possibilities for the command output based on your activity.

If you...	Configured field displays…	Applied field displays…	Action field displays…
Configure the **hw-module profile npu memory buffer-extended** command	**Yes**	**No**	**Reload**
Use the **no** form of the **hw-module profile npu memory buffer-extended** command after configuring it, but before reloading the line card	**No**	**No**	**N/A**

If you...	Configured field displays…		Applied field displays…		Action field displays…
Configure the **hw-module profile npu memory buffer-extended** command for a supported variant and reload the line card	Yes		Yes, Active		N/A
			Note	**Yes** indicates that the configuration is programmed to the hardware, **Active** indicates that the global X-off functionality is active on the hardware.	
Use the **no** form of the **hw-module profile npu memory buffer-extended** command when it is active, and commit the **no** form but don't reload the line card	No		No		**Reload**
	Note	At this stage, the output displays the user action and not the hardware status.	**Note**	At this stage, the output displays the user action and not the hardware status.	
Reload the line card after committing the **no** form of the **hw-module profile npu memory buffer-extended** command	No		No		N/A
	Note	At this stage, the output displays the hardware status.	**Note**	At this stage, the output displays the hardware status.	

Task ID

Task ID	Operation
qos	read, write

Example

This example shows how to view the current status of global pause frames (X-off) in case of High
Bandwidth Memory (HBM) congestion using the **show hw-module bandwidth-congestion-protect
location 0/1/CPU0** command:

```
RP/0/RP1/CPU0:router#show hw-module bandwidth-congestion-protect location 0/1/CPU0

Location   Configured   Applied        Action
-------------------------------------------------------------------------

0/1/CPU0     Yes          No            Reload
```

show hw-module low latency mode

To display whether the low latency mode is enabled, use the **show hw-module low latency mode** command in XR EXEC mode. You require this verification after configuring the low latency mode using the **hw-module profile qos low-latency-mode** command.

show hw-module low latency mode

Command Default
No default behavior or values

Command Modes
XR EXEC mode

Command History

Release	Modification
Release 24.2.1	This command was introduced.

Usage Guidelines
None

Example

This example shows a sample output of the **show hw-module low latency mode** command:

```
Router#show hw-module low latency mode
Location      Configured      Applied         Action
------------------------------------------------------------------------
0/0/CPU0      Yes             Yes             N/A
0/2/CPU0      Yes             Yes             N/A
```

show hw-module low latency mode

Congestion Management Commands

clear qos counters interface

To clear QoS counters for a specified interface, use the **clear qos counters interface** command in EXEC mode.

clear qos counters interface {*type* | **all**} [{**input** | **output**}]

Syntax Description

type	Interface type. For more information, use the question mark (?) online help function.
all	Specifies all interfaces.
input	(Optional) Clears input QoS counters that are attached to the specified interface.
output	(Optional) Clears output QoS counters that are attached to the specified interface.

Command Default   No default behavior or values

Command Modes   EXEC

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **clear qos counters interface** command clears all input and output QoS counters that are attached to a specified interface, unless the **input** or **output** keyword is specified. If the **input** or **output** keyword is specified, only counters attached to the interface in a specified direction are cleared.

The MIB counters are not reset with this command.

> **Note**   The **clear qos counters interface** command when executed on satellite may lead to unexpected behavior for QoS offload.

Task ID

Task ID	Operations
qos	read, write

Examples   This example shows how to clear QoS counters attached to GigabitEthernet interface 0/0/0/0:

```
RP/0/RP0/CPU0:router# clear qos counters interface GigabitEthernet 0/0/0/0
```

conform-action

To configure the action to take on packets that conform to the rate limit, use the **conform-action** command in policy map police configuration mode. To remove a conform action from the policy-map, use the **no** form of this command.

conform-action [{**drop** | **transmit**}]
no conform-action [{**drop** | **transmit**}]

Syntax Description

drop	(Optional) Drops the packet.
transmit	(Optional) Transmits the packets.

Command Default

By default, if no action is configured on a packet that conforms to the rate limit, the packet is transmitted.

Command Modes

Policy map police configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

For more information regarding the traffic policing feature, see the police rate, on page 53 command.

Task ID

Task ID	Operations
qos	read, write

Examples

In this example for MPLS, traffic policing is configured to set the MPLS experimental bit for packets that conform to the rate limit:

```
RP/0/RP0/CPU0:router(config)# class-map class
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 0
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map child
RP/0/RP0/CPU0:router(config-pmap)# class prec1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 100000000 peak-rate 3125000
RP/0/RP0/CPU0:router(config-pmap-c-police)# conform-action set mpls experimental imposition
 1
RP/0/RP0/CPU0:router(config-pmap-c-police)# exit
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/0/0/0
RP/0/RP0/CPU0:router(config-if) service-policy input policy1
```

In this example, the police rate (Committed Information Rate) is set to 5. Conforming traffic is marked with a discard-class value of 0; traffic that exceeds the police rate is marked with a discard-class value of 1.

```
RP/0/RP0/CPU0:router(config)# policy-map 1ad-mark-dei
RP/0/RP0/CPU0:router(config-pmap)# class c1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 5
RP/0/RP0/CPU0:router(config-pmap-c-police)# conform-action set discard-class 0
RP/0/RP0/CPU0:router(config-pmap-c-police)# exceed-action set discard-class 1
RP/0/RP0/CPU0:router(config-pmap-c-police)# end-policy-map
```

decapsulate gue

To enable decapsulation of the Generic UDP Encapsulation (GUE) packets, use the **decapsulate gue** command in policy map class configuration mode. To remove a previously configured GUE decapsulation for a class, use the **no** form of this command.

decapsulate gue *version*
no   **decapsulate gue** *version*

Syntax Description	*version*	Specifies the variant number that can indicate the version of the GUE protocol. Supports variant 1 only.

Command Default

No default action.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 7.3.1	This command was introduced.

Usage Guidelines

Supports Generic UDP Decapsulation for variant 1 only. This command is supported only in Cisco NCS 5500 Series Routers.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to configure decapsulation of the GUE packets:

```
Router# configure
Router(config)# policy-map type pbr gue-decap
Router(config-pmap)# class type traffic gue-class
Router(config-pmap-c)# decapsulate gue
```

exceed-action

To configure the action to take on packets that exceed the rate limit, use the **exceed-action** command in policy map police configuration mode. To remove an exceed action from the policy-map, use the **no** form of this command.

exceed-action [{**drop** | **set** *options* | **transmit**}]
no **exceed-action** [{**drop** | **set** *options* | **transmit**}]

Syntax Description		
drop	(Optional) Drops the packet.	
set *options*	Configures the specified packet properties. Replace *options* with one of the following keywords or keyword arguments:	

- **cos** *value* —Sets the class of service value. Range is 0 to 7.

- **dei** —Sets the drop eligible indicator (DEI). Can be 0 or 1.

- **discard-class** *value* —Sets the discard class value. Range is 0 to 7.

- **dscp** *value* —Sets the differentiated services code point (DSCP) value and sends the packet. See match dscp, on page 85 for a list of valid values.

- **dscp** [**tunnel**] *value* —Sets the differentiated services code point (DSCP) value and sends the packet. See match dscp, on page 85 for a list of valid values. With the **tunnel** keyword, the DSCP is set in the outer header.

- **mpls experimental** {**topmost** | **imposition**} *value* —Sets the experimental (EXP) value of the Multiprotocol Label Switching (MPLS) packet topmost label or imposed label. Range is 0 to 7.

- **precedence** *precedence* —Sets the IP precedence and sends the packet. See match precedence, on page 90 for a list of valid values.

- **precedence** [**tunnel**] *precedence* —Sets the IP precedence and sends the packet. See match precedence, on page 90 for a list of valid values. With the **tunnel** keyword, the precedence is set in the outer header.

- **qos-group** *value* —Sets the QoS group value. Range is 0 to 63.

transmit	(Optional) Transmits the packets.	

Command Default

By default, if no action is configured on a packet that exceeds the rate limit, the packet is dropped.

Command Modes

Policy map police configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

For more information regarding the traffic policing feature, see the police rate, on page 53 command.

The **set cos** action in policy maps is supported on 802.1ad packets for:

• Egress

• Layer 3 subinterfaces

Task ID

Task ID	Operations
qos	read, write

Examples

In this example for MPLS, traffic policing is configured to drop traffic that exceeds the rate limit:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 0
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 250 kbps burst 50
RP/0/RP0/CPU0:router(config-pmap-c-police)# exceed-action drop
RP/0/RP0/CPU0:router(config-pmap-c-police)# exit
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface pos 0/5/0/0
RP/0/RP0/CPU0:router(config-if) service-policy input policy1
```

In this example, the police rate is set to 5 Mbps. Conforming traffic is marked with a DEI value of 0; traffic that exceeds the police rate is marked with a DEI value of 1.

```
RP/0/RP0/CPU0:router(config)# policy-map 1ad-mark-dei
RP/0/RP0/CPU0:router(config-pmap)# class c1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 5 mbps
RP/0/RP0/CPU0:router(config-pmap-c-police)# conform-action set dei 0
RP/0/RP0/CPU0:router(config-pmap-c-police)# exceed-action set dei 1
RP/0/RP0/CPU0:router(config-pmap-c-police)# end-policy-map
```

nve

To configure network virtualization encapsulation and enter nve configuration mode, use the **nve** command in XR Config mode.

nve

This command has no keywords or arguments.

Command Default	None

Command Modes	XR Config

Command History

Release	Modification
Release 7.10.1	This command was introduced.

Usage Guidelines	No specific guidelines impact the use of this command.

Task ID

Task ID	Operations
interface	read, write

In this example, VXLAN ingress traffic policing is configured at a rate of 4000000 kbps.

```
RP/0/RP0/CPU0:router(config)# nve
RP/0/RP0/CPU0:router(config-nve)# overlay-encap vxlan
RP/0/RP0/CPU0:router(config-vxlan)# vrf vrf1
RP/0/RP0/CPU0:router(config-nve-vxlan-vrf)# policer-rate 4000000 kbps
RP/0/RP0/CPU0:router(config-nve-vxlan-vrf)# commit
```

police rate

To configure traffic policing and enter policy map police configuration mode, use the **police rate** command in policy map class configuration mode. To remove traffic policing from the configuration, use the **no** form of this command.

police rate {*value* [*units*] | **percent** *percentage* | *rate* [*units*] | }[**peak-rate** {*value* [*units*] | **percent** *percentage*}]

no police rate {*value* [*units*] | **percent** *percentage* | *rate* [*units*] | | }[**peak-rate** {*value* [*units*] | **percent** *percentage*}]

Syntax Description	

value	Committed information rate (CIR). Range is from 1 to 4294967295.
units	(Optional) Unit of measurement for the CIR. Values can be: • **bps** —bits per second (default) • **gbps** —gigabits per second • **kbps** —kilobits per second • **mbps** —megabits per second
percent *percentage*	Specifies the police rate as a percentage of the CIR. Range is from 1 to 100. See the Usage Guidelines for information on how to use this keyword.
peak-rate *value*	(Optional) Specifies the Peak Information Rate (PIR) in the specified *units*.

Command Default No restrictions on the flow of data are applied to any interface.

Command Modes Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines Policer conditional set discard-class is supported.

Policing can be applied only in the ingress direction.

For **police rate** commands, interpret the **percent** keyword in this way:

 • For a one-level policy, the **percent** keyword specifies the CIR as a percentage of the link rate. For example, the command **police rate percent 35** configures the CIR as 35% of the link rate.

Note Configured values take into account the Layer 2 encapsulation applied to traffic. This applies to ingress policing. For Ethernet transmission, the encapsulation is considered to be 14 bytes, whereas for IEEE 802.1Q, the encapsulation is 18 bytes.

Task ID

Task ID	Operations
qos	read, write

In this example for MPLS, traffic policing is configured with the average rate at 250 kbps for all packets leaving HundredGigE interface 0/1/0/0:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 0
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 250 kbps
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# HundredGigE interface 0/1/0/0
RP/0/RP0/CPU0:router(config-if) service-policy input policy1
```

policy-map

To create or modify a policy map that can be attached to one or more interfaces to specify a service policy, use the **policy-map** command in XR Config mode. To delete a policy map, use the **no** form of this command.

policy-map [**type qos**] *policy-name*
no policy-map [**type qos**] *policy-name*

policy-map [**type pbr**] *policy-name*
no policy-map [**type pbr**] *policy-name*

Syntax Description		
	type	(Optional) Specifies type of the service policy.
	qos	(Optional) Specifies a quality-of-service (QoS) policy map.
	pbr	(Optional) Specifies a policy-based routing (PBR) policy map.
	policy-name	Name of the policy map.

Command Default

A policy map does not exist until one is configured. Because a policy map is applied to an interface, no restrictions on the flow of data are applied to any interface until a policy map is created.

Type is QoS when not specified.

Command Modes

XR Config mode

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

Use the **policy-map** command to specify the name of the policy map to be created, added to, or modified before you can configure policies for classes whose match criteria are defined in a class map. Entering the **policy-map** command enables policy map configuration mode in which you can configure or modify the class policies for that policy map.

You can configure class policies in a policy map only if the classes have match criteria defined for them. Use the **class-map** and **match** commands to configure the match criteria for a class.

A single policy map can be attached to multiple interfaces concurrently.

The number of classes per policy-map supported in the egress direction is 8 and ingress direction is 32.

For egress classification, in order to see statistics on all 8 CoSQs, you are recommended to configure all 8 classes including class-default.

Task ID	
Task ID	Operations
qos	read, write

Examples

These examples show how to create a policy map called policy1 and configures two class policies included in that policy map. The policy map is defined to contain policy specification for class1 and the default class (called class-default) to which packets that do not satisfy configured match criteria are directed. Class1 specifies policy for traffic that matches access control list 136.

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv4 136

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# set precedence 3
RP/0/RP0/CPU0:router(config-pmap-c)# exit
```

priority (QoS)

To assign priority to a traffic class based on the amount of available bandwidth within a traffic policy, use the **priority** command in policy map class configuration mode. To remove a previously specified priority for a class, use the **no** form of this command.

priority **level** *priority-level*
no **priority**

Syntax Description	**level** *priority-level*	Sets multiple levels of priority to a traffic class. Level 1 through 7. Default level is 1. Level 1 traffic has higher priority.

Command Default

No default action.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

The **priority** command configures low-latency queueing (LLQ), providing strict priority queueing (PQ). Strict PQ allows delay-sensitive data such as voice to be dequeued and sent before packets in other queues are dequeued. The **priority** command is supported only in the egress direction. To limit the priority traffic use the **shape average** command.

Classification policy determines traffic class and traffic class maps to priority.

The **bandwidth** and **priority** commands cannot be used in the same class, within the same policy map. These commands can be used together in the same policy map.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to configure priority queuing for the policy map named policy1 :

```
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# priority level 1
```

show policy-map interface

To display policy information and statistics for all classes configured for all service policies on the specified interface, use the **show policy-map interface** command in XR EXEC mode.

show **policy-map** [**interface** {*interface type* | **all**} *interface-path-id*] [{**input** | **output** }]

Syntax Description

interface type	Interface type. For more information, use the question mark (?) online help function.
all	Specifies all interfaces.
interface-path-id	Physical interface or virtual interface.
	Note Use the **show interfaces** command to see a list of all interfaces currently configured on the router.
	For more information about the syntax for the router, use the question mark (?) online help function.
input	(Optional) Displays per class statistics on inbound traffic for the specified policy map and interface.
output	(Optional) Displays per class statistics on outbound traffic for the specified policy map and interface.

Command Default

None

Command Modes

XR EXEC mode

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

The **show policy-map interface** command displays the statistics for classes in the service policy attached to an interface.

The **show policy-map interface** command does not display the statistics and counters for the egress marking policy.

Task ID

Task ID	Operations
qos	read

Examples

This sample output shows how to display policy statistics information for all classes on the **interface hundredGigE 0/6/0/18** that are in the input direction:

```
RP/0/RP0/CPU0:router# show policy-map interface hundredGigE 0/6/0/18 input

Mon Nov 30 17:10:29.065 UTC

HundredGigE0/6/0/18 input: 32-classmaps

Class exp-classifier-af1
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :              53186/54090162           3769
    Transmitted         :              53186/54090162           3769
    Total Dropped       :                    0/0                   0
Class exp-classifier-af2
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :              54279/55201743           7483
    Transmitted         :              54279/55201743           7483
    Total Dropped       :                    0/0                   0
Class exp-classifier-af3
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :              56710/57674070           7898
    Transmitted         :              56710/57674070           7898
    Total Dropped       :                    0/0                   0
Class exp-classifier-af4
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :             110405/112281885         11584
    Transmitted         :             110405/112281885         11584
    Total Dropped       :                    0/0                   0
Class exp-classifier-be1
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :              52753/53649801           3756
    Transmitted         :              52753/53649801           3756
    Total Dropped       :                    0/0                   0
Class inet4-classifier-af1
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :           38796901/14695393569      1580677
    Transmitted         :           38796901/14695393569      1580677
    Total Dropped       :                    0/0                   0
Class inet4-classifier-af2
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :           38850080/14715510334      1589124
    Transmitted         :           38850080/14715510334      1589124
    Total Dropped       :                    0/0                   0
Class inet4-classifier-af3
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :           38757080/14679867944      1580632
    Transmitted         :           38757080/14679867944      1580632
    Total Dropped       :                    0/0                   0
Class inet4-classifier-af4
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :           77228177/29251757855      3137985
    Transmitted         :           77228177/29251757855      3137985
    Total Dropped       :                    0/0                   0
Class inet4-classifier-be1
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :           38921394/14742645566      1588557
    Transmitted         :           38921394/14742645566      1588557
    Total Dropped       :                    0/0                   0
Class inet4-classifier-nc1
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :           77088116/29199136824      3144053
    Transmitted         :           77088116/29199136824      3144053
    Total Dropped       :                    0/0                   0
Class inet6-classifier-af1
  Classification statistics          (packets/bytes)     (rate - kbps)
```

```
            Matched            :       21953707/22326920019         1237979
            Transmitted        :       21953707/22326920019         1237979
            Total Dropped      :               0/0                        0
Class inet6-classifier-af2
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :       21701336/22070258712         1208262
            Transmitted        :       21701336/22070258712         1208262
            Total Dropped      :               0/0                        0
Class inet6-classifier-af3
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :       21715705/22084871985         1210060
            Transmitted        :       21715705/22084871985         1210060
            Total Dropped      :               0/0                        0
Class inet6-classifier-af4
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :       43418446/44156559582         2413245
            Transmitted        :       43418446/44156559582         2413245
            Total Dropped      :               0/0                        0
Class inet6-classifier-be1
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :       21958845/22332119845         1236894
            Transmitted        :       21958845/22332119845         1236894
            Total Dropped      :               0/0                        0
Class inet6-classifier-nc1
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :       43428930/44167221810         2415137
            Transmitted        :       43428930/44167221810         2415137
            Total Dropped      :               0/0                        0
Class inet-classifier-ipv6-af1
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class inet-classifier-ipv6-af2
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class inet-classifier-ipv6-af3
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class inet-classifier-ipv6-af4
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class inet-classifier-ipv6-af5
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class inet-classifier-ipv6-af6
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class inet-management-classifier-af4
   Classification statistics       (packets/bytes)       (rate - kbps)
            Matched            :               0/0                        0
            Transmitted        :               0/0                        0
            Total Dropped      :               0/0                        0
Class exp-classifier-nc1
```

```
    Classification statistics          (packets/bytes)     (rate - kbps)
      Matched             :             57115/58085955            7953
      Transmitted         :             57115/58085955            7953
      Total Dropped       :                  0/0                     0
    Policing statistics                (packets/bytes)     (rate - kbps)
      Policed(conform)    :             57115/58085955            7953
      Policed(exceed)     :                  0/0                     0
      Policed(violate)    :                  0/0                     0
      Policed and dropped :                  0/0
Class class-default
    Classification statistics          (packets/bytes)     (rate - kbps)
      Matched             :                  0/0                     0
      Transmitted         :                  0/0                     0
      Total Dropped       :                  0/0                     0
```

This sample output shows how to display policy statistics information for all classes on the **interface hundredGigE 0/6/0/0** that are in the output direction:

```
RP/0/RP0/CPU0:router# show policy-map interface hundredGigE 0/6/0/0 output

Wed Dec  9 16:18:10.179 UTC
HundredGigE0/6/0/0 output: test-pol-out

Class tc2
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :      3080542734/394309469952       4808049
    Transmitted         :      3080542734/394309469952       4808049
    Total Dropped       :                  0/0                     0
  Queueing statistics
    Queue ID                         : 1026
    Taildropped(packets/bytes)       : 0/0
Class tc1
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :      1562482674/199997782272       2883014
    Transmitted         :      1434402692/183603544576       2646687
    Total Dropped       :       128079982/16394237696         236327
  Queueing statistics
    Queue ID                         : 1025
    Taildropped(packets/bytes)       : 128079982/16394237696

Class class-default
  Classification statistics          (packets/bytes)     (rate - kbps)
    Matched             :                  0/0                     0
    Transmitted         :                  0/0                     0
    Total Dropped       :                  0/0                     0
  Queueing statistics
    Queue ID                         : 1024
    Taildropped(packets/bytes)       : 0/0
Policy Bag Stats time: 1557231345776  [Local Time: 05/07/19 12:15:45.776]
```

This table describes the significant fields shown in the display.

Table 2: show policy-map interface Field Descriptions

Field	Description
Classification statistics	
Matched	Number of packets or bytes that matched this class.
Transmitted	Number of packets or bytes transmitted for this class.

Field	Description
Total Dropped	Number of packets or bytes dropped for this class.
Policing statistics	
Policed(conform)	Number of packets or bytes that conformed to the police rate for this class.
Policed(exceed)	Number of packets or bytes that exceeded the police rate for this class.
Policed(violate)	Number of packets or bytes that violated the police rate for this class.
Policed and dropped	Number of packets or bytes dropped by the policer of this class.
Queuing statistics	
Queue ID	VOQ number of the packet in this class.
Taildropped (bytes)	Number of bytes taildropped for this queue.

show policy-map targets

To display information about the interfaces on which policy maps are applied, use the **show policy-map targets** command in XR EXEC mode.

show policy-map targets [{**location** *node-id* | **pmap-name** *name* | **type qos** [{**location** *node-id* | **pmap-name** *name*}]}]

Syntax Description		
location *node-id*	(Optional) Displays information about the interfaces on which policy maps are applied for the specified location. The *node-id* argument is entered in the *rack/slot/module* notation.
pmap-name *name*	(Optional) Displays information about the interfaces on which the specified policy map is applied.
type qos	(Optional) Displays information about the interfaces on which QoS policy maps are applied. This is the default type.

Command Default

The default QoS policy type is QoS.

Command Modes

XR EXEC mode

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

For a short period of time while a QoS policy is being modified, there might not be any policy in effect on the interfaces in which the modified policy is used. For this reason, modify QoS policies that affect the fewest number of interfaces at a time. Use the **show policy-map targets** command to identify the number of interfaces that will be affected during policy map modification.

Task ID

Task ID	Operations
qos	read

Examples

In this example, the TenGigabit Ethernet interface 4/0/10/0 has one policy map attached as a main policy. Outgoing traffic on this interface will be affected if the policy is modified:

```
RP/0/RP0/CPU0:router# show policy-map targets

Wed Dec  2 22:35:13.993 UTC
1) Policymap: test-qlimit    Type: qos
     Targets (applied as main policy):
       TenGigE0/4/0/10/0 output
       TenGigE0/6/0/30/1 output
     Total targets: 2

     Targets (applied as child policy):
     Total targets: 0
```

```
2) Policymap: test-priority    Type: qos
   Targets (applied as main policy):
      HundredGigE0/6/0/35 output
      HundredGigE0/6/0/34 output
      HundredGigE0/6/0/33 output
      HundredGigE0/6/0/32 output
      HundredGigE0/6/0/31 output
      HundredGigE0/6/0/29 output
      HundredGigE0/6/0/28 output
      HundredGigE0/6/0/27 output
      HundredGigE0/6/0/25 output
      HundredGigE0/6/0/24 output
      HundredGigE0/6/0/23 output
      HundredGigE0/6/0/22 output
      HundredGigE0/6/0/21 output
      HundredGigE0/6/0/20 output
      HundredGigE0/6/0/19 output
      HundredGigE0/6/0/1 output
      HundredGigE0/6/0/3 output
      HundredGigE0/6/0/4 output
      HundredGigE0/6/0/5 output
      HundredGigE0/6/0/6 output
      HundredGigE0/6/0/7 output
      HundredGigE0/6/0/8 output
      HundredGigE0/6/0/9 output
      HundredGigE0/6/0/10 output
      HundredGigE0/6/0/11 output
      HundredGigE0/6/0/13 output
      HundredGigE0/6/0/14 output
      HundredGigE0/6/0/15 output
      HundredGigE0/6/0/16 output
      HundredGigE0/6/0/17 output
   Total targets: 30

   Targets (applied as child policy):
   Total targets: 0
```

show qos interface

To display QoS information for a specific interface, use the **show qos interface** command in the XR EXEC mode.

show qos interface *interface-name* {**input** | **output**}[**location** *node-id*]

Syntax Description	*interface-name*	Interface name. For more information about the syntax for the router, use the question mark (?) online help function.
		Note Use the **show interfaces** command to see a list of all interfaces currently configured on the router.
	input	Attaches the specified policy map to the input interface.
	output	Attaches the specified policy map to the output interface.
	location *node-id*	(Optional) Displays detailed QoS information for the designated node. The *node-id* argument is entered in the rack/slot/module notation.

Command Default   No default behavior or values

Command Modes   XR EXEC mode

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **show qos interface** command displays configuration for all classes in the service policy that is attached to an interface.

Use this command to check the actual values programmed in the hardware from the action keywords in the **police rate** command.

Task ID

Task ID	Operations
qos	read

Examples   This is the sample output shows the QoS information on a **interface hundredGigE 0/6/0/18** that are in the input direction:

```
RP/0/RP0/CPU0:router# show qos interface hundredGigE 0/6/0/18 input
```

```
Wed Dec  2 22:34:20.241 UTC
NOTE:- Configured values are displayed within parentheses
Interface HundredGigE0/6/0/18 ifh 0x3000210  -- input policy
NPU Id:                       3
Total number of classes:      28
Interface Bandwidth:          100000000 kbps
Accounting Type:              Layer1 (Include Layer 1 encapsulation and above)
-------------------------------------------------------------------------------
Level1 Class                          =    exp-classifier-af1
New topmost exp                       =    7

Default Policer Bucket ID             =    0x102a0
Default Policer Stats Handle          =    0x8b304d98
Policer not configured for this class

Level1 Class                          =    exp-classifier-af2
New topmost exp                       =    6

Default Policer Bucket ID             =    0x102a1
Default Policer Stats Handle          =    0x8b304b48
Policer not configured for this class

Level1 Class                          =    exp-classifier-af3
New topmost exp                       =    5

Default Policer Bucket ID             =    0x102a2
Default Policer Stats Handle          =    0x8b3048f8
Policer not configured for this class

Level1 Class                          =    exp-classifier-af4
New topmost exp                       =    3

Default Policer Bucket ID             =    0x102a3
Default Policer Stats Handle          =    0x8b3046a8
Policer not configured for this class

Level1 Class                          =    exp-classifier-be1
New topmost exp                       =    4

Default Policer Bucket ID             =    0x102a4
Default Policer Stats Handle          =    0x8b304458
Policer not configured for this class

Level1 Class                          =    inet4-classifier-af1
New qos group                         =    1

Default Policer Bucket ID             =    0x102a5
Default Policer Stats Handle          =    0x8b304208
Policer not configured for this class

Level1 Class                          =    inet4-classifier-af2
New qos group                         =    2

Default Policer Bucket ID             =    0x102a6
Default Policer Stats Handle          =    0x8b303fb8
Policer not configured for this class

Level1 Class                          =    inet4-classifier-af3
New qos group                         =    3

Default Policer Bucket ID             =    0x102a7
Default Policer Stats Handle          =    0x8b303d68
Policer not configured for this class
```

```
            Level1 Class                          =    inet4-classifier-af4
            New qos group                         =    4

            Default Policer Bucket ID             =    0x102a8
            Default Policer Stats Handle          =    0x8b303b18
            Policer not configured for this class

            Level1 Class                          =    inet4-classifier-be1
            New qos group                         =    5

            Default Policer Bucket ID             =    0x102a9
            Default Policer Stats Handle          =    0x8b3038c8
            Policer not configured for this class

            Level1 Class                          =    inet4-classifier-nc1
            New qos group                         =    6

            Default Policer Bucket ID             =    0x102aa
            Default Policer Stats Handle          =    0x8b303678
            Policer not configured for this class

            Level1 Class                          =    inet6-classifier-af1
            New qos group                         =    1

            Default Policer Bucket ID             =    0x102ab
            Default Policer Stats Handle          =    0x8b303428
            Policer not configured for this class

            Level1 Class                          =    inet6-classifier-af2
            New qos group                         =    2

            Default Policer Bucket ID             =    0x102ac
            Default Policer Stats Handle          =    0x8b3031d8
            Policer not configured for this class

            Level1 Class                          =    inet6-classifier-af3
            New qos group                         =    3

            Default Policer Bucket ID             =    0x102ad
            Default Policer Stats Handle          =    0x8b302f88
            Policer not configured for this class

            Level1 Class                          =    inet6-classifier-af4
            New qos group                         =    4

            Default Policer Bucket ID             =    0x102ae
            Default Policer Stats Handle          =    0x8b302d38
            Policer not configured for this class

            Level1 Class                          =    inet6-classifier-be1
            New qos group                         =    5

            Default Policer Bucket ID             =    0x102af
            Default Policer Stats Handle          =    0x8b302ae8
            Policer not configured for this class

            Level1 Class                          =    inet6-classifier-nc1
            New qos group                         =    6

            Default Policer Bucket ID             =    0x102b0
            Default Policer Stats Handle          =    0x8b302898
            Policer not configured for this class

            Level1 Class                          =    inet-classifier-ipv6-af1
```

```
New qos group                           =    1

Default Policer Bucket ID               =    0x102b1
Default Policer Stats Handle            =    0x8b302648
Policer not configured for this class

Level1 Class                            =    inet-classifier-ipv6-af2
New qos group                           =    2

Default Policer Bucket ID               =    0x102b2
Default Policer Stats Handle            =    0x8b3023f8
Policer not configured for this class

Level1 Class                            =    inet-classifier-ipv6-af3
New qos group                           =    3

Default Policer Bucket ID               =    0x102b3
Default Policer Stats Handle            =    0x8b3021a8
Policer not configured for this class

Level1 Class                            =    inet-classifier-ipv6-af4
New qos group                           =    4

Default Policer Bucket ID               =    0x102b4
Default Policer Stats Handle            =    0x8b301f58
Policer not configured for this class

Level1 Class                            =    inet-classifier-ipv6-af5
New qos group                           =    5

Default Policer Bucket ID               =    0x102b5
Default Policer Stats Handle            =    0x8b301d08
Policer not configured for this class

Level1 Class                            =    inet-classifier-ipv6-af6
New qos group                           =    6

Default Policer Bucket ID               =    0x102b6
Default Policer Stats Handle            =    0x8b301ab8
Policer not configured for this class

Level1 Class                            =    inet-management-classifier-af4
New qos group                           =    7

Default Policer Bucket ID               =    0x102b7
Default Policer Stats Handle            =    0x8b301868
Policer not configured for this class

Level1 Class                            =    exp-classifier-nc1
New qos group                           =    6
New topmost exp                         =    2

Default Policer Bucket ID               =    0x102b8
Default Policer Stats Handle            =    0x8b301618
Policer not configured for this class

Level1 Class                            =    inet-management-classifier-nc1
New prec                                =    6
New qos group                           =    5

Default Policer Bucket ID               =    0x102b9
Default Policer Stats Handle            =    0x8b3013c8
Policer not configured for this class
```

```
Level1 Class                             =    inet6-management-classifier-nc1
New qos group                            =    4

Default Policer Bucket ID                =    0x102ba
Default Policer Stats Handle             =    0x8b301178
Policer not configured for this class


Level1 Class                             =    class-default

Default Policer Bucket ID                =    0x102bb
Default Policer Stats Handle             =    0x8b3074e8
Policer not configured for this class
```

This is the sample output shows the QoS information on an `interface hundredGigE 0/0/0/30` that are in the output direction:

```
RP/0/RP0/CPU0:ios#
RP/0/RP0/CPU0:ios#show qos interface hundredGigE 0/0/0/30 output
NOTE:- Configured values are displayed within parentheses
Interface HundredGigE0/0/0/30 ifh 0xf000210  -- output policy
NPU Id:                        0
Total number of classes:       2
Interface Bandwidth:           100000000 kbps
Policy Name:                   egress_pol_dql
VOQ Base:                      464
Accounting Type:               Layer1 (Include Layer 1 encapsulation and above)
VOQ Mode:                      8
Shared Counter Mode:           1
------------------------------------------------------------------------------
Level1 Class (HP1)                       =    tc7
Egressq Queue ID                         =    471 (HP1 queue)
Queue Max. BW.                           =    no max (default)
Discard Class 1 Threshold                =    25165824 bytes / 2 ms (50 mbytes)
Discard Class 0 Threshold                =    75497472 bytes / 5 ms (100 mbytes)
WRED not configured for this class

Level1 Class                             =    class-default
Egressq Queue ID                         =    464 (Default LP queue)
Queue Max. BW.                           =    no max (default)
Inverse Weight / Weight                  =    1 / (1)
TailDrop Threshold                       =    749568 bytes / 6 ms (default)
WRED not configured for this class
```

This table describes the significant fields shown in the display.

Table 3: show QoS interface Field Descriptions

Field	Description
Level 1 class	Level 1 class identifier in decimal format.
Policer Bucket ID	Policer bucket identifier.
Policer Stats Handle	Policer statistics handle for this class.
Queue ID	VOQ number of the packet in this class.
Queue Max. BW	Maximum bandwidth of the queue.
Queue Min. BW	Minimum bandwidth of the queue.

Field	Description
Inverse Weight / Weight	Remaining bandwidth weight. **Note** The hardware weight is expressed in inverse value.
TailDrop Threshold	Number of bytes taildropped for this queue and the default/user-configured queue-limit expressed in milliseconds/user-configured unit.

violate-action

To configure the action to take on packets that violate the rate limit, use the **violate-action** command in policy map police configuration mode. To remove a conform action from the policy-map, use the **no** form of this command.

violate-action {**drop** | **set** *options* | **transmit**}
no violate-action {**drop** | **set** *options* | **transmit**}

Syntax Description		
	drop	Drops the packet.
	set *options*	Configures the specified packet properties. Replace *options* with one of the following keywords or keyword arguments: • **discard-class** *value* —Sets the discard class value. Range is 0 to 1.
	transmit	Transmits the packets.

Command Default
No default behavior or values

Command Modes
Policy map police configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines
For more information regarding the traffic policing feature refer to the police rate, on page 53 command.

The **violate-action** command can set the discard class values for IP packets and MPLS packets.

Task ID

Task ID	Operations
qos	read, write

Examples
In this example for MPLS, traffic policing is configured to drop packets that violate the rate limit:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 0
RP/0/RP0/CPU0:router(config-cmap)# exit
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 250 kbps burst 50
RP/0/RP0/CPU0:router(config-pmap-c-police)# violate-action drop
RP/0/RP0/CPU0:router(config-pmap-c-police)# exit
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit
RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/1/0/0
```

```
RP/0/RP0/CPU0:router(config-if) service-policy input policy1
```

random-detect ecn

To enable ECN-based (Explicit Congestion Notification) random-detect, use the **random-detect ecn** command in policy-map configuration mode. To remove random-detect, use the **no** form of the command.

random-detect ecn
no random-detect ecn

Syntax Description   This command has no keywords or arguments.

Command Default   No default behavior or value.

Command Modes   Policy-map configuration mode.

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   None

Task ID

Task ID	Operation
qos	read, write

Example

This example shows how to use the **random-detect ecn**command:

```
RP/0/RP0/CPU0:router(config-pmap-c)#random-detect ecn
```

QoS Classification Commands

cef pbts class

To override the default behaviour of the policy based tunnel selection (PBTS), use the **cef pbts class** command in the global configuration mode.

cef pbts class any | *forward-class-value* **fallback-to** { *forward-class-value* | **any** | **drop** }

Syntax Description		
	forward-class-value	Set the forward-class. You can choose the forward-classs value from 0 to 7. The default value is 0 (zero).
	any	Specify **any** forward-class.
	fallback-to *forward-class-value*| **any** | **drop**	Specify to which forward-class it has to fall back during a tunnel failure. You can either choose the forward-class value from 0 to 7, any, or you can choose to drop the forward-class. When **any** class is specified, it takes precedence over other forward-class value (0 to 7) .

Command Default No default behavior or values

Command Modes Policy map class configuration

Command History	Release	Modification
	Release 7.5.3	This command was introduced.

Usage Guidelines When TE tunnels associated with the forward-class goes down, traffic can be redirected to another forward-class, any forward-class or chosen to be dropped using fallback PBTS configuration. This configuration overrides the default behavior when PBTS enabled TE tunnel goes down. You can specify the sequence of preferred fallback classes to revert to when TE tunnel of main forward-class goes down.

When **cef pbts class any fallback-to any** is specified, then the lowest available forward-class in ascending order of 0 to 7 is chosen as fallback when paths to any class goes down.

Task ID		
	Task ID	**Operations**
	qos	read, write

Examples This example shows how to enable fallback during a tunnel failure:

```
RP/0/RP0/CPU0:router(config)#  cef pbts class 0 fallback-to 1 2 3 5
```

class-map

To define a traffic class and the associated rules that match packets to the class, use the **class-map** command in XR Config mode. To remove an existing class map from the router, use the **no** form of this command.

class-map [**type** [**traffic** | **qos**]] [**match-all**] [**match-any**] *class-map-name*
no class-map [**type** [**traffic** | **qos**]] [**match-all**] [**match-any**] *class-map-name*

Syntax Description		
type qos	(Optional) Specifies a quality-of-service (QoS) class-map.	
traffic	(Optional) Specifies traffic type class-map.	
match-all	(Optional) Specifies a match on all of the match criteria.	
match-any	(Optional) Specifies a match on any of the match criteria. This is the default.	
class-map-name	Name of the class for the class map. The class name is used for the class map and to configure policy for the class in the policy map. The class name can be a maximum of 63 characters, must start with an alphanumeric character, and in addition to alphanumeric characters, can contain any of the following characters: . _ @ $ % +	# : ; - =	

Command Default   Type is QoS when not specified.

Command Modes   XR Config mode

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **class-map** command specifies the name of the class for which you want to create or modify class map match criteria. Use of this command enables class map configuration mode in which you can enter any **match** command to configure the match criteria for this class. Packets arriving on the interface are checked against the match criteria configured for a class map to determine if the packet belongs to that class.

These commands can be used in a class map match criteria for the ingress direction:

- **match access-group**
- **match [not] dscp**
- **match [not] mpls experimental topmost**
- **match [not] precedence**
- **match [not] protocol**

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to specify class1 as the name of a class and defines a class map for this class. The packets that match the access list 1 are matched to class class1.

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv4 1
```

class (policy-map)

To specify the name of the class whose policy you want to create or change, use the **class** command in policy map configuration mode. To remove a class from the policy map, use the **no** form of this command.

class [**type qos**] {*class-name* | **class-default**}
no class [**type qos**] {*class-name* | **class-default**}

Syntax Description

type qos	(Optional) Specifies a quality-of-service (QoS) class.
class-name	Name of the class for which you want to configure or modify policy.
class-default	Configures the default class.

Command Default

No class is specified.

Type is QoS when not specified.

Command Modes

Policy map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

Within a policy map, the **class (policy-map)** command can be used to specify the name of the class whose policy you want to create or change. The policy map must be identified first.

To identify the policy map (and enter the required policy map configuration mode), use the **policy-map** command before you use the **class (policy-map)** command. After you specify a policy map, you can configure the policy for new classes or modify the policy for any existing classes in that policy map.

The class name that you specify in the policy map ties the characteristics for that class—that is, its policy—to the class map and its match criteria, as configured using the **class-map** command.

The **class-default** keyword is used for configuring default classes. It is a reserved name and cannot be used with user-defined classes. It is always added to the policy map (type qos) even if the class is not configured. For example, the following configuration shows that the class has not been configured, but the running configuration shows 'class class-default'.

```
RP/0/RP0/CPU0:router(config)# class-map p2
RP/0/RP0/CPU0:router(config-cmap)# match precedence 2
RP/0/RP0/CPU0:router(config-cmap)# end-class-map
RP/0/RP0/CPU0:router(config)# commit

RP/0/RP0/CPU0:router(config)# policy-map pm2
RP/0/RP0/CPU0:router(config-pmap)# class p2
RP/0/RP0/CPU0:router(config-pmap-c)# set precedence 3
RP/0/RP0/CPU0:router(config-pmap-c)# end-policy-map
RP/0/RP0/CPU0:router(config)# commit
RP/0/RP0/CPU0:router(config)# end
```

```
RP/0/RP0/CPU0:router# show run policy-map pm2
policy-map pm2
class p2
set precedence 3
!
class class-default
!
end-policy-map
!
```

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to create a policy map called policy1, which is defined to shape class1 traffic at 30 percent and default class traffic at 20 percent.

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match precedence 3
RP/0/RP0/CPU0:router(config-cmap)#  exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:routerconfig-pmap-c)# shape average percent 30
RP/0/RP0/CPU0:router(config-pmap-c)# exit


RP/0/RP0/CPU0:router(config-pmap)# class class-default
RP/0/RP0/CPU0:router(config-pmap-c)# shape average percent 20
```

The default class is used for packets that do not satisfy configured match criteria for class1. Class1 must be defined before it can be used in policy1, but the default class can be directly used in a policy map, as the system defines it implicitly.

end-class-map

To end the configuration of match criteria for the class and to exit class map configuration mode, use the **end-class-map** command in class map configuration mode.

end-class-map

Syntax Description   This command has no keywords or arguments.

Command Default   No default behavior or values

Command Modes   Class map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   No specific guidelines impact the use of this command.

Task ID

Task ID	Operations
qos	read, write

Examples   This example shows how to end the class map configuration and exit class map configuration mode:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv4 1
RP/0/RP0/CPU0:router(config-cmap)# end-class-map
```

end-policy-map

To end the configuration of a policy map and to exit policy map configuration mode, use the **end-policy-map** command in policy map configuration mode.

end-policy-map

Syntax Description   This command has no keywords or arguments.

Command Default   No default behavior or values

Command Modes   Policy map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   No specific guidelines impact the use of this command.

Task ID

Task ID	Operations
qos	read, write

Examples   This example shows how to end the policy map configuration and exit policy map configuration mode.

```
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# police rate 250
RP/0/RP0/CPU0:router(config-pmap)# end-policy-map
```

match access-group

To identify a specified access control list (ACL) number as the match criteria for a class map, use the **match access-group** command in class map configuration mode.

match **access-group** {**ipv4** | **ipv6**} *access-group-name*

Syntax Description		
ipv4	Specifies the name of the IPv4 access group to be matched.	
ipv6	Specifies the name of the IPv6 access group to be matched.	
access-group-name	ACL whose contents are used as the match criteria against which packets are checked to determine if they belong to this class.	

Command Default

By default, if neither IPv6 nor IPv4 is specified as the match criteria for a class map, IPv4 addressing is used.

Command Modes

Class map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines

For class-based features (such as marking and policing), you define traffic classes based on match criteria, including ACLs and input interfaces. Packets satisfying the match criteria for a class constitute the traffic for that class.

The **match access-group** command specifies an ACL whose contents are used as the match criteria against which packets are checked to determine if they belong to the class specified by the class map.

The **match access-group** command is supported only in the ingress direction. The maximum allowed entries: 8

To use the **match access-group** command, you must first enter the **class-map** command to specify the name of the class whose match criteria you want to establish. You can specify up to eight IPv4 and IPv6 ACLs in a match statement.

QoS classification based on the packet length or TTL (time to live) field in the IPv4 and IPv6 headers is not supported.

When an ACL list is used within a class-map, the deny action of the ACL is ignored and the traffic is classified based on the specified ACL match parameters.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to specify a class map called map1 and configures map1 to be used as the match criteria for this class:

```
RP/0/RP0/CPU0:router(config)# class-map map1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv4 map1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv6 map2
```

match dscp

To identify specific IP differentiated services code point (DSCP) values as match criteria for a class map, use the **match dscp** command in class map configuration mode. To remove a DSCP value from a class map, use the **no** form of this command.

match [**not**] **dscp** {[{**ipv4** | **ipv6**}] *dscp-value* [*dscp-value1* . . . *dscp-value7*] | [*min-value* – *max-value*]}
no match [**not**] **dscp** {[{**ipv4** | **ipv6**}] *dscp-value* [*dscp-value1* . . . *dscp-value7*] | [*min-value* – *max-value*]}

Syntax Description		
	not	(Optional) Negates the specified match result.
	ipv4	(Optional) Specifies the IPv4 DSCP value.
	ipv6	(Optional) Specifies the IPv6 DSCP value.
	dscp-value	IP DSCP value identifier that specifies the exact value or a range of values. Range is 0 - 63. Up to 64 IP DSCP values can be specified to match packets. Reserved keywords can be specified instead of numeric values. Table 4: IP DSCP Reserved Keywords, on page 86 describes the reserved keywords.
	min-value	Lower limit of DSCP range to match. Value range is 0 - 63.
	max-value	Upper limit of DSCP range to match. Value range is 0 - 63.

Command Default   Matching on IP Version 4 (IPv4) and IPv6 packets is the default.

Command Modes   Class map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **match dscp** command is supported only in the ingress direction. The minimum value is 0 and maximum value is 63. The maximum allowed entries: 64.

The **match dscp** command specifies a DSCP value that is used as the match criteria against which packets are checked to determine if they belong to the class specified by the class map.

To use the **match dscp** command, you must first enter the **class-map** command to specify the name of the class whose match criteria you want to establish

The **match dscp** command examines the higher-order six bits in the type of service (ToS) byte of the IP header. If you specify more than one **match dscp** command in a class map, the new values are added to the existing statement.

The IP DSCP value is used as a matching criterion only. The value has no mathematical significance. For instance, the IP DSCP value 2 is not greater than 1. The value simply indicates that a packet marked with the IP DSCP value of 2 should be treated differently than a packet marked with an IP DSCP value of 1. The

treatment of these marked packets is defined by the user through the setting of policies in policy map class configuration mode.

Table 4: IP DSCP Reserved Keywords

DSCP Value	Reserved Keyword
0	default
10	AF11
12	AF12
14	AF13
18	AF21
20	AF22
22	AF23
26	AF31
28	AF32
30	AF33
34	AF41
36	AF42
38	AF43
46	EF
8	CS1
16	CS2
24	CS3
32	CS4
40	CS5
48	CS6
56	CS7
ipv4	ipv4 dscp
ipv6	ipv6 dscp

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to configure the service policy called policy1 and attach service policy policy1 to an interface HundredGigE 0/7/0/0. In this example, class map dscp14 evaluates all packets entering for an IP DSCP value of 14. If the incoming packet has been marked with the IP DSCP value of 14, the packet is queued to the class queue with the bandwidth setting of 1000 mbps.

```
RP/0/RP0/CPU0:router(config)# class-map dscp14
RP/0/RP0/CPU0:router(config-cmap)# match dscp ipv4 14
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class dscp14
RP/0/RP0/CPU0:router(config-pmap-c)#bandwidth 1000 mbps
RP/0/RP0/CPU0:router(config-pmap-c)#exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/7/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input policy1
```

match mpls experimental topmost

To identify specific three-bit experimental (EXP) field values in the topmost Multiprotocol Label Switching (MPLS) label as match criteria for a class map, use the **match mpls experimental topmost** command in class map configuration mode. To remove experimental field values from the class map match criteria, use the **no** form of the command.

match [**not**] **mpls experimental topmost** *exp-value* [*exp-value1* . . .*exp-value7*]
no match [**not**] **mpls experimental topmost** *exp-value* [*exp-value1* . . .*exp-value7*]

Syntax Description		
	not	not
	exp-value	Experimental value that specifies the exact value from 0 to 7. Up to eight experimental values can be specified to match MPLS headers.

Command Default   No default behavior or values

Command Modes   Class map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **match mpls experimental topmost** command is supported only in the ingress direction. The minimum value is 0 and maximum value is 7. The maximum allowed entries: 8.

The **match mpls experimental topmost** command is used by the class map to identify MPLS experimental values matching on a packet.

To use the **match mpls experimental topmost** command, you must first enter the **class-map** command to specify the name of the class whose match criteria you want to establish. If you specify more than one **match mpls experimental topmost** command in a class map, the new values are added to the existing match statement.

This command examines the three experimental bits contained in the topmost label of an MPLS packet. Up to eight experimental values can be matched in one match statement. For example, match mpls experimental topmost 2 4 5 7 returns matches for experimental values of 2, 4, 5, and 7. Only one of the four values is needed to yield a match (OR operation).

The experimental values are used as a matching criterion only. The value has no mathematical significance. For instance, the experimental value 2 is not greater than 1. The value indicates that a packet marked with the experimental value of 2 should be treated differently than a packet marked with the EXP value of 1. The treatment of these different packets is defined by the user through the setting of QoS policies in policy map class configuration mode.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to configure the service policy called policy1 and attach service policy policy1 to an interface. In this example, class map mplsmap1 evaluates all packets entering HundredGigabit Ethernet interface 0/1/0/9 for an MPLS experimental value of 1. If the incoming packet has been marked with the MPLS experimental value of 1, the packet is queued to the class queue with the bandwidth setting of 1000 mbps.

```
RP/0/RP0/CPU0:router(config)# class-map mplsmap1
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 1
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class mplsmap1
RP/0/RP0/CPU0:router(config-pmap-c)# bandwidth 1000 mbps
RP/0/RP0/CPU0:router(config-pmap-c)#exit
RP/0/RP0/CPU0:router(config-pmap)#exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/0/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input  policy1
```

match precedence

To identify IP precedence values as match criteria, use the **match precedence** command in class map configuration mode. To remove precedence values from a class map, use the **no** form of this command.

match [**not**] **precedence** [{**ipv4**|**ipv6**}] *precedence-value* [*precedence-value1* . . . *precedence-value7*]
no match [**not**] **precedence** [{**ipv4**|**ipv6**}] *precedence-value* [*precedence-value1* . . . *precedence-value7*]

Syntax Description		
	not	(Optional) Negates the specified match result.
	ipv4	(Optional) Specifies the IPv4 precedence value.
	ipv6	(Optional) Specifies the IPv6 precedence value.
	precedence-value	An IP precedence value identifier that specifies the exact value. Reserved keywords can be specified instead of numeric values. Table 5: IP Precedence Values and Names, on page 91 describes the reserved keywords.
		Up to eight precedence values can be matched in one match statement.

Command Default Matching on both IP Version 4 (IPv4) and IPv6 packets is the default.

Command Modes Class map configuration

Command History	Release	Modification
	Release 7.0.12	This command was introduced.

Usage Guidelines The **match precedence** command is supported only in the ingress direction. The minimum value is 0 and maximum value is 7. The maximum allowed entries: 8.

The **match precedence** command specifies a precedence value that is used as the match criteria against which packets are checked to determine if they belong to the class specified by the class map.

To use the **match precedence** command, you must first enter the **class-map** command to specify the name of the class whose match criteria you want to establish. If you specify more than one **match precedence** command in a class map, the new values are added to the existing statement.

The **match precedence** command examines the higher-order three bits in the type of service (ToS) byte of the IP header. Up to eight precedence values can be matched in one match statement. For example, **match precedence ipv4 0 1 2 3 4 5 6 7** returns matches for IP precedence values of 0, 1, 2, 3, 4, 5, 6, and 7. Only one of the eight values is needed to yield a match (OR operation).

The precedence values are used as a matching criterion only. The value has no mathematical significance. For instance, the precedence value 2 is not greater than 1. The value simply indicates that a packet marked with the precedence value of 2 is different than a packet marked with the precedence value of 1. The treatment of these different packets is defined by the user through the setting of QoS policies in policy map class configuration mode.

This table lists the IP precedence value number and associated name in descending order of importance.

Table 5: IP Precedence Values and Names

Value	Name
0	routine
1	priority
2	immediate
3	flash
4	flash-override
5	critical
6	internet
7	network
ipv4	ipv4 precedence
ipv6	ipv6 precedence

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to configure the service policy called policy1 and attach service policy policy1 to an interface. In this example, class map ipprec5 evaluates all packets entering HundredGigabit Ethernet interface 0/1/0/9 for a precedence value of 5. If the incoming packet has been marked with the precedence value of 5, the packet is queued to the class queue with the bandwidth setting of 1000 mbps.

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# class-map ipprec5
RP/0/RP0/CPU0:router(config-cmap)# match precedence ipv4 5
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class ipprec5
RP/0/RP0/CPU0:router(config-pmap-c)# bandwidth 1000 mbps
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/0/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input policy1
```

match qos-group

To identify specific quality-of-service (QoS) group values as match criteria in a class map, use the **match qos-group** command in class map configuration mode. To remove a specific QoS group value from the matching criteria for a class map, use the **no** form of this command.

match **qos-group** [*qos-group-value*]
no **match** **qos-group**

Syntax Description		
	qos-group-value	QoS group value identifier that specifies the exact value from 1 to 7. Range is not supported.

Command Default   No match criteria are specified.

Command Modes   Class map configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **match qos-group** command is supported only in the egress direction. The egress default class will implicitly match qos-group 0. The minimum value is 1 and maximum value is 7. The maximum allowed entries: 7.

The **match qos-group** command sets the match criteria for examining QoS groups marked on the packet. One class map can match only one qos-group value from 1 to 7. The qos-group values 1 to 7 maps to queue 1 to 7 on the egress port. Queue 0 is reserved for class-default.

The QoS group value is used as a matching criterion only. The value has no mathematical significance. For instance, the QoS group value 2 is not greater than 1. The value simply indicates that a packet marked with the QoS group value of 2 should be treated differently than a packet marked with a QoS group value of 1. The treatment of these different packets is defined using the **service-policy** command in policy map class configuration mode.

The QoS group setting is limited in scope to the local router. Typically, the QoS group is set on the ingress on the local router to be used locally and the router to give differing levels of service based on the group identifier.

In the ingress policy-map, in order to designate the traffic class to a certain CoSQ other than CoSQ 0, the class-map needs to have an explicit set qos-group x statement, where 'x' is the CoSQ in the range of 0 to 7. The default COSQ is 0. In the egress policy-map, a class-map with a corresponding match qos-group x will allow further Quality of Service actions to be applied to the traffic class. For example,

```
class-map prec1
  match prec 1

policy-map test-ingress
  class prec1
    set qos-group 1
    police rate percent 50


class-map qg1
```

```
    match qos-group 1


policy-map test-egress
  class qg1
    shape average percent 70
```

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows a service policy called policy1 attached to an HundredGigabit Ethernet interface 0/1/0/9. In this example, class map qosgroup5 will evaluate all packets leaving HundredGigabit Ethernet interface 0/1/0/9 for a QoS group value of 5. If the packet has been marked with the QoS group value of 5, the packet is queued to the class queue with the bandwidth setting of 1000 mbps.

```
RP/0/RP0/CPU0:router(config)# class-map qosgroup5
RP/0/RP0/CPU0:router(config-cmap)# match qos-group 5
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class qosgroup5
RP/0/RP0/CPU0:router(config-pmap-c)# bandwidth 1000 mbps
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/0/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy output  policy1
```

set discard-class

To set the discard class and Quality of Service (QoS) group identifiers on IP Version 4 (IPv4) or Multiprotocol Label Switching (MPLS) packets, use the **set discard-class** command in policy map class configuration mode. To leave the discard-class values unchanged, use the **no** form of this command.

set discard-class *discard-class-value*
no set discard-class *discard-class-value*

Syntax Description	*discard-class-value* Discard class ID. An integer 0 to 1, to be marked on the packet.

Command Default   No default behavior or values

Command Modes   Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   The **set discard-class** command associates a discard class ID with a packet. After the discard class is set, other QoS services such as Random Early Detection (random-detect) can operate on the bit settings.

Discard-class indicates the discard portion of the per hop behavior (PHB). The **set discard-class** command is typically used in Pipe mode. Discard-class is required when the input PHB marking is used to classify packets on the output interface.

The **set discard-class** command is supported only in the ingress direction.Unconditional discard-class marking is supported.

The discard-class values can be used to specify the type of traffic that is dropped when there is congestion.

> **Note**   1.   Marking of the discard class has only local significance on a node.
>
> 2.   Discard class cannot be associated with a QoS profile in peering mode.

Task ID

Task ID	Operations
qos	read, write

Examples   This example shows how to set the discard class value to 1 for packets that match the MPLS experimental bits 1:

```
RP/0/RP0/CPU0:router(config)# class-map cust1
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 1
```

```
RP/0/RP0/CPU0:router(config-cmap)# exit
RP/0/RP0/CPU0:router(config)# policy-map policy2
RP/0/RP0/CPU0:router(config-pmap)# class cust1
RP/0/RP0/CPU0:router(config-pmap-c)# set discard-class 1
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit
RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/0/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input policy2
```

set forward-class

To associate the class-map with a forward-class, use the **set forward-class** command in policy-map class configuration mode. To remove a previously set forward-class, use the **no** form of this command.

set   forward-class   *forward-class-value*

Syntax Description	*forward-class-value* Number from 1 to 7 that sets the forward-class value.
Command Default	No default behavior or values
Command Modes	Policy map class configuration

Command History

Release	Modification
Release 7.5.3	This command was introduced.

Usage Guidelines   In policy based traffic selection (PBTS), 0 is the default forward-class. You cannot set forward-class 0 to the class-map.

Task ID

Task ID	Operations
qos	read, write

Examples   In this example, the class-map is associated with the forward-class 1:

```
RP/0/RP0/CPU0:router(config)#policy-map INGRESS-POLICY
RP/0/RP0/CPU0:router(config-pmap)#class AF42-Class
RP/0/RP0/CPU0:router(config-pmap-c)#set forward-class 1
```

set dscp

To mark a packet by setting the IP differentiated services code point (DSCP) in the type of service (ToS) byte, use the **set dscp** command in policy-map class configuration mode. To remove a previously set DSCP value, use the **no** form of this command.

set dscp [**tunnel**] *dscp-value*
no set dscp [**tunnel**] *dscp-value*

Syntax Description	

tunnel	(Optional) Sets the DSCP on the outer IP header. This command is available on Layer 3 interfaces in the ingress direction.
dscp-value	Number from 0 to 63 that sets the DSCP value. Reserved keywords can be specified instead of numeric values. Table 4: IP DSCP Reserved Keywords, on page 86 describes the reserved keywords.

Command Default   No default behavior or values

Command Modes   Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   After the DSCP bit is set, other quality-of-service (QoS) services can then operate on the bit settings. The **set dscp** is supported only in the ingress direction.

The network gives priority (or some type of expedited handling) to marked traffic. Typically, you set the DSCP value at the edge of the network (or administrative domain); data then is queued based on the DSCP value.

Task ID

Task ID	Operations
qos	read, write

Examples   In this example, the DSCP ToS byte is set to 6 in the policy map called policy-in. All packets that satisfy the match criteria of class1 are marked with the DSCP value of 6. The network configuration determines how packets are marked.

```
RP/0/RP0/CPU0:router (config)# policy-map policy-in
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# set dscp 6
```

set ip encapsulation

To set traffic class imposition for SRv6 encapsulation, use the **set ip encapsulation** command in policy map class configuration mode.

set ip encapsulation class-of-service *cos-value*

Syntax Description	**class-of-service**	Specifies the class of service.
	cos-value	Specifies the number that sets the SRv6 encapsulation in the IP header. The value ranges from 0 to 63.

Command Default   None

Command Modes   Policy map class configuration

Command History	Release	Modification
	Release 24.2.1	This command was introduced.

Usage Guidelines

- The **set ip encapsulation class-of-service** command is not allowed in egress QoS policies.

- The described behavior is applicable only in pipe mode. When in uniform mode or when propagate mode is active, regardless of QoS policy encapsulation settings, the class-of-service (CoS) from the inner header is always copied to the outer header.

- The set qos-group action cannot be used in conjunction with the **set ip encapsulation class-of-service** command.

- The IP encapsulation marking (**set ip encapsulation class-of-service**) and the MPLS experimental imposition marking (set mpls experimental features are mutually exclusive. Both the configurations are not allowed at the same time.

Task ID	Task ID	Operations
	qos	read, write

Examples

This example shows how to set the traffic class imposition for SRv6 encapsulations.

```
RP/0/RP0/CPU0:router(config)# class-map match-any class1
RP/0/RP0/CPU0:router(config-pmap)# match protocol ipv4
RP/0/RP0/CPU0:router(config-pmap-c)# match access-group ipv4 10
RP/0/RP0/CPU0:router(config-cmap-c)# class class-default
RP/0/RP0/CPU0:router(config-cmap-c)# end-class-map

RP/0/RP0/CPU0:router(config)# policy-map SRv6
RP/0/RP0/CPU0:router(config-pmap)# class class1
```

```
RP/0/RP0/CPU0:router(config-pmap-c)# set ip encapsulation class-of-service 55
RP/0/RP0/CPU0:router(config-cmap-c)# class class-default
RP/0/RP0/CPU0:router(config-cmap-c)# end-policy-map

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/0/0/24
RP/0/RP0/CPU0:router(config-if)# service-policy input SRv6
```

set mpls experimental

To set the experimental (EXP) value of the Multiprotocol Label Switching (MPLS) packet topmost or imposition labels, use the **set mpls experimental** command in policy map configuration mode. To leave the EXP value unchanged, use the **no** form of this command.

set mpls experimental {**topmost**} *exp-value*
no set mpls experimental {**topmost**} *exp-value*

Syntax Description

topmost	Specifies to set the EXP value of the topmost label.
exp-value	Value of the MPLS packet label. Range is 0 to 7.

Command Default
No MPLS experimental value is set

Command Modes
Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines
After the MPLS experimental bits are set, other QoS services can then operate on the bit settings.

This command is supported only in ingress direction. Unconditional MPLS experimental marking is supported.

The network gives priority (or some type of expedited handling) to the marked traffic. Typically, the MPLS experimental value is set at the edge of the network (or administrative domain) and queuing is acted on it thereafter.

Task ID

Task ID	Operations
qos	read, write

Examples
This example shows how to set the MPLS experimental to 5 for packets that match access list 101:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv4 acl101
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# set mpls experimental topmost 5
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/1/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input policy1
```

set precedence

To set the precedence value in the IP header, use the **set precedence** command in policy map class configuration mode. To leave the precedence value unchanged, use the **no** form of this command.

set precedence [**tunnel**] *value*
no set precedence [**tunnel**] *value*

Syntax Description	**tunnel**	(Optional) Sets the IP precedence on the outer IP header.
	value	Number or name that sets the precedence bits in the IP header. Range is from 0 to 7. Reserved keywords can be specified instead of numeric values. Table 5: IP Precedence Values and Names, on page 91 describes the reserved keywords.

Command Default   No default behavior or values

Command Modes   Policy map class configuration

Command History

Release	Modification
Release 7.0.12	This command was introduced.

Usage Guidelines   Precedence can be set using a number or corresponding name. After IP Precedence bits are set, other QoS services can then operate on the bit settings.

The **set precedence** command is supported only in the ingress direction. Unconditional precedence marking is supported.

The network gives priority (or some type of expedited handling) to the marked traffic. IP precedence can be set at the edge of the network (or administrative domain) and have queueing act on it thereafter.

The mapping from keywords such as 0 (routine) and 1 (priority) to a precedence value is useful only in some instances. That is, the use of the precedence bit is evolving. You can define the meaning of a precedence value by enabling other features that use the value. In the case of high-end Internet QoS, IP precedences can be used to establish classes of service that do not necessarily correspond numerically to better or worse handling in the network.

Task ID

Task ID	Operations
qos	read, write

Examples   This example shows how to set the IP precedence to 5 (critical) for packets that match the access control list named customer1:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match access-group ipv4 customer1
RP/0/RP0/CPU0:router(config-cmap)# exit
```

```
RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# set precedence 5
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/1/0/9
RP/0/RP0/CPU0:router(config-if)# service-policy input policy1
```

set qos-group

To set the quality of service (QoS) group identifiers on packets, use the **set qos-group** command in policy map class configuration mode. To leave the QoS group values unchanged, use the **no** form of this command.

set qos-group *qos-group-value*
no set qos-group *qos-group-value*

Syntax Description	*qos-group-value* QoS group ID. An integer from 1 to 7, to be marked on the packet.
	The *qos-group-value* is used to select a CoSQ and eventually to a VOQ

Command Default   No group ID is specified.

Command Modes   Policy map class configuration

Command History	**Release**	**Modification**
	Release 7.0.12	This command was introduced.

Usage Guidelines   The **set qos-group** command is supported only in the ingress direction.

The **set qos-group** will be used as internal priority to choose the queue on the egress port.

In the ingress policy-map, in order to designate the traffic class to a certain CoSQ other than CoSQ 0, the class-map needs to have an explicit set qos-group x statement, where 'x' is the CoSQ in the range of 0 to 7. The default COSQ is 0. In the egress policy-map, a class-map with a corresponding match qos-group x will allow further Quality of Service actions to be applied to the traffic class. For example,

```
class-map prec1
  match prec 1

policy-map test-ingress
  class prec1
    set qos-group 1
    police rate percent 50


class-map qg1
  match qos-group 1


policy-map test-egress
  class qg1
    shape average percent 70
```

Task ID	**Task ID**	**Operations**
	qos	read, write

Examples

This example sets the QoS group to 5 for packets that match the MPLS experimental bit 1:

```
RP/0/RP0/CPU0:router(config)# class-map class1
RP/0/RP0/CPU0:router(config-cmap)# match mpls experimental topmost 1
RP/0/RP0/CPU0:router(config-cmap)# exit

RP/0/RP0/CPU0:router(config)# policy-map policy1
RP/0/RP0/CPU0:router(config-pmap)# class class1
RP/0/RP0/CPU0:router(config-pmap-c)# set qos-group 5
RP/0/RP0/CPU0:router(config-pmap-c)# exit
RP/0/RP0/CPU0:router(config-pmap)# exit

RP/0/RP0/CPU0:router(config)# HundredGigE interface 0/1/0/0
RP/0/RP0/CPU0:router(config-if)# service-policy input policy1
```

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