Congestion Avoidance Commands

This chapter describes commands used to avoid congestion.

Congestion avoidance is achieved through packet dropping. Cisco IOS XR software supports the following quality of service (QoS) congestion avoidance techniques that drop packets:

- Random early detection (RED
- Weighted random early detection (WRED)
- Tail drop

To use commands of this module, you must be in a user group associated with a task group that includes appropriate task IDs. If the user group assignment is preventing you from using any command, contact your AAA administrator for assistance.

For detailed information about congestion avoidance concepts, configuration tasks and examples, see the Configuring Congestion Avoidance module in the *Modular QoS Configuration Guide for Cisco ASR 9000 Series Routers*

bandwidth (QoS)

To specify the minimum bandwidth allocated to a class belonging to a policy map, use the **bandwidth** command in policy map class configuration mode. To remove the bandwidth specified for a class, use the **no** form of this command.

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

Syntax Description

rate	Minimum bandwidth, in the units specified, to be assigned to the class. Range is from 1 to 4294967295.
units	Specifies the units for the bandwidth. Values can be: • **bps**—bits per second • **gbps**—gigabits per second • **kbps**—kilobits per second (default) • **mbps**—megabits per second
percent *percentage-value*	Specifies the amount of guaranteed bandwidth, based on an absolute percentage of available bandwidth. Range is from 1 to 100.

Command Default

The default units is kbps.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.

Usage Guidelines

The **bandwidth** command is used to specify the minimum guaranteed bandwidth allocated for traffic matching a particular class. Bandwidth may be defined as a specific value or may be set as a percentage of the interface bandwidth.

If a percentage value is set, the accuracy that can be expected is 1 percent.

Note The bandwidth value takes into account the Layer 2 encapsulation that is applied to traffic leaving the interface. For Ethernet , the encapsulation is considered to be 14 bytes; whereas for IEEE 802.1Q, the encapsulation is 18 bytes. The actual bandwidth assigned to a class can be seen in the output of the **show qos interface** command.

Be careful when specifying bandwidth guarantees close to 100 percent, because the Layer 2 encapsulation considered does not include the entire Layer 2 header. This can lead to oversubscription, particularly in the case of small packet sizes.

A policy map can have a single bandwidth statement per class. Both percentage and actual value bandwidth configurations can be used within a policy map.

The **bandwidth** command does not specify how the bandwidth is to be shared. Instead it specifies how much bandwidth is guaranteed per class, by setting the number of tokens that are assigned to the token bucket of a particular class. For configured behavior to work correctly, you must ensure that the sum of the bandwidths plus any priority traffic is not greater than the bandwidth of the interface itself. If the interface is oversubscribed, unpredictable behavior results.

The bandwidth of the interface is set to be that of the physical interface, unless a hierarchical policy is defined that reduces the bandwidth available to the traffic. The following example shows a hierarchical policy being used to shape traffic to the specified value. The child policy then determines how the shaped bandwidth should be apportioned between the specified classes:

```
policy-map parent
  class match_all
  shape average 1000000
  bandwidth 1000000
    service-policy child

policy-map child
  class gold
    bandwidth percent 20
  class silver
    bandwidth percent 40
  class default
    bandwidth percent 40
```

Note The **bandwidth** command is part of the parent policy. In this instance, the **bandwidth** command not only sets the minimum bandwidth for the class but also resets the reference point for the **bandwidth percent** statements in the child policy.

- If bandwidth is configured in the parent class, parent minimum bandwidth is used as a reference for the child bandwidth percentages.
- If bandwidth is not configured in the parent class, the implicit minimum bandwidth, which is a portion of the total unallocated bandwidth allocated to the class based on the explicit or implicit bandwidth remaining, is used as a reference.

For subinterface policies:

- If bandwidth is configured in the parent class, parent minimum bandwidth is used as a reference for child bandwidth percentages.
- If bandwidth remaining is configured in the parent class, *bandwidth-remaining-percent* * *interface-rate* is used as a reference.
- If bandwidth is not configured in the parent class, *shape rate* is used as a reference.

In this example, the hierarchical policy is attached to the main interface, and the parent classes are a mix of bandwidth and shape only classes:

```
policy-map hqos
 class c1
   bandwidth percent 40
```

```
    service-policy child
 class c2
   shape average 500000000
    service-policy child
```

The reference for the child policy in class c2 is the implicit bandwidth of class c2 bounded by the shape rate of class c2. Therefore, the reference = (60 percent * interface bandwidth) / 3 bounded by 500000000 kbps.

In this example, the hierarchical policy is a class-default only parent shape configured on subinterfaces:

```
policy-map sub_int_hqos
 class class-default
   shape average 40
    service-policy child
```

The class-default parent shape rate is used as reference.

When the **percent** keyword is used with the **bandwidth** command, the bandwidth of the interface is defined as being the Layer 2 capacity excluding the Gigabit Ethernet or POS encapsulation but including the High-Level Data Link Control (HDLC) flags, frame check sequence (FCS), and so on. These have to be included because they are applied per packet, and the system cannot predict how many packets of a particular packet size are being sent out.

For example, the following policy is applied to an OC-192 interface:

```
policy-map oc-192
  class c1
  bandwidth percent 50
```

The resulting bandwidth reservation for class c1 is 4,792,320 kbps. This equates to 50 percent of the OC-192 bandwidth excluding the GE or POS overhead.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to guarantee 50 percent of the interface bandwidth to a class called class1 and 10 percent of the interface bandwidth to a class called class2:

```
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# bandwidth percent 50
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# class class2
RP/0/RSP0/CPU0:router(config-pmap-c)# bandwidth percent 10
```

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 [{**percent** *percentage-value* | **ratio** *ratio-value*}]
no bandwidth remaining [{**percent** *percentage-value* | **ratio** *ratio-value*}]

Syntax Description

percent *percentage-value*	Specifies the amount of guaranteed bandwidth, based on an absolute percentage of the available bandwidth. Range is from 1 to 100.
ratio *ratio-value*	Specifies the amount of guaranteed bandwidth, based on a bandwidth ratio value. Range is 1 to 1020.

Command Default

No bandwidth is specified.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.

Usage Guidelines

The **bandwidth remaining** command is used to set the Modified Deficit Round Robin (MDRR) weight for the particular class.

When applied within an egress service policy, the command is used to define how any unallocated bandwidth should be apportioned. It is typically used in conjunction with the bandwidth configuration at the parent level in hierarchical policy maps. In such a combination, if the minimum bandwidth guarantees are met, the remaining bandwidth is shared in the ratio defined by the **bandwidth remaining** command in the class configuration in the policy map.

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

Note On egress, the actual bandwidth of the interface is determined to be the Layer 2 capacity excluding CRC. These have to be included because they are applied per packet, and the system cannot predict how many packets of a particular packet size are being sent out.

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

On both ingress and 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. When attempting precise calculations of expected MDRR behavior, you must bear in mind that because you are dealing with the bandwidth remaining on the link, you must convert the values to the bandwidth remaining percentages on the link, based upon the packet sizes of the traffic within the class. If the packet sizes are the same in all the classes, then the defined ratio is enforced precisely and predictably on the link.

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/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# bandwidth remaining percent 20
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# class class2
RP/0/RSP0/CPU0:router(config-pmap-c)# bandwidth remaining percent 80
```

child-conform-aware

To prevent the parent policer from dropping any ingress traffic that conforms to the maximum rate specified in the child policer, use the **child-conform-aware** command in policy map police configuration mode. To remove this action from the policy map, use the **no** form of this command.

child-conform-aware
no child-conform-aware

Syntax Description

This command has no keywords or arguments.

Command Default

The **child-conform-aware** command is not configured.

Command Modes

Policy map police configuration

Command History

Release	Modification
Release 4.0.0	This command was introduced.

Usage Guidelines

In hierarchical policing, traffic is policed first at the child policer level and then at the parent policer level. It is possible for traffic that conforms to the maximum rate specified by the child policer to be dropped by the parent policer.

In enhanced hierarchical ingress policing, the **child-conform-aware** command prevents the parent policer from dropping any ingress traffic that conforms to the maximum rate specified in the child policer.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows parent and child policy maps in which two classes are defined in the child policy. In class AF1, the exceed action is set to an action other than to drop traffic.

If the **child-conform-aware** command were not configured in the parent policy, the parent policer would drop traffic that matches the conform rate of the child policer but exceeds the conform rate of the parent policer.

The **child-conform-aware** command prevents the parent policer from dropping any ingress traffic that conforms to the maximum rate specified in the child policer.

This example shows parent and child policies in which two classes are defined in the child policy. In class AF1, the exceed action is set to an action other than to drop traffic.

If the **child-conform-aware** command were not configured in the parent policy, the parent policer would drop traffic that matches the conform rate of the child policer but exceeds the conform rate of the parent policer.

When used in the parent policer, the **child-conform-aware** command prevents the parent policer from dropping any ingress traffic that conforms to the committed rate specified in the child policer.

In this example, class EF in the child policy is configured with a committed rate of 1 Mbps, a conform action and an exceed action. The traffic that is below 1 Mbps is presented to the parent policer with the MPLS EXP bit set to 4, and traffic that exceeds 1 Mbps is dropped.

Class AF1 in the child policy is configured with a committed rate of 1 Mbps, a conform action and an exceed action. The traffic that is below 1 Mbps is presented to the parent policer with the MPLS EXP bit set to 3, and traffic that exceeds 1 Mbps is presented to the parent policer with the MPLS EXP bit set to 2.

With this child policy configuration, the parent policer sees traffic from the child classes as exceeding its committed rate of 2 Mbps. Without the **child-conform-aware** command in the parent policer, the parent polices to 2 Mbps, which can result into dropping some conformed traffic from class EF in the child policy. When the **child-conform-aware** command is configured in the parent policer, the parent policer does not drop any traffic that conforms under the child policy.

```
RP/0/RSP0/CPU0:router(config)# policy-map parent
RP/0/RSP0/CPU0:router(config-pmap)# class class-default
RP/0/RSP0/CPU0:router(config-pmap-c)# service-policy child
RP/0/RSP0/CPU0:router(config-pmap-c)# police rate 2 mbps
RP/0/RSP0/CPU0:router(config-pmap-c-police)# child-conform-aware
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action transmit
RP/0/RSP0/CPU0:router(config-pmap-c-police)# exceed-action drop

RP/0/RSP0/CPU0:router(config)# policy-map child
RP/0/RSP0/CPU0:router(config-pmap)# class EF
RP/0/RSP0/CPU0:router(config-pmap-c)# police rate 1 mbps
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set mpls experimental imposition
 4
RP/0/RSP0/CPU0:router(config-pmap-c-police)# exceed-action drop
RP/0/RSP0/CPU0:router(config-pmap-c-police)# exit
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# class AF1
RP/0/RSP0/CPU0:router(config-pmap-c)# police rate 1 mbps
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set mpls experimental imposition
 3
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set mpls experimental imposition
 2
```

Related Commands

Command	Description
exceed-action	Configures the action to take on packets that exceed the rate limit.
police rate	Configures traffic policing and enters policy map police configuration mode.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.

compress header ip

To enable IP header compression for a policy map class, use the **compress header ip** command in policy map class configuration mode. To disable header compression, use the **no** form of this command.

compress header ip
no compress header ip

Syntax Description

This command has no keywords or arguments.

Command Default

By default, IP header compression is disabled.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 4.0.0	This command was introduced.

Usage Guidelines

No specific guidelines impact the use of this command.

Task ID

Task ID	Operations
qos	read, write

Examples

The following example shows how to enable IP header compression for a policy map class:

```
RP/0/RSP0/CPU0:router(config)#class-map class1
RP/0/RSP0/CPU0:router(config-cmap)# match access-group ipv4 customer1
RP/0/RSP0/CPU0:router(config-cmap)# exit
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# compress header ip
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# exit
```

Related Commands

Command	Description
class-map	Defines a traffic class and the associated rules that match packets to the class.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
service-policy (interface), on page 39	Attaches a policy map to an input interface or output interface to be used as the service policy for that interface.

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

Syntax Description

drop	(Optional) Drops the packet.
set *options*	(Optional) Configures the specified packet properties. Replace *options* with one of the following keywords or keyword arguments: • **atm-clp value** —Sets the cell loss priority (CLP) bit. • **cos value** —Sets the class of service value. Range is 0 to7. • **cos** [**inner**]*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 Table 1 for a list of valid values. • **dscp** [**tunnel**] *value* —Sets the differentiated services code point (DSCP) value and sends the packet. See Table 1 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 Table 2 for a list of valid values. • **precedence** [**tunnel**] *precedence* —Sets the IP precedence and sends the packet. See Table 1 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. • **srp-priority** *value* —Sets the Spatial Reuse Protocol (SRP) priority. Range is 0 to 7.
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 3.7.2	This command was introduced.
Release 4.0.0	The **set dei** keyword was added.

Usage Guidelines

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

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

- Ingress and egress
- Layer 2 subinterfaces
- Layer 2 main interfaces
- Layer 3 main interfaces

Note The set DEI action is ignored for traffic on interfaces that are not configured for 802.1ad encapsulation.

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/RSP0/CPU0:router(config)# class-map class
RP/0/RSP0/CPU0:router(config-cmap)# match mpls experimental topmost 0
RP/0/RSP0/CPU0:router(config-cmap)# exit

RP/0/RSP0/CPU0:router(config)# policy-map child
RP/0/RSP0/CPU0:router(config-pmap)# class prec1
RP/0/RSP0/CPU0:router(config-pmap-c)# police rate 100000000 peak-rate 3125000 peak-burst
3125000
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set mpls experimental imp 1
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set qos-group 1
RP/0/RSP0/CPU0:router(config-pmap-c-police)# exit
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# exit

RP/0/RSP0/CPU0:router(config)# interface gigabitethernet 0/1/0/9
RP/0/RSP0/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/RSP0/CPU0:router(config)# policy-map 1ad-mark-dei
RP/0/RSP0/CPU0:router(config-pmap)# class c1
RP/0/RSP0/CPU0:router(config-pmap-c)# police rate 5 mbps
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set dei 0
RP/0/RSP0/CPU0:router(config-pmap-c-police)# exceed-action set dei 1
RP/0/RSP0/CPU0:router(config-pmap-c-police)# end-policy-map
```

Related Commands

Command	Description
child-conform-aware, on page 8	Prevents the parent policer from dropping any ingress traffic that conforms to the maximum rate specified in the child policer.
exceed-action	Configures the action to take on packets that exceed the rate limit.

Command	Description
police rate	Configures traffic policing and enters policy map police configuration mode.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.
violate-action	Configures the action to take on packets that violate the rate limit.

conform-color

To configure preclassification of Frame Relay packets that are not discard-eligible, use the **conform-color** command in policy map police configuration mode. To remove a conform color from the policy-map, use the **no** form of this command.

conform-color *class-map-name*
no conform-color *class-map-name*

Syntax Description

class-map-name	Specifies the class-map to associate with the conform-color.

Command Default

By default, if no preclassification is configured for a packet, the packet is not analyzed by the color-aware policer on the ingress interface, and the packet is given regular policing treatment.

Command Modes

Policy map police configuration

Command History

Release	Modification
Release 4.1.0	This command was introduced.

Usage Guidelines

Typically, frame relay packets from a previous node are marked by default as fr-de = 0 (meaning *not* discard eligible) or fr-de = 1 (meaning discard eligible). For *non*-discard-eligible treatment, you must create a class map for the fr-de=0 case and assign the conform-color to that class-map.

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

Note The multi-action policer sets cannot be used for IP packets.

Task ID

Task ID	Operations
qos	read, write

Examples

In this example, conform-color is configured for preclassification of packets that are *not* discard-eligible.

```
RP/0/RSP0/CPU0:routerconfigure
RP/0/RSP0/CPU0:router(config)# class-map match-all match_not_frde
RP/0/RSP0/CPU0:router(config-cmap)# match not fr-de 1
RP/0/RSP0/CPU0:router(config-cmap)# policy-map 2R3C_conform_example
RP/0/RSP0/CPU0:router(config-pmap)# class class-default
RP/0/RSP0/CPU0:router(config-pmap-c)#  police rate 768000 burst 288000 peak-rate 1536000
peak-burst 576000
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-color match_not_frde
RP/0/RSP0/CPU0:router(config-pmap-c-police)# conform-action set qos-group 1
RP/0/RSP0/CPU0:router(config-pmap-c-police)# exit
```

```
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# exit
RP/0/RSP0/CPU0:router(config)# interface pos 0/2/0/1
RP/0/RSP0/CPU0:router(config-if) service-policy input policy1
```

Related Commands

Command	Description
child-conform-aware, on page 8	Prevents the parent policer from dropping any ingress traffic that conforms to the maximum rate specified in the child policer.
class-map	Defines a traffic class and the associated rules that match packets to the class.
conform-action, on page 11	Configures the action to take on packets that conform to the rate limit.
exceed-action	Configures the action to take on packets that exceed the rate limit.
exceed-color	(Used for SIP 700 cards only.) Configures preclassification of ingress Layer 2 Frame Relay packets that have been previously marked as discard eligible on an upstream node. These previously-marked packets are analyzed and preclassified by the color-aware policer on the ingress interface as part of the 2-rate 3-color (2R3C) traffic policing feature.
match fr-de	Match packets on the basis of the Frame Relay discard eligibility (DE) bit setting.
police rate	Configures traffic policing and enters policy map police configuration mode.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.
violate-action	Configures the action to take on packets that violate the rate limit.

hw-module all qos-mode ingress-queue-enable

To enable ingress queueing mode on MOD80-SE and MOD80-TR 4X10 MPA line cards (LCs), use the **hw-module all qos-mode ingress-queue-enable** command in the admin configuration mode. If you are running on Cisco IOS XR 64 bit, then use the same command in XR config mode. To disable ingress queueing mode on MOD80-SE and MOD80-TR 4X10 MPA LCs, use the **no** form of this command.

hw-module all qos-mode ingress-queue-enable
no hw-module all qos-mode ingress-queue-enable

Syntax Description

This command has no keywords or arguments.

Command Default

No default behavior or values.

Command Modes

Admin configuration mode - Cisco IOS XR

XR Config mode - Cisco IOS XR 64 bit

Command History

Release	Modification
Release 6.1.2	Support for Cisco IOS XR 64 bit bit was added.
Release 5.1.1	This command was introduced.

Usage Guidelines

This command is available only on the ASR 9000 Enhanced Ethernet Line Card.

You must reload LCs for configuration changes to take effect.

Task ID

Task ID	Operation
qos	read, write
root-lr	read, write

This example shows how to enable ingress queueing mode on MOD80-SE and MOD80-TR 4X10 MPA LCs:

```
RP/0/RSP0/CPU0:router(admin-config)# hw-module all qos-mode ingress-queue-enable
RP/0/RSP0/CPU0:router(admin-config)# commit
```

This example shows how to enable ingress queueing mode on all line cards running on Cisco IOS XR 64 bit:

```
RP/0/RSP0/CPU0:router(config)# hw-module all qos-mode ingress-queue-enable
RP/0/RSP0/CPU0:router(config)# commit
```

hw-module all qos-mode per-priority-buffer-limit

To enable per priority buffer limit mode on all line cards (LCs), use the **hw-module all qos-mode per-priority-buffer-limit** command in the admin configuration mode. If you are running on Cisco IOS XR 64 bit, then use the same command in XR config mode. . To disable per priority buffer limit mode on all LCs, use the **no** form of this command.

hw-module all qos-mode per-priority-buffer-limit
no hw-module all qos-mode per-priority-buffer-limit

Syntax Description

This command has no keywords or arguments.

Command Default

No default behavior or values.

Command Modes

Admin configuration mode - Cisco IOS XR

XR config mode - Cisco IOS XR 64 bit

Command History

Release	Modification
Release 6.1.2	Support for Cisco IOS XR 64 bit bit was added.
Release 5.1.1	This command was introduced.

Usage Guidelines

This command is available only on the ASR 9000 Enhanced Ethernet Line Card.

You must reload LCs for configuration changes to take effect.

Task ID

Task ID	Operation
qos	read, write
root-lr	read, write

This example shows how to enable per priority buffer limit mode on all LCs:

```
RP/0/RSP0/CPU0:router(admin-config)# hw-module all qos-mode per-priority-buffer-limit
RP/0/RSP0/CPU0:router(admin-config)# commit
```

This example shows how to enable per priority buffer limit mode on all line cards running on Cisco IOS XR 64 bit:

```
RP/0/RSP0/CPU0:router(config)# hw-module all qos-mode per-priority-buffer-limit
RP/0/RSP0/CPU0:router(config)# commit
```

hw-module all qos-mode wred-buffer-mode

To enable buffer accounting mode on all line cards (LCs), use the **hw-module all qos-mode wred-buffer-mode** command in the admin configuration mode. If you are running on Cisco IOS XR 64 bit, then use the same command in XR config mode. To disable buffer accounting mode on all LCs, use the **no** form of this command.

hw-module all qos-mode wred-buffer-mode
no hw-module all qos-mode wred-buffer-mode

Syntax Description

This command has no keywords or arguments.

Command Default

No default behavior or values.

Command Modes

Admin configuration mode - Cisco IOS XR

XR config mode - Cisco IOS XR 64 bit

Command History

Release	Modification
Release 6.1.2	Support for Cisco IOS XR 64 bit bit was added.
Release 5.1.1	This command was introduced.

Usage Guidelines

This command is available only on the ASR 9000 Enhanced Ethernet Line Card.

You must reload LCs for configuration changes to take effect.

Task ID

Task ID	Operation
root-lr	read, write

This example shows how to enable buffer accounting mode on all LCs:

```
RP/0/RSP0/CPU0:router(admin-config)# hw-module all qos-mode wred-buffer-mode
RP/0/RSP0/CPU0:router(admin-config)# commit
```

This example shows how to enable buffer accounting mode on all line cards running on Cisco IOS XR 64 bit:

```
RP/0/RSP0/CPU0:router(config)# hw-module all qos-mode wred-buffer-mode
RP/0/RSP0/CPU0:router(config)# commit
```

hw-module location qos-mode lowburst-enabled

To enable lowburst mode on specific line card, use the **hw-module location qos-mode lowburst-enabled** command in the admin configuration mode. If you are running on Cisco IOS XR 64 bit, then use the same command in XR config mode. To disable lowburst mode on specific line card, use the **no** form of this command.

Note Lowburst mode is not required on Cisco ASR 9000 4th generation QSFP 28-based Dense 100GE line cards.

hw-module location *node-id* **qos-mode lowburst-enabled**
no hw-module location *node-id* **qos-mode lowburst-enabled**

Syntax Description

location *node-id*	Specifies location of a particular node. The *node-id* argument is entered in the rack/slot/module notation.

Command Default

No default behavior or values.

Command Modes

Admin configuration mode - Cisco IOS XR

XR config mode - Cisco IOS XR 64 bit

Command History

Release	Modification
Release 6.1.2	Support for Cisco IOS XR 64 bit bit was added.
Release 5.1.1	This command was introduced.

Usage Guidelines

This command is available only on the ASR 9000 Enhanced Ethernet Line Card.

You must reload LCs for configuration changes to take effect.

Task ID

Task ID	Operation
qos	read, write
root-lr	read, write

Example

This example shows how to enable lowburst on a line card:

```
RP/0/RSP0/CPU0:router(admin-config)# hw-module location 0/1/CPU0 qos-mode lowburst-enabled
RP/0/RSP0/CPU0:router(admin-config)# commit
```

This example shows how to enable lowburst on a line card running on Cisco IOS XR 64 bit:

```
RP/0/RSP0/CPU0:router(config)# hw-module location 0/0/0 qos-mode lowburst-enabled
RP/0/RSP0/CPU0:router(config)# commit
```

hw-module location qos-child-shaping-disabled

To disable QoS mode child level or flat policy shaping on the line card interfaces, use the **hw-module location qos-child-shaping-disabled** command in the admin configuration mode. If you are running on Cisco IOS XR 64 bit, then use the same command in XR config mode.

hw-module location *node-id* **qos-child-shaping-disabled**

Syntax Description

location	*node-id*	Specifies location of a particular node. The *node-id* argument is entered in the rack/slot/module notation.

Command Default

No default behavior or values.

Command Modes

Admin configuration mode - Cisco IOS XR

XR config mode - Cisco IOS XR 64 bit

Command History

Release	Modification
Release 6.1.2	Support for Cisco IOS XR 64 bit bit was added.
Release 5.1.1	This command was introduced.

Usage Guidelines

This command is available only on the ASR 9000 Enhanced Ethernet Line Card.

You must reload LCs for configuration changes to take effect.

Task ID

Task ID	Operation
qos	read, write
root-lr	read, write

Example

This example shows how to disable qos child shaping on a line card:

```
RP/0/RSP0/CPU0:router(admin-config)# hw-module location 0/1/CPU0 qos-child-shaping-disabled

RP/0/RSP0/CPU0:router(admin-config)# commit
```

This example shows how to disable qos child shaping on a line card running on Cisco IOS XR 64 bit:

```
RP/0/RSP0/CPU0:router(config)# hw-module location 0/0/0 qos-child-shaping-disabled
```

```
RP/0/RSP0/CPU0:router(config)# commit
```

queue-limit

To specify or modify the maximum number of packets the queue can hold for a class policy configured in a policy map, 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*]
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.

Command Default

100 milliseconds: maximum threshold for tail drop

10 milliseconds: maximum threshold for high-priority queues

Maximum threshold units are in packets.

Note The default queue limit is 100 ms of the “service rate” for a given queue class.

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.
Release 7.11.1	Changed the minimum value for 1 Gbps and 10 Gbps interfaces to 10 KB and 400 KB for 400 Gbps interfaces.

Usage Guidelines

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 an output queue is full, until congestion is eliminated.

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

From Release 7.11.1, you can configure a minimum queue limit value of:

- 10 KB for 1 Gbps and 100 Gbps interfaces
- 400 KB for 400 Gbps interfaces.

See Chapter *Configuring Modular QoS Congestion Avoidance*, Section *Low Queue Limit and WRED Values for Low Access Speeds* in the *Modular QoS Configuration Guide for Cisco ASR 9000 Series Routers* for details.

Queue Limit Default Values

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

- If QoS is not configured:
  - The queue limit is 100 ms at the interface rate.
- If QoS is configured and Weighted Random Early Detection (WRED) is not configured:
  - Queue limit is 100 ms at the guaranteed service rate of the queue for non-priority queues.
  - Queue limit is 100 ms at the interface rate for Level 1 priority classes.
  - Queue limit is 100 ms at parent guaranteed service rate for Level 2 priority classes.
- If QoS is configured and WRED is configured:
  - Queue limit is two times the WRED maximum threshold. The maximum threshold can be an explicitly configured value or an implicit 100 ms.
  - If more than one WRED profile is configured in the class, the maximum threshold is the maximum for all profiles.
  - When the **queue-limit** is configured in time units, the guaranteed service rate is used to compute the queue limit.

These restrictions apply to queue limits:

- Queue limit should be at least the maximum MTU size, which is 9 * 1024 bytes = 9kb.
- Queue limit cannot exceed 1 GB, which is the maximum packet buffer size in ingress and egress queuing ASICs.
- Only time-based units are allowed on bundle targets.

Guaranteed Service Rate

The guaranteed service rate is defined as the service rate of the queue when all queues are backlogged and derived as:

minimum_bandwidth + (bandwidth_remaining_percent * unallocated_bandwidth)

This example shows the guaranteed service rate calculation:

```
policy-map sample_policy
  class c1
```

```
    bandwidth percent 30
    bandwidth remaining percent 40
  class c2
    bandwidth percent 20
  class class-default
```

guaranteed service rate of c1 = 30 percent LR + (40 percent * 50 percent * LR)

guaranteed service rate of c2 = 20 percent LR + (30 percent * 50 percent * LR)

guaranteed service rate of class-default = 30 percent * 50 percent * LR

- Where LR is line rate of the target on which service policy "sample_policy" is attached.
- 50 percent is unallocated bandwidth.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows how to set the queue limit for a class to 1000000 packets for policy map policy1:

```
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# queue-limit 1000000
```

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 {**cos** *value* | **default** | **dei** *value* | **discard-class** *value* | **dscp** *value* | **exp** *value* | **precedence** *value* | *min-threshold* [*units*] *max-threshold* [*units*]*probability*}
no random-detect [{**cos** *value* | **default** | **dei** *value* | **discard-class** *value* | **dscp** *value* | **exp** *value* | **precedence** *value* | *min-threshold* [*units*] *max-threshold* [*units*]}]

Syntax Description

cos *value*	COS-based WRED.
default	Enables RED with default minimum and maximum thresholds.
dei *value*	Discard-eligibility indicator based WRED. Can be 0 or 1.
discard-class *value*	Discard-class based WRED.
dscp *value*	DSCP-based WRED.
exp *value*	MPLS Experimental-based WRED.
precedence *value*	Precedence-based WRED. Values can be: • 0 or routine • 1 or priority • 2 or immediate • 3 or flash • 4 or flash-override • 5 or critical • 6 or internet • 7 or network
min-threshold	Minimum threshold in number of packets. The value range of this argument is from 0 to 1073741823 in bytes.
max-threshold	Maximum threshold the units specified. The value range of this argument is from the value of the *min-threshold* argument or 23, whichever is larger, to 1073741823. When the queue length exceeds the maximum threshold, RED drops all packets with the specified discard class value.
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	Probability value.

Command Default

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

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.
Release 4.0.0	The **dei** keyword was added.
Release 7.11.1	Changed the minimum value for 1 Gbps and 10 Gbps interfaces to 5 KB and 100 KB for 400 Gbps interfaces.

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.

The default value for RED is calculated as follows:

B = 1/2 default max-threshold, based on 100 ms

where B is the bandwidth for the queue. When all the queues are congested, the bandwidth for the queue is equal to the guaranteed service rate of the queue.

The mark probability is always set to 1.

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

Weighted Random Early Detection

The following restrictions apply to Weighted Random Early Detection (WRED):

- For thresholds in time units, the guaranteed service rate is used to calculate the thresholds in bytes.
- Default RED minimum threshold—50 ms at the guaranteed service rate.
- Default RED maximum threshold—100 ms as the guaranteed service rate.

From Release 7.11.1, you can configure a minimum WRED value of 5 KB on 1 Gbps and 10 Gbps interfaces, and 100 KB for 400 Gbps interfaces. See Chapter *Configuring Modular QoS Congestion Avoidance*, Section *Low Queue Limit and WRED Values for Low Access Speeds* in the *Modular QoS Configuration Guide for Cisco ASR 9000 Series Routers* for details.

For bundles, queue limit and WRED thresholds are supported in time units only.

Note RED is enabled when you configure any of the supported **random-detect** commands.

Random early detection based on the DEI value is supported on 802.1ad packets for:

- Ingress and egress
- Layer 2 subinterfaces
- Layer 2 main interfaces
- Layer 3 main interfaces

Note If there are any marking actions in the policy, the marked values are used for doing WRED.

Note The exponential weight factor is set to 0 for Cisco ASR 9000 series routers.

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/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# random-detect 1000000 2000000
```

In this example, congestion is managed by dropping packets with a DEI value of 1 before dropping packets with a DEI value of 0.

```
RP/0/RSP0/CPU0:router(config)# policy-map dei-sample
RP/0/RSP0/CPU0:router(config-pmap)# class class-default
RP/0/RSP0/CPU0:router(config-pmap-c)# random-detect dei 1 1000 6000
RP/0/RSP0/CPU0:router(config-pmap-c)# random-detect dei 0 5000 10000
RP/0/RSP0/CPU0:router(config-pmap-c)# end-policy-map
```

Related Commands

Command	Description
random-detect precedence, on page 35	Configures the Weighted Random Early Detection (WRED) thresholds for packets with a particular IP precedence.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.

random-detect cos

To configure Weighted Random Early Detection (WRED) thresholds for packets with a specific class of service (CoS) value, use the **random-detect cos** command in policy map class configuration mode. To return the thresholds to the default for the CoS, use the **no** form of this command.

random-detect cos *cos-value* *min-threshold* [*units*] *max-threshold* [*units*]
no random-detect cos *cos-value* *min-threshold* [*units*] *max-threshold* [*units*]

Syntax Description

cos-value	CoS value. Valid values are from 0 to 7. Up to eight values can be entered separated by commas.
min-threshold	Minimum threshold in number of packets. The value range of this argument is from 0 to 1073741823 in bytes.
max-threshold	Maximum threshold in number of packets. The value range of this argument is from the value of the *min-threshold* argument to 1073741823.
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

Command Default

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

min-threshold: 30 ms

max-threshold: 100 ms

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.

Usage Guidelines

The **random-detect cos** command is allowed in a service policy attached to a Layer 2 VPN attachment circuit or physical Ethernet interface only. (The command in invalid in a policy attached to a Layer 3 interface.)

Note Only time-based units are allowed on bundle targets.

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 configure CoS:

```
RP/0/RSP0/CPU0:router(config)# policy-map map1
RP/0/RSP0/CPU0:router(config-pmap)# class c
RP/0/RSP0/CPU0:router(config-pmap-c)# random-detect cos 3 1000 bytes 2000 bytes
```

random-detect dscp

To configure the Weighted Random Early Detection (WRED) thresholds for packets with a specific differentiated services code point (DSCP) value, use the **random-detect dscp** command in policy map class configuration mode. To return the thresholds to the default for the DSCP value, use the **no** form of this command.

random-detect dscp *dscp-value* *min-threshold* [*units*] *max-threshold* [*units*]
no random-detect dscp *dscp-value* *min-threshold* [*units*] *max-threshold* [*units*]

Syntax Description

dscp-value	DSCP value. Up to eight *dscp-values* (any combination of numbers, ranges, and reserved keywords) can be used separated by commas. The following arguments are supported: • Number from 0 to 63 that sets the DSCP value. • Range of DSCP values. Range is from 0 to 63. • Reserved keywords can be specified instead of numeric values. Table 1 describes the reserved keywords.
min-threshold	Minimum threshold in number of packets. The value range of this argument is from 0 to 1073741823. When the average queue length reaches the minimum threshold, WRED randomly drops some packets with the specified DSCP value.
max-threshold	Maximum threshold in number of packets. The value range of this argument is from the value of the *min-threshold* argument to 1073741823. When the average queue length exceeds the maximum threshold, WRED drops all packets with the specified DSCP value.
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

Command Default

Match packets with default DSCP (000000).

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

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. WRED is most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

Reserved keywords can be specified instead of numeric values. See Table 1 for the list of keywords.

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 that for packets with DSCP AF11, the WRED minimum threshold is 1,000,000 bytes and the maximum threshold is 2,000,000 bytes:

```
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# random-detect dscp AF11 1000000 2000000
```

Related Commands

Command	Description
class (policy-map)	Specifies the name of the class whose policy you want to create or change.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
random-detect precedence, on page 35	Configures the Weighted Random Early Detection (WRED) thresholds for packets with a particular IP precedence.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.

random-detect exp

To configure the Weighted Random Early Detection (WRED) thresholds for packets marked with a specific MPLS experimental (EXP) bit value, use the **random-detect exp** command in policy map class configuration mode. To return the value to the default, use the **no** form of this command.

random-detect exp *exp-value* *min-threshold* [*units*] *max-threshold* [*units*]
no random-detect exp *exp-value* *min-threshold* [*units*] *max-threshold* [*units*]

Syntax Description

exp-value	MPLS experimental value. Valid values are from 0 to 7. Up to eight values can be entered separated by commas.
min-threshold	Minimum threshold in number of packets. The value range of this argument is from 0 to 1073741823 in bytes.
max-threshold	Maximum threshold in units specified. The value range of this argument is from the value of the *min-threshold* argument to 1073741823. When the average queue length exceeds the maximum threshold, WRED drops all packets with the specified experimental value.
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

Command Default

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

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. WRED is most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

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 that for Multiprotocol Label Switching (MPLS) packets with an EXP field value of 4, the WRED minimum threshold is 1,000,000 bytes and the maximum threshold is 2,000,000 bytes:

```
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# random-detect exp 4 1000000 20000
```

Related Commands

Command	Description
class (policy-map)	Specifies the name of the class whose policy you want to create or change.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
random-detect dscp, on page 31	Configures the Weighted Random Early Detection (WRED) thresholds for packets with a specific differentiated services code point (DSCP) value.
random-detect precedence, on page 35	Configures the Weighted Random Early Detection (WRED) thresholds for packets with a particular IP precedence.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.

random-detect precedence

To configure the Weighted Random Early Detection (WRED) thresholds for packets with a particular IP precedence, use the **random-detect precedence** command in policy map class configuration mode. To return the thresholds to the default for the precedence, use the **no** form of this command.

random-detect precedence *precedence-value min-threshold* [*units*] *max-threshold* [*units*]
no random-detect precedence *precedence-value min-threshold* [*units*] *max-threshold* [*units*]

Syntax Description

precedence-value	An IP precedence value identifier that specifies the exact value. Range is from 0 to 7. Reserved keywords can be specified instead of numeric values. Table 1 describes the reserved keywords. Up to eight values or reserved keywords can be entered separated by commas.
min-threshold	Minimum threshold in number of packets. Range is from 0 to 1073741823 in bytes.
max-threshold	Maximum threshold in the units specified. Range is from the value of the *min-threshold* argument to 1073741823. When the average queue length exceeds the maximum threshold, WRED drops all packets with the specified precedence value.
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

Command Default

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

Command Modes

Policy map class configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. WRED is most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

When you configure the **random-detect** command on an interface, packets are given preferential treatment based on the IP precedence of the packet. Use the **random-detect precedence** command to adjust the treatment for different precedences.

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 that for packets with precedence 3, the WRED minimum threshold is 1,000,000 bytes and maximum threshold is 2,000,000 bytes:

```
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)#random-detect precedence 3 1000000 2000000
```

Related Commands

Command	Description
bandwidth (QoS), on page 3	Specifies the minimum bandwidth allocated to a class belonging to a policy map.
class (policy-map)	Specifies the name of the class whose policy you want to create or change.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
random-detect dscp, on page 31	Configures the Weighted Random Early Detection (WRED) thresholds for packets with a specific differentiated services code point (DSCP) value.
show policy-map interface	Displays policy configuration information for all classes configured for all service policies on the specified interface.

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 3.7.2	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 these restrictions:

- The **priority** command can be used only in the child policy.
- If the **bandwidth** command is used in the child policy, the **bandwidth** command must also be used in the parent policy. The one exception is for policies using the default class.

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/RSP0/CPU0:router(config)# policy-map child
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# priority
```

```
RP/0/RSP0/CPU0:router(config-pmap-c)# exit
RP/0/RSP0/CPU0:router(config-pmap)# exit
RP/0/RSP0/CPU0:router(config)# policy-map parent
RP/0/RSP0/CPU0:router(config-pmap)# class class-default
RP/0/RSP0/CPU0:router(config-pmap-c)# shape average 10000000
RP/0/RSP0/CPU0:router(config-pmap-c)# service-policy child
```

Related Commands

Command	Description
bandwidth (QoS), on page 3	Specifies the minimum bandwidth allocated to a class belonging to a policy map.
class-map	Defines a traffic class and the associated rules that match packets to the class.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
priority (QoS)	Assigns a priority to a class of traffic belonging to a policy map.
service-policy (interface), on page 39	Attaches a policy map to an input interface or output interface to be used as the service policy for that interface.

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, and optionally multiple subinterfaces, 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* [**shared-policy-instance** *instance-name*]

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.
shared-policy-instance	(Optional) Allows sharing of QoS resources across multiple subinterfaces. **Note** Sharing across multiple physical interfaces is not supported.
instance-name	(Optional) String of up to 32 characters to identify the shared policy instance.

Command Default

No service policy is specified.

Command Modes

Interface configuration. This does not apply to BNG.

Layer 2 transport configuration. This does not apply to BNG.

Subinterface configuration. This does not apply to BNG.

Dynamic template configuration

Command History

Release	Modification
Release 3.7.2	This command was introduced.
Release 3.9.0	This command was updated to support shared policy instance over bundle interfaces.
Release 4.3.0	The command was supported in dynamic template configuration mode in BNG.

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.

To enter the dynamic template configuration mode, run **dynamic-template** command in the Global Configuration mode.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows policy map policy1 applied to Packet-over-SONET/SDH (POS) interface 0/2/0/0:

```
RP/0/RSP0/CPU0:router(config)# class-map class1
RP/0/RSP0/CPU0:router(config-cmap)# match precedence ipv4 1
RP/0/RSP0/CPU0:router(config-cmap)# exit
RP/0/RSP0/CPU0:router(config)# policy-map policy1
RP/0/RSP0/CPU0:router(config-pmap)# class class1
RP/0/RSP0/CPU0:router(config-pmap-c)# set precedence 2
RP/0/RSP0/CPU0:router(config-pmap)# exit
RP/0/RSP0/CPU0:router(config)# interface POS 0/2/0/0
RP/0/RSP0/CPU0:router(config-if)# service-policy output policy1
```

This example shows policy map policy2 applied to GigabitEthernet subinterface 0/1/0/0.1.

```
RP/0/RSP0/CPU0:router(config)# class-map class2
RP/0/RSP0/CPU0:router(config-cmap)# exit

RP/0/RSP0/CPU0:router(config)# policy-map policy2
RP/0/RSP0/CPU0:router(config-pmap)# class-map class2
RP/0/RSP0/CPU0:router(config-pmap-c)# set precedence 3
RP/0/RSP0/CPU0:router(config-pmap)# exit

RP/0/RSP0/CPU0:router(config)# interface gigabitethernet 0/1/0/0.1
RP/0/RSP0/CPU0:router(config-subif)# service-policy input policy2 shared-policy-instance
ethernet101
```

Note This example does not apply to BNG.

This example shows policy map policy 1 applied to Bundle-Ether interfaces 100.1 and 100.2

```
RP/0/RSP0/CPU0:router(config)# interface Bundle-Ether 100.1
RP/0/RSP0/CPU0:router(config-if)# service-policy policy1 shared-policy-instance subscriber1
RP/0/RSP0/CPU0:router(config-if)# exit

RP/0/RSP0/CPU0:router(config)# interface Bundle-Ether 100.2
RP/0/RSP0/CPU0:router(config-if)# service-policy output policy1 shared-policy-instance
subscriber1
```

.

Note This example does not apply to BNG.

This example is specific to BNG. It shows policy map policy 1 applied in the dynamic template configuration mode.

```
RP/0/RSP0/CPU0:router(config)#dynamic-template type ppp p1
RP/0/RSP0/CPU0:router(config-dynamic-template-type)#service-policy policy1
shared-policy-instance subscriber1
RP/0/RSP0/CPU0:router(config-dynamic-template-type)#exit

RP/0/RSP0/CPU0:router(config)# dynamic-template type ipsubscriber ipsub1
RP/0/RSP0/CPU0:router(config-dynamic-template-type)# service-policy output policy1
shared-policy-instance subscriber1
```

service-policy (VLAN)

To enable the QoS policy on a parent S-VLAN, or to enable ingress and egress VLAN policies on an access-interface, use the **service-policy** command in the interface configuration mode. To disable this feature, use the **no** form of this command.

Egress S-VLAN Policy:
service-policy output *service_policy_name* **subscriber-parent** [**subscriber-group** *group-name*] [**resource-id** *value*]

Ingress and Egress VLAN Policies:
service-policy { **input** | **output** } *service_policy_name*

Syntax Description

input	Attaches the specified service-policy to the ingress direction.
output	Attaches the specified service-policy to the egress direction.
service_policy_name	Name of the input or output service-policy.
subscriber-parent	Configures an S-VLAN policy. **Note** This keyword applies only to the egress direction.
subscriber-group	Groups subscribers and attaches them to an aggregate shaper based on a logical Group-ID.
group-name	Name of the logical group for the subscribers.
resource-id	Specifies a resource-ID that allows to map the desired chunk to be used for this particular S-VLAN and all the subscribers under it. **Note** This keyword applies only to an S-VLAN policy and not to VLAN policy. Policies with **subscriber-group** do not support **resource-id**.
value	The resource-ID value that ranges from 0-3.

Command Default

None

Command Modes

Interface configuration

Command History

Release	Modification
Release 4.2.0	This command was introduced.

Release	Modification
Release 4.3.0	Support for the **resource-id** keyword was added.
Release 4.3.1	Support for the ingress and egress VLAN policies on an access interface was added.
Release 6.2.1	Support was added for **subscriber-group** keyword.

Usage Guidelines

If the **resource-id** option is not specified, then the S-VLAN policy and all the subscribers under it are assigned to the default chunk to which its parent interface is associated with.

The VLAN policy needs to be attached to the access-interfaces before bringing up the sessions with the QoS policy. It is recommended that you do not remove VLAN policies when sessions are already active.

You cannot make non-rate modifications when sessions are already active on the access-interface. To make non-rate modifications to the VLAN policy, you must bring down the sessions that are brought up over the access-interface, modify the policy, and then bring up the sessions again over the access-interface.

For restrictions on the usage of group-based grand parent shaping feature (using **subscriber-group**), see *Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*.

Task ID

Task ID	Operation
qos	read, write

This example shows how to configure an egress S-VLAN policy using the **service-policy** command, with **subscriber-parent** keyword, in the interface configuration mode:

```
RP/0/RSP0/CPU0:router# configure
RP/0/RSP0/CPU0:router(config)# interface bundle-ether 18.12
RP/0/RSP0/CPU0:router(config-subif)# service-policy output svlan-policy subscriber-parent
resource-id 1
```

This example shows how to configure an ingress VLAN policy on an access-interface:

```
RP/0/RSP0/CPU0:router# configure
RP/0/RSP0/CPU0:router(config)# interface bundle-ether 18.203
RP/0/RSP0/CPU0:router(config-subif)# service-policy input mark
```

This example shows how to configure an egress VLAN policy on an access-interface:

```
RP/0/RSP0/CPU0:router# configure
RP/0/RSP0/CPU0:router(config)# interface bundle-ether 18.203
RP/0/RSP0/CPU0:router(config-subif)# service-policy output metering
```

This example shows how to enable group-based grand parent shaping feature by grouping subscribers and attaching them to an aggregate shaper based on a logical Group-ID:

```
RP/0/RSP0/CPU0:router#configure
```

```
RP/0/RSP0/CPU0:router(config)#interface Bundle-Ether1.1234
RP/0/RSP0/CPU0:router(config-if)#encapsulation ambiguous dot1q 1-4
RP/0/RSP0/CPU0:router(config-if)#service-policy output P0 subscriber-parent subscriber-group
 G0
RP/0/RSP0/CPU0:router(config-if)#service-policy output P1 subscriber-parent subscriber-group
 G1
RP/0/RSP0/CPU0:router(config-if)#service-policy output P2 subscriber-parent subscriber-group
 G2
RP/0/RSP0/CPU0:router(config-if)#service-policy output P3 subscriber-parent subscriber-group
 G3
```

show qos summary

To view the QoS summary, use the **show qos summary** command in EXEC mode.

show qos summary {**shared-policy-instance** *instance-name* **location** *node-id* | **police** {**interface** *type instance* | **location** *node-location*} | **policy** *policy-name* {**interface** *type instance* | **location** *node-location*} | **queue** {**interface** *type instance* | **location** *node-location*}} {**input** | **output**} [**member** *type instance*] [**host-link** *type instance*] [**location** *node-location*][**np** *np-location*]

Syntax Description

shared-policy-instance *instance-name*	String of up to 32 characters to identify the shared policy instance.
police	Show policer interface statistics.
policy *policy-name*	String to identify the policy.
queue	Show queue statistics.
interface *type instance*	Interface type and instance. For more information, use the question mark (?) online help function .
location *node-location*	Identifies fully qualified location specification.
input	Shows the specified policy map to the input interface.
output	Shows the specified policy map to the output interface.
np *np-location*	(Optional) Node processor location. The node processor location is np0, np1, np2, or np3. The **np** keyword is available only for **BVI** interface type.
member	Specifies member's interface name. The **member** keyword is available only for **bundle-ether**, **PW-Ether** and **PW-IW** interface types.
host-link	(Optional) Specifies the host-link. This keyword is applicable only for satellite interfaces.

Command Default

None

Command Modes

EXEC mode

Command History

Release	Modification
Release 3.7.2	This command was introduced.
Release 4.3.0	The command was supported in dynamic template configuration mode in BNG. The **np** keyword was introduced.

Release	Modification
Release 5.1.1	PWHE interface type **PW-Ether** and **PW-IW** were added.

Usage Guidelines

To enter the dynamic template configuration mode, run **dynamic-template** command in the Global Configuration mode.

Task ID

Task ID	Operations
qos	read, write

Examples

This example shows the results of the command to show interfaces at location 0/1/CPU0 for a shared-policy-instance:

```
RP/0/RSP0/CPU0:router# show qos summary shared-policy-instance bundlespi location 0/1/CPU0
 output

List of interfaces/NPs retrieved
GigabitEthernet0/1/1/1 (member of Bundle-Ether1.1)
GigabitEthernet0/1/1/2 (member of Bundle-Ether1.1)
```

This example shows policer interface statistics of BVI interface at location 0/5/cpu0:

```
RP/0/RSP0/CPU0:router# show qos summary police interface bvi 1 output location 0/5/cpu0 np
 np1

Legend:
=======
1. Policer ID is displayed in HEX.
2. A '*' against the counter means the action is drop.
3. Conform displays match counter for non-policer leaf.

Policy:Class                        PoliceID     Conform      Exceed     Violate
BVI1 NP1
foo
:dscp48                            6145               0           0*          0*
foo
:class-default                     6146               0           0*          0*
```

show qoshal qos-mode

To display QoS mode information, use the **show qoshal qos-mode** command in EXEC mode.

show qoshal qos-mode location *node-id*

Syntax Description

location *node-id*	Specifies location of a particular node. The *node-id* argument is entered in the rack/slot/module notation.

Command Default

No default behavior or values.

Command Modes

EXEC mode

Command History

Release	Modification
Release 5.1.1	This command was introduced.

Usage Guidelines

No specific guidelines impact the use of this command.

Task ID

Task ID	Operation
qos	read

The following example shows how to display QoS mode information at location 0/1/CPU0:

```
RP/0/RSP0/CPU0:router# show qoshal qos-mode location 0/1/CPU0
L4 WRED buffer mode:Disable
Per priority buffer limit:Disable
MOD-80 4*10 Ingress queue:Disable
```