

Layer 3 subinterface queuing

This document provides detailed understanding about Layer 3 subinterface queuing and its configuration.

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Feature history for Layer 3 Subinterface Queuing

This table provides release and platform support information for the features explained in this module.

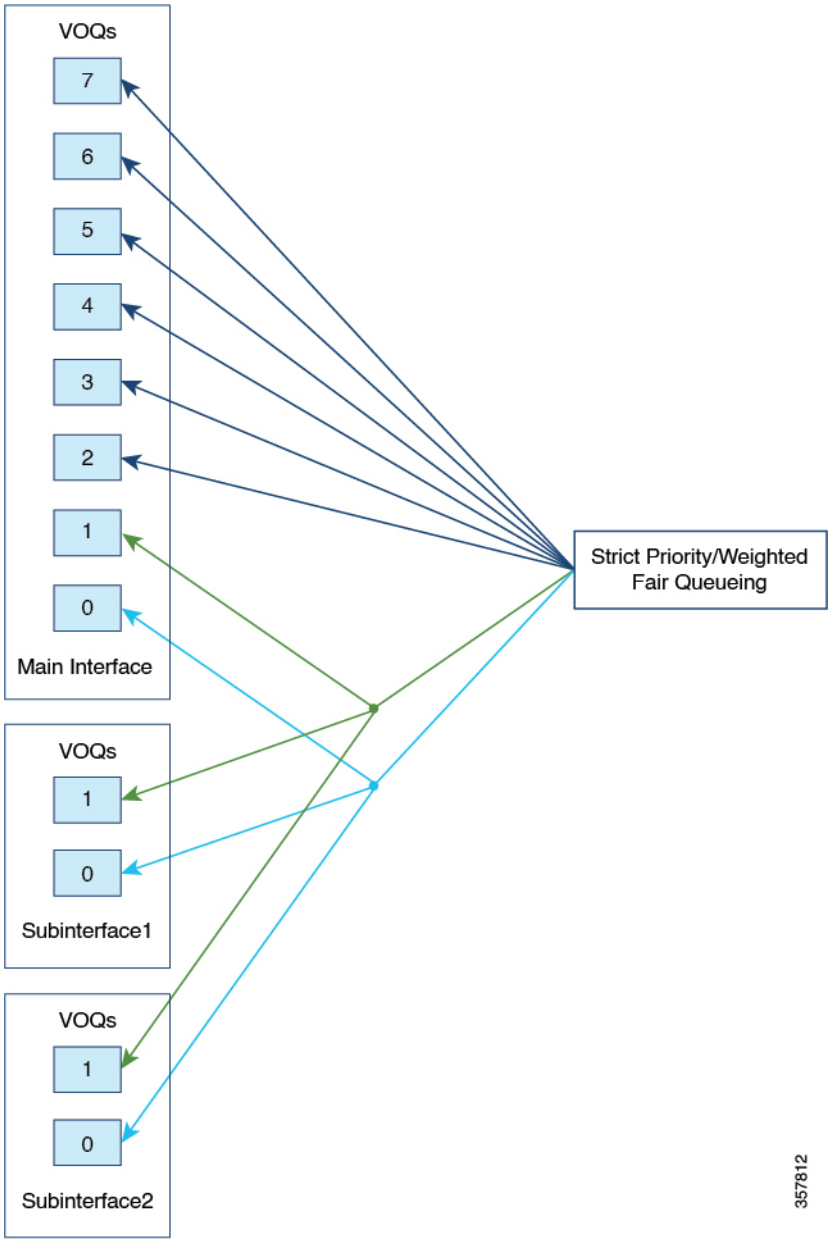
These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature name and description	Supported platform
Cisco IOS XE 17.18.1	Layer 3 Subinterface Queuing: Queuing support on Layer 3 subinterfaces.	Cisco C9350 Series Smart Switches

Default queuing mode

In default queuing mode, the main interface queue configuration has absolute priority control over the subinterface queues. The main interface has eight queues (7 to 0 in order) by default, which can be configured using [pP(8-p)Q, where p=1 to 7, P=priority, and Q=queue] combination. A subinterface has two queues (Q1 and Q0) that map to or share the priority level with the queues (Q1 and Q0) of the main interface. Therefore, these subinterface queues are lower in priority when compared to the main interface queues, based on the policy applied on the main interface.

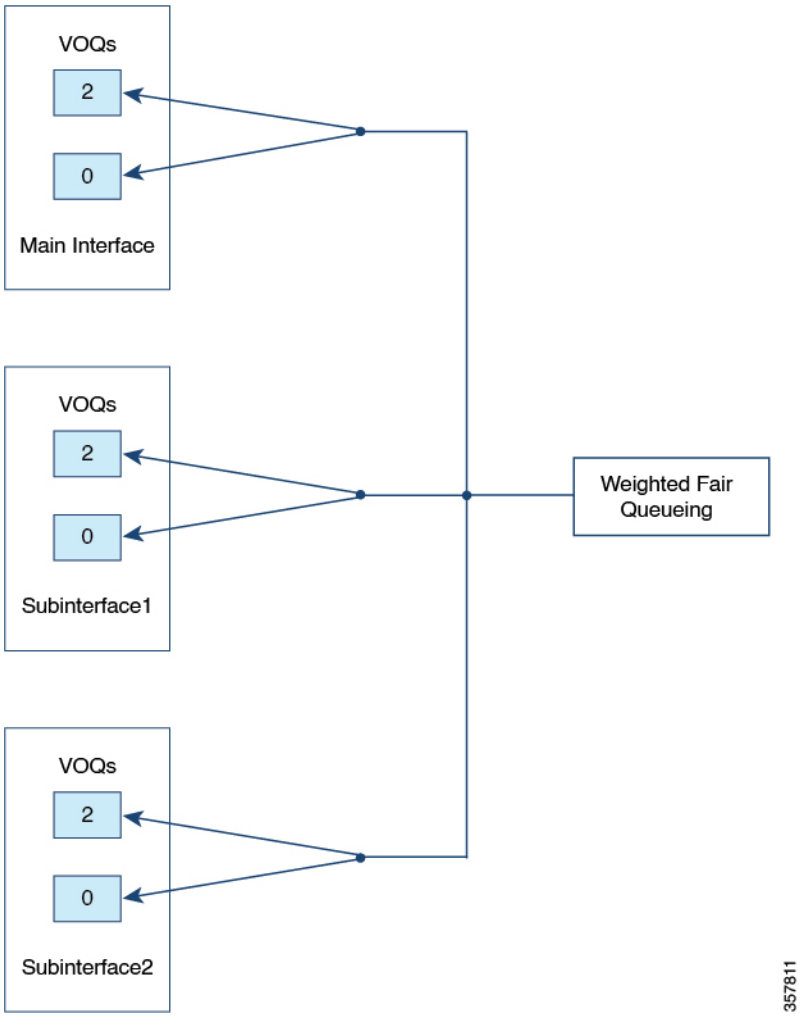
Figure 1: Default queuing mode



Subinterface propagation queuing mode

In this mode, the main interface queues are treated and configured just as any other subinterface queue, and all the behavior and restrictions of the subinterface queues are applicable to the main interface queue as well. A queue of the same priority level across the main interface and subinterfaces contend for bandwidth or priority at the same level. Further, in this mode a user can configure bandwidth distribution ratio between the main interface and subinterfaces. A user cannot change the mode of the main interface when queuing policy is applied on the main interface.

Figure 2: Subinterface propagation queuing mode



Hierarchical QoS

Hierarchical QoS (HQoS) manages network traffic by applying QoS policies at multiple levels to enhances bandwidth utilization, traffic prioritization, and overall network performance.

HQoS allows you to perform:

- Multiple levels of QoS management: HQoS manages QoS at three levels—physical interface, logical interface, and class level—enabling integrated queueing and shaping across these layers.
- Hierarchical classification: Traffic classification can be based on other classes, allowing combination of multiple classification criteria into a single class map.
- Hierarchical policing and shaping: Policing and shaping can be applied at multiple levels in the hierarchy, such as shaping at the parent level and policing at child levels.

- Integrated queueing hierarchy: HQoS supports forming an integrated queueing hierarchy on physical interfaces, which is useful in complex network architectures like Ethernet DSL access networks.
- Benefits: Fast deployment of QoS in large-scale networks; consistent behavior across Cisco platforms; support for multiple scheduling levels; ability to apply fair queuing and drop policies per class.

HQoS configuration options

HQoS configuration options include:

- Port shaper: Port shaper is used to limit or shape the overall transmission rate for a given port (main or subinterface). Port shaper is supported through a HQoS queuing policy on the main interface and subinterfaces with the shaper configured on the parent policy.
- Main interface: Port shaper applied on the main interface is applicable to all subinterfaces.
- Subinterface: Port shaper is applied only to the subinterface on which the port shaper policy is applied.
- Port bandwidth distribution ratio among subinterfaces: Port bandwidth remaining ratio is used to govern or configure the bandwidth distribution ratio between subinterfaces. Port bandwidth remaining ratio is supported with the bandwidth remaining ratio command that is configured on the parent policy applied on the subinterface.

  Port bandwidth remaining ratio is also supported between the main interface and subinterface when subinterface priority propagation mode is enabled. A maximum of seven ratio values are supported for bandwidth distribution across subinterfaces.



Note

- Hierarchical queueing features are supported only on egress; service policies with queueing cannot coexist simultaneously on child and parent interfaces.
- Hierarchical shaping supports only the port shaper. The parent configuration includes only the class default, and shaping is the sole default action.
- The value of a port shaper set on the main interface is the maximum allowed value on subinterfaces even if a higher port shaper value is defined on the subinterfaces.

Limitations for Layer 3 subinterface queuing

- Subinterface queuing is supported only on Layer 3 subinterfaces.
- Queuing policy is not supported on port channels or subinterfaces of port channels.
- Subinterface queuing supports a maximum of two queues—priority traffic class (class 7) and nonpriority traffic class (class default).
- Subinterface queuing is not supported for multicast traffic.
- Queued traffic on subinterfaces cannot be re-marked on the main interface using the re-mark policy.

- Hierarchical queuing is supported on the subinterface with this restriction—the parent policy can contain only class-default, which can have shape or bandwidth remaining ratio or both shape and bandwidth remaining ratio.
- Shaping is only supported in:
  - Priority traffic class for child or non-HQoS queuing policy.
  - Class-default for parent policy in HQoS policy.
- Bandwidth remaining ratio is not supported for queue policies with priority level defined.
- Bandwidth remaining ratio is only supported in the parent class of the HQoS queuing policy on subinterfaces.
- Traffic on all the subinterfaces without queuing policy applied, flows through the main interface queues, while traffic for the subinterfaces with queuing policy applied, flows through their respective queues.
- For direct, connected interfaces with defined IP addresses, traffic does not flow through subinterface queues but through the main interface queue. For indirect connected interfaces, traffic flows through subinterface queues.
- The **no switchport** command should be run to configure layer 3 subinterfaces.
- If a policy is applied on any of the subinterfaces, you cannot apply or remove a policy on the main interface without removing the policy on the subinterface. You can only modify the policy on the main interface.
- Queuing policy maps can be applied to a maximum of 400 Layer 3 subinterfaces.
- When HQoS is enabled on a subinterface, and the parent is configured with shape rate value (in percent), then the parent shape rate value is calculated using the main interface physical bandwidth as the reference bandwidth.
- When queuing policy is enabled on a subinterface, the subinterface queuing packet drop statistics are not reflected in the total packet drop statistics at the main interface level.

Enabling subinterface queuing policy

This procedure describes how to enable subinterface queuing policy.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**class-map** {**match-any** | **match-all**} {*class name*} **Example:** `Device(config)# class-map match-all traffic-class7`	Enters class map configuration mode, and creates a class map to be used for matching packets to the class whose name you specify. • **match-any**: At least one of the match criteria must be met for traffic entering the traffic class to be classified as being a part of the traffic class. • **match-all**: All of the match criteria must be met for traffic entering the traffic class to be classified as part of the traffic class. **Note** **match-all** is the default. If **match-any** or **match-all** is not explicitly defined, **match-all** is chosen by default.
Step 4	**match traffic-class** *traffic class value* **Example:** `Device(config-cmap)# match traffic-class 7`	Matches QoS traffic class value (from 1 to 7). **Note** Only traffic class 7 is supported for queueing on subinterfaces. If it is not a subinterface queue, you can perform steps 3 and 4 to create class maps for all the traffic classes (7 to 1), and attach these to policy-map queues.
Step 5	**exit** **Example:** `Device(config-cmap)# exit`	Exits class map configuration mode and enters global configuration mode.
Step 6	**policy-map type queueing** *policy name* **Example:** `Device(config)# policy-map type queueing subif_q_policy`	Specifies the name of the main interface queueing profile policy and enters policy map configuration mode.
Step 7	**class** *class-name* **Example:** `Device(config-pmap)# class traffic-class7`	Specifies the name of the class to be associated with the policy and enters policy class map configuration mode. Command options for policy class map configuration mode include the following: • *word*: Class map name. • **class-default**: System default class matching otherwise unclassified packets, if any.

	Command or Action	Purpose
Step 8	**shape average** {*Kb/s* | **percent**} **Example:** `Device(config-pmap-c)# shape average percent 10`	Configures the traffic shaping average. The parameters include: • *Kb/s*: Use this argument to configure a specific value. The range is 1.2 Mbps to 400 Gbps. • **percent**: Allocates a maximum bandwidth to a particular class. The queue can oversubscribe bandwidth in case other queues do not utilize the entire port bandwidth. The total sum cannot exceed 100 percent, and in case it is less than 100 percent, the rest of the bandwidth is divided along all nonpriority queues based on the bandwidth remaining ratio.
Step 9	**priority level** *level* **Example:** `Device(config-pmap-c)# priority level 1`	Configures a multilevel priority queue.
Step 10	**exit** **Example:** `Device(config-pmap-c)# exit`	Exits policy class map configuration mode and enters class map configuration mode.
Step 11	**exit** **Example:** `Device(config-pmap)# exit`	Exits policy map configuration mode and enters global configuration mode.
Step 12	**interface** *interface-id* **Example:** `Device(config)# interface HundredGigE1/0/9`	Identifies the main interface and enters interface configuration mode.
Step 13	**no switchport** **Example:** `Device(config-if)# no switchport`	Switches the interface that is in Layer 2 mode into Layer 3 mode for Layer 3 configuration.
Step 14	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and enters global configuration mode.

	Command or Action	Purpose
Step 15	**interface** *interface-id.subinterface-id* **Example:** `Device(config)# interface HundredGigE1/0/9.1`	Identifies the subinterface and enters subinterface configuration mode.
Step 16	**encapsulation dot1Q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1Q 11`	Enables IEEE 802.1Q encapsulation of traffic on the subinterface.
Step 17	**service-policy type queueing output** *policy name* **Example:** `Device(config-subif)# service-policy type queueing output subif_q_policy`	Attaches two queue policy maps to the subinterface.
Step 18	**end** **Example:** `Device(config-subif)# end`	Returns to privileged EXEC mode.

Enabling subinterface priority propagation mode

This procedure describes how to enable subinterface priority propagation mode on the main interface.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:**	Identifies the main interface and enters interface configuration mode.

	Command or Action	Purpose
	`Device(config)# interface HundredGigE1/0/23`	
Step 4	**no switchport** **Example:** `Device(config-if)# no switchport`	Switches the main interface that is in Layer 2 mode to Layer 3 mode for Layer 3 configuration.
Step 5	**queuing mode sub-interface priority-propagation** **Example:** `Device(config-if)# queuing mode sub-interface priority-propagation`	Enables subinterface priority propagation mode. **Note** This mode can be enabled only when no policy is applied on the main interface.
Step 6	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

Configuring hierarchical QoS policy on a subinterface

This procedure describes how to configure HQoS policy on a subinterface.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**class-map match-all** {*classname*} **Example:** `Device(config)# class-map match-all traffic-class7`	Configures the class map to match all the criteria for traffic entering the traffic class, and enters class map configuration mode.

	Command or Action	Purpose
Step 4	**match traffic-class** *class value* **Example:** `Device(config-cmap)# match traffic-class 7`	Matches QoS traffic class value.
Step 5	**exit** **Example:** `Device(config-cmap)# exit`	Exits class map configuration mode and enters global configuration mode.
Step 6	**policy-map type queueing** *child policy name* **Example:** `Device(config)# policy-map type queueing child`	Specifies the child queueing profile policy and enters policy map configuration mode.
Step 7	**class** *class-name* **Example:** `Device(config-pmap)# class traffic-class7`	Specifies the name of the class to be associated with the policy and enters policy class map configuration mode. Command options for policy class map configuration mode include the following: • *word*: Class map name. • **class-default**: System default class matching any otherwise unclassified packets.
Step 8	**shape average** {*Kb/s* | **percent**} **Example:** `Device(config-pmap-c)# shape average 1000000`	Configures the traffic shaping average. The parameters include: • *Kb/s*: Use this command to configure a specific value. The range is 1.2 Mbps to 400 Gbps. • **percent**: Allocates a maximum bandwidth to a particular class.
Step 9	**priority level** *level* **Example:** `Device(config-pmap-c)# priority level 1`	Specifies the priority level of the queue.
Step 10	**exit** **Example:** `Device(config-pmap-c)# exit`	Exits policy class map configuration mode and enters class map configuration mode.

	Command or Action	Purpose
Step 11	**exit** **Example:** `Device(config-pmap)# exit`	Exits policy map configuration mode and enters global configuration mode.
Step 12	**policy-map type queueing** *parent policy name* **Example:** `Device(config)# policy-map type queueing parent`	Specifies the parent queueing profile policy and enters policy map configuration mode.
Step 13	**class class-default** **Example:** `Device(config-pmap)# class class-default`	Specifies the class default to be associated with the parent policy and enters policy class map configuration mode.
Step 14	**shape average** {*port shaper value*} {*Kb/s* | **percent**} **Example:** `Device(config-pmap-c)# shape average 2000000000`	Configures the traffic shaping average. **Note** The shaping average must be greater than 1.35G.
Step 15	**service-policy** *child policy-map name* **Example:** `Device(config-pmap-c)# service-policy child`	Configures the QoS service policy of a child.
Step 16	**exit** **Example:** `Device(config-pmap-c)# exit`	Exits policy class map configuration mode and enters class map configuration mode.
Step 17	**exit** **Example:** `Device(config-pmap)# exit`	Exits policy map configuration mode and enters global configuration mode.
Step 18	**interface** *interface-id* **Example:** `Device(config)# interface HundredGigE1/0/5`	Identifies the interface and enters interface configuration mode.
Step 19	**no switchport** **Example:**	Switches the interface that is in Layer 2 mode into Layer 3 mode for Layer 3 configuration.

	Command or Action	Purpose
	`Device(config-if)# no switchport`	
Step 20	**exit** **Example:** `Device(config-pmap)# exit`	Exits interface configuration mode and enters global configuration mode.
Step 21	**interface** *interface-id.subinterface-id* **Example:** `Device(config)# interface HundredGigE1/0/5.1`	Identifies the subinterface and enters subinterface configuration mode.
Step 22	**encapsulation dot1Q** *vlan-id* **Example:** `Device(config-if)# encapsulation dot1Q 11`	Enables IEEE 802.1Q encapsulation of traffic on a subinterface.
Step 23	**service-policy type queueing output** *parent policy name* **Example:** `Device(config-if)# service-policy type queueing output parent`	Attaches the parent queue policy map to the subinterface.
Step 24	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configuration examples

This is an example of how to enable the subinterface queuing policy:

```
Device# configure terminal
Device(config)# class-map match-all traffic-class7
Device(config-cmap)# match traffic-class 7
Device(config)# policy-map type queueing llq
Device(config-pmap)# class traffic-class7
Device(config-pmap-c)# shape average percent 10
Device(config-pmap-c)# priority level 1
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# interface HundredGigE1/0/9
Device(config-if)# no switchport
Device(config-if)# exit
Device(config)# interface HundredGigE1/0/9.1
Device(config-subif)# encapsulation dot1Q 11
```

```
Device(config-subif)# service-policy type queueing output subif_q_policy
Device(config-subif)# end
```

This is an example of how to enable the subinterface priority propagation mode:

```
Device# configure terminal
Device(config)# interface HundredGigE1/0/23
Device(config-if)# no switchport
Device(config-if)# queuing mode sub-interface priority-propagation
Device(config-subif)# end
```

This is an example of how to configure the hierarchical QoS policy on a subinterface:

```
Device# configure terminal
Device(config)# class-map match-all traffic-class7
Device(config-cmap)# match traffic-class 7
Device(config-cmap)# exit
Device(config)# policy-map type queueing child
Device(config-pmap)# class traffic-class7
Device(config-pmap-c)# shape average 1000000
Device(config-pmap-c)# priority level 1
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# policy-map type queueing parent
Device(config-pmap)# class class-default
Device(config-pmap-c)# shape average 2000000000
Device(config-pmap-c)# service-policy child
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# interface HundredGigE1/0/5
Device(config-if)# no switchport
Device(config-pmap)# exit
Device(config)# interface HundredGigE1/0/5.1
Device(config-if)# encapsulation dot1Q 11
Device(config-if)# service-policy type queueing output parent
Device(config-if)# end
```

This is an example of how to configure the hierarchical QoS bandwidth remaining ratio on subinterface:

```
Device# configure terminal
Device(config)# class-map match-all traffic-class7
Device(config-cmap)# match traffic-class 7
Device(config-cmap)# exit
Device(config)# policy-map type queueing child
Device(config-pmap)# class traffic-class7
Device(config-pmap-c)# shape average 1000000
Device(config-pmap-c)# priority level 1
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# policy-map type queueing parent_ratio_5
Device(config-pmap)# class class-default
Device(config-pmap-c)# bandwidth remaining ratio 5
Device(config-pmap-c)# service-policy child
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# policy-map type queueing parent_ratio_10
Device(config-pmap)# class class-default
Device(config-pmap-c)# bandwidth remaining ratio 10
Device(config-pmap-c)# service-policy child
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# interface HundredGigE1/0/5
Device(config-if)# no switchport
Device(config-pmap)# exit
```

```
Device(config)# interface HundredGigE1/0/5.1
Device(config-if)# encapsulation dot1Q 11
Device(config-if)# service-policy type queueing output parent_ratio_5
Device(config-if)# exit
Device(config)# interface HundredGigE1/0/5.2
Device(config-if)# encapsulation dot1Q 15
Device(config-if)# service-policy type queueing output parent_ratio_10
Device(config-if)# end
```

Monitor Layer 3 subinterface queuing

These commands can be used to monitor Layer 3 subinterface queuing configuration on the device.

Command	Description
show policy-map type queueing interface *interface-id[.subinterface]*	Displays the runtime representation and statistics of all the queueing policies configured on the device.
show running interface *interface-id[.subinterface]*	Displays the configured interface and values under it.
show running policy-map *name*	Displays a list of the policy maps along with traffic class information.