Configuring Policy Maps

This chapter contains the following sections:

Information About Policy Types

The device supports a number of policy types. You create class maps in the policy types.

There are three policy types

- Network-qos
- Queuing
- QoS

Before you enable FCoE on the Cisco Nexus device, you must enable class-fcoe in the three types of qos policies (network QoS, queuing, and QoS) by entering the **type qos policy maps** command and applying at least one FCoE QoS policy under system QoS.

The following QoS parameters can be specified for each type of class:

- Type network-qos—A network-qos policy is used to instantiate system classes and associate parameters with those classes that are of system-wide scope.
  - Classification—The traffic that matches this class are as follows:
    - QoS Group—A class map of type network-qos identifies a system class and is matched by its associated qos-group.
  - Policy—The actions that are performed on the matching traffic are as follows:

> **Note** A network-qos policy can only be attached to the system QoS target.

- MTU—The MTU that needs to be enforced for the traffic that is mapped to a system class. Each system class has a default MTU and the system class MTU is configurable.

- Multicast optimization—This configuration specifies if the performance of multicast traffic mapped to this class will be optimized.

- Pause no-drop—No drop specifies lossless service for the system class. Drop specifies that tail drop is used (arriving packets are dropped when the queue reaches its allocated size) when a queue for this system class is full.

  An additional parameter pfc-cos can be configured. This parameter identifies the class of service (CoS) values to assert priority flow control (PFC) when traffic for a no-drop system class is not mapped based purely on CoS experiences congestion.

- You can change the buffer for the no-drop class.

- Queue Limit—This configuration specifies the number of buffers that need to be reserved to the queues of this system class. This option is not configurable for no-drop system classes.

- Type queuing—A type queuing policy is used to define the scheduling characteristics of the queues associated with system classes.

  Note Some configuration parameters when applied to an EtherChannel are not reflected on the configuration of the member ports.

  - Classification—The traffic that matches this class are as follows:

    - QoS Group—A class map of type queuing identifies a system class and is matched by its associated QoS group.

  - Policy—The actions that are performed on the matching traffic are as follows:

    Note These policies can be attached to the system qos target or to any interface. The output queuing policy is used to configure output queues on the device associated with system classes. The input queuing policy is used to configure scheduling for queues in the CNA. The input queuing policy parameters are signaled to the CNA over the DCBX protocol.

    - Bandwidth—Sets the guaranteed scheduling deficit weighted round robin (DWRR) percentage for the system class.

    - Priority—Sets a system class for strict-priority scheduling. Only one system class can be configured for priority in a given queuing policy.

- Type qos—A type QoS policy is used to classify traffic that is based on various Layer 2, Layer 3, and Layer 4 fields in the frame and to map it to system classes.

Note Some configuration parameters when applied to an EtherChannel are not reflected on the configuration of the member ports.

- Classification—The traffic that matches this class are as follows:

  - Access Control Lists—Classifies traffic based on the criteria in existing ACLs.

  - Class of Service—Matches traffic based on the CoS field in the frame header.

  - DSCP—Classifies traffic based on the Differentiated Services Code Point (DSCP) value in the DiffServ field of the IP header.

  - IP Real Time Protocol—Classifies traffic on the port numbers used by real-time applications.

  - Precedence—Classifies traffic based on the precedence value in the type of service (ToS) field of the IP header.

  - Protocol—Classifies traffic based on the IPv4 Protocol field or the IPv6 Next Header field of the IP header.

- Policy—The actions that are performed on the matching traffic are as follows:

  Note This policy can be attached to the system or to any interface. It applies to input traffic only.

  - QoS Group—Sets the QoS group that corresponds to the system class this traffic flow is mapped to.

Configuring Policy Maps

Creating Policy Maps

The **policy-map** command is used to create a named object that represents a set of policies that are to be applied to a set of traffic classes.

The device provides two default system classes: a no-drop class for lossless service (class-fcoe) and a drop class for best-effort service (class-default). You can define up to four additional system classes for Ethernet traffic.

Note The Cisco Nexus 5500 Series device supports five user-defined classes and one default drop system class.

The following predefined policy maps are used as default service policies:

- network-qos: default-nq-policy

- Input qos: default-in-policy

- Input queuing: default-in-policy

- Output queuing: default-out-policy

For the Cisco Nexus 5500 Series device, there are four pre-defined policy maps for FCoE:

- service-policy type qos input fcoe-default-in-policy

- service-policy type queuing input fcoe-default-in-policy

- service-policy type queuing output fcoe-default-out-policy

- service-policy type network-qos fcoe-default-nq-policy

Note Before you enable FCoE on the Cisco Nexus 5500 Series device running Cisco NX-OS Release 5.0(2)N1(1), you must enable class-fcoe in the three types of qos policies:

- type qos policy maps

- type network-qos policy map (attached to system qos)

- type queuing policy map (class-fcoe must be configured with a non-zero bandwidth percentage for input queuing policy maps.

When class-fcoe is not included in the qos policies, vFC interfaces do not come up and increased drops occur.

You need to create a policy map to specify the policies for any user-defined class. In the policy map, you can configure the QoS parameters for each class. You can use the same policy map to modify the configuration of the default classes.

The device distributes all the policy-map configuration values to the attached network adapters.

Before You Begin

Before creating the policy map, define a class map for each new system class.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map** [**type** {**network-qos** | **qos** | **queuing**}] *policy-name*	Creates a named object representing a set of policies that are to be applied to a set of traffic classes. Policy-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
		The three policy-map configuration modes are as follows:
		• network-qos—Network-wide (global) mode. CLI prompt: switch(config-pmap-nq)#
		• qos—Classification mode; this is the default mode. CLI prompt: switch(config-pmap-qos)#

	Command or Action	**Purpose**
		• queuing—Queuing mode. CLI prompt: switch(config-pmap-que)#
Step 3	switch(config)# **no policy-map** [**type** {**network-qos** | **qos** | **queuing**}] *policy-name*	(Optional) Deletes the specified policy map.
Step 4	switch(config-pmap)# **class** [**type** {**network-qos** | **qos** | **queuing**}] *class-name*	Associates a class map with the policy map, and enters configuration mode for the specified system class. The three class-map configuration modes are as follows: • network-qos—Network-wide (global) mode. CLI prompt: switch(config-pmap-c-nq)# • qos—Classification mode; this is the default mode. CLI prompt: switch(config-pmap-c-qos)# • queuing—Queuing mode. CLI prompt: switch(config-pmap-c-que)# **Note** The associated class map must be the same type as the policy-map type.
Step 5	switch(config-pmap)# **no class** [**type** {**network-qos** | **qos** | **queuing**}] *class-name*	(Optional) Deletes the class map association.

Configuring Type QoS Policies

Type qos policies are used for classifying the traffic of a specific system class identified by a unique qos-group value. A type qos policy can be attached to the system or to individual interfaces (including Fabric Extender host interfaces) for ingress traffic only.

You can set a maximum of five QoS groups for ingress traffic.

Procedure

	Command or Action	**Purpose**
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map type qos** *policy-name*	Creates a named object that represents a set of policies that are to be applied to a set of traffic classes. Policy-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-pmap-qos)# [**class** | **class-default**] **type qos** *class-name*	Associates a class map with the policy map, and enters configuration mode for the specified system class.

	Command or Action	Purpose
		Note The associated class map must be the same type as the policy map type.
Step 4	switch(config-pmap-c-qos)# **set qos-group** *qos-group-value*	Configures one or more **qos-group** values to match on for classification of traffic into this class map. The list below identifies the ranges of the *qos-group-value* . There is no default value. For the Cisco Nexus 5500 Series device, the range is from 1 to 5.

This example shows how to define a type qos policy map:

```
switch# configure terminal
switch(config)# policy-map type qos policy-s1
switch(config-pmap-qos)# class type qos class-s1
switch(config-pmap-c-qos)# set qos-group 2
```

Configuring Type Network QoS Policies

Type network qos policies can only be configured on the system qos attachment point. They are applied to the entire switch for a particular class.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map type network-qos** *policy-name*	Creates a named object that represents a set of policies that are to be applied to a set of traffic classes. Policy-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-pmap-nq)# **class type network-qos** *class-name*	Associates a class map with the policy map, and enters configuration mode for the specified system class. **Note** The associated class map must be the same type as the policy map type.
Step 4	switch(config-pmap-c-nq)# **mtu** *mtu-value*	Specifies the MTU value in bytes. **Note** The *mtu-value* that you configure must be less than the value set by the **system jumbomtu** command.
Step 5	switch(config-pmap-c-nq)# **no mtu**	(Optional) Resets the MTU value in this class.
Step 6	switch(config-pmap-c-nq)# **pause no-drop**	Configures a no-drop class.

	Command or Action	Purpose
Step 7	switch(config-pmap-c-nq)# **multicast-optimize**	Enables multicast optimization. Multicast traffic in this class will be served by all available multicast queues.
		Note Only one class in a policy map can be configured for multicast optimization.
		Note For the Cisco Nexus device, multicast optimization is enabled by default on class-default. You must remove it from class-default before enabling it on a user-defined class.
Step 8	switch(config-pmap-c-nq)# **no multicast-optimize**	(Optional) Disables multicast optimization.
Step 9	switch(config-pmap-c)# **pause no-drop** [**pfc-cos** *pfc-cos-value*]	Configures a no-drop class. If you do not specify this command, the default policy is drop.
		Note The operation for the drop policy is a simple tail drop, where arriving packets will be dropped if the queue increases to its allocated size.
		The *pfc-cos-value* range is from 0 to 7. This option is supported only for for a ACL-based system class (which filters traffic using criteria other than cos-based matches).
		Caution The list of CoS values can potentially include the CoS value that is used for FCoE traffic in class-fcoe. You must determine if this is desired behavior for your topology.
Step 10	switch(config-pmap-c-nq)# **no pause no-drop**	(Optional) Removes the no-drop option from this class.
Step 11	switch(config-pmap-c-nq)# **queue-limit** *number-bytes* **bytes**	Specifies the tail drop threshold on this interface. The threshold range is from 20480 to 204800 bytes. For the Cisco Nexus device, the range is from 20480 to 426880 bytes.
		Note The queue limit can only be configured on drop classes. If you try to configure a queue limit on a no-drop class, or try to configure no-drop on a class where a queue limit is already defined, the CLI will return an error.
		Use the pause no-drop buffer size option to change the buffer size and pause threshold for the no-drop class.
Step 12	switch(config-pmap-c-nq)# **no queue-limit** *number-bytes* **bytes**	(Optional) Disables the queue limit specification in this class.
Step 13	switch(config-pmap-c-nq)# **set cos** *cos-value*	Specifies a 802.1Q CoS value which is used to mark packets on this interface. The value range is from 0 to 7.
Step 14	switch(config-pmap-c-nq)# **no set cos** *cos-value*	(Optional) Disables the marking operation in this class.

This example shows how to define a type network-qos policy map:

```
switch# configure terminal
switch(config)# policy-map type network-qos policy-que1
switch(config-pmap-nq)# class type network-qos class-que1
switch(config-pmap-c-nq)# mtu 5000
switch(config-pmap-c-nq)# set cos 4
```

Configuring Type Queuing Policies

Type queuing policies are used for scheduling and buffering the traffic of a specific system class. A type queuing policy is identified by its QoS group and can be attached to the system or to individual interfaces (except for Fabric Extender host interfaces) for input or output traffic.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **policy-map type queuing** *policy-name*	Creates a named object that represents a set of policies that are to be applied to a set of traffic classes. Policy-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-pmap-que)# **class type queuing** *class-name*	Associates a class map with the policy map, and enters configuration mode for the specified system class.
Step 4	switch(config-pmap-c-que)# **priority**	Specifies that traffic in this class is mapped to a strict priority queue. **Note** Only one class in each policy map can have strict priority set on it.
Step 5	switch(config-pmap-c-que)# **no priority**	(Optional) Removes the strict priority queuing from the traffic in this class.
Step 6	switch(config-pmap-c-que)# **bandwidth percent** *percentage*	Specifies the guaranteed percentage of interface bandwidth allocated to this class. By default, no bandwidth is specified for a class. **Note** Before you can successfully allocate bandwidth to the class, you must first reduce the default bandwidth configuration on class-default and class-fcoe.
Step 7	switch(config-pmap-c-que)# **no bandwidth percent** *percentage*	(Optional) Removes the bandwidth specification from this class.

Enabling QoS Statistics under show policy-map interface

The **qos statistics** command must be enabled when you migrate to Cisco NX-OS release 7.3(0)N1(1) to enable statistics for policy maps. In addition, the existing policies need to be removed and reassigned to ensure the statistics work. Any new policy maps (that are not already configured on any interface) configured after enabling statistics would have the statistics enabled. The detailed procedure is as follows:

Before You Begin

Enabling statistics can take up additional TCAM space. Hence, you must ensure that there is enough space available to perform this operation, given the existing configuration. Refer to CSCuq00149 for details on whether the statistics can be enabled on your switch.

Procedure

Step 1   switch# **configure terminal**
Enters global configuration mode.

Step 2   switch(config)# **show policy-map vlan** *vlan-number*
Verify the existing status of the statistics on your switch.

```
switch(config)# show policy-map vlan 13

Global statistics status: disabled

Vlan 13

  Service-policy (qos) input:   rq1
    policy statistics status:   disabled

    Class-map (qos):   rq1 (match-any)
      Match: cos 4
      set qos-group 2

    Class-map (qos):   class-default (match-any)
      Match: any
      set qos-group 0

switch(config)#
```

Step 3   switch(config)# **qos statistics**
Enable the statistics.

```
switch(config)# qos statistics

Warning: Turning on the statistics would increase the TCAM utilisation. Disable the CLI if
 this is not intended.
Note that the policies need to be removed and re-applied, for statistics to take effect.

switch(config)#
```

Step 4   switch(config)# **vlan configuration** *vlan-number*

Enter VLAN configuration mode for the specified VLAN.

```
switch(config)#vlan configuration 13-59
```

Step 5 switch(config-vlan-config)# **no service-policy type qos input** *policy-name*
Remove the policy from the VLAN. The *policy-name* is the name assigned to the policy map.

```
switch(config-vlan-config)#no service-policy type qos input rq1
```

Step 6 switch(config-vlan-config)# **vlan configuration** *vlan-number*
Enter VLAN configuration mode for the specified VLAN.

```
switch(config-vlan-config)#vlan configuration 13
```

Step 7 switch(config-vlan-config)# **service-policy type qos input** *policy-name*
Assign or reapply the policy map to the VLAN. The policy-name is the name assigned to the policy map.
Note that the policy must be removed from all attachment points (VLANs and interfaces) before you enable
the statistics on even one attachment point.

```
switch(config-vlan-config)#service-policy type qos input rq1
```

Step 8 switch(config-vlan-config)# **show policy-map vlan** *vlan-number*
Verify the status of the statistics on your switch. You can also use the **show policy-map interface** command.

```
switch(config-vlan-config)# show policy-map vlan 13

Global statistics status: enabled

Vlan 13

  Service-policy (qos) input:   rq1
    policy statistics status:   enabled

    Class-map (qos):   rq1 (match-any)
      3094788 packets
      Match: cos 4
        3094788 Match packets
      set qos-group 2

    Class-map (qos):   class-default (match-any)
      0 packets
      Match: any
      set qos-group 0

switch(config-vlan-config)#
```

Note   To remove the statistics, use the **no qos statistics** command, then remove and reassign the policies
for them to take effect.

Restrictions for Viewing the QoS Statistics

Due to the way statistics and policers are attached to the TCAM entries, there are certain limitations to viewing the statistics:

- Statistics are incremented cumulatively for each VLAN or interface where the policy is applied. The statistics are not per-interface/vlan.

- Default policies and system-level policies do not have statistics.

- Statistics per ACE in an ACL cannot be viewed if there is more than one ACE in the ACL and a policer is attached to the QoS policy.

- The above limitation applies to qos-based matches as well (for example, **match dscp** *value*, **match precedence** *value*, and so on).

    ◦ Statistics cannot be viewed with match-all rules.

    ◦ Statistics can be viewed only with match-any.

- Statistics per-ACE of ACL for QoS policies applied of FEX HIF ports will be shown only if policer is not present.

Verifying the Policy Map Configuration

Command	Purpose
show policy-map [*name*]	Displays the policy maps defined on the switch. Optionally, you can display the named policy only.
show policy-map interface [*interface number*]	Displays the policy map settings for an interface or all interfaces.
show policy-map system	Displays the policy map settings attached to the system qos.
show policy-map type {**network-qos**	**qos**	**queuing**} [*name*]	Displays the policy map settings for a specific policy type. Optionally, you can display the named policy only.
running-config ipqos	Displays information about the running configuration for QoS.
startup-config ipqos	Displays information about the startup configuration for QoS.