Cisco Nexus 5000 Series NX-OS Quality of Service Configuration Guide

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Text Part Number: OL-20921-01

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Preface

This preface describes the audience, organization, and conventions of the *Cisco Nexus 5000 Series NX-OS Quality of Service Configuration Guide*. It also provides information on how to obtain related documentation.

Audience

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Document Organization

This document is organized into the following chapters:

Chapter	Description
New and Changed Information	Describes the new and changed information for the new Cisco NX-OS software releases.
Overview	Describes the Quality of Service features supported by the Cisco NX-OS software.
Configuring Quality of Service	Describes Quality of Service, guidelines and limitations, and information about how to configure the Quality of Service feature.

Document Conventions

Command descriptions use the following conventions:

Convention	Description
bold	Bold text indicates the commands and keywords that you enter literally as shown.
Italic	Italic text indicates arguments for which the user supplies the values.
[x]	Square brackets enclose an optional element(keyword or argument).
[x | y]	Square brackets enclosing keywords or arguments separated by a vertical bar indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a vertical bar indicate a required choice.
[x {y | z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
`variable`	Indicates a variable for which you supply values, in context where italics cannot be used.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.

Screen examples use the following conventions:

Convention	Description
`screen font`	Terminal sessions and information the switch displays are in screen font.
`boldface screen font`	Information you must enter is in boldface screen font.
`italic screen font`	Arguments for which you supply values are in italic screen font.
< >	Nonprinting characters, such as passwords, are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

This document uses the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Related Documentation for Nexus 5000 Series NX-OS Software

Cisco NX-OS documentation is available at the following URL:

http://www.cisco.com/en/US/products/ps9670/tsd_products_support_series_home.htmll

The documentation set for the Cisco Nexus 5000 Series NX-OS software includes the following documents:

Release Notes

- *Cisco Nexus 5000 Series and Cisco Nexus 2000 Series Release Notes*
- *Cisco Nexus 5000 Series Switch Release Notes*

Cisco Nexus 5000 Series NX-OS Configuration Guides

- *Cisco Nexus 5000 Series NX-OS Fibre Channel over Ethernet Configuration Guide*
- *Cisco Nexus 5000 Series NX-OS Layer 2 Switching Configuration Guide*
- *Cisco Nexus 5000 Series NX-OS Quality of Service Configuration Guide*
- *Cisco Nexus 5000 Series NX-OS SAN Switching Configuration Guide*
- *Cisco Nexus 5000 Series NX-OS Security Configuration Guide*
- *Cisco Nexus 5000 Series NX-OS System Management Configuration Guide*
- *Cisco Nexus 5000 Series Switch CLI Software Configuration Guide*
- *Cisco Nexus 5000 Series Fabric Manager Configuration Guide, Release 3.4(1a)*

Installation and Upgrade Guides

- *Cisco Nexus 5000 Series Hardware Installation Guide*
- *Regulatory Compliance and Safety Information for the Cisco Nexus 5000 Series*

Cisco NX-OS Command References

- *Cisco Nexus 5000 Series Command Reference*

Cisco NX-OS Technical References

- *Cisco Nexus 5000 MIBs Reference*

Cisco NX-OS Error and System Messages

- *Cisco NX-OS System Messages Reference*

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

CHAPTER 1

New and Changed Information

This chapter provides release-specific information for each new and changed feature in the *Cisco Nexus 5000 Series NX-OS Quality of Service Configuration Guide*.

New and Changed Information

This chapter provides release-specific information for each new and changed feature in the *Cisco Nexus 5000 Series NX-OS Quality of Service Configuration Guide*.

The latest version of this document is available at the following Cisco website: http://www.cisco.com/en/US/products/ps9670/products_installation_and_configuration_guides_list.html

To check for additional information about Cisco NX-OS, see the *Cisco Nexus 5000 Series NX-OS Release Notes* available at the following Cisco website:

http://www.cisco.com/en/US/products/ps9670/prod_release_notes_list.html

Documentation Organization

As of Cisco NX-OS Release 4.1(3)N2(1), the Nexus 5000 Series configuration information is available in new feature-specific configuration guides for the following information:

- System Management
- Layer 2 Switching
- SAN Switching
- Fibre Channel over Ethernet
- Security
- Quality of Service

The information in these new guides previously existed in the *Cisco Nexus 5000 Series NX-OS Configuration Guide* which remains available on Cisco.com and should be used for all software releases prior to Cisco Nexus 5000 NX-OS Software Rel 4.1(3). Each new configuration guide addresses the features that are introduced

in or are available in a particular release. Select and view the configuration guide that pertains to the software installed in your switch.

The information in the new *Cisco Nexus 5000 Series NX-OS Quality of Service Configuration Guide* previously existed in Part 6: Quality of Service of the *Cisco Nexus 5000 Series CLI Configuration Guide*.

For a complete list of Nexus 5000 Series document titles, see the list of Related Documentation in the *Preface*.

CHAPTER 2

Overview

Cisco Nexus 5000 Series switches support the Quality of Service features that are described in this guide.

Overview

This document describes the configurable Cisco Nexus 5000 Series NX-OS Quality of Service (QoS) features. You use the QoS features to provide the most desirable flow of traffic through a network. QoS allows you to classify the network traffic, police and prioritize the traffic flow, and provide congestion avoidance. The control of traffic is based on the fields in the packets that flow through the system. You use the Modular QoS CLI (MQC) to create the traffic classes and policies of the QoS features.

QoS features are applied using QoS policies and queuing policies, as follows:

- QoS policies include classification and marking features.
- Queuing policies use the queuing and scheduling features.
- Network QoS policies include configuring MTU, no-drop, and queue-limit.

CHAPTER 3

Configuring QoS

This chapter describes how to configure quality of service (QoS) on Cisco Nexus 5000 Series switches. It contains the following sections:

Information About QoS

The configurable Cisco NX-OS QoS features on the Cisco Nexus 5000 Series switch allow you to classify the network traffic, prioritize the traffic flow, and provide congestion avoidance.

The default QoS configuration on the switch provides lossless service for Fibre Channel and Fibre Channel Over Ethernet (FCoE) traffic and best-effort service for Ethernet traffic. QoS can be configured to provide additional classes of service for Ethernet traffic. Cisco Nexus 5000 Series QoS features are configured using Cisco Modular QoS CLI (MQC).

The FCoE QoS must be configured either if native FC or FCoE or FC and FCoE are in use. The FCoE QoS must be added even if Ethernet is not configured on the switch.

The following commands will enable the default QoS configuration:

```
switch(config)# system qos
switch(config-sys-qos)# service-policy type queuing input fcoe-default-in-policy
switch(config-sys-qos)# service-policy type queuing output fcoe-default-out-policy
```

```
switch(config-sys-qos)# service-policy type qos input fcoe-default-in-policy
switch(config-sys-qos)# service-policy type network-qos fcoe-default-nq-policy
```

Note Standard Ethernet is a best-effort medium which means that it lacks any form of flow control. In the event of congestion or collisions, Ethernet will drop packets. The higher level protocols detect the missing data and retransmit the dropped packets.

Fibre Channel requires a reliable transport system that guarantees the delivery of every packet. To properly support FCoE, Ethernet has been enhanced with a priority flow control (PFC) mechanism to prevent congestion.

MQC

The Cisco Modular QoS CLI (MQC) provides a standard set of commands for configuring QoS.

You can use MQC to define additional traffic classes and to configure QoS policies for the whole system and for individual interfaces. Configuring a QoS policy with MQC consists of the following steps:

1. Define traffic classes.
2. Associate policies and actions with each traffic class.
3. Attach policies to logical or physical interfaces as well as at the global system level.

MQC provides two command types to define traffic classes and policies:

- class-map—Defines a class map that represents a class of traffic based on packet-matching criteria. Class maps are referenced in policy maps.

  The class map classifies incoming packets based on matching criteria, such as the IEEE 802.1p CoS value. Unicast and multicast packets are classified.

- policy-map—Defines a policy map that represents a set of policies to be applied on a class-by-class basis to class maps.

  The policy map defines a set of actions to take on the associated traffic class, such as limiting the bandwidth or dropping packets.

You define the following class-map and policy-map object types when you create them:

- network-qos—Defines MQC objects that you can use for system level related actions.
- qos—Defines MQC objects that you can use for classification.
- queuing—Defines MQC objects that you can use for queuing and scheduling.

Note The qos type is the default for the **class-map** and **policy-map** commands, but not for the **service-policy** which requires that you specify an explicit type.

You can attach policies to interfaces or EtherChannels as well as at the global system level by using the **service-policy** command.

You can view all or individual values for MQC objects by using the **show class-map** and **show policy-map** commands.

An MQC target is an entity (such as an Ethernet interface) that represents a flow of packets. A service policy associates a policy map with an MQC target, and specifies whether to apply the policy on incoming or outgoing packets. This mapping enables the configuration of QoS policies such as marking, bandwidth allocation, buffer allocation, and so on.

System Classes

The system qos is a type of MQC target. You use a service-policy to associate a policy map with the system qos target. A system qos policy applies to all interfaces on the switch unless a specific interface has an overriding service-policy configuration. The system qos policies are used to define system classes, the classes of traffic across the entire switch, and their attributes. To ensure QoS consistency (and for ease of configuration), the switch distributes the system class parameter values to all its attached network adapters using the Data Center Bridging Exchange (DCBX) protocol.

If service policies are configured at the interface level, the interface-level policy always takes precedence over system class configuration or defaults.

On the Cisco Nexus 5000 Series switch, a system class is uniquely identified by a qos-group value. A total of six system classes are supported. Two of the six system classes are defaults and are always present on the switch. Up to four additional system classes can be created by the administrator.

Default System Classes

The Cisco Nexus 5000 Series switch provides the following system classes:

- Drop system class

  By default, the software classifies all unicast and multicast Ethernet traffic into the default drop system class. This class is identified by qos-group 0.

  This class is created automatically when the system starts up (the class is named class-default in the CLI). You cannot delete this class and you cannot change the match criteria associated with the default class.

- FCoE system class (For the Cisco Nexus 5010 switch and the Cisco Nexus 5020 switch)

  All Fibre Channel and FCoE control and data traffic is automatically classified into the FCoE system class, which provides no-drop service.

  This class is created automatically when the system starts up (the class is named class-fcoe in the CLI).

  You cannot delete class-fcoe and you can only modify the IEEE 802.1p CoS value to associate with this class. This class is identified by qos-group 1.

  The switch classifies packets into the FCoE system class as follows:

  - FCoE traffic is classified based on EtherType.
  - Native Fibre Channel traffic is classified based on the physical interface type.

Note The optional N5K-M1404 or N5K-M1008 expansion modules provide native ½/4-Gigabit Fibre Channel ports.

- FCoE system class (For the Cisco Nexus 5548 switch)

  For the Cisco Nexus 5548 switch, the class-fcoe is not automatically created. Before you enable FCoE on the Cisco Nexus 5548 switch 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.

Note The Cisco Nexus 5548 switch supports five user-defined classes and one default drop system class.

Policy Types

The Cisco Nexus 5000 Series switch supports a number of policy types. You create class maps in the policy types.

There are three policy types. 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.

- 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.
- Set CoS value—This configuration is used to mark 802.1p values for all traffic mapped to this system class. For the Cisco Nexus 5020 switch and the Cisco Nexus 5010 switch, the marking value for a system class needs to be unique and cannot be used as a marking value for any other system class. The marking value does not need to be unique for the Cisco Nexus 5548 switch.

- 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 queueing policy is used to configure output queues on the switch associated with system classes. The input queuing policy is used to configure scheduling for queues in the CNA. The input queuing policy parameters are signalled 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 protocol 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 corresponding to the system class this traffic flow is mapped to.

Link-Level Flow Control

IEEE 802.3x link-level flow control allows a congested receiver to communicate a transmitter at the other end of the link to pause its data transmission for a short period of time. The link-level flow control feature applies to all the traffic on the link.

The transmit and receive directions are separately configurable. By default, link-level flow control is disabled for both directions.

On the Cisco Nexus 5000 Series switch, Ethernet interfaces do not automatically detect the link-level flow control capability. You must configure the capability explicitly on the Ethernet interfaces.

On each Ethernet interface, the switch can enable either priority flow control or link-level flow control (but not both).

Priority Flow Control

Priority flow control (PFC) allows you to apply pause functionality to specific classes of traffic on a link instead of all the traffic on the link. PFC applies pause functionality based on the IEEE 802.1p CoS value. When the switch enables PFC, it communicates to the adapter which CoS values to apply the pause.

Ethernet interfaces use PFC to provide lossless service to no-drop system classes. PFC implements pause frames on a per-class basis and uses the IEEE 802.1p CoS value to identify the classes that require lossless service.

In the switch, each system class has an associated IEEE 802.1p CoS value that is assigned by default or configured on the system class. If you enable PFC, the switch sends the no-drop CoS values to the adapter, which then applies PFC to these CoS values.

The default CoS value for the FCoE system class is 3. This value is configurable.

By default, the switch negotiates to enable the PFC capability. If the negotiation succeeds, PFC is enabled and link-level flow control remains disabled regardless of its configuration settings. If the PFC negotiation fails, you can either force PFC to be enabled on the interface or you can enable IEEE 802.x link-level flow control.

If you do not enable PFC on an interface, you can enable IEEE 802.3X link-level pause. By default, link-level pause is disabled.

MTU

The Cisco Nexus 5000 Series switch is a Layer 2 switch, and it does not support packet fragmentation. A maximum transmission unit (MTU) configuration mismatch between ingress and egress interfaces may result in packets being truncated.

When configuring MTU, follow these guidelines:

- MTU is specified per system class. The system class allows a different MTU for each class of traffic but they must be consistent on all ports across the entire switch. You cannot configure MTU on the interfaces.
- Fibre Channel and FCoE payload MTU is 2158 bytes across the switch. As a result, the rxbufsize for Fibre Channel interfaces is fixed at 158 bytes. If the Cisco Nexus 5000 Series switch receives an rxbufsize from a peer that is different than 2158 bytes, it will fail the exchange of link parameters (ELP) negotiation and not bring the link up.
- Enter the **system jumbomtu** command to define the upper bound of any MTU in the system. The system jumbo MTU has a default value of 9216 bytes. The minimum MTU is 21 58 bytes and the maximum MTU is 9216 bytes.
- The system class MTU sets the MTU for all packets in the class. The system class MTU cannot be configured larger than the global jumbo MTU.
- The FCoE system class (for Fibre Channel and FCoE traffic) has a default MTU of 2158 bytes. This value cannot be modified.
- The default drop system class has a default MTU of 1500 bytes. You can configure this value.
- The switch sends the MTU configuration to network adapters that support DCBX.

Note MTU is not supported in Converged Enhanced Ethernet (CEE) mode for DCBX.

Trust Boundaries

The trust boundary is enforced by the incoming interface as follows:

- All Fibre Channel and virtual Fibre Channel interfaces are automatically classified into the FCoE system class.
- By default, all Ethernet interfaces are trusted interfaces.The 802.1p CoS and DSCP are preserved unless the marking is configured. There is no default CoS to queue and DSCP to queue mapping. You can define and apply a policy to create these mappings. By default, without a user defined policy, all traffic is assigned to the default queue.

- Any packet that is not tagged with an 802.1p CoS value is classified into the default drop system class. If the untagged packet is sent over a trunk, it is tagged with the default untagged CoS value, which is zero.
- You can override the default untagged CoS value for an Ethernet interface or port channel.

After the system applies the untagged CoS value, QoS functions the same as for a packet that entered the system tagged with the CoS value.

Ingress Queuing Policies

You can associate an ingress policy map with an Ethernet interface to guarantee bandwidth for the specified traffic class or to specify a priority queue.

The ingress policy is applied in the adapter to all outgoing traffic that matches the specified CoS value.

When you configure an ingress policy for an interface, the switch sends the configuration data to the adapter. If the adapter does not support the DCBX protocol or the ingress policy type-length-value (TLV), the ingress policy configuration is ignored.

Ingress Classification Policies

You use classification to partition traffic into classes. You classify the traffic based on the port characteristics (CoS field) or the packet header fields that include IP precedence, Differentiated Services Code Point (DSCP), and Layer 2 to Layer 4 parameters. The values used to classify traffic are called match criteria. When you define a traffic class, you can specify multiple match criteria, you can choose to not match on a particular criterion, or you can determine traffic class by matching any or all criteria.

Traffic that fails to match any class is assigned to a default class of traffic called class-default.

Egress Queuing Policies

You can associate an egress policy map with an Ethernet interface to guarantee the bandwidth for the specified traffic class or to configure the egress queues.

The bandwidth allocation limit applies to all traffic on the interface including any FCoE traffic.

Each Ethernet interface supports up to six queues, one for each system class. The queues have the following default configuration:

- In addition to the six queues, control traffic that is destined for the CPU uses strict priority queues. These queues are not accessible for user configuration.
- FCoE traffic (traffic that maps to the FCoE system class) is assigned a queue. This queue uses weighted round-robin (WRR) scheduling with 50 percent of the bandwidth.
- Standard Ethernet traffic in the default drop system class is assigned a queue. This queue uses WRR scheduling with 50 percent of the bandwidth.

If you add a system class, a queue is assigned to the class. You must reconfigure the bandwidth allocation on all affected interfaces. Bandwidth is not dedicated automatically to user-defined system classes.

You can configure a strict priority queue. This queue is serviced before all other queues except the control traffic queue (which carries control rather than data traffic).

QoS for Multicast Traffic

The six multicast queues applies to Nexus 5010 and Nexus 5020. For Nexus 5548 there are 128 multicast queues. Additionally we need to highlight these are the queues at ingress.

For the Cisco Nexus 5548 switch, Cisco NX-OS Release 5.0(2)N1(1) provides 128 multicast queues at ingress. For the Cisco Nexus 5020 switch and the Cisco Nexus 5020 switch, the system provides six multicast queues per interface and allocates one queue for each system class. By default, all multicast Ethernet traffic is classified into the default drop system class. This traffic is serviced by one multicast queue.

Optimized multicasting allows use of the unused multicast queues to achieve better throughput for multicast frames. If optimized multicast is enabled for the default drop system class, the system will use all six queues to service the multicast traffic (all six queues are given equal priority).

If you define a new system class, a dedicated multicast queue is assigned for this class. This queue is removed from the set of queues available for the optimized multicast class.

Optimized multicasting achieves better throughput and improves performance for multicast frames.

The system provides two predefined class maps for matching broadcast or multicast traffic. These class maps are convenient for creating separate policy maps for unicast and multicast traffic. The predefined class maps are as follows:

- class-all-flood

  The class-all-flood class map matches all broadcast, multicast, and unknown unicast traffic (across all CoS values). If you configure a policy map with the class-all-flood class map, the system automatically uses all available multicast queues for this traffic.

- class-ip-multicast

  The class-ip-multicast class map matches all IP multicast traffic. Policy options configured in this class map apply to traffic across all Ethernet CoS values. For example, if you enable optimized multicast for this class, the IP multicast traffic for all CoS values is optimized.

Note If you configure either of these predefined class maps as a no-drop class, the priority flow control capability is applied across all Ethernet CoS values. In this configuration, pause will be applied to unicast and multicast traffic.

Policy for Fibre Channel Interfaces

The egress queues are not configurable for native Fibre Channel interfaces. Two queues are available as follows:

- A strict priority queue to serve high-priority control traffic.
- A queue to serve all data traffic and low-priority control traffic.

QoS for Traffic Directed to the CPU

The switch automatically applies QoS policies to traffic that is directed to the CPU to ensure that the CPU is not flooded with packets. Control traffic, such as BPDU frames, is given higher priority to ensure delivery.

QoS Configuration Guidelines and Limitations

Switch resources (such as buffers, virtual output queues, and egress queues) are partitioned based on the default and user-defined system classes. Cisco NX-OS automatically adjusts the resource allocation to accommodate the configured system classes.

To maintain optimal switch performance, follow these guidelines when configuring system classes and policies:

- If less than four Ethernet classes are defined, up to two of these classes can be configured as no-drop classes. If more than three Ethernet classes are defined, only one of these classes can be configured as a no-drop class. The default drop class is counted as an Ethernet class.
- If priority flow control is enabled on an Ethernet interface, pause will never be applied to traffic with a drop system class. PFC does not apply pause to drop classes and the link-level pause feature is never enabled on an interface with PFC.
- All FCoE traffic on an Ethernet interface is mapped to one no-drop system class. By default, this class is associated with CoS value 3, although you can configure a different value. If you configure standard Ethernet traffic to use the same CoS value as FCoE, this traffic is still mapped to the FCoE system class and the switch will apply priority flow control on the FCoE CoS value.
- When a Cisco Nexus 2148T Fabric Extender is connected and in use, data traffic should never be marked with a CoS value of 7. CoS 7 is reserved for control traffic transiting the Fabric Extender.
- On the Cisco Nexus 5548 Switch, the FCoE class-fcoe system class is not enabled by default in the QoS configuration. Before enabling FCoE, you must include class-fcoe in each of the three policy types (network-qos, queuing, and qos).

Note Type qos policies can be activated only on Cisco Nexus 5000 Series interfaces and Cisco Nexus 2000 Series Fabric Extender interfaces. Type qos policies on Fabric Extender fabric interfaces or Fabric Extender fabric EtherChannel interfaces are ineffective, though the Cisco NX-OS CLI does not reject the configuration.

We recommend that you do not configure type qos policy-maps on Fabric Extender fabric interfaces or Fabric Extender fabric EtherChannel interfaces to avoid wasting hardware resources.

When configuring EtherChannels, note the following guidelines:

- The service policy configured on an EtherChannel applies to all member interfaces.
- The priority flow control configured on an EtherChannel applies to all member interfaces.

Configuring System Classes

Configuring Class Maps

You can create or modify a class map with the **class-map** command. The class map is a named object that represents a class of traffic. In the class map, you specify a set of match criteria for classifying the packets. You can then reference class maps in policy maps.

Note The class map type default is type qos and its match criteria default is match-all.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map** [**type** {**network-qos** | **qos** | **queuing**}] *class-map name*
3. (Optional) switch(config)# **class-map** [**type qos**] [**match-all** | **match-any**] *class-map name*
4. (Optional) switch(config)# **no class-map** [**type** {**network-qos** | **qos** | **queuing**}] *class-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map** [**type** {**network-qos** | **qos** | **queuing**}] *class-map name*	Creates or accesses a named object that represents the specified class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters. The three class-map configuration modes are as follows: • network-qos—Network-wide (global) mode. CLI prompt: switch(config-cmap-nq)# • qos—Classification mode; this is the default mode. CLI prompt: switch(config-cmap-qos)# • queuing—Queuing mode. CLI prompt: switch(config-cmap-que)#
Step 3	switch(config)# **class-map** [**type qos**] [**match-all** | **match-any**] *class-map name*	(Optional) Specifies that packets must match any or all criteria that is defined for a class map. The default is match-all. • match-all—Classifies traffic if packets match all criteria that is defined for a specified class map.(for example, if the defined CoS and the ACL criteria matches) • match-any—Classifies traffic if packets match any criteria that is defined for a specified class map. (for example, if the CoS or the ACL criteria matches).

	Command or Action	Purpose
Step 4	switch(config)# **no class-map** [**type** {**network-qos** | **qos** | **queuing**}] *class-name*	(Optional) Deletes the specified class map. **Note** You cannot delete the two system-defined class maps: class-fcoe and class-default.

Configuring ACL Classification

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

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type qos** *class-name*
3. switch(config-cmap-qos)# **match access-group name** *acl-name*
4. (Optional) switch(config-cmap-qos)# **no match access-group name** *acl-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type qos** *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-qos)# **match access-group name** *acl-name*	Configures a traffic class by matching packets based on the *acl-name*. The **permit** and **deny** ACL keywords are ignored in the matching. **Note** You can only define a single ACL in a class map. You cannot add any other match criteria to a class with a **match access-group** defined.
Step 4	switch(config-cmap-qos)# **no match access-group name** *acl-name*	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic by matching packets based on existing ACLs:

```
switch# configure terminal
switch(config)# class-map type qos class_acl
switch(config-cmap-qos)# match access-group name acl-01
```

Use the **show class-map** command to display the ACL class-map configuration:

```
switch# show class-map class_acl
```

Configuring CoS Classification

You can classify traffic based on the class of service (CoS) in the IEEE 802.1Q header. This 3-bit field is defined in IEEE 802.1p to support QoS traffic classes. CoS is encoded in the high order 3 bits of the VLAN ID Tag field and is referred to as *user_priority*.

If a system class is configured with a no-drop function, the **match cos** command serves an additional purpose. The switch sends the CoS value to the adapter so that the adapter will apply a PFC pause for this CoS value.

The FCoE system class has a default CoS value of 3. You can add a **match cos** configuration to the FCoE system class to set a different CoS value. A PFC pause will be applied to traffic that matches the new value.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type qos** *class-name*
3. switch(config-cmap-qos)# **match cos** *cos-value*
4. (Optional) switch(config-cmap-qos)# **no match cos** *cos-value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type qos** *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-qos)# **match cos** *cos-value*	Specifies the CoS value to match for classifying packets into this class. You can configure a CoS value in the range of 0 to 7. **Note** When a Cisco Nexus 2148T Fabric Extender is connected and in use, data traffic should never be marked with a CoS value of 7. CoS 7 is reserved for control traffic transiting the Fabric Extender.
Step 4	switch(config-cmap-qos)# **no match cos** *cos-value*	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic by matching packets based on a defined CoS value:

```
switch# configure terminal
switch(config)# class-map type qos class_cos
switch(config-cmap-qos)# match cos 4, 5-6
```

Use the **show class-map** command to display the CoS value class-map configuration:

```
switch# show class-map class_cos
```

Configuring DSCP Classification

You can classify traffic based on the Differentiated Services Code Point (DSCP) value in the DiffServ field of the IP header (either IPv4 or IPv6). The following table shows the standard DSCP values:

Table 1: Standard DSCP Values

Value	List of DSCP Values
af11	AF11 dscp (001010)—decimal value 10
af12	AF12 dscp (001100)—decimal value 12
af13	AF13 dscp (001110)—decimal value 14
af21	AF21 dscp (010010)—decimal value 18
af22	AF22 dscp (010100)—decimal value 20
af23	AF23 dscp (010110)—decimal value 22
af31	AF31 dscp (011010)—decimal value 26
af32	AF40 dscp (011100)—decimal value 28
af33	AF33 dscp (011110)—decimal value 30
af41	AF41 dscp (100010)—decimal value 34
af42	AF42 dscp (100100)—decimal value 36
af43	AF43 dscp (100110)—decimal value 38
cs1	CS1 (precedence 1) dscp (001000)—decimal value 8
cs2	CS2 (precedence 2) dscp (010000)—decimal value 16
cs3	CS3 (precedence 3) dscp (011000)—decimal value 24
cs4	CS4 (precedence 4) dscp (100000)—decimal value 32
cs5	CS5 (precedence 5) dscp (101000)—decimal value 40
cs6	CS6 (precedence 6) dscp (110000)—decimal value 48

Value	List of DSCP Values
cs7	CS7 (precedence 7) dscp (111000)—decimal value 56
default	Default dscp (000000)—decimal value 0
ef	EF dscp (101110)—decimal value 46

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type qos** *class-name*
3. switch(config-cmap-qos)# **match dscp** *dscp-list*
4. (Optional) switch(config-cmap-qos)# **no match dscp** *dscp-list*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type qos** *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-qos)# **match dscp** *dscp-list*	Configures the traffic class by matching packets based on the values in the *dscp-list* . The standard DSCP values are shown in the preceding table.
Step 4	switch(config-cmap-qos)# **no match dscp** *dscp-list*	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic by matching packets based on the DSCP value in the DiffServ field of the IP header:

```
switch# configure terminal
switch(config)# class-map type qos class_dscp
switch(config-cmap-qos)# match  dscp af21, af32
```

Use the **show class-map** command to display the DSCP class-map configuration:

```
switch# show class-map class_dscp
```

Configuring IP RTP Classification

The IP Real-time Transport Protocol (RTP) is a transport protocol for real-time applications that transmits data such as audio or video and is defined by RFC 3550. Although RTP does not use a common TCP or UDP

port, you typically configure RTP to use ports 16384 to 32767. UDP communications use an even port and the next higher odd port is used for RTP Control Protocol (RTCP) communications.

You can classify based on UDP port ranges, which are likely to target applications using RTP.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type qos** *class-name*
3. switch(config-cmap-qos)# **match ip rtp** *port-number*
4. (Optional) switch(config-cmap-qos)# **no match ip rtp** *port-number*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type qos** *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-qos)# **match ip rtp** *port-number*	Configures the traffic class by matching packets based on a range of lower and upper UDP port numbers, which is likely to target applications using RTP. Values can range from 2000 to 65535.
Step 4	switch(config-cmap-qos)# **no match ip rtp** *port-number*	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic by matching packets based on UDP port ranges that are typically used by RTP applications:

```
switch# configure terminal
switch(config)# class-map type qos class_rtp
switch(config-cmap-qos)# match  ip rtp 2000-2100, 4000-4100
```

Use the **show class-map** command to display the RTP class-map configuration:

```
switch# show class-map class_rtp
```

Configuring Precedence Classification

You can classify traffic based on the precedence value in the type of service (ToS) byte field of the IP header (either IPv4 or IPv6). The following table shows the precedence values:

Table 2: Precedence Values

Value	List of Precedence Values
<0-7>	IP precedence value

Value	List of Precedence Values
critical	Critical precedence (5)
flash	Flash precedence (3)
flash-override	Flash override precedence (4)
immediate	Immediate precedence (2)
internet	Internetwork control precedence (6)
network	Network control precedence (7)
priority	Priority precedence (1)
routine	Routine precedence (0)

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type qos** *class-name*
3. switch(config-cmap-qos)# **match precedence** *precedence-values*
4. (Optional) switch(config-cmap-qos)# **no match precedence** *precedence-values*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type qos** *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-qos)# **match precedence** *precedence-values*	Configures the traffic class by matching packets based on *precedence-values* . Values are shown in the preceding table.
Step 4	switch(config-cmap-qos)# **no match precedence** *precedence-values*	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic by matching packets based on the precedence value in the ToS byte field of the IP header:

```
switch# configure terminal
switch(config)# class-map type qos class_precedence
switch(config-cmap-qos)# match precedence 1-2, critical
```

Use the **show class-map** command to display the IP precedence value class-map configuration:

```
switch# show class-map class_precedence
```

Configuring Protocol Classification

You can classify traffic based on the protocol field in the IP header. The following table shows the protocol arguments:

Table 3: Protocol Arguments

Argument	Description
arp	Address Resolution Protocol (ARP)
clns_es	CLNS End Systems
clns_is	CLNS Intermediate System
dhcp	Dynamic Host Configuration (DHCP)
ldp	Label Distribution Protocol (LDP)
netbios	NetBIOS Extended User Interface (NetBEUI)

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type qos** *class-name*
3. switch(config-cmap-qos)# **match protocol** {**arp** | **clns_es** | **clns_is** | **dhcp** | **ldp** | **netbios**}
4. (Optional) switch(config-cmap-qos)# **no match protocol** {**arp** | **clns_es** | **clns_is** | **dhcp** | **ldp** | **netbios**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type qos** *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-qos)# **match protocol** {**arp** | **clns_es** | **clns_is** | **dhcp** | **ldp** | **netbios**}	Configures the traffic class by matching packets based on the specified protocol.

	Command or Action	Purpose
Step 4	switch(config-cmap-qos)# **no match protocol** {**arp** | **clns_es** | **clns_is** | **dhcp** | **ldp** | **netbios**}	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic by matching packets based on the protocol field:

```
switch# configure terminal
switch(config)# class-map type qos class_protocol
switch(config-cmap-qos)# match protocol arp
```

Use the **show class-map** command to display the protocol class-map configuration:

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

Configuring QoS Group Classification

You can classify traffic based on the value of the QoS group internal label, that represents a system class. You can set the value of the QoS group within a policy map using the **set qos-group** command.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **class-map type** {**network-qos** | **queuing**} *class-name*
3. switch(config-cmap-que)# **match qos-group** *qos-group-value*
4. (Optional) switch(config-cmap-que)# **no match qos-group** *qos-group-value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **class-map type** {**network-qos** | **queuing**} *class-name*	Creates a named object that represents a class of traffic. Class-map names can contain alphabetic, hyphen, or underscore characters, are case sensitive, and can be up to 40 characters.
Step 3	switch(config-cmap-que)# **match qos-group** *qos-group-value*	Configures the traffic class by matching packets based on a list of QoS group values. Values can range from 0 to 5. QoS group 0 is equivalent to class-default and QoS group 1 is equivalent to class-fcoe. **Note** qos-groups 0 and 1 are reserved for default classes and cannot be configured.
Step 4	switch(config-cmap-que)# **no match qos-group** *qos-group-value*	(Optional) Removes the match from the traffic class.

This example shows how to classify traffic based on the value of the QoS group:

```
switch# configure terminal
switch(config)# class-map type queuing class_qos_group
switch(config-cmap-que)# match qos-group 4
```

Use the **show class-map** command to display the QoS group class-map configuration:

```
switch# show class-map class_qos_group
```

Configuring 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 switch 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 5548 switch 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

Beginning with Cisco NX-OS Release 5.0(2)N1(1), for the Cisco Nexus 5548 switch, 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 5548 switch 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 switch 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.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **policy-map** [**type** {**network-qos** | **qos** | **queuing**}] *policy-name*
3. (Optional) switch(config)# **no policy-map** [**type** {**network-qos** | **qos** | **queuing**}] *policy-name*
4. switch(config-pmap)# **class** [**type** {**network-qos** | **qos** | **queuing**}] *class-name*
5. (Optional) switch(config-pmap)# **no class** [**type** {**network-qos** | **qos** | **queuing**}] *class-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters 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)# • 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)#

	Command or Action	Purpose
		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.

Beginning with Cisco Release NX-OS Release 5.0(2)N1(1), for the Cisco Nexus 5548 switch, you can set a maximum of five qos groups for ingress traffic.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **policy-map type qos** *policy-name*
3. switch(config-pmap-qos)# **class type qos** *class-name*
4. switch(config-pmap-c-qos)# **set qos-group** *qos-group-value*
5. (Optional) switch(config-pmap-c-qos)# **no set qos-group** *qos-group-value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters 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 type 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-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 5020 switch and the Cisco Nexus 5010 switch, the range is from 2-5. For the Cisco Nexus 5548 switch, the range is from 1 to 5.

	Command or Action	Purpose
		Note The Cisco Nexus 5000 Series switch can only support a maximum of five qos-groups within this range.
Step 5	switch(config-pmap-c-qos)# **no set qos-group** *qos-group-value*	(Optional) Removes the **qos-group** values from this class.

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.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **policy-map type network-qos** *policy-name*
3. switch(config-pmap-nq)# **class type network-qos** *class-name*
4. switch(config-pmap-c-nq)# **mtu** *mtu-value*
5. (Optional) switch(config-pmap-c-nq)# **no mtu**
6. switch(config-pmap-c-nq)# **multicast-optimize**
7. (Optional) switch(config-pmap-c-nq)# **no multicast-optimize**
8. switch(config-pmap-c)# **pause no-drop** [**pfc-cos** *pfc-cos-value*]
9. (Optional) switch(config-pmap-c-nq)# **no pause no-drop**
10. switch(config-pmap-c-nq)# **queue-limit** *number-bytes* **bytes**
11. (Optional) switch(config-pmap-c-nq)# **no queue-limit** *number-bytes* **bytes**
12. switch(config-pmap-c-nq)# **set cos** *cos-value*
13. (Optional) switch(config-pmap-c-nq)# **no set cos** *cos-value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.

	Command or Action	Purpose
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)# **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.
Step 7	switch(config-pmap-c-nq)# **no multicast-optimize**	(Optional) Disables multicast optimization.
Step 8	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 9	switch(config-pmap-c-nq)# **no pause no-drop**	(Optional) Removes the no-drop option from this class.
Step 10	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. **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.

	Command or Action	Purpose
Step 11	switch(config-pmap-c-nq)# **no queue-limit** *number-bytes* **bytes**	(Optional) Disables the queue limit specification in this class.
Step 12	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 13	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)# pause no-drop pfc-cos 1-3,5
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.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **policy-map type queuing** *policy-name*
3. switch(config-pmap-que)# **class type queuing** *class-name*
4. switch(config-pmap-c-que)# **bandwidth percent** *percentage*
5. (Optional) switch(config-pmap-c-que)# **no bandwidth percent** *percentage*
6. switch(config-pmap-c-que)# **priority**
7. (Optional) switch(config-pmap-c-que)# **no priority**

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters 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.

	Command or Action	Purpose
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)# **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 5	switch(config-pmap-c-que)# **no bandwidth percent** *percentage*	(Optional) Removes the bandwidth specification from this class.
Step 6	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 7	switch(config-pmap-c-que)# **no priority**	(Optional) Removes the strict priority queuing from the traffic in this class.

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

```
switch# configure terminal
switch(config)# policy-map type queuing policy-queue1
switch(config-pmap-que)# class type queuing class-queue1
switch(config-pmap-c-que)# bandwidth 20
```

Information About Marking

Marking is a method that you use to modify the QoS fields of the incoming and outgoing packets. The QoS fields that you can mark are CoS, IP precedence, and Differentiated Service Code Point (DSCP).

You can use marking commands in traffic classes that are referenced in a policy map. The marking features that you can configure are listed below:

- DSCP (Supported only on the Cisco Nexus 5548 switch.)
- IP precedence
- CoS

Configuring CoS Marking

You can set the value of the CoS field in the high-order three bits of the VLAN ID Tag field in the IEEE 802.1Q header.

SUMMARY STEPS

1. **config t**
2. **policy-map** [**type network-qos**] *policy-map name*
3. **class** [**type network-qos**] {*class-map name* |**class-default**}
4. **set cos** *cos-value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**config t**	Enters configuration mode.
Step 2	**policy-map** [**type network-qos**] *policy-map name*	Creates or accesses the policy map named policy-map-name, and then enters policy-map mode. The policy-map name can contain alphabetic, hyphen, or underscore characters, is case sensitive, and can be up to 40 characters.
Step 3	**class** [**type network-qos**] {*class-map name* |**class-default**}	Creates a reference to class-map-name, and enters policy-map class configuration mode. Use the **class-default** keyword to select all traffic that is not currently matched by classes in the policy map.
Step 4	**set cos** *cos-value*	Sets the CoS value to cos-value. The value can range from 0 to 7. You can use this command only in egress policies.

Attaching the System Service Policy

You can use the **service-policy** command to associate the system class policy map as the service policy for the system.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **system qos**
3. switch(config-sys-qos)# **service-policy type** {**network-qos** | **qos** | **queuing**} [**input** | **output**] *policy-name*
4. (Optional) switch(config-sys-qos)# **service-policy type** {**network-qos** | **qos** | **queuing**} [**input** | **output**] *fcoe default policy-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **system qos**	Enters system class configuration mode.

	Command or Action	Purpose
Step 3	switch(config-sys-qos)# **service-policy type** {**network-qos** | **qos** | **queuing**} [**input** | **output**] *policy-name*	Specifies the policy map to use as the service policy for the system. There are three policy-map configuration modes: • network-qos—Network-wide (system qos) mode. • qos—Classification mode (system qos input or interface input only). • queuing—Queuing mode (input and output at system qos and interface). **Note** There is no default policy-map configuration mode; you must specify the **type**. The **input** keyword specifies that this policy map should be applied to traffic received on an interface. The **output** keyword specifies that this policy-map should be applied to traffic transmitted from an interface. You can only apply **input** to a qos policy; you can apply both **input** and **output** to a queuing policy.
Step 4	switch(config-sys-qos)# **service-policy type** {**network-qos** | **qos** | **queuing**} [**input** | **output**] *fcoe default policy-name*	(Optional) Specifies the default FCoE policy map to use as the service policy for the system. 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** Befoe enabling FCoE on the Cisco Nexus 5548 switch, you must attach the pre-defined FCoE policy maps to the type qos, type network-qos, and type queuing policy maps.

This example shows how to set a no-drop Ethernet policy map as the system class:

```
switch(config)# class-map type network-qos ethCoS4
switch(config-cmap-nq)# match qos-group
switch(config-cmap-nq)# exit
switch(config)# policy-map type network-qos ethNoDrop
switch(config-pmap-nq)# class type network-qos ethCoS4
switch(config-pmap-c-nq)# pause no-drop
switch(config-pmap-c-nq)# exit
switch(config-pmap-nq)# exit
switch(config)# system qos
switch(config-sys-qos)# service-policy type network-qos ethNoDrop
```

Restoring the Default System Service Policies

If you have created and attached new policies to the system qos configuration, enter the **no** form of the command to reapply the default policies.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **system qos**
3. switch(config-sys-qos)# **no service-policy type qos input** *policy-map name*
4. switch(config-sys-qos)# **no service-policy type network-qos** *policy-map name*
5. switch(config-sys-qos)# **no service-policy type queuing output** *policy-map name*
6. switch(config-sys-qos)# **no service-policy type queuing input** *policy-map name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **system qos**	Enters system class configuration mode.
Step 3	switch(config-sys-qos)# **no service-policy type qos input** *policy-map name*	Resets the classification mode policy map. This policy-map configuration is for system qos input or interface input only:
Step 4	switch(config-sys-qos)# **no service-policy type network-qos** *policy-map name*	Resets the network-wide policy map.
Step 5	switch(config-sys-qos)# **no service-policy type queuing output** *policy-map name*	Resets the output queuing mode policy map.
Step 6	switch(config-sys-qos)# **no service-policy type queuing input** *policy-map name*	Resets the input queuing mode policy map.

This example shows how to reset the system qos configuration:

```
switch# configure terminal
switch(config)# system qos
switch(config-sys-qos)# no service-policy type qos input my-in-policy
switch(config-sys-qos)# no service-policy type network-qos my-nq-policy
switch(config-sys-qos)# no service-policy type queuing output my-out-policy
switch(config-sys-qos)# no service-policy type queuing input my-in-policy
```

The default service policies are shown in this example:

```
switch# show policy-map


   Type qos policy-maps
   ====================

   policy-map type qos default-in-policy
     class type qos class-fcoe
       set qos-group 1
     class type qos class-default
       set qos-group 0

   Type queuing policy-maps
   ========================
```

```
policy-map type queuing default-in-policy
  class type queuing class-fcoe
    bandwidth percent 50
  class type queuing class-default
    bandwidth percent 50
policy-map type queuing default-out-policy
  class type queuing class-fcoe
    bandwidth percent 50
  class type queuing class-default
    bandwidth percent 50


Type network-qos policy-maps
==============================

policy-map type network-qos default-nq-policy
  class type network-qos class-fcoe
    pause no-drop
    mtu 2240
  class type network-qos class-default
    mtu 1538
```

Configuring the Queue Limit for Fabric Extenders

At the system level, you can enable or disable tail drop for Fabric Extenders for egress direction (from the network to the host).

By default, the tail drop threshold applies to each Fabric Extender port to limit the amount of buffer allocated to each port. To restore the default queue limit, use the **fex queue-limit** command. To disable the tail drop threshold and to allow Fabric Extender ports to use all available buffer space, use the **no** form of this command.

Note You can also set the queue limit for a specified Fabric Extender by using the **hardware** *fex-card-type* **queue-limit** command. Configuring specific Fabric Extenders overrides the queue limit configuration set at the global system level for that Fabric Extender.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **system qos**
3. switch(config-sys-qos)# **fex queue-limit**
4. switch(config-sys-qos)# **no fex queue-limit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **system qos**	Enters system class configuration mode.
Step 3	switch(config-sys-qos)# **fex queue-limit**	Limits the amount of input buffer space allocated to each Fabric Extender port.

	Command or Action	Purpose
Step 4	switch(config-sys-qos)# **no fex queue-limit**	Allows a Fabric Extender port to use all available buffer space.

This example shows how to set the queue limit for the input buffer for each Fabric Extender port:

```
switch# configure terminal
switch(config)# system qos
switch(config-sys-qos)# fex queue-limit
```

This example shows how to remove the queue limit that is enabled by default:

```
switch# configure terminal
switch(config)# system qos
switch(config-sys-qos)# no fex queue-limit
```

Enabling the Jumbo MTU

You can enable the jumbo MTU for the whole switch by setting the MTU to its maximum size (9216 bytes) in the policy map for the default Ethernet system class (class-default).

This example shows how to configure the default Ethernet system class to support the jumbo MTU:

```
switch(config)# policy-map type network-qos jumbo
switch(config-pmap-nq)# class type network-qos class-default
switch(config-pmap-c-nq)# mtu 9216
switch(config-pmap-c-nq)# exit
switch(config-pmap-nq)# exit
switch(config)# system qos
switch(config-sys-qos)# service-policy type network-qos jumbo
```

Note The **system jumbomtu** command defines the maximum MTU size for the switch. However, jumbo MTU is only supported for system classes that have MTU configured.

Verifying the Jumbo MTU

To verify that the jumbo MTU is enabled, enter the **show interface ethernet** *slot*/*port* command for an Ethernet interface that carries traffic with jumbo MTU.

This example shows how to display summary jumbo MTU information for Ethernet 1/2 (the relevant part of the output is shown in bold font):

```
switch# show interface ethernet 1/2
Ethernet1/2 is up
...
    Rx
    1547805598 Input Packets 1547805596 Unicast Packets 0 Multicast Packets
    0 Broadcast Packets 1301767362 Jumbo Packets 33690 Storm Suppression Packets
    7181776513802 Bytes
    Tx
    1186564478 Output Packets 7060 Multicast Packets
    0 Broadcast Packets 997813205 Jumbo Packets
    4813632103603 Bytes
...
```

This example shows how to display detailed jumbo MTU information for Ethernet 1/2 (the relevant part of the output is shown in bold font):

```
switch# show interface ethernet 1/2 counters detailed
Rx Packets: 1547805598
Rx Unicast Packets: 1547805596
Rx Jumbo Packets: 1301767362
Rx Bytes: 7181776513802
Rx Storm Suppression: 33690
Rx Packets from 0 to 64 bytes: 169219
Rx Packets from 65 to 127 bytes: 10657133
Rx Packets from 128 to 255 bytes: 21644488
Rx Packets from 256 to 511 bytes: 43290596
Rx Packets from 512 to 1023 bytes: 86583071
Rx Packets from 1024 to 1518 bytes: 83693729
Rx Trunk Packets: 1547805596
Tx Packets: 1186564481
Tx Unicast Packets: 1005445334
Tx Multicast Packets: 7063
Tx Jumbo Packets: 997813205
Tx Bytes: 4813632103819
Tx Packets from 0 to 64 bytes: 137912
Tx Packets from 65 to 127 bytes: 8288443
Tx Packets from 128 to 255 bytes: 16596457
Tx Packets from 256 to 511 bytes: 33177999
Tx Packets from 512 to 1023 bytes: 66363944
Tx Packets from 1024 to 1518 bytes: 64186521
Tx Trunk Packets: 1005451729
```

Configuring QoS on Interfaces

Configuring Untagged CoS

Any incoming packet not tagged with an 802.1p CoS value is assigned the default untagged CoS value of zero (which maps to the default Ethernet drop system class). You can override the default untagged CoS value for an Ethernet or EtherChannel interface.

Note Beginning with Cisco NX-OS Release 5.0(2)N1(1), on the Cisco Nexus 5548 switch, you can configure qos policy and untagged cos on the same interface.

On the Cisco Nexus 5010 switch and the Cisco Nexus 5020 switch, untagged CoS and type QoS input policies are mutually exclusive on an Ethernet or EtherChannel interface. If a type qos policy is configured at the interface, untagged frames received over that interface will not match any **match cos 0** commands in the policy.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **interface** {**ethernet** [*chassis*/]*slot*/*port* | **port-channel** *channel-number*}
3. switch(config-if)# **untagged cos** *cos-value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** {**ethernet** [*chassis*/]*slot*/*port* | **port-channel** *channel-number*}	Enters configuration mode for the specified interface or port channel.
Step 3	switch(config-if)# **untagged cos** *cos-value*	Configures the untagged CoS value.

Configuring Interface Service Policy

An input qos policy is a service policy applied to incoming traffic on an Ethernet interface for classification. For type queuing, the output policy is applied to all outgoing traffic that matches the specified class. When you configure an input queuing policy on an interface or EtherChannel, the switch sends the configuration data to the adapter using the DCBX protocol.

Note Type qos policies can be activated only on Cisco Nexus 5000 Series interfaces and Cisco Nexus 2000 Series Fabric Extender interfaces. Type qos policies on Fabric Extender fabric interfaces or Fabric Extender fabric EtherChannel interfaces are ineffective, though the Cisco NX-OS CLI does not reject the configuration.

We recommend that you do not configure type qos policy-maps on Fabric Extender fabric interfaces or Fabric Extender fabric EtherChannel interfaces to avoid wasting hardware resources.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **interface** {**ethernet** [*chassis*/]*slot*/*port* | **port-channel** *channel-number*}
3. switch(config-if)# **service-policy** [**type** {**qos** | **queuing**}] [**input** | **output**]*policy-name*
4. switch(config-if)# **service-policy input** *policy-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** {**ethernet** [*chassis*/]*slot*/*port* | **port-channel** *channel-number*}	Enters configuration mode for the specified interface. **Note** The service policy on a port channel applies to all member interfaces.
Step 3	switch(config-if)# **service-policy** [**type** {**qos** | **queuing**}] [**input** | **output**]*policy-name*	Specifies the policy map to use as the service policy for the system. There are two policy-map configuration modes: • qos—Classification mode; this is the default mode. • queuing—Queuing mode. **Note** The **input** keyword specifies that this policy map should be applied to traffic received on an interface. The **output** keyword specifies that this policy map should be applied to traffic transmitted from an interface. You can only apply **input** to a qos policy; you can apply both **input** and **output** to a queuing policy.
Step 4	switch(config-if)# **service-policy input** *policy-name*	Applies the policy map to the interface. **Note** There is a restriction that system type qos policy cannot be the same as any the type qos policy applied to an interface or EtherChannel.

This example shows how to apply a policy to an Ethernet interface:

```
switch# configure terminal
switch(config)# interface ethernet 1/1
switch(config-if)# service-policy type qos input policy1
```

Configuring the Queue Limit for a Specified Fabric Extender

At the Fabric Extender configuration level, you can control the queue limit for a specified Fabric Extender for egress direction (from the network to the host). You can use a lower queue limit value on the Fabric Extender to prevent one blocked receiver from affecting traffic that is sent to other noncongested receivers ("head-of-line blocking"). A higher queue limit provides better burst absorption and less head-of-line blocking protection. You can use the **no** form of this command to allow the Fabric Extender to use all available hardware space.

Note At the system level, you can set the queue limit for Fabric Extenders by using the **fex queue-limit** command. However, configuring the queue limit for a specific Fabric Extender will override the queue limit configuration set at the system level for that Fabric Extender.

You can specify the queue limit for the following Fabric Extenders:

- Cisco Nexus 2148T Fabric Extender (48x1G 4x10G SFP+ Module)
- Cisco Nexus 2224TP Fabric Extender (24x1G 2x10G SFP+ Module)
- Cisco Nexus 2232P Fabric Extender (32x10G SFP+ 8x10G SFP+ Module)
- Cisco Nexus 2248T Fabric Extender (48x1G 4x10G SFP+ Module)

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **fex** *fex-id*
3. switch(config-fex)# **hardware** *fex_card_type* **queue-limit** *queue-limit*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **fex** *fex-id*	Specifies the Fabric Extender and enters the Fabric Extender mode.
Step 3	switch(config-fex)# **hardware** *fex_card_type* **queue-limit** *queue-limit*	Configures the queue limit for the specified Fabric Extender. The queue limit is specified in bytes. The range is from 81920 to 652800 for a Cisco Nexus 2148T Fabric Extender and from 2560 to 652800 for all other supported Fabric Extenders.

This example shows how to restore the default queue limit on a Cisco Nexus 2248T Fabric Extender:

```
switch# configure terminal
switch(config-if)# fex 101
switch(config-fex)# hardware N2248T queue-limit 327680
```

This example shows how to remove the queue limit that is set by default on a Cisco Nexus 2248T Fabric Extender:

```
switch# configure terminal
switch(config)# fex 101
switch(config-fex)# no hardware N2248T queue-limit 327680
```

Configuring No-Drop Buffer Thresholds

Beginning with Cisco NX-OS Release 5.0(2)N1(1), you can configure the no-drop buffer threshold settings for 3000m lossless Ethernet.

Note To achieve lossless Ethernet for both directions, the devices connected to the Cisco Nexus 5548 switch must have the similar capability. The default buffer and threshold value for the no-drop can ensure lossless Ethernet for up to 3000 meters.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **policy-map type network-qos** *policy-map name*
3. switch(config-pmap-nq)# **class type network-qos** *class-map name*
4. switch(config-pmap-nq-c)# **pause no-drop buffer-size** *buffer-size* **pause-threshold** *xoff-size* **resume-threshold** *xon-size*
5. (Optional) switch(config-pmap-nq-c)# **no pause no-drop buffer-size** *buffer-size* **pause-threshold** *xoff-size* **resume-threshold** *xon-size*
6. switch(config-pmap-nq-c)# **exit**
7. switch(config-pmap-nq)# **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **policy-map type network-qos** *policy-map name*	Enters policy-map network-qos class mode and identifies the policy map assigned to the type network-qos policy map.
Step 3	switch(config-pmap-nq)# **class type network-qos** *class-map name*	References an existing network QoS class map in a policy map and enters class mode.
Step 4	switch(config-pmap-nq-c)# **pause no-drop buffer-size** *buffer-size* **pause-threshold** *xoff-size* **resume-threshold** *xon-size*	Specifies the buffer threshold settings for pause and resume for 3000m lossless Ethernet: • buffer-size—Buffer size for ingress traffic, in bytes. Valid values are from 10240 to 490880. **Note** On a Cisco Nexus 5020 switch, you can configure a maximum buffer size of 143680 bytes. On a Cisco Nexus 5548 switch, you can configure a maximum buffer size of 152000 bytes. • pause-threshold—Specifies the buffer limit at which the port pauses the peer. • xoff-size—Buffer limit for pausing, in bytes. Valid values are 0 to 490880.

	Command or Action	Purpose
		Note On a Cisco Nexus 5020 switch, you can configure a maximum pause-threshold value of 58860 bytes. On a Cisco Nexus 5548 switch, you can configure a maximum pause-threshold value of 103360 bytes. • resume-threshold—Specifies the buffer limit at which the port resumes the peer. • xon-size—Buffer limit at which to resume, in bytes. Valid values are 0 to 490880. **Note** On a Cisco Nexus 5020 switch, you can configure a maximum resume-threshold value of 38400 bytes. On a Cisco Nexus 5548 switch, you can configure a maximum resume-threshold value of 83520 bytes.
Step 5	switch(config-pmap-nq-c)# **no pause no-drop buffer-size** *buffer-size* **pause-threshold** *xoff-size* **resume-threshold** *xon-size*	(Optional) Removes the buffer threshold settings for pause and resume for 3000m lossless Ethernet.
Step 6	switch(config-pmap-nq-c)# **exit**	Exits class mode.
Step 7	switch(config-pmap-nq)# **exit**	Exits policy-map network-qos mode.

This example shows how to configure the no-drop buffer threshold for the Cisco Nexus 5548 switch.

```
switch(config-pmap-nq)# policy-map type network-qos nqos_policy
switch(config-pmap-nq)# class type network-qos nqos_class
switch(config-pmap-nq-c)# pause no-drop buffer-size 152000
pause-threshold 103360 resume-threshold 83520
switch(config-pmap-nq-c)# exit
switch(config-pmap-nq)# exit
switch(config)# exit
switch#
```

This example shows how to configure the no-drop buffer threshold for the Cisco Nexus 5020 switch.

```
switch(config)# policy-map type network-qos pu-buffer
switch(config-pmap-nq)# class type network-qos cu1
switch(config-pmap-nq-c)# pause no-drop buffer-size 143680
pause-threshold 58860 resume-threshold 38400
switch(config-pmap-nq-c)# exit
switch(config-pmap-nq)# exit
switch(config)# exit
switch#
```

Configuring the Buffer Threshold for the Cisco Nexus 2148T Fabric Extender

In the Fabric Extender configuration mode, you can configure the buffer threshold for the Cisco Nexus 2148T Fabric Extender. The buffer threshold sets the consumption level of input buffers before an indication is sent

to the egress queue to start observing the tail drop threshold. If the buffer usage is lower than the configured buffer threshold, the tail drop threshold is ignored.

Note In Cisco NX-OS Release 4.2(1)N2(1), this command is supported only on the Cisco Nexus 2148T Fabric Extender.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **fex** *fex-id*
3. switch(config-fex)# **hardware N2148T buffer-threshold** *buffer limit*

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **fex** *fex-id*	Specifies the Fabric Extender and enters the Fabric Extender mode.
Step 3	switch(config-fex)# **hardware N2148T buffer-threshold** *buffer limit*	Configures the buffer threshold for the Cisco Nexus 2148T Fabric Extender. The buffer threshold is specified in bytes. The range is from 81920 to 316160 for the Cisco Nexus 2148T Fabric Extender.

This example shows how to restore the default buffer threshold on the Cisco Nexus 2148T Fabric Extender:

```
switch# configure terminal
switch(config)# fex 101
switch(config-fex)# hardware N2148T buffer-threshold 163840
```

This example shows how to remove the default buffer threshold on the Cisco Nexus 2148T Fabric Extender:

```
switch# configure terminal
switch(config)# fex 101
switch(config-fex)# no hardware N2148T buffer-threshold
```

Configuring Priority Flow Control and Link-Level Flow Control

Cisco Nexus 5000 Series switches support priority flow control (PFC) and Link-Level Flow Control (LLC) on Ethernet interfaces. The Ethernet interface can operate in two different modes: FCoE mode or standard Ethernet mode.

If the interface is operating in FCoE mode, the Ethernet link is connected at the server port using a converged network adapter (CNA).

If the interface is operating in a standard Ethernet mode, the Ethernet link is connected at the server port with a standard Ethernet network adapter (NIC). The network adapter must support the Data Center Bridging Exchange protocol (DCBX) for PFC or ingress policing to be supported on the interface.

Note You must configure a system class with the pause no-drop parameter for PFC to operate on Ethernet traffic (PFC will be applied to traffic that matches the CoS value configured for this class).

Configuring Priority Flow Control

By default, Ethernet interfaces negotiate PFC with the network adapter using the DCBX protocol. When PFC is enabled, PFC is applied to traffic that matches the CoS value configured for the no-drop class.

You can override the negotiation result by forcing the interface to enable PFC.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **interface** *type slot/port*
3. switch(config-if)# **priority-flow-control mode** {**auto** | **on**}
4. (Optional) switch(config-if)# **no priority-flow-control mode on**

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Specifies the interface to be changed.
Step 3	switch(config-if)# **priority-flow-control mode** {**auto** | **on**}	Sets PFC mode for the selected interface. Specifies auto to negotiate PFC capability. This is the default. Specifies on to force-enable PFC.
Step 4	switch(config-if)# **no priority-flow-control mode on**	(Optional) Disables the PFC setting for the selected interface.

This example shows how to force-enable PFC on an interface:

```
switch# configure terminal
switch(config)# interface ethernet 1/2
switch(config-if)# priority-flow-control mode on
```

Configuring Link-Level Flow Control

By default, LLC on Ethernet interfaces is disabled. You can enable LLC for the transmit and receive directions.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **interface** *type slot/port*
3. switch(config-if)# **flowcontrol** [**receive** {**on** | **off**}] [**transmit** {**on** | **off**}]
4. (Optional) switch(config-if)# **no flowcontrol** [**receive** {**on** | **off**}] [**transmit** {**on** | **off**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Specifies the interface to be changed.
Step 3	switch(config-if)# **flowcontrol** [**receive** {**on** | **off**}] [**transmit** {**on** | **off**}]	Enables LLC for the selected interface. Set **receive** and/or **transmit on** or **off**.
Step 4	switch(config-if)# **no flowcontrol** [**receive** {**on** | **off**}] [**transmit** {**on** | **off**}]	(Optional) Disables LLC for the selected interface.

This example shows how to enable LLC on an interface:

```
switch# configure terminal
switch(config)# interface ethernet 1/2
switch(config-if)# flowcontrol receive on transmit on
```

Enabling Virtual Output Queuing Limits for Unicast Traffic on the Cisco Nexus 5548 Switch

You can enable the Virtual Output Queuing (VOQ) limit for unicast traffic. To alleviate congestion and blocking, use VOQ to prevent one blocked receiver from affecting traffic that is sent to other noncongested blocking receivers.

SUMMARY STEPS

1. switch# **configure terminal**
2. switch(config)# **hardware unicast voq-limit**
3. switch(config)# **no hardware unicast voq-limit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **hardware unicast voq-limit**	Enables the VOQ limit for unicast traffic. The default is disabled.
Step 3	switch(config)# **no hardware unicast voq-limit**	Disables the VOQ limit for unicast traffic.

This example shows how to enable the VOQ limits for unicast packets on a switch:

```
switch(config)# hardware unicast voq-limit
switch(config)#
```

Verifying QoS Configuration

To verify QoS configuration information, perform one of these tasks:

Command	Purpose
switch# **show class-map**	Displays the class maps defined on the switch.
switch# **show policy-map** [*name*]	Displays the policy maps defined on the switch. Optionally, you can display the named policy only.
switch# **show policy-map interface** [*interface number*]	Displays the policy map settings for an interface or all interfaces.
switch# **show policy-map system**	Displays the policy map settings attached to the system qos.
switch# **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.
switch# **show queuing interface** [*interface number*]	Displays the queue configuration and statistics.

You can clear the QoS policy statistics.

Command	Purpose
switch# **clear qos statistics**	Clears the policy statistics.

This example shows how to display the class maps defined on the switch:

```
switch# show class-map


  Type qos class-maps
  ===================

    class-map type qos c1
      match cos 0,7

    class-map type qos c2
      match protocol ldp
      match ip rtp 2000-65535
      match dscp 10,12
      match precedence 6-7
      match protocol dhcp
      match protocol arp

    class-map type qos c3
      match cos 2,4-6

    class-map type qos c4
      match access-group name ipv4

    class-map type qos class-fcoe
      match cos 3

    class-map type qos class-default
      match any

    class-map type qos class-ip-multicast
      match ip multicast


  Type queuing class-maps
  =======================

    class-map type queuing c1
      match qos-group 2

    class-map type queuing c2
      match qos-group 3

    class-map type queuing c3
      match qos-group 4

    class-map type queuing class-fcoe
      match qos-group 1

    class-map type queuing class-default
      match qos-group 0


  Type network-qos class-maps
  ===============================

    class-map type network-qos c1
      match qos-group 2

    class-map type network-qos c2
      match qos-group 3

    class-map type network-qos c3
      match qos-group 4

    class-map type network-qos c4
      match qos-group 5

    class-map type network-qos class-fcoe
      match qos-group 1
```

```
    class-map type network-qos class-default
      match qos-group 0
```

This example shows how to display the policy maps defined on the switch:

```
switch# show policy-map


  Type qos policy-maps
  ====================

  policy-map type qos p1
    class type qos c1
      set qos-group 2
    class type qos c3
      set qos-group 4
    class type qos c4
      set qos-group 5
    class type qos c2
      set qos-group 3
    class type qos c22
      set qos-group 3
    class type qos class-fcoe
      set qos-group 1
    class type qos class-default
      set qos-group 0


  Type queuing policy-maps
  ========================

  policy-map type queuing p1
    class type queuing c2
      bandwidth percent 10
    class type queuing c4
      bandwidth percent 25
    class type queuing c1
      bandwidth percent 20
    class type queuing c3
      bandwidth percent 5
    class type queuing class-fcoe
      bandwidth percent 30
    class type queuing class-default
      bandwidth percent 10


  Type network-qos policy-maps
  ================================

  policy-map type network-qos p1
    class type network-qos c1
      mtu 5000
    class type network-qos c2
      mtu 9216
      queue-limit 30000 bytes
    class type network-qos c3
      mtu 8000
    class type network-qos c4
      pause no-drop
    class type network-qos class-fcoe
      pause no-drop
      mtu 2240
    class type network-qos class-default
      mtu 1538
```

This example shows how to display the policy maps attached on the system qos:

```
switch# show policy-map system


  Type network-qos policy-maps
  ================================
```

```
  policy-map type network-qos p1
    class type network-qos c1      match qos-group 2

      mtu 5000
    class type network-qos c2      match qos-group 3

      mtu 9216
      queue-limit 30000 bytes
    class type network-qos c3      match qos-group 4

      mtu 8000
    class type network-qos c4      match qos-group 5

      pause no-drop
    class type network-qos class-fcoe      match qos-group 1

      pause no-drop
      mtu 2240
    class type network-qos class-default      match qos-group 0

      mtu 1538


  Service-policy (queuing) input:   p1
    policy statistics status:   disabled

    Class-map (queuing):   c2 (match-any)
      Match: qos-group 3
      bandwidth percent 10

    Class-map (queuing):   c4 (match-any)
      Match: qos-group 5
      bandwidth percent 25

    Class-map (queuing):   c1 (match-any)
      Match: qos-group 2
      bandwidth percent 20

    Class-map (queuing):   c3 (match-any)
      Match: qos-group 4
      bandwidth percent 5

    Class-map (queuing):   class-fcoe (match-any)
      Match: qos-group 1
      bandwidth percent 30

    Class-map (queuing):   class-default (match-any)
      Match: qos-group 0
      bandwidth percent 10

  Service-policy (queuing) output:   default-out-policy
    policy statistics status:   disabled

    Class-map (queuing):   class-fcoe (match-any)
      Match: qos-group 1
      bandwidth percent 50

    Class-map (queuing):   class-default (match-any)
      Match: qos-group 0
      bandwidth percent 50
```

This example shows how to display the policy maps attached to an interface:

```
switch# show policy-map interface ethernet 1/1


Global statistics status :   disabled

Ethernet1/1

  Service-policy (qos) input:   p2
    policy statistics status:   disabled
```

```
  Class-map (qos):   c1 (match-any)
    Match: cos 0,7
    set qos-group 2

  Class-map (qos):   c2 (match-any)
    Match: protocol ldp
    Match: ip rtp 2000-65535
    Match: dscp 10,12
    Match: precedence 6-7
    Match: protocol dhcp
    Match: protocol arp
    set qos-group 3

  Class-map (qos):   c3 (match-any)
    Match: cos 2,4-6
    set qos-group 4

  Class-map (qos):   class-ip-multicast (match-any)
    Match: ip multicast
    set qos-group 5
  Class-map (qos):   class-fcoe (match-any)
    Match: cos 3
    set qos-group 1

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

Service-policy (queuing) input:   p1
  policy statistics status:   disabled

  Class-map (queuing):   c2 (match-any)
    Match: qos-group 3
    bandwidth percent 10

  Class-map (queuing):   c4 (match-any)
    Match: qos-group 5
    bandwidth percent 25

  Class-map (queuing):   c1 (match-any)
    Match: qos-group 2
    bandwidth percent 20

  Class-map (queuing):   c3 (match-any)
    Match: qos-group 4
    bandwidth percent 5

  Class-map (queuing):   class-fcoe (match-any)
    Match: qos-group 1
    bandwidth percent 30

  Class-map (queuing):   class-default (match-any)
    Match: qos-group 0
    bandwidth percent 10

Service-policy (queuing) output:   p2
  policy statistics status:   disabled

  Class-map (queuing):   c1 (match-any)
    Match: qos-group 2
    bandwidth percent 5
    priority

  Class-map (queuing):   c2 (match-any)
    Match: qos-group 3
    bandwidth percent 20

  Class-map (queuing):   c3 (match-any)
    Match: qos-group 4
    bandwidth percent 20
```

```
    Class-map (queuing):   c4 (match-any)
      Match: qos-group 5
      bandwidth percent 40

    Class-map (queuing):   class-fcoe (match-any)
      Match: qos-group 1
      bandwidth percent 10

    Class-map (queuing):   class-default (match-any)
      Match: qos-group 0
      bandwidth percent 5
```

This example shows how to display the queue configuration and statistics:

```
switch# show queuing interface ethernet 1/1

Interface Ethernet1/1 TX Queuing
qos-group  sched-type  oper-bandwidth
    0       WRR             5
    1       WRR            10
    2       priority        5
    3       WRR            20
    4       WRR            20
    5       WRR            40

Interface Ethernet1/1 RX Queuing
qos-group  0:
    q-size: 21120, MTU: 1538
    drop-type: drop, xon: 0, xoff: 132
    Statistics:
        Pkts received over the port             : 1265258330
        Ucast pkts sent to the cross-bar        : 0
        Mcast pkts sent to the cross-bar        : 2883444539
        Ucast pkts received from the cross-bar  : 0
        Pkts sent to the port                   : 367529517
        Pkts discarded on ingress               : 781087 (36419)
        Per-priority-pause status               : Rx (Inactive), Tx (Inactive)

qos-group  1:
    q-size: 76800, MTU: 2240
    drop-type: no-drop, xon: 128, xoff: 240
    Statistics:
        Pkts received over the port             : 0
        Ucast pkts sent to the cross-bar        : 0
        Mcast pkts sent to the cross-bar        : 0
        Ucast pkts received from the cross-bar  : 0
        Pkts sent to the port                   : 0
        Pkts discarded on ingress               : 0 (0)
        Per-priority-pause status               : Rx (Inactive), Tx (Inactive)

qos-group  2:
    q-size: 20480, MTU: 5000
    drop-type: drop, xon: 0, xoff: 128
    Statistics:
        Pkts received over the port             : 0
        Ucast pkts sent to the cross-bar        : 0
        Mcast pkts sent to the cross-bar        : 0
        Ucast pkts received from the cross-bar  : 0
        Pkts sent to the port                   : 0
        Pkts discarded on ingress               : 0 (0)
        Per-priority-pause status               : Rx (Inactive), Tx (Inactive)
```

```
qos-group  3:
    q-size: 30080, MTU: 9216
    drop-type: drop, xon: 0, xoff: 188
    Statistics:
        Pkts received over the port             : 0
        Ucast pkts sent to the cross-bar        : 0
        Mcast pkts sent to the cross-bar        : 0
        Ucast pkts received from the cross-bar  : 0
        Pkts sent to the port                   : 0
        Pkts discarded on ingress               : 0 (0)
        Per-priority-pause status               : Rx (Inactive), Tx (Inactive)

qos-group  4:
    q-size: 20480, MTU: 8000
    drop-type: drop, xon: 0, xoff: 128
    Statistics:
        Pkts received over the port             : 0
        Ucast pkts sent to the cross-bar        : 0
        Mcast pkts sent to the cross-bar        : 0
        Ucast pkts received from the cross-bar  : 0
        Pkts sent to the port                   : 0
        Pkts discarded on ingress               : 0(0)
        Per-priority-pause status               : Rx (Inactive), Tx (Inactive)

qos-group  5:
    q-size: 76800, MTU: 1538
    drop-type: no-drop, xon: 128, xoff: 242
    Statistics:
        Pkts received over the port             : 0
        Ucast pkts sent to the cross-bar        : 0
        Mcast pkts sent to the cross-bar        : 0
        Ucast pkts received from the cross-bar  : 0
        Pkts sent to the port                   : 0
        Pkts discarded on ingress               : 0(0)
        Per-priority-pause status               : Rx (Inactive), Tx (Inactive)

Total Multicast crossbar statistics:
    Mcast pkts received from the cross-bar      : 557155515
```

Example QoS Configurations

QoS Example 1

This example shows how to configure traffic in the entire system matching an access control list to have the frame CoS fields rewritten to the value 5.

SUMMARY STEPS

1. Set up the ingress classification policy (the access control list was defined previously).
2. Attach the classification policy to the system.
3. Set up the system class allocation and rewrite policy. Allocate the system class for qos-group 4 and define the rewrite action.
4. Attach the allocation and rewrite policy to the system.

DETAILED STEPS

	Command or Action	Purpose

Step 1	Set up the ingress classification policy (the access control list was defined previously).	`(config)# class-map type qos cmap-qos-acl`
		`(config-cmap-qos)# match access-group ACL-CoS`
		`(config-cmap-qos)# exit`
		`(config)# policy-map type qos pmap-qos-acl`
		`(config-pmap-qos)# class cmap-qos-acl`
		`(config-pmap-c-qos)# set qos-group 4`
		`(config-pmap-c-qos)# exit`
		`(config-pmap-qos)# exit`

Step 2	Attach the classification policy to the system.	`(config)# system qos`
		`(config-sys-qos)# service-policy type qos input pmap-qos-acl`
		`(config-sys-qos)# exit`

Step 3	Set up the system class allocation and rewrite policy. Allocate the system class for qos-group 4 and define the rewrite action.	`(config)# class-map type network-qos cmap-nq-acl`
		`(config-cmap-nq)# match qos-group 4`
		`(config-cmap-nq)# exit`
		`(config)# policy-map type network-qos pmap-nq-acl`
		`(config-pmap-nq)# class type network-qos cmap-nq-acl`
		`(config-pmap-c-nq)# set cos 5`
		`(config-pmap-c-nq)# exit`
		`(config-pmap-nq)# exit`

Step 4	Attach the allocation and rewrite policy to the system.	`(config)# system qos`
		`(config-sys-qos)# service-policy type network-qos pmap-nq-acl`
		`(config-sys-qos)# exit`

QoS Example 2

This example shows how to use an access control list to apply 50% bandwidth to traffic on Ethernet interface 1/3 that matches traffic on Ethernet interface 1/1.

SUMMARY STEPS

1. Set up the ingress classification policy.
2. Attach the classification policy to the interface Ethernet 1/1.
3. Set up the system-wide definition of the qos-group first.
4. Set up the egress bandwidth policy.
5. Attach the bandwidth policy to the egress interface.
6. Allocate the system class for qos-group 2.
7. Set up the network-qos policy.
8. Attach the network-qos policy to the system.

DETAILED STEPS

	Command or Action	Purpose

Step 1	Set up the ingress classification policy.	`(config)# class-map type qos cmap-qos-bandwidth`
		`(config-cmap-qos)# match access-group ACL-bandwidth`
		`(config-cmap-qos)# exit`
		`(config)# policy-map type qos pmap-qos-eth1-1`
		`(config-pmap-qos)# class cmap-qos-bandwidth`
		`(config-pmap-c-qos)# set qos-group 2`
		`(config-pmap-c-qos)# exit`
		`(config-pmap-qos)# exit`

Step 2	Attach the classification policy to the interface Ethernet 1/1.	`(config)# interface ethernet 1/1`
		`(config-if)# service-policy type qos input pmap-qos-eth1-1`
		`(config-if)# exit`

Step 3	Set up the system-wide definition of the qos-group first.	`(config)# class-map type queuing cmap-que-bandwidth`
		`(config-cmap-que)# match qos-group 2`
		`(config-cmap-que)# exit`

Step 4	Set up the egress bandwidth policy.	**Note** Before you can successfully allocate bandwidth to the user-defined class cmap-que-bandwidth, you must first reduce the default bandwidth configuration on class-default and class-fcoe.
		`(config)# policy-map type queuing pmap-que-eth1-2`
		`(config-pmap-que)# class type queuing class-default`
		`(config-pmap-c-que)# bandwidth percent 10`
		`(config-pmap-c-que)# exit`
		`(config-pmap-que)# class type queuing class-fcoe`
		`(config-pmap-c-que)# bandwidth percent 40`
		`(config-pmap-c-que)# exit`
		`(config-pmap-que)# class type queuing cmap-que-bandwidth`
		`(config-pmap-c-que)# bandwidth percent 50`
		`(config-pmap-c-que)# exit`
		`(config-pmap-que)# exit`

	Command or Action	Purpose

Step 5	Attach the bandwidth policy to the egress interface.	`(config)# interface ethernet 1/3`
		`(config-if)# service-policy type queuing output pmap-que-eth1-2`
		`(config-if)# exit`

Step 6	Allocate the system class for qos-group 2.	`(config)# class-map type network-qos cmap-nq-bandwidth`
		`(config-cmap-nq)# match qos-group 2`
		`(config-cmap-nq)# exit`

Step 7	Set up the network-qos policy.	`(config)# policy-map type network-qos pmap-nq-bandwidth`
		`(config-pmap-nq)# class type network-qos cmap-nq-bandwidth`
		`(config-pmap-c-nq)# exit`
		`(config-pmap-nq)# exit`

Step 8	Attach the network-qos policy to the system.	`(config)# system qos`
		`(config-sys-qos)# service-policy type network-qos pmap-nq-bandwidth`
		`(config-sys-qos)# exit`

QoS Example 3

This example shows how to attach a 802.1p tag with a CoS value of 3 to incoming untagged packets, and force priority-flow-control negotiation on Ethernet interface 1/15.

SUMMARY STEPS

1. Set up the ingress classification policy (the access control list was defined previously).

DETAILED STEPS

	Command or Action	Purpose

Step 1	Set up the ingress classification policy (the access control list was defined previously).	`(config)# interface Ethernet 1/15`
		`(config-if)# untagged cos 3`
		`(config-if)# priority-flow-control mode on`
		`(config-if)# exit`

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