

Cisco MDS 9000 Series FCoE Configuration Guide, Release 9.x

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Preface

This preface describes the audience, organization of, and conventions used in the Cisco MDS 9000 Series Configuration Guides. It also provides information on how to obtain related documentation, and contains the following sections:

- Audience, on page vii
- Document Conventions, on page vii
- Documentation Feedback, on page ix
- Related Documentation, on page ix
- Communications, Services, and Additional Information, on page ix

Audience

This publication is for network administrators who install, configure, and maintain Cisco MDS 9000 Series Switches.

Document Conventions

Command descriptions use these 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.

Convention	Description
[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.

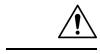
Examples use these conventions:

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.



Warning IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Documentation Feedback

To provide technical feedback on this document, or to report an error or omission, please send your comments to mds-docfeedback@cisco.com. We appreciate your feedback.

Related Documentation

The entire Cisco MDS 9000 Series switches documentation set is available at the following URL:

https://www.cisco.com/c/en/us/support/storage-networking/mds-9000-nx-os-san-os-software/series.html

Documentation Roadmap

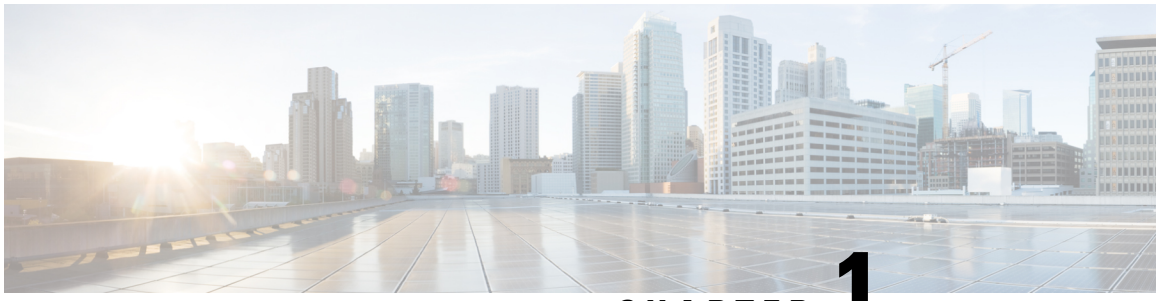
https://www.cisco.com/c/en/us/td/docs/storage/san_switches/mds9000/roadmaps/rel90.html

Communications, Services, and Additional Information

- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.
- To get the business results you're looking for with the technologies that matter, visit Cisco Services.
- To submit a service request, visit Cisco Support.
- To discover and browse secure, validated enterprise-class apps, products, solutions and services, visit Cisco DevNet.
- To obtain general networking, training, and certification titles, visit Cisco Press.
- To find warranty information for a specific product or product family, access Cisco Warranty Finder.

Cisco Bug Search Tool

Cisco Bug Search Tool (BST) is a web-based tool that acts as a gateway to the Cisco bug tracking system that maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. BST provides you with detailed defect information about your products and software.



CHAPTER 1

New and Changed Information

- New and Changed Information, on page 1
- Change Summary, on page 1

New and Changed Information

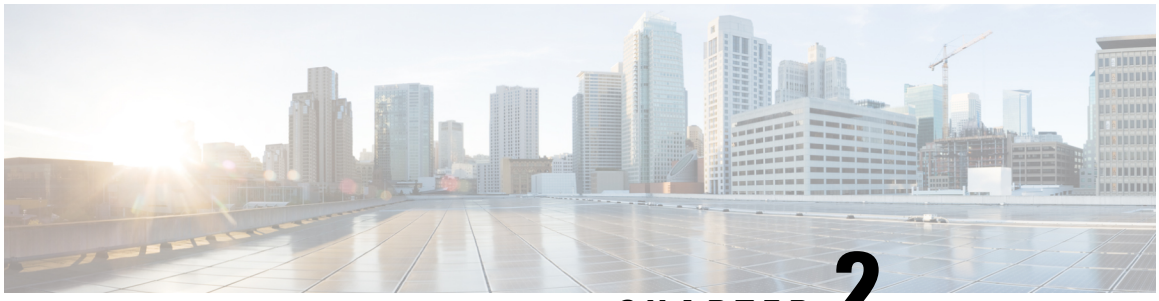
The table below summarizes the new and changed features for this document and shows the releases in which each feature is supported. Your software release might not support all the features in this document. For the latest caveats and feature information, see the Bug Search Tool at https://tools.cisco.com/bugsearch/ and the release notes for your software release.

Table 1: New and Changed Information

Feature	Description	Changed in Release
24-port 40-Gbps FCoE Module (DS-X9824-960K9)	Cisco MDS 9700 supports 24-port 40 Gbps FCoE Module (DS-X9824-960K9).	7.3(0)D1(1)
FCoE is supported on Cisco MDS 9710	FCoE is supported on Cisco MDS 9710 with the 48-Port 10-Gigabit Fibre Channel over Ethernet module (DS-X9848-480K9).	6.2(7)
FIP	Supports the T11-compliant FIP.	5.2(1)
FCoE	This feature was introduced.	5.2(1)

Change Summary

This book does not contain any new feature for Cisco MDS NX-OS Release 8.1(1).



CHAPTER 2

Overview

This chapter contains the following sections:

- Licensing Requirements, on page 3
- Information About Fibre Channel Over Ethernet, on page 3
- Fibre Channel Forwarder, on page 4
- Fibre Channel Bridge, on page 4

Licensing Requirements

For a complete explanation of Cisco NX-OS licensing recommendations and how to obtain and apply licenses, see the *Cisco NX-OS Licensing Guide*.

Information About Fibre Channel Over Ethernet

Fibre Channel over Ethernet (FCoE) allows Fibre Channel traffic to be encapsulated over a physical Ethernet link. FCoE and FIP frames use a unique EtherType so that FCoE traffic and standard Ethernet traffic can be carried on the same link.

Classic Ethernet is a best-effort protocol, which means that in a congested network, Ethernet discards packets and relies on higher level protocols to provide retransmission and other reliability mechanisms.

Fibre Channel traffic requires a lossless transport layer; as a data storage protocol, it is unacceptable to lose a single data packet. Native Fibre Channel implements a lossless service at the transport layer using a buffer-to-buffer credit system.

Ethernet links on Cisco NX-OS switches provide two mechanisms to ensure lossless transport for FCoE traffic: link-level flow control and priority flow control.

IEEE 802.3x link-level flow control allows a congested receiver to signal the far end to pause the data transmission for a short period of time. The pause functionality is applied to all traffic on the link.

The priority flow control (PFC) feature on Cisco NX-OS platforms applies pause functionality to specific classes of traffic on the Ethernet link. For example, PFC can provide lossless service for the FCoE traffic and best-effort service for the standard Ethernet traffic using IEEE 802.1p traffic classes.

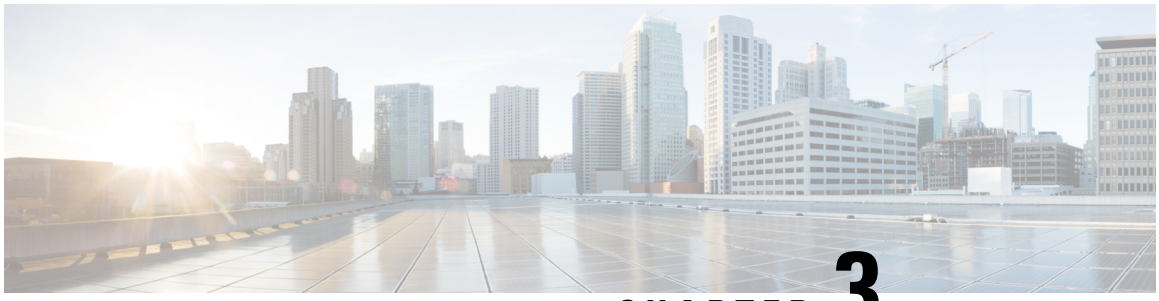
Fibre Channel Forwarder

Fibre Channel traffic requires a lossless transport layer, which means that it requires a data storage protocol that does not lose a single data packet. A FCoE Forwarder (FCF) communicates with FCoE end devices, such as converged network adapters (CNAs). The FCF accepts the Fibre Channel frame that is encapsulated in an Ethernet packet and forwards that packet over a VLAN across an Ethernet network to a remote FCoE end device. The FCF has a unique FC-MAC address in the FCoE network. An FCF can also assign FC address IDs to the CNAs. An FCF can assign Fabric Provide MAC Addresses (FPMA) to the CNAs consisting of the FC-Map Value for the Fabric and the Fibre Channel IDs (FC IDs) assigned during Fabric Login.

Fibre Channel Bridge

A Fibre Channel Bridge connects an FCoE network to a Fibre Channel network. A Fibre Channel Bridge decapsulates an FCoE frame and sends the Fibre Channel frame to the Fibre Channel network. A Fibre Channel Bridge also encapsulates FC frames from a Fibre Channel network and forwards them to the FCoE network.

Cisco MDS 9700 switches, Cisco MDS 9500 switches, and MDS 9250i switch support Fibre Channel Bridge functions.



CHAPTER 3

Preparing the Switch for Configuring FCoE

- Information About FCoE, on page 5
- Default Settings for FCoE, on page 9
- Guidelines and Limitations, on page 9
- Enabling and Disabling FCoE, on page 10
- Configuring the FC-Map , on page 12
- Configuring the Fabric Priority, on page 13
- Setting the Advertisment Interval, on page 13
- Disabling LAN Traffic on an FCoE Link, on page 14
- Additional References for FCoE, on page 15

Information About FCoE

FCoE provides a method of transporting Fibre Channel traffic over a physical Ethernet connection. FCoE requires the underlying Ethernet to be full duplex and to provide lossless behavior for Fibre Channel traffic.

Note Lossless behavior on Ethernet is provided by using a priority flow control (PFC) mechanism that prevents packet loss during congestion conditions.

The Cisco NX-OS software supports T11-compliant FCoE on all 10-Gigabit and 40-Gigabit Ethernet interfaces.

FCoE and FIP

FCoE Initiation Protocol

The FCoE Initialization Protocol (FIP) allows the switch to discover and initialize FCoE-capable entities that are connected to an Ethernet LAN. Cisco NX-OS switches support the Converged Enhanced Ethernet Data Center Bridging Exchange (CEE-DCBX) protocol for T11-compliant Generation 2 CNAs.

The following switches do not support Pre-FIP on Generation 1 CNAs:

- Cisco MDS 9700
- Cisco MDS 9500

- Cisco MDS 9250i

FIP Virtual Link Instantiation

FIP is used to perform device discovery, initialization, and link maintenance. FIP performs the following tasks:

- FIP VLAN discovery— Discovers the FCoE VLAN that will be used by all other FIP protocols as well as by the FCoE encapsulation for Fibre Channel payloads on the established virtual link. FIP VLAN discovery occurs in the native VLAN used by the initiator or target to exchange Ethernet traffic. The FIP VLAN discovery protocol is the only FIP protocol running on the native VLAN; all other FIP protocols run on the discovered FCoE VLANs.
- FIP FCF discovery—When a FCoE device is connected to the fabric, it sends a Discovery Solicitation message. A Fibre Channel Forwarder (FCF) or a switch responds to the message with a Solicited Advertisement that provides an FCF MAC address to use for subsequent logins.
- FCoE virtual link instantiation— FIP defines the encapsulation of fabric login (FLOGI), fabric discovery (FDISC), logout (LOGO), and exchange link parameter (ELP) frames along with the corresponding reply frames. The FCoE devices use these messages to perform a fabric login.
- FCoE virtual link maintenance— FIP periodically sends maintenance messages between the switch and the CNA to ensure that the connection is still valid.

FCoE Frame Format

FCoE is implemented when the switch encapsulates a Fibre Channel frame in an Ethernet packet with a dedicated Ethernet type, 0x8906. The packet has a 4-bit version field. The other header fields in the frame (the source and destination MAC addresses, VLAN tags, and frame markers) are all standard Ethernet fields. Reserved bits pad the FCoE frame to the IEEE 802.3 minimum packet length of 64 bytes.

A Fibre Channel frame consists of 36 bytes of headers and up to 2112 bytes of data for a total maximum size of 2148 bytes. The encapsulated Fibre Channel frame has all the standard headers, which allow it to be passed to the storage network without further modification. To accommodate the maximum Fibre Channel frame in an FCoE frame, the class-fcoe is defined with a default Maximum Transmission Unit (MTU) of 2240 bytes.

VLAN Tagging for FCoE Frames

The Ethernet frames that are sent by the switch to the adapter include the IEEE 802.1Q tag. This tag includes a field for the class of service (CoS) value used by the priority flow control (PFC). The IEEE 802.1Q tag also includes a VLAN field.

The switch expects frames from a FIP T11-compliant CNA to be tagged with the VLAN tag for the FCoE VLAN. Frames that are not correctly tagged are discarded.



Note You cannot map VLAN 1 or the native VLAN to an FCoE VSAN.

FIP Ethernet Frame Format

FIP is encapsulated in an Ethernet packet with a dedicated EtherType, 0x8914. The packet has a 4-bit version field. Along with the source and destination MAC addresses, the FIP packet also contains a FIP operation code and a FIP operation subcode. The following table describes the FIP operation codes and subcodes.

Table 2: FIP Operation Codes

FIP Operation Code	FIP Subcode	FIP Operation
0x0001	0x01	Discovery Solicitation
	0x02	Discovery Advertisement
0x0002	0x01	Virtual Link Instantiation Request
	0x02	Virtual Link Instantiation Reply
0x0003	0x01	FIP Keepalive
	0x02	FIP Clear Virtual Links
0x0004	0x01	FIP VLAN Request
	0x02	FIP VLAN Notification

DCBX

Data Center Bridging Exchange Protocol

The Data Center Bridging Exchange (DCBX) protocol is an extension of the Link Layer Discovery Protocol (LLDP). DCBX end points exchange request and acknowledgment messages. For flexibility, parameters are coded in a type-length-value (TLV) format. Cisco NX-OS switches support the Converged Enhanced Ethernet Data Center Bridging Exchange (CEE-DCBX) is supported on all T11-compliant Generation 2 CNAs.

DCBX runs on the physical Ethernet link between the switch and the CNA. By default, DCBX is enabled on Ethernet interfaces. When an Ethernet interface is brought up, the switch automatically starts to communicate with the CNA.

During the normal operation of FCoE between the switch and the CNA, DCBX provides link-error detection.

DCBX is also used to negotiate capabilities between the switch and the CNA and to send configuration values to the CNA.

The CNAs that are connected to a switch are programmed to accept the configuration values that are sent by the switch, allowing the switch to distribute configuration values to all attached CNAs, which reduces the possibility of configuration errors and simplifies CNA administration.

Lossless Ethernet

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 drops packets. The higher level protocols detect the missing data and retransmit the dropped packets.

To properly support Fibre Channel, Ethernet has been enhanced with a priority flow control (PFC) mechanism.

Logical Link Up/Down

On a native Fibre Channel link, some configuration actions (such as changing the VSAN) require that you reset the interface status. When you reset the interface status, the switch disables the interface and then immediately reenables the interface.

Caution:

If an Ethernet link provides FCoE service, do not reset the physical link because this action is disruptive to all traffic on the link.

The logical link up/down feature allows the switch to reset an individual virtual link. The logical link down is signaled with a FIP Clear Virtual Link message.

Caution:

If the CNA does not support the logical link level up/down feature, the CNA resets the physical link, which means that all traffic on the Ethernet interface is disrupted.

Converged Network Adapters

Cisco NX-OS switches support the following CNA types:

- Hardware adapter
  - Works with the existing Fibre Channel host bus adapter (HBA) driver and Ethernet Network Interface Card (NIC) driver in the server.
  - Server operating system view of the network is unchanged; the CNA presents a SAN interface and a LAN interface to the operating system.
- FCoE software stack
  - Runs on existing 10-Gigabit Ethernet adapters.

The following Cisco NX-OS series and platforms support Generation 2 CNAs that use the FIP to exchange information about its available capabilities and to negotiate the configurable values with the switch:

- Cisco MDS 9700
- Cisco MDS 9500
- Cisco MDS 9250i

To reduce configuration errors and simplify administration, the switch distributes the configuration data to all the connected adapters.

STP Lite

FCoE does not require full Spanning Tree Protocol (STP) because FCoE has no bridging functionality, which means that no STP loops are created in the network. STP Lite on FCoE interfaces ensures rapid convergence across the network by sending an agreement Bridge Protocol Data Unit (BPDU) whenever it receives a proposal BPDU. The FCoE link sends the identical agreement BPDU in response to either an Multiple Spanning Tree

(MST) or a Per VLAN Rapid Spanning Tree Plus (PVRST+) proposal BPDU. Additionally, STP Lite suppresses the MAC address flushing function for FCoE VLANs.

STP Lite is enabled automatically by default across the entire device for FCoE VLANs as soon as the first FCoE VLAN comes up. At the same time, the system automatically converts all FCoE links as the STP-type normal ports. This feature runs only in FCoE VLANs.

Default Settings for FCoE

This table lists the default settings for FCoE parameters.

Table 3: Default FCoE Parameter Settings

Parameters	Default
FCoE feature	Not installed, disabled
FC-Map	0E.FC.00
Fabric priority	128
Advertisement interval	8 seconds

Guidelines and Limitations

FCoE

- You cannot enable FCoE on the default VLAN.
- FCoE is already enabled on a Cisco MDS switch.
- The QoS policy must be the same on all Cisco FCoE switches in the network.
- Cisco MDS 9700 Series, MDS 9500 Series, and 9250i switch do not support LAN traffic and only accepts and processes FCoE frames.
- On Cisco MDS 9500 Series, you must install a Supervisor-2A module to configure FCoE.
- You can install an FCoE module in a fabric that uses FC-Redirect services but do not install the FCoE module in the same switch where FC-Redirect services application modules are enabled.
- SME does not support any FCoE connected devices including devices connected through the MDS FCoE linecard (DX-X9708-K9).
- In Cisco MDS NX-OS Release 5.2(x), you cannot install a FCoE module in a switch that is running DMM, SME, or IOA.
- Cisco MDS 9250i supports a maximum number of up to 32 VSANs.
- MDS 9250i does not support FCoE Switched Port Analyzer (SPAN).

- MDS 9250i does not support FCoE port diagnostics, such as generic online diagnostics (GOLD) and Online Health Management System (OHMS).
- Cisco MDS 9500 switches support only the 8 port 10 Gbps FCoE Module (DS-X9708-K9). Cisco MDS 9700 switches support the following modules:
  - 48 port 10 Gbps FCoE Module (DS-X9848-480K9)
  - 24 port 40 Gbps FCoE Module (DS-X9824-960K9)
- Cisco MDS 9000 does not support 10-Gigabit or 40-Gigabit FEX connectivity on FCoE modules.
- We recommend that you use a minimum of five fabric modules (FABs) to receive complete throughput of the MDS 40-G line cards across 24 ports. Usage of three of four fabric modules might result in the oversubscription of ports.
- When you configure a multi-hop FCoE[1], ensure that you use the same no-drop classes on both sides. Priority flow control does not work when you use different no-drop classes. Use the **show interface priority-flow-control** command to verify the priority flow control operation.

Multi-Hop FCoE Distance Configuration

In Multi-Hop FCoE, when a device sends a pause, the interface that generates the pause frame must have an ingress queue with a buffer space large enough to buffer twice the link distance. This is because, when the pause is generated the wire might get congested. By the time the adjacent device receives or processes the generated pause frame, the wire might get congested again. Therefore, the device that generates the pause must have the ability to buffer twice the link distance.

The 48 port 10 Gbps FCoE Module (DS-X9848-480K9) line cards support a long haul lossless distance of up to 80 kilometers. In Cisco NX-OS Release 6.2(9) and later, you can change the ingress queuing buffer configuration.

The 24 port 40 Gbps FCoE Module (DS-X9824-960K9) line cards support long haul lossless distance of up to 40 kilometers. In Cisco NX-OS Release 7.3(x) and later, you can change the ingress queuing buffer configuration.

Enabling and Disabling FCoE

Enabling FCoE

The Cisco MDS 9700 Series, MDS 9500 Series, and MDS 9250i switches automatically enables the FCoE feature when an FCoE-capable module is present in the chassis. The Cisco MDS 9250i switches already have fixed FCoE ports. These FCoE ports can be enabled only if a minimum of two Power Supply Units (PSUs) are online.

Before you begin

Do not enable FCoE on VLAN 1 or the native VLAN.

[1] A Multihop FCoE switch continues to subscribe to the appropriate fibre channel traffic engineering, domain creation, and forwarding.

Procedure

Step 1 **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Enters configuration mode.

Step 2 (Optional) **feature lacp**

Example:

```
switch(config)# feature lacp
```

Enables the Link Aggregation Control Protocol (LACP) feature. This feature is considered a best practice for FCoE operation.

Step 3 **system qos**

Example:

```
switch(config)# system qos
```

Enters Quality of Service (QoS) configuration mode.

Step 4 **service-policy type network-qos** *default policy-name*

Example:

On Cisco MDS 9700 Series switches:

```
switch(config-sys-qos)# service-policy type network-qos default-nq-7e-4q8q-policy
```

Example:

On Cisco MDS 9500 Series switches:

```
switch(config-sys-qos)# service-policy type network-qos default-nq-7e-policy
```

Example:

On Cisco MDS 9250i Multiservice switch:

```
switch(config-sys-qos)# service-policy type network-qos default-nq-4e-2q4q-policy
```

Enables the QoS policy that supports FCoE traffic. The *policy-name* default is different for each Cisco MDS switch.

Step 5 (Optional) **show feature**

Example:

```
switch(config-sys-qos)# show feature
```

Displays information about the enabled features.

Step 6 (Optional) **copy running-config startup-config**

Example:

```
switch(config-sys-qos)# copy running-config startup-config
```

Copies the running configuration to the startup configuration.

Disabling FCoE

FCoE is enabled by default on supported Cisco MDS 9000 series switches. You cannot disable FCoE on these switches.

Configuring the FC-Map

You can prevent data corruption due to cross-fabric talk by configuring an FC-Map that identifies the Fibre Channel fabric for this switch. When the FC-Map is configured, the switch discards the MAC addresses that are not part of the current fabric. An FCF can assign Fabric Provide MAC Addresses (FPMA) to the CNAs consisting of the FC-Map Value for the Fabric and the Fibre Channel ID (FCID) assigned during Fabric Login

Note In most deployments, changing the fc-map is not needed. We recommend that you use VSAN to VLAN mapping. For more information, see the Configuring FCoE VLANs and Virtual Fibre Channel Interfaces chapter.

Procedure

Step 1 **configure terminal**

Example:

```
fcoe# configure terminal
fcoe(config)#
```

Enters configuration mode.

Step 2 **fcoe fcmap** *fabric-map*

Example:

```
fcoe(config)# fcoe fcmap 0x0efc2a
```

Configures the global FC-Map. The default value is 0x0EFC00. The range is from 0x0EFC00 to 0x0EFCFF. Use the **no fcoe map** command to reset to the default value.

Example

This example shows how to configure the global FC-Map on a Cisco MDS 9700, or MDS 9500, or an MDS 9250i switch:

```
switch# configure terminal
switch(config)# fcoe fcmap 0x0efc2a
```

Configuring the Fabric Priority

The FCoE switch advertises its priority. The priority is used by the CNAs in the fabric to determine the best switch to connect to.

Procedure

Step 1 **configure terminal**

Example:

```
fcoe# configure terminal
fcoe(config)#
```

Enters configuration mode.

Step 2 **fcoe fcf-priority** *fabric-priority*

Example:

```
fcoe(config)# fcoe fcf-priority 42
```

Configures the global fabric priority. The default value is 128. The range is from 0 (higher) to 255 (lower). Use the **no fcoe fcf-priority** command to reset the global fabric priority to the default value.

Example

This example shows how to configure the global fabric priority for a Cisco MDS 9700, MDS 9500, and MDS 9250i switch:

```
switch# configure terminal
switch(config)# fcoe fcf-priority 42
```

Setting the Advertisment Interval

You can configure the interval for Fibre Channel fabric advertisement on the switch.

Procedure

Step 1 **configure terminal**

Example:

```
fcoe# configure terminal
fcoe(config)#
```

Enters configuration mode.

Step 2 **fcoe fka-adv-period** *interval*

Example:

```
fcoe(config)# fcoe fka-adv-period 8
fcoe#
```

Configures the advertisement interval for the fabric. The default value is 8 seconds. The range is from 4 to 60 seconds.

Example

This example shows how to configure the advertisement interval for the fabric on a Cisco MDS 9000 switch:

```
switch# configure terminal
switch(config)# fcoe fka-adv-period 42
```

Disabling LAN Traffic on an FCoE Link

You can disable LAN traffic on an FCoE link.

DCBX allows the switch to send a LAN Logical Link Status (LLS) message to a directly-connected CNA. Enter the **shutdown lan** command to send an LLS-Down message to the CNA. This command causes all VLANs on the interface that are not enabled for FCoE to be brought down. If a VLAN on the interface is enabled for FCoE, it continues to carry SAN traffic without any interruption.

Procedure

Step 1 **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Enters configuration mode.

Step 2 **interface ethernet** *slot*/*port*

Example:

```
switch(config)# interface e 2/1
switch(config-if)#
```

Specifies an interface to configure, and enters interface configuration mode. Use **?** to view a list of supported interfaces.

Step 3 **shutdown lan**

Example:

```
switch(config-if)# shutdown lan
```

Shuts down Ethernet traffic on the interface. If the interface is part of an FCoE VLAN, the shutdown has no impact on the FCoE traffic. Use **no shutdown lan** to reenable Ethernet traffic on this interface.

Step 4 (Optional) **show interface**

Example:

```
switch(config-if)# show interface
```

Displays information about the interface.

Step 5 (Optional) **copy running-config startup-config**

Example:

```
switch(config-if)# copy running-config startup-config
```

Copies the running configuration to the startup configuration.

Additional References for FCoE

Related Documents

Related Topic	Document Title
Command reference	Cisco NX-OS FCoE Command Reference Guide, Nexus 7000 and MDS 9500
Configuration guide	Cisco MDS 9000 Series NX-OS Quality of Service Configuration Guide
Cisco NX-OS licensing	Cisco MDS 9000 Series Licensing Guide

Standards and RFCs

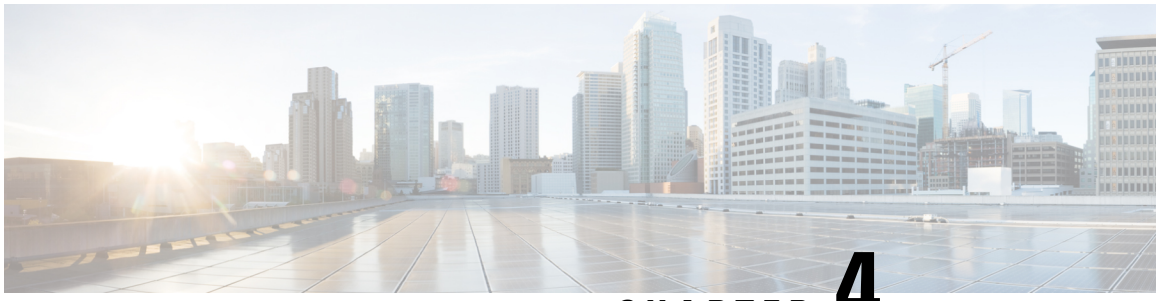
Standard/RFC	Title
T11 FC BB-5	Fibre Channel Backbone 5

MIBs

MIB	MIBs Link
	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support



CHAPTER 4

Configuring FCoE VLANs and Virtual Fibre Channel Interfaces

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Information About Virtual Fibre Channel (VFC) Interfaces

Fibre Channel over Ethernet (FCoE) allows Fibre Channel and Ethernet traffic to be carried on the same physical Ethernet connection between the switch and the servers.

The Fibre Channel portion of FCoE is configured as a virtual Fibre Channel interface. Logical Fibre Channel features (such as interface mode) can be configured on virtual Fibre Channel interfaces.

A virtual Fibre Channel (vfc) interface must be bound to an interface before it can be used. The binding is to a physical Ethernet interface when the converged network adapter (CNA) is directly connected to the switch or port channel when the CNA connects to the Fibre Channel Forwarder (FCF) over a virtual port channel (vPC).

VF Port

A virtual fabric (VF) port in an FCoE network acts as a fabric port that connects to a peripheral device (host or disk) operating as an N port. A VF port can be attached to only one N port.

VE Port

A virtual expansion (VE) port acts as an expansion port in an FCoE network. VE ports can connect multiple FCoE switches together in the network. You can bind a VE port to a physical ethernet port or a port channel.

Traffic is load balanced across equal cost E_Ports and VE_Ports based on SID, DID, and OXID. Traffic across members of a port channel that a VE_Port is bound to is load balanced based on SID, DID, and OXID.

VNP Ports

Connectivity from an FCoE NPV bridge to the FCF is supported only over point-to-point links. These links can be individual Ethernet interfaces or port channel interfaces. For each FCF connected to an Ethernet/port-channel interface, a vFC interface must be created and bound to it. These vFC interfaces must be configured as VNP ports.

On the VNP port, the FCoE NPV bridge emulates an FCoE-capable host with multiple FCoE nodes (ENodes), each with a unique ENodes MAC address. By default, the VNP port is enabled in trunk mode.

Multiple VSANs can be configured on the VNP port. The FCoE VLANs that correspond to the VNP port VSANs must be configured on the bound Ethernet interface.

Default Settings for FCoE

This table lists the default settings for FCoE parameters.

Table 4: Default FCoE Parameter Settings

Parameters	Default
FCoE feature	Not installed, disabled
FC-Map	0E.FC.00
Fabric priority	128
Advertisement interval	8 seconds

Guidelines and Limitations

Configuring Virtual Interfaces

Mapping a VSAN to a VLAN

A unique, dedicated VLAN must be configured at every converged access switch to carry traffic for each virtual fabric (VSAN) in the SAN (for example, VLAN 1002 for VSAN 10, VLAN 1003 for VSAN 2, and so on). If you enable MST, you must use a separate Multiple Spanning Tree (MST) instance for FCoE VLANs.

Before you begin

- Ensure you have installed the correct license for FCoE.
- Ensure you have enabled FCoE.

Procedure

Step 1 **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Enters configuration mode.

Step 2 **vsan database**

Example:

```
switch(config)# vsan database
switch(config-vsan-db)#
```

Enters VSAN database configuration mode.

Step 3 **vsan** *vsan-id*

Example:

```
switch(config-vsan-db)# vsan 200
```

Defines the VSAN. The VSAN number range is from 1 to 4094.

Step 4 **vlan** *vlan-id*

Example:

```
switch(config-vsan-db)# vlan 200
switch(config-vlan)#
```

Enters VLAN configuration mode. The VLAN number range is from 1 to 4096.

Step 5 **fcoe** [**vsan** *vsan-id*]

Example:

```
switch(config-vlan)# fcoe vsan 200
```

Enables FCoE for the specified VLAN and configures the mapping from this VLAN to the specified VSAN. If you do not specify a VSAN number, a mapping is created from this VLAN to the VSAN with the same number.

Step 6 **exit**

Example:

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

Step 7 (Optional) **show vlan fcoe**

Example:

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

Displays information about the FCoE configuration for a VLAN.

Step 8 (Optional) **copy running-config startup-config**

Example:

```
switch(config-vlan)# copy running-config startup-config
```

Copies the running configuration to the startup configuration.

Example

This example shows how to map VLAN 200 to VSAN 200 on a Cisco MDS 9000 Series Switch:

```
switch(config)# vlan 200
switch(config-vlan)# fcoe vsan 200
```

Creating a Virtual Fibre Channel Interface

To use FCoE, you must first create Virtual Fibre Channel (VFC) interfaces. Then, you must bind the VFC interfaces to physical interfaces before FCoE can be used.

Before you begin

- Ensure you have installed the correct license for FCoE.
- Ensure you have enabled FCoE.

Procedure

Step 1 **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Enters configuration mode.

Step 2 **interface vfc** *vfc-id*

Example:

```
switch(config)# interface vfc 4
switch(config-if)#
```

Creates a virtual Fibre Channel interface (if it does not already exist) and enters interface configuration mode. The *vfc-id* range is from 1 to 8192.

Step 3 **switchport mode** *mode*

Example:

```
switch(configif)# switchport mode e
```

Configures the switchport mode for a virtual Fibre Channel interface. The *mode* is E or F. The default is F mode.

Step 4 **bind** {**interface** {**ethernet** *slot*/*port* | **ethernet-port-channel** *number*}}

Example:

```
switch(config-if)# bind interface ethernet 1/4
```

Binds the virtual Fibre Channel interface to the specified interface. Use **?** to see the supported interfaces and port channels. Use the **no** form of this command to unbind the virtual Fibre Channel interface from the specified interface.

Step 5 (Optional) **show interface vfc**

Example:

```
switch(config-if)# show interface vfc
```

Displays information about the virtual Fibre Channel interfaces.

Step 6 (Optional) **copy running-config startup-config**

Example:

```
switch(config)# copy running-config startup-config
```

Copies the running configuration to the startup configuration.

Example

This example shows how to bind a virtual Fibre Channel interface to an Ethernet interface:

```
switch# configure terminal
switch(config)# interface vfc 4
switch(config-if)# bind interface ethernet 1/4
```

This example shows how to delete a virtual Fibre Channel interface:

```
switch# configure terminal
switch(config)# no interface vfc 4
```

Creating a Virtual Fibre Channel Port Channel Interface

You can create a virtual Fibre Channel port channel interface that automatically binds to the port channel with the same interface number.

Before you begin

For the Cisco MDS 9700 switches, MDS 9500 switches, and MDS 9250i switch, ensure that you create the Ethernet port channel interface before you create the virtual Fibre Channel port channel interface.

Procedure

Step 1 **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Enters configuration mode.

Step 2 **interface vfc-port-channel** *int-number*

Example:

```
switch(config)# interface vfc-port-channel 2
switch(config-if)#
```

Creates a virtual Fibre Channel interface (if it does not already exist) that is bound to the port channel with the same interface number and enters interface configuration mode.

The *int-number* range is from 257 to 4095.

The default switchport mode for this interface is E.

Note
Starting from the MDS 9710, MDS 9700, MDS 9250i, and newer switches, we support only the Ethernet port channel or the channel group ID numbers ranging from 513 to 4096. However, we support ID numbers ranging from 257 to 4096 on the MDS Ethernet port channel.

Step 3 **switchport mode** *mode*

Example:

```
switch(config-if)# switchport mode e
```

Configures the switchport mode for a virtual Fibre Channel interface. The *mode* is E or F. The default is F mode.

Step 4 (Optional) **show interface vfc-port-channel** *int-number*

Example:

```
switch(config-if)# show interface vfc-port-channel 2
```

Displays information about the virtual Fibre Channel interfaces bound to port channel interfaces.

Step 5 (Optional) **copy running-config startup-config**

Example:

```
switch(config)# copy running-config startup-config
[########################################] 100%
Copy complete.
```

Copies the running configuration to the startup configuration.

Step 6 (Optional) **show running-config interface vfc***id/slot*

Example:

```
awitch# show running-config interface vfc-po540
!Command: show running-config interface vfc-po540
!Time: Fri Dec 2 15:36:07 2016

version 7.3(0)D1(1)

interface vfc-po540
bind interface ethernet-port-channel540
switchport mode E
no shutdown
```

Displays the virtual Fibre Channel interface configuration information.

Associating a Virtual Fibre Channel Interface to a VSAN

You must configure unique, dedicated VLAN at every converged access switch to carry traffic for each Virtual Fabric (VSAN) in the SAN (for example, VLAN 1002 for VSAN 1, VLAN 1003 for VSAN 2, and so on). If you enable MST, you must use a separate MST instance for FCoE VLANs.

Procedure

Step 1 **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Enters configuration mode.

Step 2 **vsan database**

Example:

```
switch(config)# vsan database
switch(config-vsan-db)#
```

Enters VSAN configuration mode.

Step 3 (Optional) **vsan** *vsan-id*

Example:

```
switch(config-vsan-db)# vsan 2
```

Creates the VSAN. The *vsan-id* range is from 1 to 4094 and must map to a VLAN on the physical Ethernet interface that is bound to the virtual Fibre Channel interface.

Step 4 Enter one of the following commands:

- **vsan** *vsan-id* **interface vfc** *vfc-id*
- **vsan** *vsan-id* **interface vfc-port-channel** *vfc-id*

Example:

```
switch(config-vsan-db)# vsan 2 interface vfc 4
```

Configures the association between the VSAN and virtual Fibre Channel interface or virtual Fibre Channel port channel. The *vsan-id* range is from 1 to 4094 and must map to a VLAN on the physical Ethernet interface or port channel that is bound to the virtual Fibre Channel interface or virtual Fibre Channel port channel. The *vfc-id* range is from 1 to 8192. Us the **no** form of this command to dissassociate the connection between the VSAN and virtual Fibre Channel interface or virtual Fibre Channel port channel.

Step 5 (Optional) **show vsan**

Example:

```
switch(config-vsan-db)# show vsan
```

Displays information about the VSAN.

Step 6 (Optional) **copy running-config startup-config**

Example:

```
switch(config-vsan-db)# copy running-config startup-config
```

Copies the running configuration to the startup configuration.

Example

This example shows how to associate a virtual Fibre Channel interface to a VSAN:

```
switch# configure terminal
switch(config)# vsan database
switch(config-vsan-db)# vsan 2 interface vfc 4
```

Enabling VE Loopback Configuration

The VFID check verifies that the VSAN configuration is correct on both ends of a VE link. You can turn off the VFID check for VE ports to allow VE loopback configuration between to VE ports on the same switch.

Procedure

Step 1 **configure terminal**

Example:

```
fcoe# configure terminal
fcoe(config)#
```

Enters configuration mode.

Step 2 **fcoe veloopback**

Example:

```
fcoe(config)# fcoe veloopback
```

Enables the VFID check for all VE ports.

Example

This example shows how to enable VE loopback for a Cisco MDS 9700 or MDS 9500, or an MDS 9250i switch:

```
switch# configure terminal
switch(config)# fcoe veloopback
```

Verifying the Virtual Fibre Channel Interface

To display configuration information about virtual Fibre Channel interfaces, perform one of the following tasks:

Command	Purpose
show interface vfc *vfc-id*	Displays the detailed configuration of the specified Fibre Channel interface.
show interface brief	Displays the status of all interfaces.
show vlan fcoe	Displays the mapping of FCoE VLANs to VSANs.

This example shows how to display a virtual Fibre Channel interface bound to an Ethernet interface:

```
switch# show interface vfc 3
vfc3 is up
    Bound interface is Ethernet1/37
    Hardware is Virtual Fibre Channel
    Port WWN is 20:02:00:0d:ec:6d:95:3f
    Admin port mode is F, trunk mode is on
    snmp link state traps are enabled
    Port mode is F, FCID is 0x490100
    Port vsan is 931
    1 minute input rate 0 bits/sec, 0 bytes/sec, 0 frames/sec
    1 minute output rate 0 bits/sec, 0 bytes/sec, 0 frames/sec
      0 frames input, 0 bytes
        0 discards, 0 errors
      0 frames output, 0 bytes
        0 discards, 0 errors
    Interface last changed at Thu May 21 04:44:42 2009
```

This example shows how to display the status of all the interfaces on the switch (some output has been removed for brevity):

```
switch# show interface brief
--------------------------------------------------------------------------------
Interface  Vsan   Admin  Admin   Status          SFP    Oper  Oper   Port
                 Mode   Trunk                          Mode  Speed  Channel
                        Mode                                 (Gbps)
--------------------------------------------------------------------------------
fc3/1      1      auto   on      trunking         swl    TE      2    --
fc3/2      1      auto   on      sfpAbsent        --     --           --
...
```

```
fc3/8      1      auto   on      sfpAbsent        --     --           --
--------------------------------------------------------------------------------
Interface               Status     IP Address        Speed    MTU   Port
                                                                   Channel
--------------------------------------------------------------------------------
Ethernet1/1             hwFailure  --                --       1500  --
Ethernet1/2             hwFailure  --                --       1500  --
Ethernet1/3             up         --                10000    1500  --
...
Ethernet1/39            sfpIsAbsen --                --       1500  --
Ethernet1/40            sfpIsAbsen --                --       1500  --
--------------------------------------------------------------------------------
Interface               Status     IP Address        Speed    MTU
--------------------------------------------------------------------------------
mgmt0                   up         172.16.24.41      100      1500
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Interface  Vsan   Admin  Admin   Status          SFP    Oper  Oper   Port
                  Mode   Trunk                          Mode  Speed  Channel
                         Mode                                 (Gbps)
--------------------------------------------------------------------------------
vfc 1        1      F      --      down             --     --           --
...
```

This example shows how to display the mapping between the VLANs and VSANs on the switch:

```
switch# show vlan fcoe
VLAN      VSAN      Status
--------  --------  --------
15        15        Operational
20        20        Operational
25        25        Operational
30        30        Non-operational
```

Example:Mapping VSANs to VLANs

The following example shows how to configure the FCoE VLAN and a virtual Fibre Channel interface:

Procedure

Step 1 Enable the associated VLAN and map the VLAN to a VSAN.

```
switch(config)# vlan 200
switch(config-vlan)# fcoe vsan 200
switch(config-vlan)# exit
```

Step 2 Configure the VLAN on a physical Ethernet interface.

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# spanning-tree port type edge trunk
switch(config-if)# switchport mode trunk
switch(config-if)# switchport trunk allowed vlan 1,200
switch(config-if)# exit
```

Step 3 Create a virtual Fibre Channel interface and bind it to a physical Ethernet interface.

```
switch(config)# interface vfc 4
switch(config-if)# bind interface ethernet 1/4
```

Note
By default, all virtual Fibre Channel interfaces reside on VSAN 1. If the VLAN to VSAN mapping is to a VSAN other than VSAN 1, then proceed to Step 4.

Step 4 Associate the virtual Fibre Channel interface to the VSAN.

```
switch(config)# vsan database
switch(config-vsan)# vsan 200 interface vfc 4
switch(config-vsan)# exit
```

Step 5 (Optional) Display membership information for the VSAN.

```
switch# show vsan 200 membership
vsan 200 interfaces
           vfc 4
```

Step 6 (Optional) Display the interface information for the virtual Fibre Channel interface.

```
switch# show interface vfc 4

vfc4 is up
Bound interface is Ethernet1/4
Hardware is Virtual Fibre Channel
Port WWN is 20:02:00:0d:ec:6d:95:3f
Port WWN is 20:02:00:0d:ec:6d:95:3f
snmp link state traps are enabled
Port WWN is 20:02:00:0d:ec:6d:95:3f
APort WWN is 20:02:00:0d:ec:6d:95:3f
snmp link state traps are enabled
Port mode is F, FCID is 0x490100
```

```
Port vsan is 200
1 minute input rate 0 bits/sec, 0 bytes/sec, 0 frames/sec
1 minute output rate 0 bits/sec, 0 bytes/sec, 0 frames/sec
0 frames input, 0 bytes 0 discards, 0 errors
0 frames output, 0 bytes 0 discards, 0 errors
Interface last changed at Thu Mar 11 04:44:42 2010
```

Verifying the FCoE Configuration

To display FCoE configuration information, perform one of these tasks in the context of storage VDC:

Command	Purpose
show fcoe	Displays whether FCoE is enabled on the switch.
show fcoe database	Displays the contents of the FCoE database. **Note** This command is effective when interfaces are configured.
show interface vfc [*number*]	Displays information about the vFC interfaces.
show interface [*interface number*] **fcoe**	Displays the FCoE settings for an interface or all interfaces.

This example shows how to verify that the FCoE capability is enabled:

```
switch# show fcoe
Global FCF details
        FCF-MAC is 00:0d:ec:6d:95:00
        FC-MAP is 0e:fc:00
        FCF Priority is 128
        FKA Advertisement period for FCF is 8 seconds
```

This example shows how to display the FCoE database:

```
switch# show fcoe database
------------------------------------------------------------------------------
INTERFACE       FCID            PORT NAME               MAC ADDRESS
------------------------------------------------------------------------------
vfc3            0x490100        21:00:00:1b:32:0a:e7:b8 00:c0:dd:0e:5f:76
```

This example shows how to display the FCoE settings for an interface.

```
switch# show interface ethernet 1/37 fcoe
Ethernet1/37 is FCoE UP
    vfc3 is Up
        FCID is 0x490100
       PWWN is 21:00:00:1b:32:0a:e7:b8
```

```
MAC addr is 00:c0:dd:0e:5f:76
```

Additional References for FCoE

Related Documents

Related Topic	Document Title
Command reference	Cisco NX-OS FCoE Command Reference Guide, Nexus 7000 and MDS 9500
Configuration guide	Cisco MDS 9000 Series NX-OS Quality of Service Configuration Guide
Cisco NX-OS licensing	Cisco MDS 9000 Series Licensing Guide

Standards and RFCs

Standard/RFC	Title
T11 FC BB-5	Fibre Channel Backbone 5

MIBs

MIB	MIBs Link
	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support