Cisco MDS 9000 Series Fabric Configuration Guide

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CHAPTER 1

New and Changed Information

This chapter lists the New and Changed features for this guide, starting with MDS NX-OS Release 5.0(1a).

Table 1: New and Changed Features

Feature	New and Change Topics	Changed in Release	Where Documented
Zone Server Enhancements	The Zone Server performance is enhanced using the following features: • Zone Server FCNS Shared Database • Zone Server SNMP Optimizations • Zone Server Delta Distribution	7.3(0)D1(1)	Configuring and Managing Zones, on page 37
Device Alias Diffs-only Distribution	When this feature is enabled on all the switches in a fabric, it enables better scalability.	7.3(0)D1(1)	Device Alias Diffs-Only Distribution, on page 145
Organizationally Unique Identifiers	This feature introduces a new command which enables dynamic addition of Organizationally Unique Identifiers (OUIs) to the system OUI database.	7.3(0)D1(1)	Organizationally Unique Identifiers, on page 282
Confirm commit device-alias Confirm commit zone	Added pending-diff display on commit for zone and device-alias.	6.2(9)	Organizationally Unique Identifiers, on page 282Configuring and Managing Zones, on page 37

Feature	New and Change Topics	Changed in Release	Where Documented
FC and FCOE Scale – Device Alias	Added "Device Alias Configuration Best Practices" section.	6.2(9)	Organizationally Unique Identifiers, on page 282
Fibre Channel Common Transport Management Server Query	Configuring Fibre Channel Common Transport Management Server Query	6.2(9)	Configuring Fibre Channel Common Transport Management Security, on page 297
FCNS, RSCN	Added bulk notification feature to improve the performance of all the components listening to FCNS database changes. Added coalesced SWRSCN to improve RSCN performance. Added "Displaying Fabric Switch Information" section.	6.2(7)	Managing FLOGI, Name Server, FDMI, and RSCN Databases, on page 197
Smart Zoning	Added the command output.	6.2(7)	Configuring and Managing Zones, on page 37
Smart Zoning	Added the Smart Zoning section.	5.2.6	Configuring and Managing Zones, on page 37
FICON Tape Read Acceleration	Added "FICON Tape Acceleration" section.	5.0(1a)	Configuring FICON, on page 223

CHAPTER 2

Fabric Overview

The Cisco MDS 9000 Family NX-OS command-line interface (CLI) can configure and manage features such as VSANs, SAN device virtualization, dynamic VSANs, zones, distributed device alias services, Fibre Channel routing services and protocols, FLOGI, name server, FDMI, RSCN database, SCSI targets, FICON, and other advanced features.

This chapter describes some of these features and includes the following topics:

Virtual SANs

Virtual SAN (VSAN) technology partitions a single physical SAN into multiple VSANs. VSAN capabilities allow Cisco NX-OS software to logically divide a large physical fabric into separate, isolated environments to improve Fibre Channel SAN scalability, availability, manageability, and network security. For FICON, VSANs facilitate hardware-based separation of FICON and open systems.

Each VSAN is a logically and functionally separate SAN with its own set of Fibre Channel fabric services. This partitioning of fabric services greatly reduces network instability by containing fabric reconfigurations and error conditions within an individual VSAN. The strict traffic segregation provided by VSANs helps ensure that the control and data traffic of a specified VSAN are confined within the VSAN’s own domain, increasing SAN security. VSANs help reduce costs by facilitating consolidation of isolated SAN islands into a common infrastructure without compromising availability.

Users can create administrator roles that are limited in scope to certain VSANs. For example, a network administrator role can be set up to allow configuration of all platform-specific capabilities, while other roles can be set up to allow configuration and management only within specific VSANs. This approach improves the manageability of large SANs and reduces disruptions due to human error by isolating the effect of a user action to a specific VSAN whose membership can be assigned based on switch ports or the worldwide name (WWN) of attached devices.

VSANs are supported across FCIP links between SANs, which extends VSANs to include devices at a remote location. The Cisco MDS 9000 Family switches also implement trunking for VSANs. Trunking allows Inter-Switch Links (ISLs) to carry traffic for multiple VSANs on the same physical link.

Dynamic Port VSAN Membership

Port VSAN membership on the switch is assigned on a port-by-port basis. By default each port belongs to the default VSAN. You can dynamically assign VSAN membership to ports by assigning VSANs based on the device WWN. This method is referred to as Dynamic Port VSAN Membership (DPVM). DPVM offers flexibility and eliminates the need to reconfigure the port VSAN membership to maintain fabric topology when a host or storage device connection is moved between two Cisco MDS switches or two ports within a switch. DPVM retains the configured VSAN regardless of where a device is connected or moved.

SAN Device Virtualization

Cisco SAN device virtualization (SDV) allows virtual devices representing physical end devices to be used for SAN configuration. Virtualization of SAN devices significantly reduces the time needed to swap out hardware. For example, if a storage array was replaced without using SDV, server downtime would be required for SAN zoning changes and host operating system configuration updates. With SDV, only the mapping between virtual and physical devices needs to change after hardware is swapped, insulating the SAN and end devices from extensive configuration changes.

Note SDV is not supported from Cisco MDS NX-OS Release 4.x and later.

Zoning

Zoning provides access control for devices within a SAN. Cisco NX-OS software supports the following types of zoning:

- N port zoning—Defines zone members based on the end-device (host and storage) port.
    - WWN
    - Fibre Channel identifier (FC-ID)
- Fx port zoning—Defines zone members based on the switch port.
    - WWN
    - WWN plus interface index, or domain ID plus interface index
- Domain ID and port number (for Brocade interoperability)
- iSCSI zoning—Defines zone members based on the host zone.
    - iSCSI name

  - ◦ IP address

- LUN zoning—When combined with N port zoning, LUN zoning helps ensure that LUNs are accessible only by specific hosts, providing a single point of control for managing heterogeneous storage-subsystem access.
- Read-only zones—An attribute can be set to restrict I/O operations in any zone type to SCSI read-only commands. This feature is especially useful for sharing volumes across servers for backup, data warehousing, etc.

Note LUN zoning and read-only zones are not supported from Cisco MDS NX-OS Release 5.x and later.

- Broadcast zones—An attribute can be set for any zone type to restrict broadcast frames to members of the specific zone.

To provide strict network security, zoning is always enforced per frame using access control lists (ACLs) that are applied at the ingress switch. All zoning polices are enforced in hardware, and none of them cause performance degradation. Enhanced zoning session-management capabilities further enhance security by allowing only one user at a time to modify zones.

Distributed Device Alias Services

All switches in the Cisco MDS 9000 Family support Distributed Device Alias Services (device alias) on a per-VSAN basis and on a fabric-wide basis. Device alias distribution allows you to move host bus adapters (HBAs) between VSANs without manually reentering alias names.

Fibre Channel Routing Services and Protocols

Fabric Shortest Path First (FSPF) is the standard path selection protocol used by Fibre Channel fabrics. The FSPF feature is enabled by default on all Fibre Channel switches. You do not need to configure any FSPF services except in configurations that require special consideration. FSPF automatically calculates the best path between any two switches in a fabric. Specifically, FSPF is used to perform these functions:

- Dynamically compute routes throughout a fabric by establishing the shortest and quickest path between any two switches.
- Select an alternative path in the event of the failure of a given path. FSPF supports multiple paths and automatically computes an alternative path around a failed link. FSPF provides a preferred route when two equal paths are available.

Multiprotocol Support

In addition to supporting Fibre Channel Protocol (FCP), Cisco NX-OS software supports IBM Fibre Connection (FICON), Small Computer System Interface over IP (iSCSI), and Fibre Channel over IP (FCIP) in a single platform. Native iSCSI support in the Cisco MDS 9000 Family switches helps customers consolidate storage for a wide range of servers into a common pool on the SAN.

CHAPTER 3

Configuring and Managing VSANs

You can achieve higher security and greater stability in Fibre Channel fabrics by using virtual SANs (VSANs) on Cisco MDS 9000 Family switches and Cisco Nexus 5000 Series switches. VSANs provide isolation among devices that are physically connected to the same fabric. With VSANs you can create multiple logical SANs over a common physical infrastructure. Each VSAN can contain up to 239 switches and has an independent address space that allows identical Fibre Channel IDs (FC IDs) to be used simultaneously in different VSANs. This chapter includes the following sections:

About VSANs

A VSAN is a virtual storage area network (SAN). A SAN is a dedicated network that interconnects hosts and storage devices primarily to exchange SCSI traffic. In SANs, you use the physical links to make these interconnections. A set of protocols run over the SAN to handle routing, naming, and zoning. You can design multiple SANs with different topologies.

With the introduction of VSANs, the network administrator can build a single topology containing switches, links, and one or more VSANs. Each VSAN in this topology has the same behavior and property of a SAN. A VSAN has the following additional features:

- Multiple VSANs can share the same physical topology.
- The same Fibre Channel IDs (FC IDs) can be assigned to a host in another VSAN, thus increasing VSAN scalability.
- Every instance of a VSAN runs all required protocols such as FSPF, domain manager, and zoning.
- Fabric-related configurations in one VSAN do not affect the associated traffic in another VSAN.
- Events causing traffic disruptions in one VSAN are contained within that VSAN and are not propagated to other VSANs.

This section describes VSANs and includes the following topics:

VSANs Topologies

The switch icons shown in both Figure 1: Logical VSAN Segmentation, on page 8 and Figure 2: Example of Two VSANs, on page 9 indicate that these features apply to any switch in the Cisco MDS 9000 Family.

Figure 1: Logical VSAN Segmentation, on page 8 shows a fabric with three switches, one on each floor. The geographic location of the switches and the attached devices is independent of their segmentation into logical VSANs. No communication between VSANs is possible. Within each VSAN, all members can talk to one another.

Figure 1: Logical VSAN Segmentation

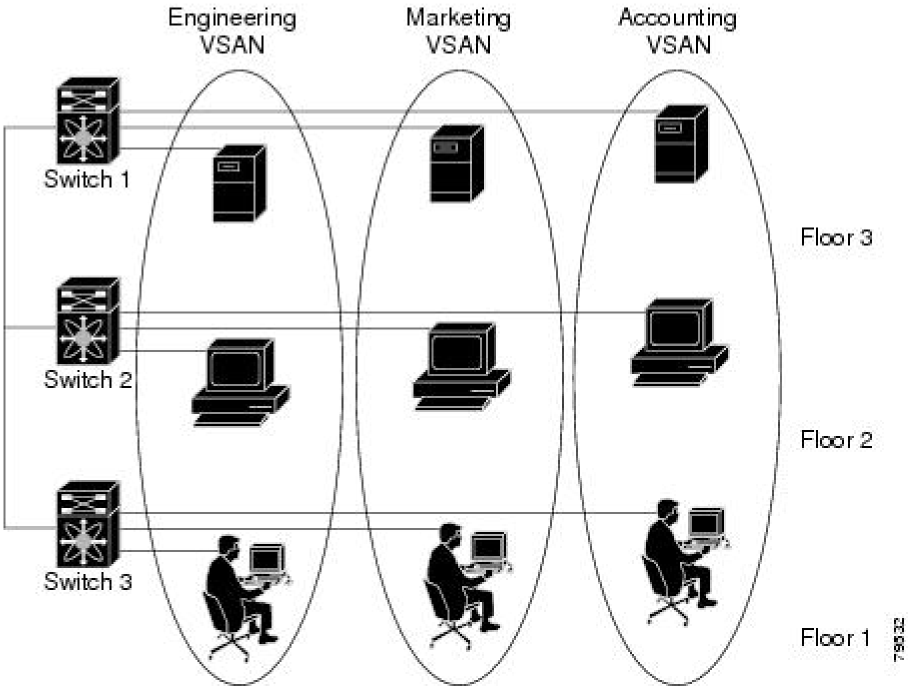
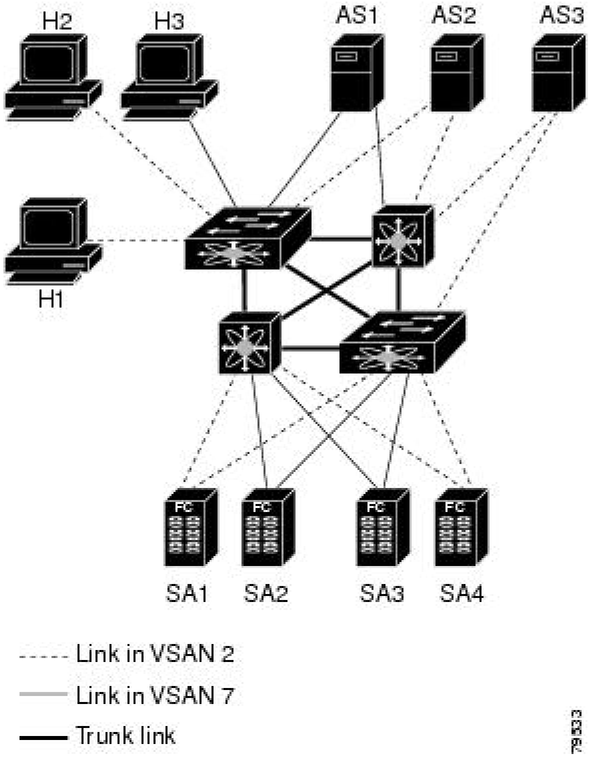


Figure 2: Example of Two VSANs, on page 9 shows a physical Fibre Channel switching infrastructure with two defined VSANs: VSAN 2 (dashed) and VSAN 7 (solid). VSAN 2 includes hosts H1 and H2, application servers AS2 and AS3, and storage arrays SA1 and SA4. VSAN 7 connects H3, AS1, SA2, and SA3.

Figure 2: Example of Two VSANs



The four switches in this network are interconnected by trunk links that carry both VSAN 2 and VSAN 7 traffic. The inter-switch topology of both VSAN 2 and VSAN 7 are identical. This is not a requirement and a network administrator can enable certain VSANs on certain links to create different VSAN topologies.

Without VSANs, a network administrator would need separate switches and links for separate SANs. By enabling VSANs, the same switches and links may be shared by multiple VSANs. VSANs allow SANs to be built on port granularity instead of switch granularity. Figure 2: Example of Two VSANs, on page 9 illustrates that a VSAN is a group of hosts or storage devices that communicate with each other using a virtual topology defined on the physical SAN.

The criteria for creating such groups differ based on the VSAN topology:

- VSANs can separate traffic based on the following requirements:
    - Different customers in storage provider data centers
    - Production or test in an enterprise network
    - Low and high security requirements
    - Backup traffic on separate VSANs
    - Replicating data from user traffic

- VSANs can meet the needs of a particular department or application.

VSAN Advantages

VSANs offer the following advantages:

- Traffic isolation—Traffic is contained within VSAN boundaries and devices reside only in one VSAN ensuring absolute separation between user groups, if desired.
- Scalability—VSANs are overlaid on top of a single physical fabric. The ability to create several logical VSAN layers increases the scalability of the SAN.
- Per VSAN fabric services—Replication of fabric services on a per VSAN basis provides increased scalability and availability.
- Redundancy—Several VSANs created on the same physical SAN ensure redundancy. If one VSAN fails, redundant protection (to another VSAN in the same physical SAN) is configured using a backup path between the host and the device.
- Ease of configuration—Users can be added, moved, or changed between VSANs without changing the physical structure of a SAN. Moving a device from one VSAN to another only requires configuration at the port level, not at a physical level.

Up to 256 VSANs can be configured in a switch. Of these, one is a default VSAN (VSAN 1), and another is an isolated VSAN (VSAN 4094). User-specified VSAN IDs range from 2 to 4093.

VSANs Versus Zones

You can define multiple zones in a VSAN. Because two VSANs are equivalent to two unconnected SANs, zone A on VSAN 1 is different and separate from zone A in VSAN 2. Table 2: VSAN and Zone Comparison , on page 10 lists the differences between VSANs and zones.

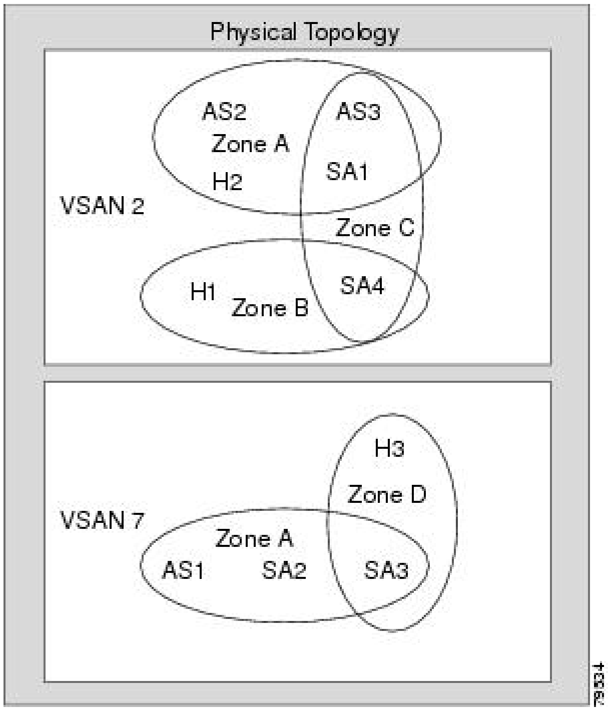
Table 2: VSAN and Zone Comparison

VSAN Characteristic	Zone Characteristic
VSANs equal SANs with routing, naming, and zoning protocols.	Routing, naming, and zoning protocols are not available on a per-zone basis.
—	Zones are always contained within a VSAN. Zones never span two VSANs.
VSANs limit unicast, multicast, and broadcast traffic.	Zones limit unicast traffic.
Membership is typically defined using the VSAN ID to Fx ports.	Membership is typically defined by the pWWN.
An HBA or a storage device can belong only to a single VSAN—the VSAN associated with the Fx port.	An HBA or storage device can belong to multiple zones.
VSANs enforce membership at each E port, source port, and destination port.	Zones enforce membership only at the source and destination ports.

VSAN Characteristic	Zone Characteristic
VSANs are defined for larger environments (storage service providers).	Zones are defined for a set of initiators and targets not visible outside the zone.
VSANs encompass the entire fabric.	Zones are configured at the fabric edge.

Figure 3: VSANS with Zoning, on page 11 shows the possible relationships between VSANs and zones. In VSAN 2, three zones are defined: zone A, zone B, and zone C. Zone C overlaps both zone A and zone B as permitted by Fibre Channel standards. In VSAN 7, two zones are defined: zone A and zone D. No zone crosses the VSAN boundary—they are completely contained within the VSAN. Zone A defined in VSAN 2 is different and separate from zone A defined in VSAN 7.

Figure 3: VSANS with Zoning



VSAN Configuration

VSANs have the following attributes:

- VSAN ID—The VSAN ID identifies the VSAN as the default VSAN (VSAN 1), user-defined VSANs (VSAN 2 to 4093), and the isolated VSAN (VSAN 4094).
- State—The administrative state of a VSAN can be configured to an active (default) or suspended state. Once VSANs are created, they may exist in various conditions or states.

- ◦ The active state of a VSAN indicates that the VSAN is configured and enabled. By enabling a VSAN, you activate the services for that VSAN.
- ◦ The suspended state of a VSAN indicates that the VSAN is configured but not enabled. If a port is configured in this VSAN, it is disabled. Use this state to deactivate a VSAN without losing the VSAN's configuration. All ports in a suspended VSAN are disabled. By suspending a VSAN, you can preconfigure all the VSAN parameters for the whole fabric and activate the VSAN immediately.

- VSAN name—This text string identifies the VSAN for management purposes. The name can be from 1 to 32 characters long and it must be unique across all VSANs. By default, the VSAN name is a concatenation of VSAN and a four-digit string representing the VSAN ID. For example, the default name for VSAN 3 is VSAN0003.

Note A VSAN name must be unique.

- Load balancing attributes—These attributes indicate the use of the source-destination ID (src-dst-id) or the originator exchange OX ID (src-dst-ox-id, the default) for load balancing path selection.

Note OX ID based load balancing of IVR traffic from IVR- enabled switches is not supported on Generation 1 switching modules. OX ID based load balancing of IVR traffic from a non-IVR MDS switch should work. Generation 2 switching modules support OX ID based load balancing of IVR traffic from IVR-enabled switches.

This section describes how to create and configure VSANs and includes the following topics:

Reserved VSAN Range and Isolated VSAN Range Guidelines

On an NPV switch with a trunking configuration on any interface, or on a regular switch where the f port-channel-trunk command is issued to enable the Trunking F Port Channels feature, follow these configuration guidelines for reserved VSANs and the isolated VSAN:

- If trunk mode is on for any of the interfaces or NP Port Channel is up, the reserved VSANs are 3040 to 4078, and they are not available for user configuration.
- The Exchange Virtual Fabric Protocol (EVFP) isolated VSAN is 4079, and it is not available for user configuration.

VSAN Creation

A VSAN is in the operational state if the VSAN is active and at least one port is up. This state indicates that traffic can pass through this VSAN. This state cannot be configured.

Creating VSANs Statically

You cannot configure any application-specific parameters for a VSAN before creating the VSAN.

Creating VSANs

To create VSANs, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# **vsan database**
switch(config-vsan-db)#

Configures the database for a VSAN. Application specific VSAN parameters cannot be configured from this prompt.

Step 3 switch(config-vsan-db)# **vsan 2**
Creates a VSAN with the specified ID (2) if that VSAN does not exist already.

Step 4 switch(config-vsan-db)# **vsan 2 name TechDoc**
updated vsan 2

Updates the VSAN with the assigned name (TechDoc).

Step 5 switch(config-vsan-db)# **vsan 2 suspend**
Suspends the selected VSAN.

Step 6 switch(config-vsan-db)# **no vsan 2 suspend**
Negates the **suspend** command issued in the previous step.

Step 7 switch(config-vsan-db)# **end**
switch#

Returns you to EXEC mode.

Port VSAN Membership

Port VSAN membership on the switch is assigned on a port-by-port basis. By default, each port belongs to the default VSAN. You can assign VSAN membership to ports using one of two methods:

- Statically—By assigning VSANs to ports.

  See the Assigning Static Port VSAN Membership, on page 14.

- Dynamically—By assigning VSANs based on the device WWN. This method is referred to as dynamic port VSAN membership (DPVM).

  See create_dynamic_vsan.ditamap#map_2861B3F48B334468BB9FBC52B85CC84A

Trunking ports have an associated list of VSANs that are part of an allowed list (refer to the *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide*).

Assigning Static Port VSAN Membership

To statically assign VSAN membership for an interface port, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# **vsan database**
switch(config-vsan-db)#

Configures the database for a VSAN.

Step 3 switch(config-vsan-db)# **vsan 2**
Creates a VSAN with the specified ID (2) if that VSAN does not exist already.

Step 4 switch(config-vsan-db)# **vsan 2 interface fc1/8**
Assigns the membership of the fc1/8 interface to the specified VSAN (VSAN 2).

Step 5 switch(config-vsan-db)# **vsan 7**
Creates another VSAN with the specified ID (7) if that VSAN does not exist already.

Step 6 switch(config-vsan-db)# **vsan 7 interface fc1/8**
Updates the membership information of the interface to reflect the changed VSAN.

Step 7 switch(config-vsan-db)# **vsan 1 interface fc1/8**
Removes the interface fc1/8 from VSAN 7 to VSAN 1(the default VSAN).

To remove the VSAN membership of interface fc1/8 from VSAN 7, you should define the VSAN membership of fc1/8 to another VSAN.

The best practice is to assign it back to VSAN 1.

Displaying VSAN Static Membership

To display the VSAN static membership information, use the **show vsan membership** command (see Displays Membership Information for the Specified VSAN, on page 14 through Displays Static Membership Information for a Specified Interface, on page 15).

Displays Membership Information for the Specified VSAN

```
switch # show vsan 1 membership
vsan 1 interfaces:
        fc1/1    fc1/2    fc1/3    fc1/4    fc1/5    fc1/6    fc1/7    fc1/9
        fc1/10   fc1/11   fc1/12   fc1/13   fc1/14   fc1/15   fc1/16   port-channel 99
```

Note Interface information is not displayed if interfaces are not configured on this VSAN.

Displays Static Membership Information for All VSANs

```
switch # show vsan membership

vsan 1 interfaces:
        fc2/16  fc2/15  fc2/14  fc2/13  fc2/12  fc2/11  fc2/10  fc2/9
        fc2/8   fc2/7   fc2/6   fc2/5   fc2/4   fc2/3   fc2/2   fc2/1
        fc1/16  fc1/15  fc1/14  fc1/13  fc1/12  fc1/11  fc1/10  fc1/9
        fc1/7   fc1/6   fc1/5   fc1/4   fc1/3   fc1/2   fc1/1
vsan 2 interfaces:
        fc1/8
vsan 7 interfaces:
vsan 100 interfaces:
vsan 4094(isolated vsan) interfaces:
```

Displays Static Membership Information for a Specified Interface

```
switch # show vsan membership interface fc1/1
fc1/1
        vsan:1
        allowed list:1-4093
```

Default VSAN

The factory settings for switches in the Cisco MDS 9000 Family have only the default VSAN 1 enabled. We recommend that you do not use VSAN 1 as your production environment VSAN. If no VSANs are configured, all devices in the fabric are considered part of the default VSAN. By default, all ports are assigned to the default VSAN.

Note VSAN 1 cannot be deleted, but it can be suspended.

Note Up to 256 VSANs can be configured in a switch. Of these, one is a default VSAN (VSAN 1), and another is an isolated VSAN (VSAN 4094). User-specified VSAN IDs range from 2 to 4093.

Isolated VSAN

VSAN 4094 is an isolated VSAN. All non-trunking ports are transferred to this VSAN when the VSAN to which they belong is deleted. This avoids an implicit transfer of ports to the default VSAN or to another configured VSAN. All ports in the deleted VSAN are isolated (disabled).

Note When you configure a port in VSAN 4094 or move a port to VSAN 4094, that port is immediately isolated.

Caution Do not use an isolated VSAN to configure ports.

Note Up to 256 VSANs can be configured in a switch. Of these, one is a default VSAN (VSAN 1), and another is an isolated VSAN (VSAN 4094). User-specified VSAN IDs range from 2 to 4093.

Displaying Isolated VSAN Membership

The **show vsan 4094 membership** command displays all ports associated with the isolated VSAN.

Operational State of a VSAN

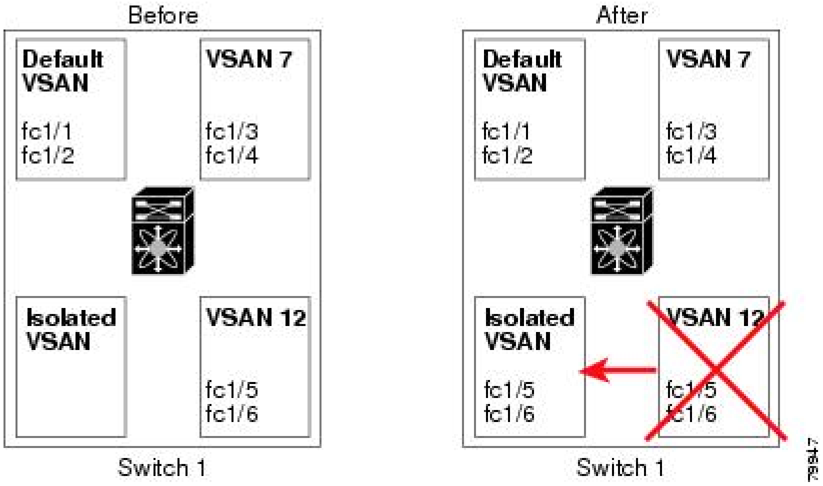
A VSAN is in the operational state if the VSAN is active and at least one port is up. This state indicates that traffic can pass through this VSAN. This state cannot be configured.

Static VSAN Deletion

When an active VSAN is deleted, all of its attributes are removed from the running configuration. VSAN-related information is maintained by the system software as follows:

- VSAN attributes and port membership details are maintained by the VSAN manager. This feature is affected when you delete a VSAN from the configuration. When a VSAN is deleted, all the ports in that VSAN are made inactive and the ports are moved to the isolated VSAN. If the same VSAN is recreated, the ports do not automatically get assigned to that VSAN. You must explicitly reconfigure the port VSAN membership (see Figure 4: VSAN Port Membership Details, on page 16)

Figure 4: VSAN Port Membership Details



- VSAN-based runtime (name server), zoning, and configuration (static routes) information is removed when the VSAN is deleted.
- Configured VSAN interface information is removed when the VSAN is deleted.

Note The allowed VSAN list is not affected when a VSAN is deleted (refer to the *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide*).

Any commands for a nonconfigured VSAN are rejected. For example, if VSAN 10 is not configured in the system, then a command request to move a port to VSAN 10 is rejected.

Deleting Static VSANs

To delete a VSAN and its various attributes, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# **vsan database**
Configures the VSAN database.

Step 3 switch-config-db# **vsan 2**
switch(config-vsan-db)#

Places you in VSAN configuration mode.

Step 4 switch(config-vsan-db)# **no vsan 5**
switch(config-vsan-db)#

Deletes VSAN 5 from the database and switch.

Step 5 switch(config-vsan-db)# **end**
switch#

Places you in EXEC mode.

Load Balancing

Load balancing attributes indicate the use of the source-destination ID (src-dst-id) or the originator exchange OX ID (src-dst-ox-id, the default) for load balancing path selection.

Configuring Load Balancing

To configure load balancing on an existing VSAN, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# **vsan database**
switch(config-vsan-db)#

Enters VSAN database configuration submode

Step 3 switch(config-vsan-db)# **vsan 2**
Specifies an existing VSAN.

Step 4 switch(config-vsan-db)# **vsan 2 loadbalancing src-dst-id**
Enables the load balancing guarantee for the selected VSAN and directs the switch to use the source and destination ID for its path selection process.

Step 5 switch(config-vsan-db)# **no vsan 2 loadbalancing src-dst-id**
Negates the command issued in the previous step and reverts to the default values of the load balancing parameters.

Step 6 switch(config-vsan-db)# **vsan 2 loadbalancing src-dst-ox-id**
Changes the path selection setting to use the source ID, the destination ID, and the OX ID (default).

Step 7 switch(config-vsan-db)# **vsan 2 suspend**
Suspends the selected VSAN.

Step 8 switch(config-vsan-db)# **no vsan 2 suspend**
Negates the **suspend** command issued in the previous step.

Step 9 switch(config-vsan-db)# **end**
switch#

Returns you to EXEC mode.

Interop Mode

Interoperability enables the products of multiple vendors to come into contact with each other. Fibre Channel standards guide vendors towards common external Fibre Channel interfaces. See the Switch Interoperability, on page 287.

FICON VSANs

You can enable FICON in up to eight VSANs. See the FICON VSAN Prerequisites, on page 229.

Displaying Static VSAN Configuration

Use the **show vsan** command to display information about configured VSANs (see Examples Displays the Configuration for a Specific VSAN, on page 18 to Displays All VSANs, on page 19).

Displays the Configuration for a Specific VSAN

```
switch# show vsan 100
vsan 100 information
```

```
         name:VSAN0100 state:active
         in-order guarantee:no interoperability mode:no
         loadbalancing:src-id/dst-id/oxid
```

Displays the VSAN Usage

```
switch# show vsan usage
4 vsan configured
configured vsans:1-4
vsans available for configuration:5-4093
```

Displays All VSANs

```
switch# show vsan
vsan 1 information
         name:VSAN0001 state:active
         in-order guarantee:no interoperability mode:no
         loadbalancing:src-id/dst-id/oxid
vsan 2 information
         name:VSAN0002 state:active
         in-order guarantee:no interoperability mode:no
         loadbalancing:src-id/dst-id/oxid
vsan 7 information
         name:VSAN0007 state:active
         in-order guarantee:no interoperability mode:no
         loadbalancing:src-id/dst-id/oxid
vsan 100 information
         name:VSAN0100 state:active
         in-order guarantee:no interoperability mode:no
         loadbalancing:src-id/dst-id/oxid
vsan 4094:isolated vsan
```

Default Settings

Table 3: Default VSAN Parameters , on page 19 lists the default settings for all configured VSANs.

Table 3: Default VSAN Parameters

Parameters	Default
Default VSAN	VSAN 1.
State	Active state.
Name	Concatenation of VSAN and a four-digit string representing the VSAN ID. For example, VSAN 3 is VSAN0003.
Load-balancing attribute	OX ID (src-dst-ox-id).

Displaying Fabric Switch Information

Use the **show fabric switch information** vsan command to display information about each switch in the fabric in the given VSAN.

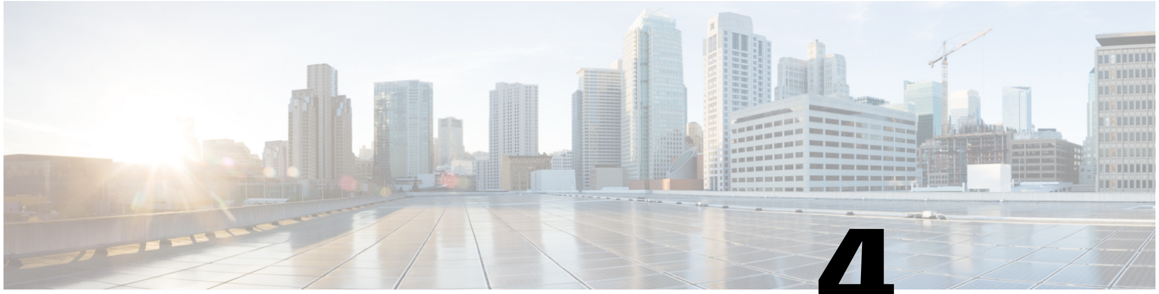
Displays Information about All the Switches in the Fabric

```
switch# show fabric switch information vsan 100
VSAN 1:
----------------------------------------------------------------------------
SwitchName                       Model                Version     SupMemory
----------------------------------------------------------------------------
huashan12                        DS-C9148-48P-K9      5.2(2d)           n/a
alishan-bgl-25                   DS-C9250I-K9         6.2(5a)           n/a
Hac18                            DS-C9506             6.2(7)           2 GB
Hac17                            DS-C9506             6.2(5)            n/a
Coco1                            DS-C9222I-K9         6.2(7)                     1 GB
switch#
```

Note This command is not supported prior to Cisco NX-OS Release 6.2(7).

Note SUP memory is not displayed for the switches that are running Cisco NX-OS Release prior to 6.2(7).

Note Without the VSAN option, this command displays information about switches in all the VSANs.



CHAPTER 4

Creating Dynamic VSANs

This chapter includes the following sections:

About DPVM

Port VSAN membership on the switch is assigned on a port-by-port basis. By default each port belongs to the default VSAN.

You can dynamically assign VSAN membership to ports by assigning VSANs based on the device WWN. This method is referred to as Dynamic Port VSAN Membership (DPVM). DPVM offers flexibility and eliminates the need to reconfigure the port VSAN membership to maintain fabric topology when a host or storage device connection is moved between two Cisco MDS switches or two ports within a switch. It retains the configured VSAN regardless of where a device is connected or moved. To assign VSANs statically, see Creating Dynamic VSANs, on page 21

DPVM configurations are based on port world wide name (pWWN) and node world wide name (nWWN) assignments. A DPVM database contains mapping information for each device pWWN/nWWN assignment and the corresponding VSAN. The Cisco NX-OS software checks the database during a device FLOGI and obtains the required VSAN details.

The pWWN identifies the host or device and the nWWN identifies a node consisting of multiple devices. You can assign any one of these identifiers or any combination of these identifiers to configure DPVM mapping. If you assign a combination, then preference is given to the pWWN.

DPVM uses the Cisco Fabric Services (CFS) infrastructure to allow efficient database management and distribution. DPVM uses the application driven, coordinated distribution mode and the fabric-wide distribution scope (for information about CFS, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .

Note DPVM does not cause any changes to device addressing. DPVM only pertains to the VSAN membership of the device, ensuring that the host gets the same VSAN membership on any port on the switch. For example, if a port on the switch has a hardware failure, you can move the host connection to another port on the switch and you do not need to update the VSAN membership manually.

Note DPVM is not supported on FL ports. DPVM is supported only on F ports.

This section describes DPVM and includes the following topics:

About DPVM Configuration

To use the DPVM feature as designed, be sure to verify the following requirements:

- The interface through which the dynamic device connects to the Cisco MDS 9000 Family switch must be configured as an F port.
- The static port VSAN of the F port should be valid (not isolated, not suspended, and in existence).
- The dynamic VSAN configured for the device in the DPVM database should be valid (not isolated, not suspended, and in existence).

Note The DPVM feature overrides any existing static port VSAN membership configuration. If the VSAN corresponding to the dynamic port is deleted or suspended, the port is shut down.

Enabling DPVM

To begin configuring DPVM, you must explicitly enable DPVM on the required switches in the fabric. By default, this feature is disabled in all switches in the Cisco MDS 9000 Family.

The configuration and verification commands for DPVM are only available when DPVM is enabled on a switch. When you disable this feature, all related configurations are automatically discarded.

To enable DPVM on any participating switch, follow these steps:

Step 1 switch# **config t**
switch(config)#
Enters configuration mode.

Step 2 switch(config)# **feature dpvm**
Enables DPVM on that switch.

Step 3 switch(config)# **no feature dpvm**
Disables (default) DPVM on that switch.

Note To overwrite the login information with the duplicate pWWN login, enter the **dpvm overwrite-duplicate-pwwn** command.

About DPVM Databases

The DPVM database consists of a series of device mapping entries. Each entry consists of a device pWWN or nWWN assignment along with the dynamic VSAN to be assigned. You can configure a maximum of 16,000 DPVM entries in the DPVM database. This database is global to the whole switch (and fabric) and is not maintained for each VSAN.

The DPVM feature uses three databases to accept and implement configurations.

- Configuration (config) database—All configuration changes are stored in the configuration database when distribution is disabled.
- Active database—The database currently enforced by the fabric.
- Pending database—All configuration changes are stored in the DPVM pending database when distribution is enabled (see the DPVM Database Distribution, on page 26).

Changes to the DPVM config database are not reflected in the active DPVM database until you activate the DPVM config database. Changes to the DPVM pending database are not reflected in the config or active DPVM database until you commit the DPVM pending database. This database structure allows you to create multiple entries, review changes, and let the DPVM config and pending databases take effect.

Configuring DPVM Config and Pending Databases

To create and populate the DPVM config and pending databases, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **device-alias mode enhanced**
switch(config)# **device-alias commit**

Enables enhanced device alias mode. This is required for device-alias configuration in the DPVM database.

Step 3 switch(config)# **dpvm database**
switch(config-dpvm-db)#

Creates the DPVM config database.

Step 4 switch(config)# **no dpvm database**
(Optional) Deletes the DPVM config database.

Step 5 switch(config-dpvm-db)# **pwwn 12:33:56:78:90:12:34:56 vsan 100**
Maps the specified device pWWN to VSAN 100.

Step 6 switch(config-dpvm-db)# **no pwwn 12:33:56:78:90:12:34:56 vsan 101**
(Optional) Removes the specified device pWWN mapping from the DPVM config database.

Step 7 switch(config-dpvm-db)# **nwwn 14:21:30:12:63:39:72:81 vsan 101**
Maps the specified device nWWN to VSAN 101.

Step 8 switch(config-dpvm-db)# **no nwwn 14:21:30:12:63:39:72:80 vsan 101**
(Optional) Removes the specified device nWWN mapping from the DPVM config database.

Step 9 switch(config-dpvm-db)# **device-alias device1 vsan 102**
Maps the specified device-alias to VSAN 102.

Step 10 switch(config-dpvm-db)# **no device-alias device1 vsan 102**
(Optional) Removes the specified device-alias mapping from the DPVM config database.

Activating DPVM Config Databases

When you explicitly activate the DPVM config database, the DPVM config database becomes the active DPVM database. Activation may fail if conflicting entries are found between the DPVM config database and the currently active DPVM database. However, you can force activation to override conflicting entries.

To disable DPVM, you must explicitly deactivate the currently active DPVM database by issuing the **no dpvm activate** command.

To activate the DPVM config database, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **dpvm activate**
Activates the DPVM config database.

Step 3 switch(config)# **no dpvm activate**
Deactivates the currently active DPVM database.

Step 4 switch(config)# **dpvm activate force**
Forcefully activates the DPVM config database to override conflicting entries.

About Autolearned Entries

The DPVM database can be configured to automatically learn (autolearn) about new devices within each VSAN. The autolearn feature can be enabled or disabled at any time. Learned entries are created by populating device pWWNs and VSANs in the active DPVM database. The active DPVM database should already be available to enable autolearn.

You can delete any learned entry from the active DPVM database when you enable autolearn. These entries only become permanent in the active DPVM database when you disable autolearn.

Note Autolearning is only supported for devices connected to F ports. Devices connected to FL ports are not entered into the DPVM database because DPVM is not supported on FL ports.

The following conditions apply to learned entries:

- If a device logs out while autolearn is enabled, that entry is automatically deleted from the active DPVM database.
- If the same device logs multiple times into the switch through different ports, then the VSAN corresponding to last login is remembered.
- Learned entries do not override previously configured and activated entries.
- Learning is a two-part process—Enabling autolearning followed by disabling autolearning. When the **auto-learn** option is enabled, the following applies:
    - Learning currently logged-in devices—Occurs from the time learning is enabled.
    - Learning new device logins— Occurs as and when new devices log in to the switch.

Enabling Autolearning

To enable autolearning, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **dpvm auto-learn**
Enables learning on this switch.

Step 3 switch(config)# **no dpvm auto-learn**
Disables (default) learning on this switch.

Step 4 switch(config)# **clear dpvm auto-learn**
Clears the list of auto-learned entries.

Step 5 switch(config)# **clear dpvm auto-learn pwwn** *pwwn*
Clears the list of auto-learned pWWN entries in the distributed DPVM database.

Clearing Learned Entries

You can clear DPVM entries from the active DPVM database (if autolearn is still enabled) using one of two methods.

- To clear a single autolearn entry, use the **clear dpvm auto-learn pwwn** command.

```
switch# clear dpvm auto-learn pwwn 55:22:33:44:55:66:77:88
```

- To clear all autolearn entries, use the **clear dpvm auto-learn** command.

```
switch# clear dpvm auto-learn
```

Note These two commands do not start a session and can only be issued in the local switch.

DPVM Database Distribution

If the DPVM database is available on all switches in the fabric, devices can be moved anywhere and offer the greatest flexibility. To enable database distribution to the neighboring switches, the database should be consistently administered and distributed across all switches in the fabric. The Cisco NX-OS software uses the Cisco Fabric Services (CFS) infrastructure to achieve this requirement (refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*).

This section describes how to distribute the DPVM database and includes the following topics:

About DPVM Database Distribution

Using the CFS infrastructure, each DPVM server learns the DPVM database from each of its neighboring switches during the ISL bring-up process. If you change the database locally, the DPVM server notifies its neighboring switches, and that database is updated by all switches in the fabric.

If fabric distribution is enabled, all changes to the configuration database are stored in the DPVM pending database. These changes include the following tasks:

- Adding, deleting, or modifying database entries.
- Activating, deactivating, or deleting the configuration database.
- Enabling or disabling autolearning.

These changes are distributed to all switches in a fabric when you commit the changes. You can also discard (abort) the changes at this point.

Tip You can view the contents of the DPVM pending database by issuing the **show dpvm pending** command.

Disabling DPVM Database Distribution

To disable DPVM database distribution to the neighboring switches, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **no dpvm distribute**
Disables DPVM distribution to the neighboring switches.

Step 3 switch(config)# **dpvm distribute**
Enables (default) DPVM distribution to the neighboring switches.

About Locking the Fabric

The first action that modifies the existing configuration creates the DPVM pending database and locks the feature in the fabric. Once you lock the fabric, the following conditions apply:

- No other user can make any configuration changes to this feature.
- A copy of the configuration database becomes the DPVM pending database. Modifications from this point on are made to the DPVM pending database. The DPVM pending database remains in effect until you commit the modifications to the DPVM pending database or discard (abort) the changes to the DPVM pending database.

Locking the Fabric

To lock the fabric and apply changes to the DPVM pending database, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **dpvm database**
switch(config-dpvm-db)#

Accesses the DPVM config database.

Step 3 switch(config-dpvm-db)# **pwwn 11:22:33:44:55:66:77:88 vsan 11**
Adds one entry to the DPVM config database.

Step 4 switch(config-dpvm-db)# **exit**

switch(config)#

Exits to configuration mode.

Step 5 switch(config)# **dpvm activate**
Activates the DPVM config database.

Committing Changes

If you commit the changes made to the configuration, the configuration in the DPVM pending database are distributed to other switches. On a successful commit, the configuration change is applied throughout the fabric and the lock is released.

To commit the DPVM pending database, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **dpvm commit**
Commits the database entries that are currently in the DPVM pending database.

Discarding Changes

If you discard (abort) the changes made to the DPVM pending database, the configurations remain unaffected and the lock is released.

To discard the DPVM pending database, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **dpvm abort**
Discards the database entries that are currently in the DPVM pending database.

Clearing a Locked Session

If you have performed a DPVM task and have forgotten to release the lock by either committing or discarding the changes, an administrator can release the lock from any switch in the fabric. If the administrator performs this task, your changes to the DPVM pending database are discarded and the fabric lock is released.

Tip The DPVM pending database is only available in the volatile directory and is subject to being discarded if the switch is restarted.

To use administrative privileges and release a locked DPVM session, use the **clear dpvm session** command in EXEC mode.

```
switch# clear dpvm session
```

Database Merge Guidelines

A database merge refers to a union of the configuration database and static (unlearned) entries in the active DPVM database. For information about CFS merge support, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* for detailed concepts.

When merging the DPVM database between two fabrics, follow these guidelines:

- Verify that the activation status and the auto-learn status is the same is both fabrics.
- Verify that the combined number of device entries in each database does not exceed 16 K.

Caution If you do not follow these two conditions, the merge will fail. The next distribution will forcefully synchronize the databases and the activation states in the fabric.

This section describes how to merge DPVM databases and includes the following topics:

About Copying DPVM Databases

The following circumstances may require the active DPVM database to be copied to the DPVM config database:

- If the learned entries are only added to the active DPVM database.
- If the DPVM config database or entries in the DPVM config database are accidently deleted.

Note If you copy the DPVM database and fabric distribution is enabled, you must commit the changes.

Copying DPVM Databases

To copy the currently active DPVM database to the DPVM config database, use the **dpvm database copy** command.

```
switch# dpvm database
 copy active
Legend: “+” New Entry, “-” Missing Entry, “*” Possible Conflict Entry
---------------------------------------------------------------------
-  pwwn  12:33:56:78:90:12:34:56  vsan 100
-  nwwn  14:21:30:12:63:39:72:81  vsan 101
```

Comparing Database Differences

You can compare the DPVM databases as follows:

- Use the **dpvm database diff active** command to compare the active DPVM database with the DPVM config database.

```
switch# dpvm database diff active
Legend: “+” New Entry, “-” Missing Entry, “*” Possible Conflict Entry
---------------------------------------------------------------------
-  pwwn  44:22:33:44:55:66:77:88  vsan 44
*  pwwn  11:22:33:44:55:66:77:88  vsan 11
```

- Use the **dpvm database diff config** command to compare the DPVM config database with the active DPVM database.

```
switch# dpvm database diff config
Legend: “+” New Entry, “-” Missing Entry, “*” Possible Conflict Entry
---------------------------------------------------------------------
+  pwwn  44:22:33:44:55:66:77:88  vsan 44
*  pwwn  11:22:33:44:55:66:77:88  vsan 22
```

- Use the **show dpvm pending-diff** command (when CFS distribution is enabled) to compare the DPVM pending database with the DPVM config database.

To add pending database entries to the DPVM config database, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **dpvm distribute**
Enables CFS distribution.

Step 3 switch(config)# **dpvm database**
Accesses the DPVM config database.

Step 4 switch(config-dpvm-db)# **pwwn 44:22:33:44:55:66:77:88 vsan 55**
switch(config-dpvm-db)# **pwwn 55:22:33:44:55:66:77:88 vsan 55**

Adds two entries to the DPVM config database.

Displaying DPVM Merge Status and Statistics

To display the DPVM databases merge statistics, follow these steps:

Command	Purpose
`switch#` **show dpvm merge statistics** `switch(config)#`	Displays the DPVM databases merge statistics.
`switch(config)#` **clear dpvm merge statistics** `switch(config)#`	Clears the DPVM databases merge statistics.

This example shows the conflicts in DPVM databases merge:

```
switch# show dpvm merge status
Last Merge Time Stamp     : Fri Aug  8 15:46:36 2008
Last Merge State          : Fail
Last Merge Result         : Fail
Last Merge Failure Reason : DPVM DB conflict found during merge [cfs_status: 76] Last Merge
 Failure Details: DPVM merge failed due to database conflict
Local Switch WWN          : 20:00:00:0d:ec:24:e5:00
Remote Switch WWN         : 20:00:00:0d:ec:09:d5:c0

--------------------------------------------------------------------------
        Conflicting DPVM member(s)                    Loc VSAN   Rem VSAN
--------------------------------------------------------------------------
dev-alias dpvm_dev_alias_1 [21:00:00:04:cf:cf:45:ba]    1313       1414
dev-alias dpvm_dev_alias_2 [21:00:00:04:cf:cf:45:bb]    1313       1414
dev-alias dpvm_dev_alias_3 [21:00:00:04:cf:cf:45:bc]    1313       1414
[Total 3 conflict(s)]
rbadri-excal13#
```

This example shows the conflicts in DDAS mode:

```
switch# show dpvm merge status
Last Merge Time Stamp     : Fri Aug  8 15:46:36 2008
Last Merge State          : Fail
Last Merge Result         : Fail
Last Merge Failure Reason : DPVM DB conflict found during merge [cfs_status: 76] Last Merge
 Failure Details: DPVM merge failed due to DDAS mode conflict
Local Switch WWN          : 20:00:00:0d:ec:24:e5:00
Remote Switch WWN         : 20:00:00:0d:ec:09:d5:c0
Local DDAS mode           : Basic
Remote DDAS mode          : Enhanced
```

Displaying DPVM Configurations

Use the **show dpvm** command to display information about WWNs configured on a per VSAN basis (see the following examples).

Displays the DPVM Configuration Status

```
switch# show dpvm status
DB is activated successfully, auto-learn is on
```

Displays the DPVM Current Dynamic Ports for the Specified VSAN

```
switch# show dpvm ports vsan 10
--------------------------------------------------------------
Interface Vsan Device pWWN             Device nWWN
--------------------------------------------------------------
fc1/2     10   29:a0:00:05:30:00:6b:a0 fe:65:00:05:30:00:2b:a0
```

Displays the DPVM Config Database

```
switch# show dpvm database
pwwn  11:22:33:44:55:66:77:88  vsan 11
pwwn  22:22:33:44:55:66:77:88  vsan 22
pwwn  33:22:33:44:55:66:77:88  vsan 33
pwwn  44:22:33:44:55:66:77:88  vsan 44
[Total 4 entries]
```

Displays the DPVM Database

```
switch# show dpvm database active
pwwn  11:22:33:44:55:66:77:88  vsan 22
pwwn  22:22:33:44:55:66:77:88  vsan 22
pwwn  33:22:33:44:55:66:77:88  vsan 33
[Total 3 entries]
* is auto-learnt entry
```

Displays DPVM Config Database

```
switch# show dpvm database
pwwn  11:22:33:44:55:66:77:88  vsan 11
pwwn  22:22:33:44:55:66:77:88  vsan 22
pwwn  33:22:33:44:55:66:77:88  vsan 33
pwwn  44:22:33:44:55:66:77:88  vsan 44
[Total 4 entries]
```

Compares Pending Database with the DPVM Config Database

```
switch# show dpvm pending-diff
Legend: “+” New Entry, “-” Missing Entry, “*” Possible Conflict Entry
---------------------------------------------------------------------
+  pwwn  55:22:33:44:55:66:77:88  vsan 55
-  pwwn  11:22:33:44:55:66:77:88  vsan 11
*  pwwn  44:22:33:44:55:66:77:88  vsan 44
```

Sample DPVM Configuration

To configure a basic DPVM scenario, follow these steps:

Step 1 Enable DPVM and enable DPVM distribution.

Example:

```
switch1# config
Enter configuration commands, one per line.  End with CNTL/Z.
switch1(config)# feature dpvm
switch1(config)# end

switch1# show dpvm database
switch1# show dpvm database active
switch1# show dpvm status
```

At this stage, the configuration does not have an active DPVM database and the **auto-learn** option is disabled.

Step 2 Activate a null (empty) database so it can be populated with autolearned entries.

Example:

```
switch1# config

Enter configuration commands, one per line.  End with CNTL/Z.
switch1(config)# dpvm activate
switch1(config)# dpvm commit
switch1(config)# end

switch1# show dpvm database

switch1# show dpvm database active

switch1# show dpvm status
```

At this stage, the database is successfully activated and the **auto-learn** option continues to be disabled.

Step 3 Enable the **auto-learn** option and commit the configuration changes.

Example:

```
switch1# config

Enter configuration commands, one per line.  End with CNTL/Z.
switch1(config)# dpvm auto-learn
switch1(config)# dpvm commit
switch1(config)# end

switch1# show dpvm database active
pwwn 21:00:00:e0:8b:0e:74:8a vsan 4(*)
pwwn 21:01:00:e0:8b:2e:87:8a vsan 5(*)
[Total 2 entries]
* is auto-learnt entry
switch1# show dpvm ports
--------------------------------------------------------------
Interface   Vsan        Device pWWN       Device nWWN
--------------------------------------------------------------
fc1/24       4   21:00:00:e0:8b:0e:74:8a  20:00:00:e0:8b:0e:74:8a
fc1/27       5   21:01:00:e0:8b:2e:87:8a  20:01:00:e0:8b:2e:87:8a
switch1# show flogi database
---------------------------------------------------------------------------
INTERFACE  VSAN    FCID            PORT NAME               NODE NAME
---------------------------------------------------------------------------
fc1/24     4     0xe70100  21:00:00:e0:8b:0e:74:8a  20:00:00:e0:8b:0e:74:8a
fc1/27     5     0xe80100  21:01:00:e0:8b:2e:87:8a  20:01:00:e0:8b:2e:87:8a
Total number of flogi = 2.
switch195# show dpvm status
DB is activated successfully, auto-learn is on
```

At this stage, the currently logged in devices (and their current VSAN assignment) populate the active DPVM database. However the entries are not yet permanent in the active DPVM database.

The output of the **show dpvm ports** and the **show flogi database** commands displays two other devices that have logged in (referred to as switch9 and switch3 in this sample configuration).

Step 4 Access switch9 and issue the following commands:

Example:

```
switch9# show dpvm database active
pwwn 21:00:00:e0:8b:0e:87:8a vsan 1(*)
pwwn 21:01:00:e0:8b:2e:74:8a vsan 1(*)
[Total 2 entries]
* is auto-learnt entry
switch9# show dpvm status
DB is activated successfully, auto-learn is on
```

Step 5 Access switch3 and issue the following commands:

Example:

```
switch3# show dpvm database active
pwwn 21:00:00:e0:8b:0e:76:8a vsan 1(*)
pwwn 21:01:00:e0:8b:2e:76:8a vsan 1(*)
[Total 2 entries]
* is auto-learnt entry
switch3# show dpvm status
DB is activated successfully, auto-learn is on
```

Step 6 Disable autolearning in switch1 and commit the configuration changes.

Example:

```
switch1# config

Enter configuration commands, one per line.  End with CNTL/Z.
switch1(config)# no dpvm auto-learn
switch1(config)# dpvm commit
switch1(config)# end

switch1# show dpvm status
DB is activated successfully, auto-learn is off
switch1# show dpvm database active
pwwn 21:00:00:e0:8b:0e:74:8a vsan 4
pwwn 21:01:00:e0:8b:2e:87:8a vsan 5
pwwn 21:00:00:e0:8b:0e:87:8a vsan 1
pwwn 21:01:00:e0:8b:2e:74:8a vsan 1
pwwn 21:00:00:e0:8b:0e:76:8a vsan 1
pwwn 21:01:00:e0:8b:2e:76:8a vsan 1
[Total 6 entries]
* is auto-learnt entry
switch1# show dpvm status
DB is activated successfully, auto-learn is off
```

At this stage, the autolearned entries are made permanent in the active DPVM database.

Step 7 Access switch9 and issue the following commands:

Example:

```
switch9# show dpvm database active
pwwn 21:00:00:e0:8b:0e:87:8a vsan 1
pwwn 21:01:00:e0:8b:2e:74:8a vsan 1
pwwn 21:00:00:e0:8b:0e:76:8a vsan 1
pwwn 21:01:00:e0:8b:2e:76:8a vsan 1
pwwn 21:00:00:e0:8b:0e:74:8a vsan 4
pwwn 21:01:00:e0:8b:2e:87:8a vsan 5
[Total 6 entries]
```

```
* is auto-learnt entry
switch9# show dpvm status
DB is activated successfully, auto-learn is off
```

Step 8 Access switch3 and issue the following commands:

Example:

```
switch3# show dpvm database active
pwwn 21:00:00:e0:8b:0e:76:8a vsan 1
pwwn 21:01:00:e0:8b:2e:76:8a vsan 1
pwwn 21:00:00:e0:8b:0e:87:8a vsan 1
pwwn 21:01:00:e0:8b:2e:74:8a vsan 1
pwwn 21:00:00:e0:8b:0e:74:8a vsan 4
pwwn 21:01:00:e0:8b:2e:87:8a vsan 5
[Total 6 entries]
* is auto-learnt entry
switch3# show dpvm status
DB is activated successfully, auto-learn is off
```

Note These basic steps help you determine that the information is identical in all the switches in the fabric.

You have now configured a basic DPVM scenario in a Cisco MDS 9000 Family switch.

Default Settings

Table 4: Default DPVM Parameters , on page 35 lists the default settings for DPVM parameters.

Table 4: Default DPVM Parameters

Parameters	Default
DPVM	Disabled.
DPVM distribution	Enabled.
Autolearning	Disabled.

CHAPTER 5

Configuring and Managing Zones

Zoning enables you to set up access control between storage devices or user groups. If you have administrator privileges in your fabric, you can create zones to increase network security and to prevent data loss or corruption. Zoning is enforced by examining the source-destination ID field.

Advanced zoning capabilities specified in the FC-GS-4 and FC-SW-3 standards are provided. You can use either the existing basic zoning capabilities or the advanced, standards-compliant zoning capabilities.

About Zoning

Zoning has the following features:

- A zone consists of multiple zone members.

    - Members in a zone can access each other; members in different zones cannot access each other.
    - If zoning is not activated, all devices are members of the default zone.
    - If zoning is activated, any device that is not in an active zone (a zone that is part of an active zoneset) is a member of the default zone.
    - Zones can vary in size.
    - Devices can belong to more than one zone.

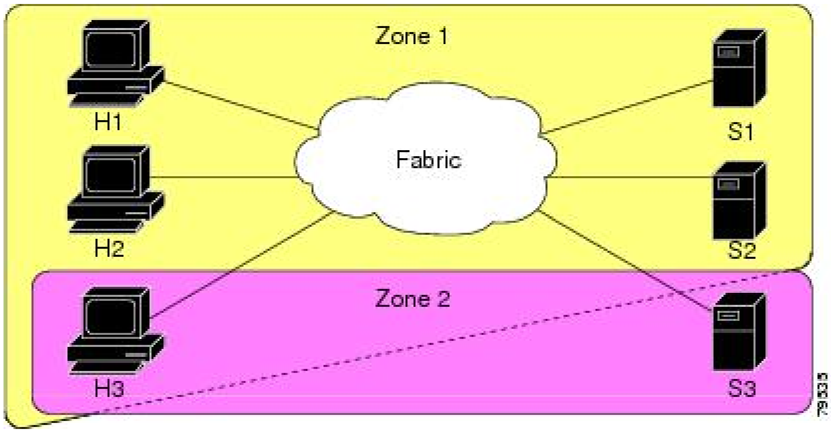
- A zoneset consists of one or more zones.
    - A zoneset can be activated or deactivated as a single entity across all switches in the fabric.
    - Only one zoneset can be activated at any time.
    - A zone can be a member of more than one zoneset.
    - An MDS switch can have a maximum of 1000 zonesets.
- Zoning can be administered from any switch in the fabric.
    - When you activate a zone (from any switch), all switches in the fabric receive the active zoneset. Additionally, full zone sets are distributed to all switches in the fabric, if this feature is enabled in the source switch.
    - If a new switch is added to an existing fabric, zone sets are acquired by the new switch.
- Zone changes can be configured nondisruptively. New zones and zone sets can be activated without interrupting traffic on unaffected ports or devices.
- Zone membership criteria is based mainly on WWNs or FC IDs.
    - Port world wide name (pWWN)—Specifies the pWWN of an N port attached to the switch as a member of the zone.
    - Fabric pWWN—Specifies the WWN of the fabric port (switch port's WWN). This membership is also referred to as port-based zoning.
    - FC ID—Specifies the FC ID of an N port attached to the switch as a member of the zone.
    - Interface and switch WWN (sWWN)—Specifies the interface of a switch identified by the sWWN. This membership is also referred to as interface-based zoning.
    - Interface and domain ID—Specifies the interface of a switch identified by the domain ID.
    - Domain ID and port number—Specifies the domain ID of an MDS domain and additionally specifies a port belonging to a non-Cisco switch.
    - IPv4 address—Specifies the IPv4 address (and optionally the subnet mask) of an attached device.
    - IPv6 address—The IPv6 address of an attached device in 128 bits in colon(:)-separated hexadecimal format.
    - Symbolic-nodename—Specifies the member symbolic node name. The maximum length is 240 characters.
- Default zone membership includes all ports or WWNs that do not have a specific membership association. Access between default zone members is controlled by the default zone policy.

Note For configuration limits on configuring the number of zones, zone members and zone sets, refer to the Cisco MDS NX-OS Configuration Limits.

Zoning Example

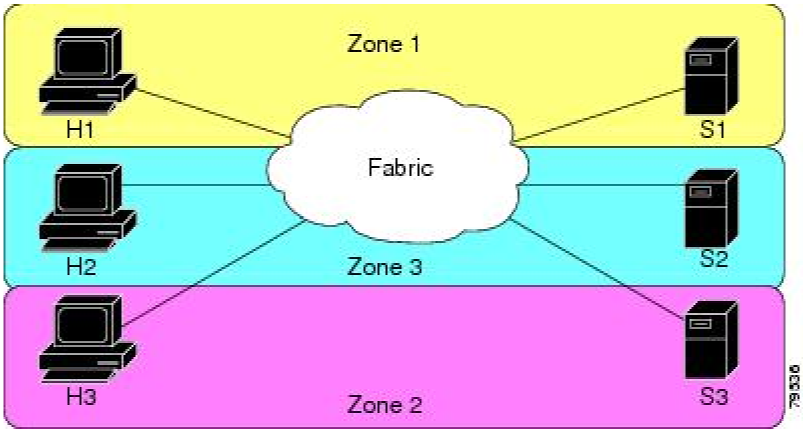
Figure 5: Fabric with Two Zones , on page 39 illustrates a zoneset with two zones, zone 1 and zone 2, in a fabric. Zone 1 provides access from all three hosts (H1, H2, H3) to the data residing on storage systems S1 and S2. Zone 2 restricts the data on S3 to access only by H3. Note that H3 resides in both zones.

Figure 5: Fabric with Two Zones



There are other ways to partition this fabric into zones. Figure 6: Fabric with Three Zones , on page 39 illustrates another possibility. Assume that there is a need to isolate storage system S2 for the purpose of testing new software. To achieve this, zone 3 is configured, which contains only host H2 and storage S2. You can restrict access to just H2 and S2 in zone 3, and to H1 and S1 in zone 1.

Figure 6: Fabric with Three Zones



Zone Implementation

All switches in the Cisco MDS 9000 Series automatically support the following basic zone features (no additional configuration is required):

- Zones are contained in a VSAN.
- Hard zoning cannot be disabled.
- Name server queries are soft-zoned.
- Only active zone sets are distributed.
- Unzoned devices cannot access each other.
- A zone or zoneset with the same name can exist in each VSAN.
- Each VSAN has a full database and an active database.
- Active zone sets cannot be changed, without activating a full zone database.
- Active zone sets are preserved across switch reboots.
- Changes to the full database must be explicitly saved.
- Zone reactivation (a zoneset is active and you activate another zoneset) does not disrupt existing traffic.

If required, you can additionally configure the following zone features:

- Propagate full zone sets to all switches on a per VSAN basis.
- Change the default policy for unzoned members.
- Interoperate with other vendors by configuring a VSAN in the interop mode. You can also configure one VSAN in the interop mode and another VSAN in the basic mode in the same switch without disrupting each other.
- Bring E ports out of isolation.

Zone Member Configuration Guidelines

All members of a zone can communicate with each other. For a zone with *N* members, *N* *(*N* -1) access permissions need to be enabled. The best practice is to avoid configuring large numbers of targets or large numbers of initiators in a single zone. This type of configuration wastes switch resources by provisioning and managing many communicating pairs (initiator-to-initiator or target-to-target) that will never actually communicate with each other. For this reason, a single initiator with a single target is the most efficient approach to zoning.

The following guidelines must be considered when creating zone members:

- Configuring only one initiator and one target for a zone provides the most efficient use of the switch resources.
- Configuring the same initiator to multiple targets is accepted.
- Configuring multiple initiators to multiple targets is not recommended.

- While configuring a zone member based on interface type always select a fabric switch which potentially has the highest interface count in the fabric.

Active and Full Zoneset Considerations

Before configuring a zoneset, consider the following guidelines:

- Each VSAN can have multiple zone sets but only one zoneset can be active at any given time.
- When you create a zoneset, that zoneset becomes a part of the full zoneset.
- When you activate a zoneset, a copy of the zoneset from the full zoneset is used to enforce zoning, and is called the active zoneset. An active zoneset cannot be modified. A zone that is part of an active zoneset is called an active zone.
- The administrator can modify the full zoneset even if a zoneset with the same name is active. However, the modification will be enforced only upon reactivation.
- When the activation is done, the active zoneset is automatically stored in persistent configuration. This enables the switch to preserve the active zoneset information across switch resets.
- All other switches in the fabric receive the active zoneset so they can enforce zoning in their respective switches.
- Hard and soft zoning are implemented using the active zoneset. Modifications take effect during zoneset activation.
- An FC ID or Nx port that is not part of the active zoneset belongs to the default zone and the default zone information is not distributed to other switches.

Note If one zoneset is active and you activate another zoneset, the currently active zoneset is automatically deactivated. You do not need to explicitly deactivate the currently active zoneset before activating a new zoneset.

Figure shows a zone being added to an activated zoneset.

Using the Quick Config Wizard

Note The Quick Config Wizard supports only switch interface zone members.

As of Cisco SAN-OS Release 3.1(1) and NX-OS Release 4.1(2), you can use the Quick Config Wizard on the Cisco MDS 9124 Switch to add or remove zone members per VSAN. You can use the Quick Config Wizard to perform interface-based zoning and to assign zone members for multiple VSANs using Device Manager.

Note The Quick Config Wizard is supported on the Cisco MDS 9124 Fabric Switch, the Cisco MDS 9134 Fabric Switch, the Cisco Fabric Switch for HP c-Class BladeSystem, and the Cisco Fabric Switch for IBM BladeCenter.

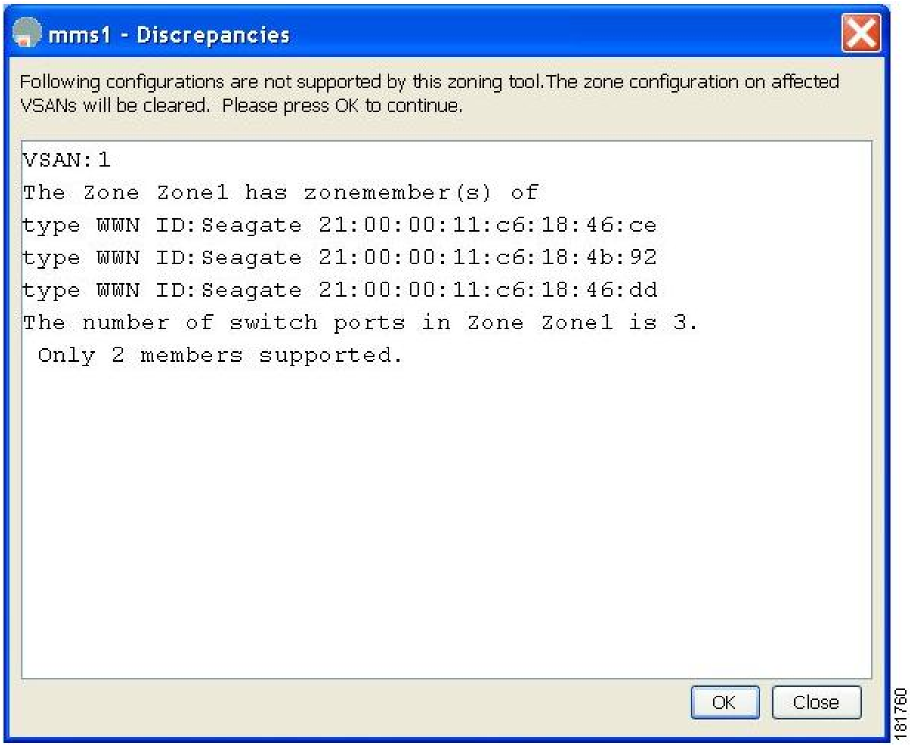
Caution The Quick Config Wizard can only be used on stand-alone switches that do not have any existing zoning defined on the switch.

To add or remove ports from a zone and to zone only the devices within a specific VSAN using Device Manager on the Cisco MDS 9124 Switch, follow these steps:

Step 1 Choose **FC** > **Quick Config** or click the Zone icon in the toolbar.
You see the Quick Config Wizard (see Figure 8: Quick Config Wizard, on page 43) with all controls disabled and the Discrepancies dialog box (see Figure 7: Discrepancies Dialog Box, on page 42), which shows all unsupported configurations.

Note You will see the Discrepancies dialog box only if there are any discrepancies.

Figure 7: Discrepancies Dialog Box



Following configurations are not supported by this zoning tool.The zone configuration on affected VSANs will be cleared. Please press OK to continue.

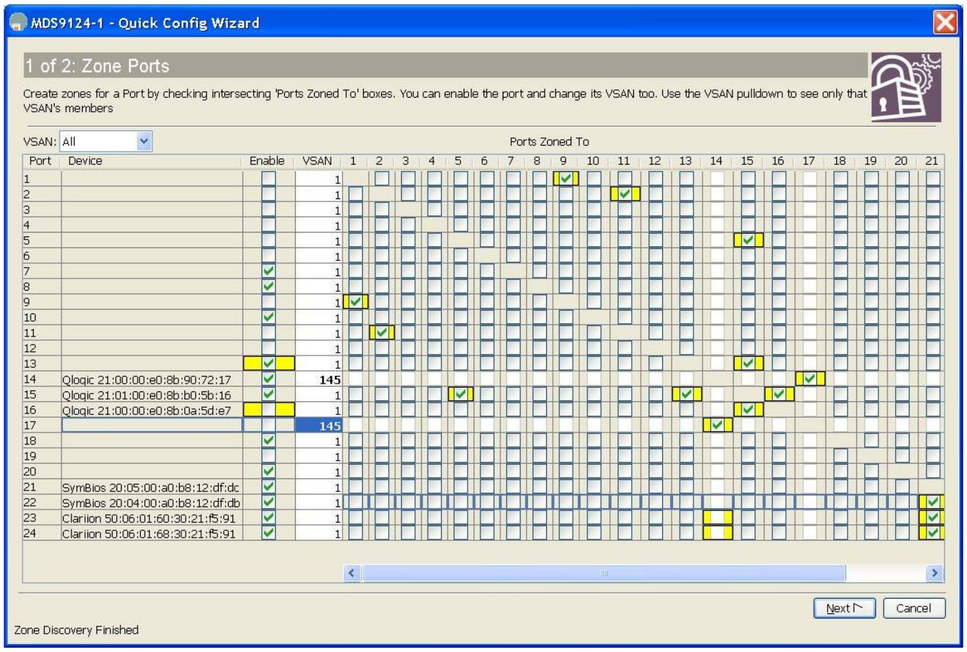
```
VSAN:1
The Zone Zone1 has zonemember(s) of
type WWN ID:Seagate 21:00:00:11:c6:18:46:ce
type WWN ID:Seagate 21:00:00:11:c6:18:4b:92
type WWN ID:Seagate 21:00:00:11:c6:18:46:dd
The number of switch ports in Zone Zone1 is 3.
 Only 2 members supported.
```

Step 2 Click **OK** to continue.

You see the Quick Config Wizard dialog box (see Figure 8: Quick Config Wizard, on page 43).

Note If there are discrepancies and you click **OK**, the affected VSANs in the zone databases are cleared. This may become disruptive if the switch is in use.

Figure 8: Quick Config Wizard



MDS9124-1 - Quick Config Wizard

1 of 2: Zone Ports

Create zones for a Port by checking intersecting 'Ports Zoned To' boxes. You can enable the port and change its VSAN too. Use the VSAN pulldown to see only that VSAN's members

VSAN: All

				Ports Zoned To																				
Port	Device	Enable	VSAN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1		□	1		□	□	□	□	□	□	□	☑	□	□	□	□		□	□		□	□	□	□
2		□	1	□		□	□	□	□	□	□	□	□	☑	□	□		□	□		□	□	□	□
3		□	1	□	□		□	□	□	□	□	□	□	□	□	□		□	□		□	□	□	□
4		□	1	□	□	□		□	□	□	□	□	□	□	□	□		□	□		□	□	□	□
5		□	1	□	□	□	□		□	□	□	□	□	□	□	□		☑	□		□	□	□	□
6		□	1	□	□	□	□	□		□	□	□	□	□	□	□		□	□		□	□	□	□
7		☑	1	□	□	□	□	□	□		□	□	□	□	□	□		□	□		□	□	□	□
8		☑	1	□	□	□	□	□	□	□		□	□	□	□	□		□	□		□	□	□	□
9		□	1	☑	□	□	□	□	□	□	□		□	□	□	□		□	□		□	□	□	□
10		☑	1	□	□	□	□	□	□	□	□	□		□	□	□		□	□		□	□	□	□
11		□	1	□	☑	□	□	□	□	□	□	□	□		□	□		□	□		□	□	□	□
12		□	1	□	□	□	□	□	□	□	□	□	□	□		□		□	□		□	□	□	□
13		☑	1	□	□	□	□	□	□	□	□	□	□	□	□			☑	□		□	□	□	□
14	Qlogic 21:00:00:e0:8b:90:72:17	☑	145																	☑				
15	Qlogic 21:01:00:e0:8b:b0:5b:16	☑	1	□	□	□	□	☑	□	□	□	□	□	□	□	☑			☑		□	□	□	□
16	Qlogic 21:00:00:e0:8b:0a:5d:e7	□	1	□	□	□	□	□	□	□	□	□	□	□	□	□		☑			□	□	□	□
17		□	145														☑							
18		☑	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□			□	□	□
19		□	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□		□		□	□
20		☑	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□		□	□		□
21	SymBios 20:05:00:a0:b8:12:df:dc	☑	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□		□	□	□	
22	SymBios 20:04:00:a0:b8:12:df:db	☑	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□		□	□	□	☑
23	Clariion 50:06:01:60:30:21:f5:91	☑	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□		□	□	□	☑
24	Clariion 50:06:01:68:30:21:f5:91	☑	1	□	□	□	□	□	□	□	□	□	□	□	□	□		□	□		□	□	□	☑

Zone Discovery Finished

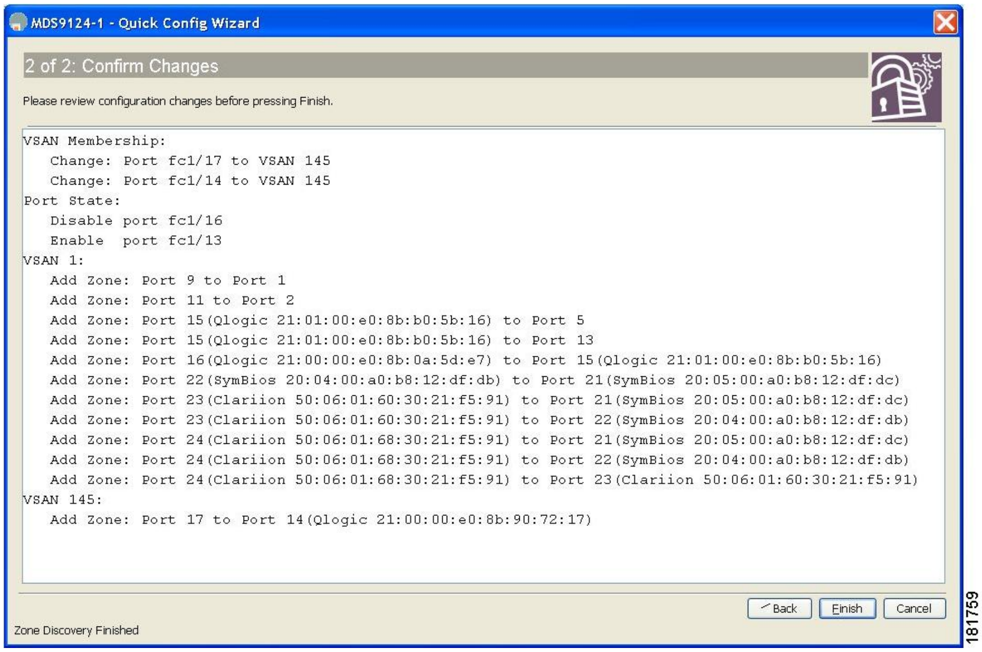
Step 3 Check the check box in the **Ports Zoned To** column for the port you want to add or remove from a zone. The check box for the matching port is similarly set. The selected port pair is added or removed from the zone, creating a two-device zone.
The VSAN drop-down menu provides a filter that enables you to zone only those devices within a selected VSAN.

Step 4 Right-click any of the column names to show or hide a column.

Step 5 Click **Next** to verify the changes.

You see the Confirm Changes dialog box (see Figure 9: Confirm Changes Dialog Box, on page 44).

Figure 9: Confirm Changes Dialog Box



Please review configuration changes before pressing Finish.

```
VSAN Membership:
   Change: Port fc1/17 to VSAN 145
   Change: Port fc1/14 to VSAN 145
Port State:
   Disable port fc1/16
   Enable  port fc1/13
VSAN 1:
   Add Zone: Port 9 to Port 1
   Add Zone: Port 11 to Port 2
   Add Zone: Port 15(Qlogic 21:01:00:e0:8b:b0:5b:16) to Port 5
   Add Zone: Port 15(Qlogic 21:01:00:e0:8b:b0:5b:16) to Port 13
   Add Zone: Port 16(Qlogic 21:00:00:e0:8b:0a:5d:e7) to Port 15(Qlogic 21:01:00:e0:8b:b0:5b:16)
   Add Zone: Port 22(SymBios 20:04:00:a0:b8:12:df:db) to Port 21(SymBios 20:05:00:a0:b8:12:df:dc)
   Add Zone: Port 23(Clariion 50:06:01:60:30:21:f5:91) to Port 21(SymBios 20:05:00:a0:b8:12:df:dc)
   Add Zone: Port 23(Clariion 50:06:01:60:30:21:f5:91) to Port 22(SymBios 20:04:00:a0:b8:12:df:db)
   Add Zone: Port 24(Clariion 50:06:01:68:30:21:f5:91) to Port 21(SymBios 20:05:00:a0:b8:12:df:dc)
   Add Zone: Port 24(Clariion 50:06:01:68:30:21:f5:91) to Port 22(SymBios 20:04:00:a0:b8:12:df:db)
   Add Zone: Port 24(Clariion 50:06:01:68:30:21:f5:91) to Port 23(Clariion 50:06:01:60:30:21:f5:91)
VSAN 145:
   Add Zone: Port 17 to Port 14(Qlogic 21:00:00:e0:8b:90:72:17)
```

Zone Discovery Finished

Step 6 If you want to see the CLI commands, right-click in the dialog box and click **CLI Commands** from the pop-up menu.

Step 7 Click **Finish** to save the configuration changes.

Zone Configuration

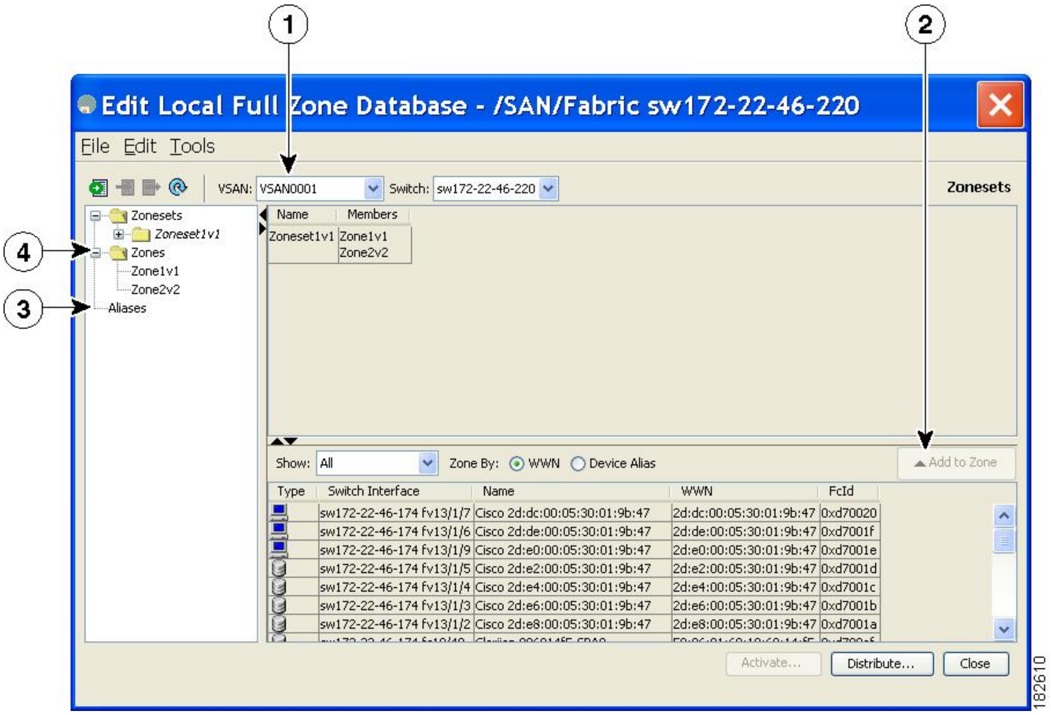
About the Edit Local Full Zone Database Tool

You can use the Edit Full Zone Database Tool to complete the following tasks:

- You can display information by VSAN by using the pull-down menu without having to get out of the screen, selecting a VSAN, and re-entering.
- You can use the **Add to zone or alias** button to move devices up or down by alias or by zone.
- You can add zoning characteristics based on alias in different folders.
- You can triple-click to rename zone sets, zones, or aliases in the tree.

The Edit Local Full Zone Database tool allows you to zone across multiple switches and all zoning features are available through the Edit Local Full Zone Database dialog box (see Figure 10: Edit Local Full Zone Database Dialog Box, on page 45).

Figure 10: Edit Local Full Zone Database Dialog Box



Edit Local Full Zone Database - /SAN/Fabric sw172-22-46-220

VSAN: VSAN0001 Switch: sw172-22-46-220

Zonesets

- Zonesets
  - Zoneset1v1
- Zones
  - Zone1v1
  - Zone2v2
- Aliases

Name	Members
Zoneset1v1	Zone1v1 Zone2v2

Show: All Zone By: ● WWN ○ Device Alias

Type	Switch Interface	Name	WWN	FcId
	sw172-22-46-174 fv13/1/7	Cisco 2d:dc:00:05:30:01:9b:47	2d:dc:00:05:30:01:9b:47	0xd70020
	sw172-22-46-174 fv13/1/6	Cisco 2d:de:00:05:30:01:9b:47	2d:de:00:05:30:01:9b:47	0xd7001f
	sw172-22-46-174 fv13/1/9	Cisco 2d:e0:00:05:30:01:9b:47	2d:e0:00:05:30:01:9b:47	0xd7001e
	sw172-22-46-174 fv13/1/5	Cisco 2d:e2:00:05:30:01:9b:47	2d:e2:00:05:30:01:9b:47	0xd7001d
	sw172-22-46-174 fv13/1/4	Cisco 2d:e4:00:05:30:01:9b:47	2d:e4:00:05:30:01:9b:47	0xd7001c
	sw172-22-46-174 fv13/1/3	Cisco 2d:e6:00:05:30:01:9b:47	2d:e6:00:05:30:01:9b:47	0xd7001b
	sw172-22-46-174 fv13/1/2	Cisco 2d:e8:00:05:30:01:9b:47	2d:e8:00:05:30:01:9b:47	0xd7001a

1	You can display information by VSAN by using the drop-down menu without closing the dialog box, selecting a VSAN, and re-entering.	3	You can add zoning characteristics based on alias in different folders.
2	You can use the **Add to zone** button to move devices up or down by alias or by zone.	4	You can triple-click to rename zone sets, zones, or aliases in the tree.

Note The Device Alias radio button is visible only if device alias is in enhanced mode. For more information, see Creating Device Aliases, on page 149 section.

Configuring a Zone

Tip Use a relevant display command (for example, **show interface** or **show flogi database**) to obtain the required value in hex format.

Tip Use the **show wwn switch** command to retrieve the sWWN. If you do not provide a sWWN, the software automatically uses the local sWWN.

Tip Expand Switches from the Physical Attributes pane to retrieve the sWWN. If you do not provide a sWWN, the software automatically uses the local sWWN.

Note Interface-based zoning only works with Cisco MDS 9000 Series switches. Interface-based zoning does not work if interop mode is configured in that VSAN.

When the number of zones configured has exceeded the maximum number of zones allowed across all VSANs, this message is displayed:

```
switch(config)# zone name temp_zone1 vsan 300
cannot create the zone; maximum possible number of zones is already configured
```

Note For configuration limits on configuring the number of zones, zone members and zone sets, refer to the Cisco MDS NX-OS Configuration Limits.

To configure a zone and assign a zone name, follow these steps:

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

Step 2 switch(config)# **zone name Zone1 vsan 3**

Example:

```
switch(config-zone)#
```

Configures a zone called Zone1 for the VSAN called vsan3.

Note All alphanumeric characters or one of the following symbols ($, -, ^, _) are supported.

Step 3 switch(config-zone)# **member** *type value*

Example:

```
pWWN example:
```

Example:

```
switch(config-zone)# member pwwn 10:00:00:23:45:67:89:ab
```

Example:

Fabric pWWN example:

Example:

```
switch(config-zone)# member fwwn 10:01:10:01:10:ab:cd:ef
```

Example:

FC ID example:

Example:

```
switch(config-zone)# member fcid 0xce00d1
```

Example:

FC alias example:

Example:

```
switch(config-zone)# member fcalias Payroll
```

Example:

Domain ID example:

Example:

```
switch(config-zone)# member domain-id 2 portnumber 23
```

Example:

IPv4 address example:

Example:

```
switch(config-zone)# member ip-address 10.15.0.0 255.255.0.0
```

Example:

IPv6 address example:

Example:

```
switch(config-zone)# member ipv6-address 2001::db8:800:200c:417a/64
```

Example:

```
Local sWWN interface example:
```

Example:

```
switch(config-zone)# member interface fc 2/1
```

Example:

```
Remote sWWN interface example:
```

Example:

```
switch(config-zone)# member interface fc2/1 swwn 20:00:00:05:30:00:4a:de
```

Example:

```
Domain ID interface example:
```

Example:

```
switch(config-zone)# member interface fc2/1 domain-id 25
```

Example:

```
switch(config-zone)# member symbolic-nodename iqn.test
```

Configures a member for the specified zone (Zone1) based on the type (pWWN, fabric pWWN, FC ID, fcalias, domain ID, IPv4 address, IPv6 address, or interface) and value specified.

Caution You must only configure pWWN-type zoning on all MDS switches running Cisco SAN-OS if there is a Cisco MDS 9020 switch running FabricWare in the same fabric.

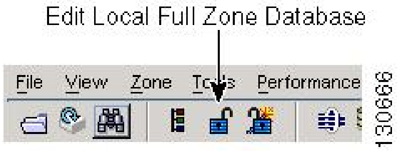
Note The Cisco MDS 9396S switch has 96 ports and the other Cisco MDS switches have lower ranges. Therefore while configuring a zone member based on interface type always select a fabric switch which potentially has the highest interface count in the fabric.

Configuring a Zone Using the Zone Configuration Tool

To create a zone and move it into a zone set using Fabric Manager, follow these steps:

Step 1 Click the Zone icon in the toolbar (see Figure 11: Zone Icon, on page 49).

Figure 11: Zone Icon

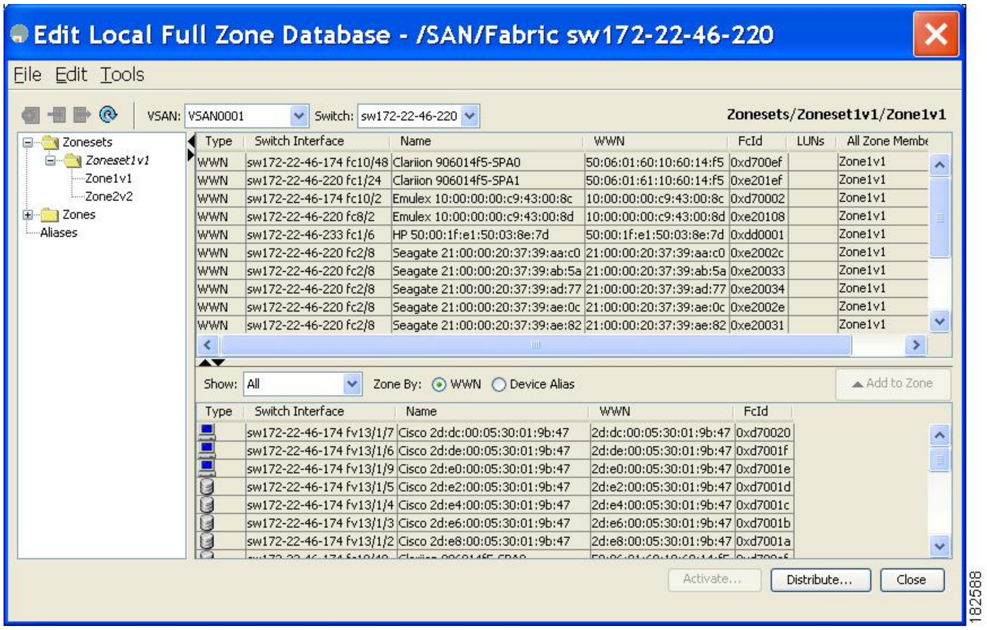


You see the Select VSAN dialog box.

Step 2 Select the VSAN where you want to create a zone and click OK.
switch(config)# **callhome**

You see the Edit Local Full Zone Database dialog box (see Figure 12: Edit Local Full Zone Database Dialog Box, on page 49).

Figure 12: Edit Local Full Zone Database Dialog Box



Edit Local Full Zone Database - /SAN/Fabric sw172-22-46-220

VSAN: VSAN0001 Switch: sw172-22-46-220 Zonesets/Zoneset1v1/Zone1v1

Type	Switch Interface	Name	WWN	FcId	LUNs	All Zone Membe
WWN	sw172-22-46-174 fc10/48	Clariion 906014f5-SPA0	50:06:01:60:10:60:14:f5	0xd700ef		Zone1v1
WWN	sw172-22-46-220 fc1/24	Clariion 906014f5-SPA1	50:06:01:61:10:60:14:f5	0xe201ef		Zone1v1
WWN	sw172-22-46-174 fc10/2	Emulex 10:00:00:00:c9:43:00:8c	10:00:00:00:c9:43:00:8c	0xd70002		Zone1v1
WWN	sw172-22-46-220 fc8/2	Emulex 10:00:00:00:c9:43:00:8d	10:00:00:00:c9:43:00:8d	0xe20108		Zone1v1
WWN	sw172-22-46-233 fc1/6	HP 50:00:1f:e1:50:03:8e:7d	50:00:1f:e1:50:03:8e:7d	0xdd0001		Zone1v1
WWN	sw172-22-46-220 fc2/8	Seagate 21:00:00:20:37:39:aa:c0	21:00:00:20:37:39:aa:c0	0xe2002c		Zone1v1
WWN	sw172-22-46-220 fc2/8	Seagate 21:00:00:20:37:39:ab:5a	21:00:00:20:37:39:ab:5a	0xe20033		Zone1v1
WWN	sw172-22-46-220 fc2/8	Seagate 21:00:00:20:37:39:ad:77	21:00:00:20:37:39:ad:77	0xe20034		Zone1v1
WWN	sw172-22-46-220 fc2/8	Seagate 21:00:00:20:37:39:ae:0c	21:00:00:20:37:39:ae:0c	0xe2002e		Zone1v1
WWN	sw172-22-46-220 fc2/8	Seagate 21:00:00:20:37:39:ae:82	21:00:00:20:37:39:ae:82	0xe20031		Zone1v1

Show: All Zone By: ● WWN ○ Device Alias

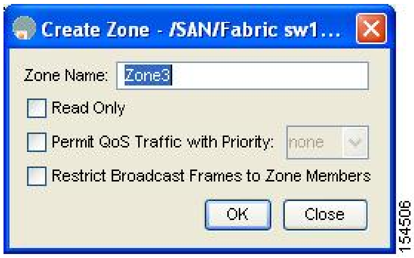
Type	Switch Interface	Name	WWN	FcId
	sw172-22-46-174 fv13/1/7	Cisco 2d:dc:00:05:30:01:9b:47	2d:dc:00:05:30:01:9b:47	0xd70020
	sw172-22-46-174 fv13/1/6	Cisco 2d:de:00:05:30:01:9b:47	2d:de:00:05:30:01:9b:47	0xd7001f
	sw172-22-46-174 fv13/1/9	Cisco 2d:e0:00:05:30:01:9b:47	2d:e0:00:05:30:01:9b:47	0xd7001e
	sw172-22-46-174 fv13/1/5	Cisco 2d:e2:00:05:30:01:9b:47	2d:e2:00:05:30:01:9b:47	0xd7001d
	sw172-22-46-174 fv13/1/4	Cisco 2d:e4:00:05:30:01:9b:47	2d:e4:00:05:30:01:9b:47	0xd7001c
	sw172-22-46-174 fv13/1/3	Cisco 2d:e6:00:05:30:01:9b:47	2d:e6:00:05:30:01:9b:47	0xd7001b
	sw172-22-46-174 fv13/1/2	Cisco 2d:e8:00:05:30:01:9b:47	2d:e8:00:05:30:01:9b:47	0xd7001a

If you want to view zone membership information, right-click in the **All Zone Membership(s)** column, and then click **Show Details** for the current row or all rows from the pop-up menu.

Step 3 Click **Zones** in the left pane and click the **Insert** icon to create a zone.

You see the Create Zone dialog box (see Figure 13: Create Zone Dialog Box, on page 50).

Figure 13: Create Zone Dialog Box



Create Zone - /SAN/Fabric sw1...

Zone Name: Zone3

□ Read Only

□ Permit QoS Traffic with Priority: none

□ Restrict Broadcast Frames to Zone Members

Step 4 Enter a zone name.

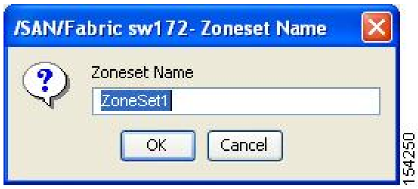
Step 5 Check one of the following check boxes:

1. **Read Only—**The zone permits read and denies write.
2. **Permit QoS traffic with Priority—**You set the priority from the drop-down menu.
3. **Restrict Broadcast Frames to Zone Members**

Step 6 Click **OK** to create the zone.
If you want to move this zone into an existing zone set, skip to Step 8.

Step 7 Click **Zoneset** in the left pane and click the Insert icon to create a zone set.
You see the Zoneset Name dialog box (see Figure 14: Zoneset Name Dialog Box, on page 50).

Figure 14: Zoneset Name Dialog Box



/SAN/Fabric sw172- Zoneset Name

Zoneset Name: ZoneSet1

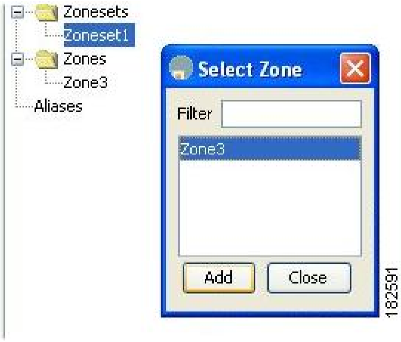
Step 8 Enter a zone set name and click **OK** .

Note One of these symbols ($, -, ^, _) or all alphanumeric characters are supported. In interop mode 2 and 3, this symbol (_) or all alphanumeric characters are supported.

Step 9 Select the zone set where you want to add a zone and click the **Insert** icon or you can drag and drop Zone3 over Zoneset1.

You see the Select Zone dialog box (see Figure 15: Select Zone Dialog Box, on page 51).

Figure 15: Select Zone Dialog Box



Step 10 Click **Add** to add the zone.

Adding Zone Members

Once you create a zone, you can add members to the zone. You can add members using multiple port identification types.

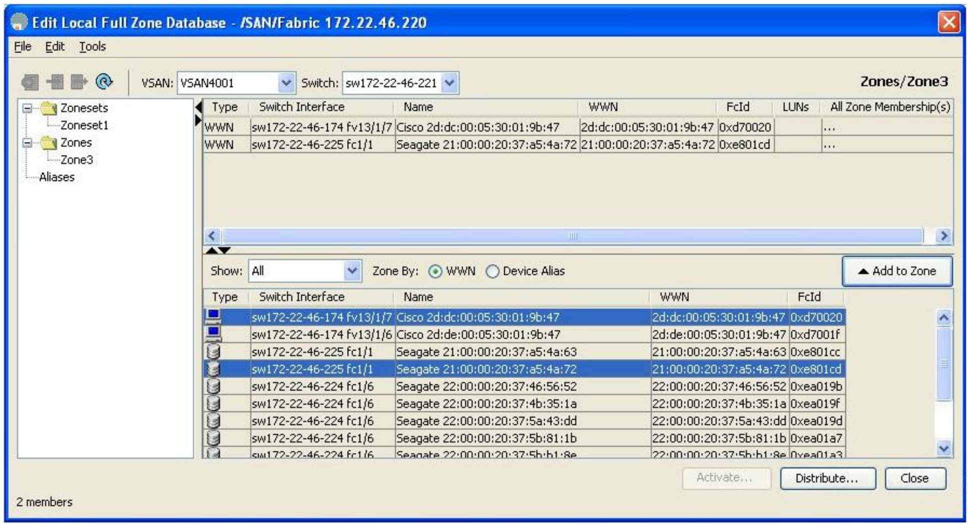
To add a member to a zone using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.

You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Figure 16: Edit Local Full Zone Database Dialog Box



VSAN: VSAN4001 Switch: sw172-22-46-221 Zones/Zone3

Type	Switch Interface	Name	WWN	FcId	LUNs	All Zone Membership(s)
WWN	sw172-22-46-174 fv13/1/7	Cisco 2d:dc:00:05:30:01:9b:47	2d:dc:00:05:30:01:9b:47	0xd70020		...
WWN	sw172-22-46-225 fc1/1	Seagate 21:00:00:20:37:a5:4a:72	21:00:00:20:37:a5:4a:72	0xe801cd		...

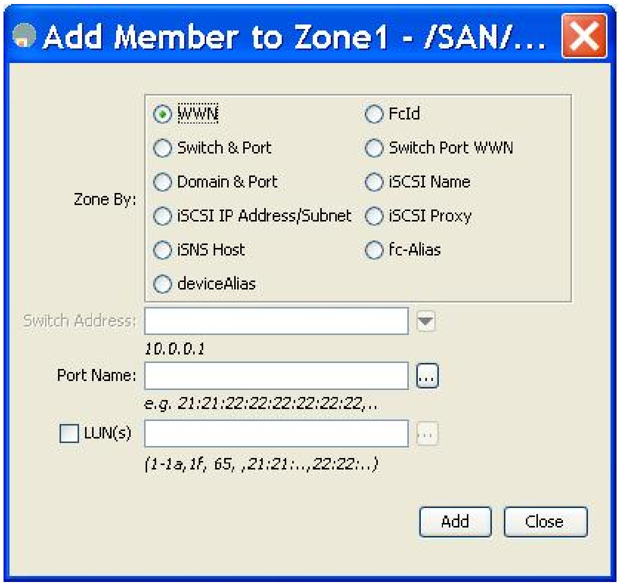
Show: All Zone By: ● WWN ○ Device Alias ▲ Add to Zone

Type	Switch Interface	Name	WWN	FcId
	sw172-22-46-174 fv13/1/7	Cisco 2d:dc:00:05:30:01:9b:47	2d:dc:00:05:30:01:9b:47	0xd70020
	sw172-22-46-174 fv13/1/6	Cisco 2d:de:00:05:30:01:9b:47	2d:de:00:05:30:01:9b:47	0xd7001f
	sw172-22-46-225 fc1/1	Seagate 21:00:00:20:37:a5:4a:63	21:00:00:20:37:a5:4a:63	0xe801cc
	sw172-22-46-225 fc1/1	Seagate 21:00:00:20:37:a5:4a:72	21:00:00:20:37:a5:4a:72	0xe801cd
	sw172-22-46-224 fc1/6	Seagate 22:00:00:20:37:46:56:52	22:00:00:20:37:46:56:52	0xea019b
	sw172-22-46-224 fc1/6	Seagate 22:00:00:20:37:4b:35:1a	22:00:00:20:37:4b:35:1a	0xea019f
	sw172-22-46-224 fc1/6	Seagate 22:00:00:20:37:5a:43:dd	22:00:00:20:37:5a:43:dd	0xea019d
	sw172-22-46-224 fc1/6	Seagate 22:00:00:20:37:5b:81:1b	22:00:00:20:37:5b:81:1b	0xea01a7
	sw172-22-46-224 fc1/6	Seagate 22:00:00:20:37:5b:b1:8e	22:00:00:20:37:5b:b1:8e	0xea01a3

2 members

Step 3 Select the members you want to add from the Fabric pane (see Figure 16: Edit Local Full Zone Database Dialog Box, on page 52) and click **Add to Zone** or click the zone where you want to add members and click the **Insert** icon. You see the Add Member to Zone dialog box (see Figure 17: Add Member to Zone Dialog Box, on page 52).

Figure 17: Add Member to Zone Dialog Box



Zone By:
● WWN ○ FcId
○ Switch & Port ○ Switch Port WWN
○ Domain & Port ○ iSCSI Name
○ iSCSI IP Address/Subnet ○ iSCSI Proxy
○ iSNS Host ○ fc-Alias
○ deviceAlias

Switch Address:
10.0.0.1

Port Name:
e.g. 21:21:22:22:22:22:22:22,..

□ LUN(s)
(1-1a, 1f, 65, ,21:21:..,22:22:..)

Note The Device Alias radio button is visible only if device alias is in enhanced mode. For more information, see Creating Device Aliases section.

Step 4 Click the browse button and select a port name or check the **LUN** check box and click the browse button to configure LUNs.

Step 5 Click **Add** to add the member to the zone.

Note When configuring a zone member, you can specify that a single LUN has multiple IDs depending on the operating system. You can select from six different operating systems

Filtering End Devices Based on Name, WWN or FC ID

To filter the end devices and device aliases, follow these steps:

Step 1 Click the Zone icon in the toolbar (see Figure 11: Zone Icon, on page 49).

Step 2 Select Name, WWN or FC ID from the With drop-down list.

Step 3 Enter a filter condition, such as *zo1*, in the Filter text box.

Step 4 Click **Go**.

Adding Multiple End Devices to Multiple Zones

To add multiple end devices to multiple zones, follow these steps:

Step 1 Click the Zone icon in the toolbar (see Figure 11: Zone Icon, on page 49).

Step 2 Use the Ctrl key to select multiple end devices.

Step 3 Right-click and then select **Add to Zone**.

Step 4 Use the Ctrl key to select multiple zones from the pop-up window displayed.

Step 5 Click **Add**.
Selected end devices are added to the selected zones.

Zone Sets

Zones provide a method for specifying access control, while zone sets are a grouping of zones to enforce access control in the fabric.

Zone sets are configured with the names of the member zones and the VSAN (if the zoneset is in a configured VSAN).

Zoneset Distribution—You can distribute full zone sets using one of two methods: one-time distribution or full zoneset distribution.

Zoneset Duplication—You can make a copy of a zoneset and then edit it without altering the original zoneset. You can copy an active zoneset from the bootflash: directory, volatile: directory, or slot0, to one of the following areas:

- To the full zoneset
- To a remote location (using FTP, SCP, SFTP, or TFTP)

The active zoneset is not part of the full zoneset. You cannot make changes to an existing zoneset and activate it, if the full zoneset is lost or is not propagated.

ZoneSet Creation

In the figure, two separate sets are created, each with its own membership hierarchy and zone members.

Either zoneset A or zoneset B can be activated (but not together).

Tip Zonesets are configured with the names of the member zones and the VSAN (if the zoneset is in a configured VSAN).

Activating a Zoneset

Changes to a zoneset do not take effect in a full zoneset until you activate it.

Tip You do not have to issue the **copy running-config startup-config** command to store the active zoneset. However, you need to issue the **copy running-config startup-config** command to explicitly store full zone sets. If there is more than one switch in a fabric, the **copy running-config startup-config fabric** command should be issued. The **fabric** keyword causes the **copy running-config startup-config** command to be issued on all the switches in the fabric, and also saves the full zone information to the startup-config on all the switches in the fabric. This is important in the event of a switch reload or power cycle.

To activate or deactivate an existing zoneset, follow these steps:

Step 1 switch# **config terminal**

Example:

```
switch(config)#
```

Enters configuration mode.

Step 2 switch(config)# **zoneset activate name Zoneset1 vsan 3**

Activates the specified zoneset.

If full zoneset distribution is configured for a VSAN, the zoneset activation also distributes the full zoning database to the other switches in the fabric.

If enhanced zoning is configured for a VSAN then the zoneset activation is held pending until the **zone commit vsan** *vsan-id* command is enabled. The **show zone pending-diff vsan** *vsan-id* displays the pending changes.

Note While activating a zoneset, if the zoneset overwrite-control vsan id command is enabled and the zoneset name is different from the current active zoneset, the activation will fail with an error message. For more information see Overwrite Control for an Active Zoneset , on page 58

```
switch(config)# zoneset activate name Zoneset2 vsan 3

WARNING: You are trying to activate zoneset2, which is different from current active zoneset1. Do
you want to continue? (y/n) [n] y
```

Step 3 switch(config)# **no zoneset activate name Zoneset1 vsan 3**
Deactivates the specified zoneset.

Activating a Zoneset Using Fabric Manager

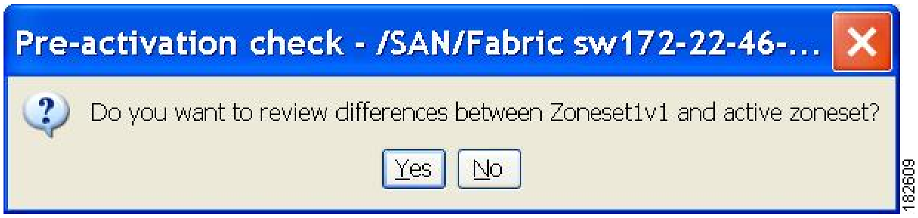
To activate an existing zone set using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Click **Activate** to activate the zone set.
You see the pre-activation check dialog box (see Figure 18: Pre-Activation Check Dialog Box, on page 55).

Figure 18: Pre-Activation Check Dialog Box



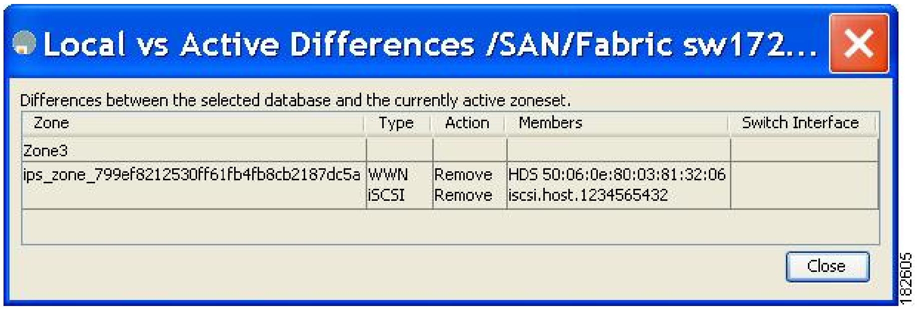
Pre-activation check - /SAN/Fabric sw172-22-46-...

Do you want to review differences between Zoneset1v1 and active zoneset?

Step 4 Click **Yes** to review the differences.

You see the Local vs. Active Differences dialog box (see Figure 19: Local vs Active Differences Dialog Box, on page 56).

Figure 19: Local vs Active Differences Dialog Box



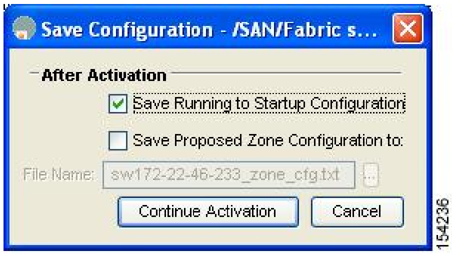
Local vs Active Differences /SAN/Fabric sw172...

Differences between the selected database and the currently active zoneset.

Zone	Type	Action	Members	Switch Interface
Zone3				
ips_zone_799ef8212530ff61fb4fb8cb2187dc5a	WWN iSCSI	Remove Remove	HDS 50:06:0e:80:03:81:32:06 iscsi.host.1234565432	

Step 5 Click **Close** to close the dialog box.
You see the Save Configuration dialog box (see Figure 20: Save Configuration Dialog Box, on page 56).

Figure 20: Save Configuration Dialog Box



Save Configuration - /SAN/Fabric s...

After Activation

☑ Save Running to Startup Configuration

□ Save Proposed Zone Configuration to:

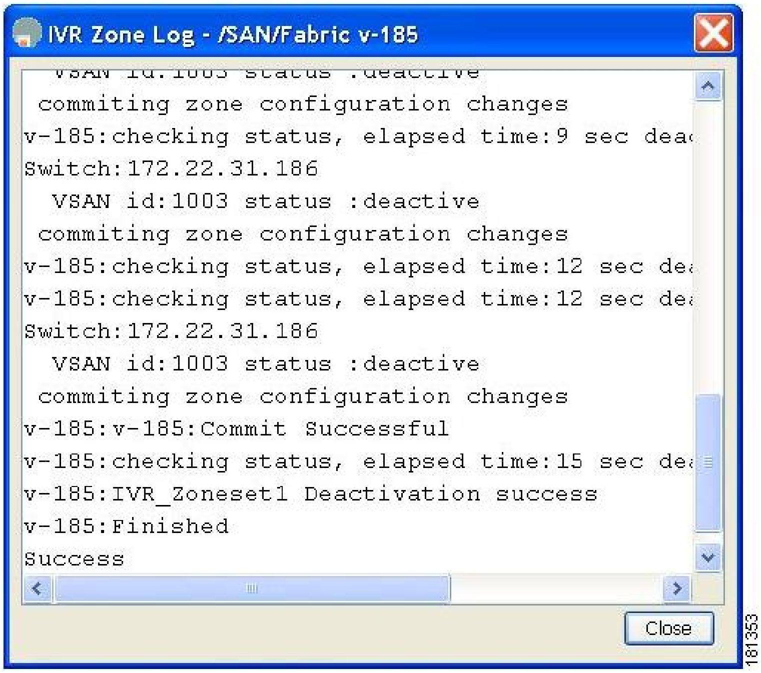
File Name: sw172-22-46-233_zone_cfg.txt

Step 6 Check the **Save Running to Startup Configuration** check box to save all changes to the startup configuration.

Step 7 Click **Continue Activation** to activate the zone set, or click **Cancel** to close the dialog box and discard any unsaved changes.

You see the Zone Log dialog box, which shows if the zone set activation was successful (see Figure 21: Zone Log Dialog Box, on page 57).

Figure 21: Zone Log Dialog Box



```
  VSAN id:1003 status :deactive
 commiting zone configuration changes
v-185:checking status, elapsed time:9 sec dea
Switch:172.22.31.186
  VSAN id:1003 status :deactive
 commiting zone configuration changes
v-185:checking status, elapsed time:12 sec de
v-185:checking status, elapsed time:12 sec de
Switch:172.22.31.186
  VSAN id:1003 status :deactive
 commiting zone configuration changes
v-185:v-185:Commit Successful
v-185:checking status, elapsed time:15 sec de
v-185:IVR_Zoneset1 Deactivation success
v-185:Finished
Success
```

Deactivating a Zoneset

To deactivate an existing zone set, follow these steps:

Step 1 Right-click the zone set you want to deactivate and then click **Deactivate** from the pop-up menu.
You see the Deactivate Zoneset dialog box.

Step 2 Enter deactivate in the text box and then click **OK**.
You see the Input dialog box.

Step 3 Enter deactivate in the text box and then click **OK** to deactivate the zone set.

Note To enable this option, you need to modify the server.properties file. Refer to the Cisco Fabric Manager Fundamentals Configuration Guide to know more about modifying server.properties file.

Displaying Zone Membership Information

To display zone membership information for members assigned to zones in Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Click **Zones** in the left pane. The right pane lists the members for each zone.

Note The default zone members are explicitly listed only when the default zone policy is configured as **permit**. When the default zone policy is configured as **deny**, the members of this zone are not shown. See the Displaying Zone Information, on page 100.

Tip You do not have to issue the **copy running-config startup-config** command to store the active zoneset. However, you need to issue the **copy running-config startup-config** command to explicitly store full zone sets. If there is more than one switch in a fabric, the **copy running-config startup-config fabric** command should be issued. The **fabric** keyword causes the **copy running-config startup-config** command to be issued on all the switches in the fabric, and also saves the full zone information to the startup-config on all the switches in the fabric. This is important in the event of a switch reload or power cycle.

Overwrite Control for an Active Zoneset

When activating a new zoneset, if users make a mistake while entering the zoneset name, and if this name already exists on the switch, it results in activation of the wrong zoneset and traffic loss. To avoid activating a wrong zoneset, the zoneset overwrite-control vsan id command is introduced.

Note Even when the zoneset overwrite-control vsan id command is enabled, the user can override it and continue with the activation of a new zoneset using the zoneset activate name zoneset name vsan *vsan* -id force command.

Step 1 switch# **configure terminal**

Example:

```
switch(config)#
```

Enters configuration mode.

Step 2 switch(config)# **zoneset overwrite-control vsan 3**

Enables overwrite-control for the specified VSAN.

```
switch(config)# zoneset overwrite-control vsan 1

WARNING: This will enable Activation Overwrite control. Do you want to continue?
                                                                        (y/n) [n]
```

Note The zoneset overwrite-control vsan id command can be enabled only in enhanced zone mode.

Step 3 switch(config)# **show zone status vsan 3**

Displays the status of the VSAN, if overwrite-control is enabled or not.

What to Do Next

Displaying Zone Status

```
switch(config)# show zone status vsan 3
VSAN: 2 default-zone: deny distribute: full Interop: default
    mode: enhanced merge-control: allow
    session: none
    hard-zoning: enabled broadcast: unsupported
    smart-zoning: disabled
    rscn-format: fabric-address
    activation overwrite control: enabled
Default zone:
    qos: none broadcast: unsupported ronly: unsupported
Full Zoning Database :
    DB size: 348 bytes
    Zonesets:2  Zones:2 Aliases: 0 Attribute-groups: 1
Active Zoning Database :
    DB size: 68 bytes
    Name: hellset  Zonesets:1  Zones:1
Current Total Zone DB Usage: 416 / 2097152 bytes (0 % used)
Pending (Session) DB size:
    Full DB Copy size: 0 bytes
    Active DB Copy size: 0 bytes
SFC size: 0 / 2097152 bytes (0 % used)
Status: Commit completed at 15:19:49 UTC Jun 11 2015
```

Default Zone

Each member of a fabric (in effect a device attached to an Nx port) can belong to any zone. If a member is not part of any active zone, it is considered to be part of the default zone. Therefore, if no zoneset is active in the fabric, all devices are considered to be in the default zone. Even though a member can belong to multiple zones, a member that is part of the default zone cannot be part of any other zone. The switch determines whether a port is a member of the default zone when the attached port comes up.

Note Unlike configured zones, default zone information is not distributed to the other switches in the fabric.

Traffic can either be permitted or denied among members of the default zone. This information is not distributed to all switches; it must be configured in each switch.

Note When the switch is initialized for the first time, no zones are configured and all members are considered to be part of the default zone. Members are not permitted to talk to each other.

Configure the default zone policy on each switch in the fabric. If you change the default zone policy on one switch in a fabric, be sure to change it on all the other switches in the fabric.

Note The default settings for default zone configurations can be changed.

The default zone members are explicitly listed when the default policy is configured as permit or when a zoneset is active. When the default policy is configured as deny, the members of this zone are not explicitly enumerated when you issue the **show zoneset active** command.

Note The current default zoning policy is deny. The hidden active zoneset is d__efault__cfg in MDS. When there is a mismatch in default-zoning policies between two switches (permit on one side and deny on the other), zone merge will fail. The behavior is the same between two Brocade switches as well. The error messages will be as shown below.

The error messages will be as shown below:

Switch1 syslog:

switch(config-if)# 2014 Sep 2 06:33:21 hac15 %ZONE-2-ZS_MERGE_FAILED: %$VSAN 1%$ Zone merge failure, isolating interface fc2/10 received reason: Default zoning policy conflict. Received rjt from adjacent switch:[reason:0]

Switch2 syslog:

switch(config-if)# 2014 Sep 2 12:13:17 hac16 %ZONE-2-ZS_MERGE_FAILED: %$VSAN 1%$ Zone merge failure, isolating interface fc3/10 reason: Default zoning policy conflict.:[reason:0]

You can change the default zone policy for any VSAN by choosing **VSANxx** > **Default Zone** from the Fabric Manager menu tree and clicking the **Policies** tab. It is recommended that you establish connectivity among devices by assigning them to a non-default zone.

Configuring the Default Zone Access Permission

To permit or deny traffic to members in the default zone, follow these steps:

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

Step 2 switch(config)# **zone default-zone permit vsan 1**
Permits traffic flow to default zone members.

Step 3 switch(config)# **no zone default-zone permit vsan 1**
Denies (default) traffic flow to default zone members.

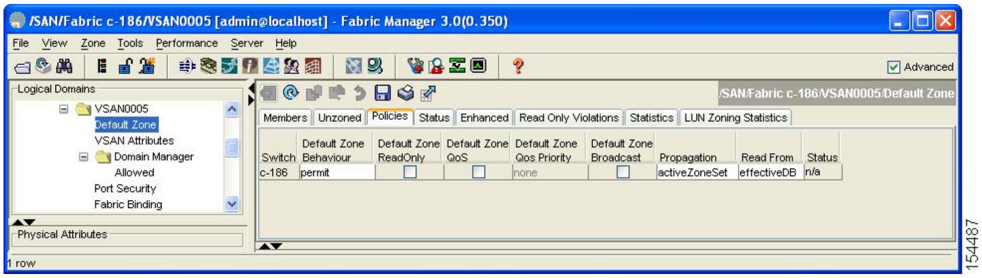
Configuring the Default Zone Access Permission Using Fabric Manager

To permit or deny traffic to members in the default zone using Fabric Manager, follow these steps:

Step 1 Expand a **VSAN** and then select **Default Zone** in the Fabric Manager Logical Domains pane.

Step 2 Click the **Policies** tab in the Information pane.
You see the zone policies information in the Information pane (see Figure 22: Default Zone Policies, on page 61).

Figure 22: Default Zone Policies



/SAN/Fabric c-186/VSAN0005 [admin@localhost] - Fabric Manager 3.0(0.350)

Switch	Default Zone Behaviour	Default Zone ReadOnly	Default Zone QoS	Default Zone Qos Priority	Default Zone Broadcast	Propagation	Read From	Status
c-186	permit	□	□	none	□	activeZoneSet	effectiveDB	n/a

The active zone set is shown in italic type. After you make changes to the active zone set and before you activate the changes, the zone set is shown in boldface italic type.

Step 3 In the Default Zone Behaviour field, choose either **permit** or **deny** from the drop-down menu.

About FC Alias Creation

You can assign an alias name and configure an alias member using the following values:

- pWWN—The WWN of the N or NL port is in hex format (for example, 10:00:00:23:45:67:89:ab).
- fWWN—The WWN of the fabric port name is in hex format (for example, 10:00:00:23:45:67:89:ab).
- FC ID—The N port ID is in 0xhhhhhh format (for example, 0xce00d1).
- Domain ID—The domain ID is an integer from 1 to 239. A mandatory port number of a non-Cisco switch is required to complete this membership configuration.
- IPv4 address—The IPv4 address of an attached device is in 32 bits in dotted decimal format along with an optional subnet mask. If a mask is specified, any device within the subnet becomes a member of the specified zone.
- IPv6 address—The IPv6 address of an attached device is in 128 bits in colon- (:) separated) hexadecimal format.
- Interface—Interface-based zoning is similar to port-based zoning because the switch interface is used to configure the zone. You can specify a switch interface as a zone member for both local and remote

switches. To specify a remote switch, enter the remote switch WWN (sWWN) or the domain ID in the particular VSAN.

Tip The Cisco NX-OS software supports a maximum of 2048 aliases per VSAN.

Creating FC Aliases

To create an alias, follow these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **fcalias name AliasSample vsan 3**

Example:

```
switch(config-fcalias)#
```

Configures an alias name (AliasSample).

Step 3 switch(config-fcalias)# **member** *type value*

Example:

```
pWWN example:
```

Example:

```
switch(config-fcalias)# member pwwn 10:00:00:23:45:67:89:ab
```

Example:

```
fWWN example:
```

Example:

```
switch(config-fcalias)# member fwwn 10:01:10:01:10:ab:cd:ef
```

Example:

```
FC ID example:
```

Example:

```
switch(config-fcalias)# member fcid 0x222222
```

Example:

```
Domain ID example:
```

Example:

```
switch(config-fcalias)# member domain-id 2 portnumber 23
```

Example:

```
IPv4 address example:
```

Example:

```
switch(config-fcalias)# member ip-address 10.15.0.0 255.255.0.0
```

Example:

```
IPv6 address example:
```

Example:

```
switch(config-fcalias)# member ipv6-address 2001::db8:800:200c:417a/64
```

Example:

```
Local sWWN interface example:
```

Example:

```
switch(config-fcalias)# member interface fc 2/1
```

Example:

```
Remote sWWN interface example:
```

Example:

```
switch(config-fcalias)# member interface fc2/1 swwn 20:00:00:05:30:00:4a:de
```

Example:

```
Domain ID interface example:
```

Example:

```
switch(config-fcalias)# member interface fc2/1 domain-id 25
```

Configures a member for the specified fcalias (AliasSample) based on the type (pWWN, fabric pWWN, FC ID, domain ID, IPv4 address, IPv6 address, or interface) and value specified.

Note Multiple members can be specified on multiple lines.

Creating FC Aliases Using Fabric Manager

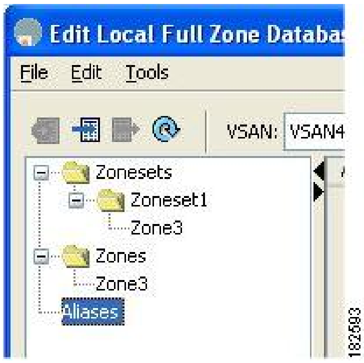
To create an FC alias using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Click **Aliases** in the lower left pane (see Figure 23: Creating an FC Alias, on page 64). The right pane lists the existing aliases.

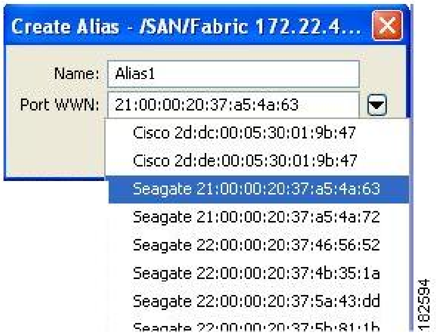
Figure 23: Creating an FC Alias



VSAN: VSAN4

Step 4 Click the **Insert** icon to create an alias.
You see the Create Alias dialog box (see Figure 24: Create Alias Dialog Box, on page 64).

Figure 24: Create Alias Dialog Box


Create Alias - /SAN/Fabric 172.22.4...
Cisco 2d:dc:00:05:30:01:9b:47
Cisco 2d:de:00:05:30:01:9b:47
Seagate 21:00:00:20:37:a5:4a:63
Seagate 21:00:00:20:37:a5:4a:72
Seagate 22:00:00:20:37:46:56:52
Seagate 22:00:00:20:37:4b:35:1a
Seagate 22:00:00:20:37:5a:43:dd
Seagate 22:00:00:20:37:5b:81:1b
182594

Name: Alias1
Port WWN: 21:00:00:20:37:a5:4a:63

Step 5 Set the Alias Name and the pWWN.

Step 6 Click **OK** to create the alias.

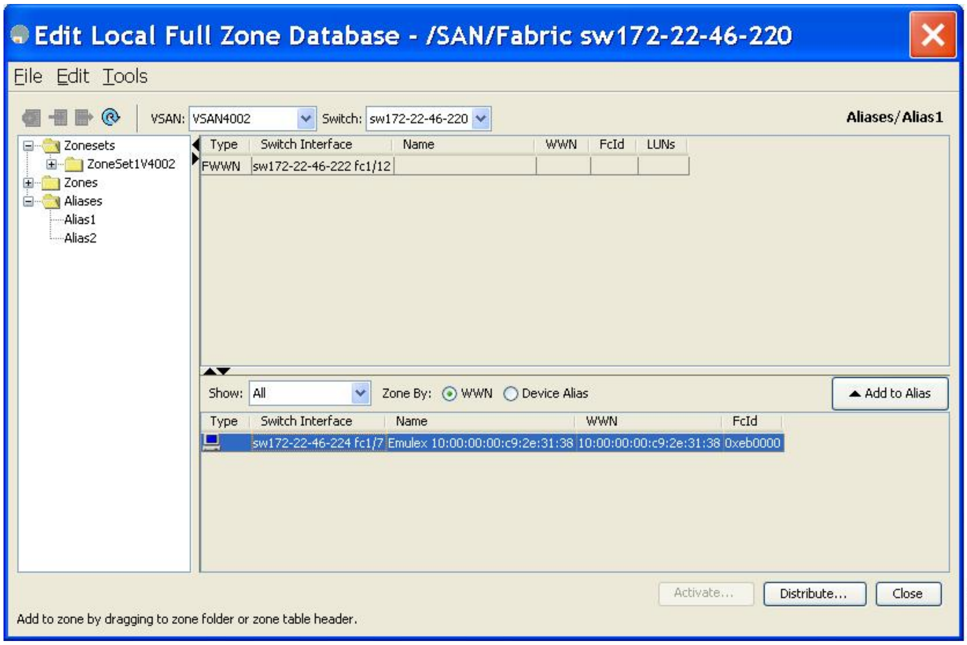
Adding Members to Aliases

To add a member to an alias using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN (see Figure 25: Edit Local Full Zone Database Dialog Box, on page 65).

Figure 25: Edit Local Full Zone Database Dialog Box



VSAN: VSAN4002 Switch: sw172-22-46-220 Aliases/Alias1

Type	Switch Interface	Name	WWN	FcId	LUNs
FWWN	sw172-22-46-222 fc1/12				

Show: All Zone By: ● WWN ○ Device Alias

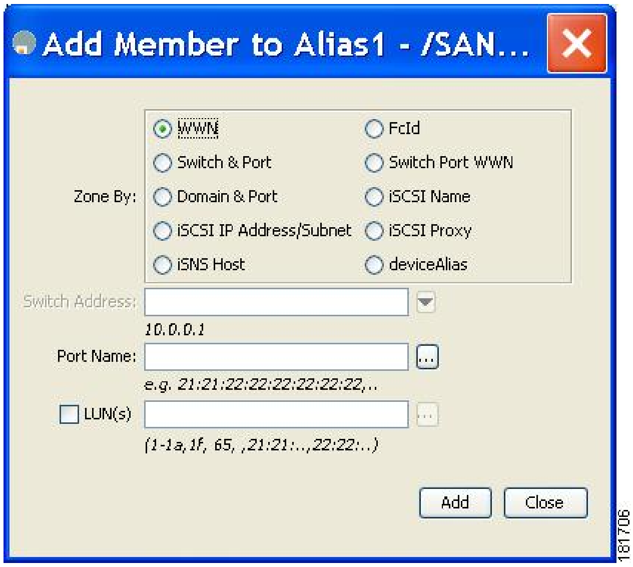
Type	Switch Interface	Name	WWN	FcId
	sw172-22-46-224 fc1/7	Emulex 10:00:00:00:c9:2e:31:38	10:00:00:00:c9:2e:31:38	0xeb0000

Add to zone by dragging to zone folder or zone table header.

Step 3 Select the member(s) you want to add from the Fabric pane (see Figure 25: Edit Local Full Zone Database Dialog Box, on page 65) and click **Add to Alias** or click the alias where you want to add members and click the **Insert** icon.

You see the Add Member to Alias dialog box (see Figure 26: Add Member to Alias Dialog Box, on page 66).

Figure 26: Add Member to Alias Dialog Box



Add Member to Alias1 - /SAN...

Zone By: ● WWN ○ FcId
○ Switch & Port ○ Switch Port WWN
○ Domain & Port ○ iSCSI Name
○ iSCSI IP Address/Subnet ○ iSCSI Proxy
○ iSNS Host ○ deviceAlias

Switch Address:
10.0.0.1

Port Name:
e.g. 21:21:22:22:22:22:22:22,..

□ LUN(s)
(1-1a,1f, 65, ,21:21:..,22:22:..)

Note The Device Alias radio button is visible only if device alias is in enhanced mode. For more information, see Creating Device Aliases, on page 149 section.

Step 4 Click the browse button and select a port name or check the **LUN** check box and click the browse button to configure LUNs.

Step 5 Click **Add** to add the member to the alias.

Converting Zone Members to pWWN-Based Members

You can convert zone and alias members from switch port or FC ID based membership to pWWN-based membership. You can use this feature to convert to pWWN so that your zone configuration does not change if a card or switch is changed in your fabric.

To convert switch port and FC ID members to pWWN members using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Click the zone you want to convert.

Step 4 Choose **Tools** > **Convert Switch Port/FCID members to By pWWN**.
You see the conversion dialog box, listing all members that will be converted.

Step 5 Verify the changes and click **Continue Conversion**.

Step 6 Click **Yes** in the confirmation dialog box to convert that member to pWWN-based membership.

Creating Zone Sets and Adding Member Zones

Tip You do not have to issue the **copy running-config startup-config** command to store the active zoneset. However, you need to issue the **copy running-config startup-config** command to explicitly store full zone sets. If there is more than one switch in a fabric, the **copy running-config startup-config fabric** command should be issued. The **fabric** keyword causes the **copy running-config startup-config** command to be issued on all the switches in the fabric, and also saves the full zone information to the startup-config on all the switches in the fabric. This is important in the event of a switch reload or power cycle.

Caution If you deactivate the active zoneset in a VSAN that is also configured for IVR, the active IVR zoneset (IVZS) is also deactivated and all IVR traffic to and from the switch is stopped. This deactivation can disrupt traffic in more than one VSAN. Before deactivating the active zoneset, check the active zone analysis for the VSAN (see the Zone and ZoneSet Analysis, on page 128). To reactivate the IVZS, you must reactivate the regular zoneset (refer to the Cisco MDS 9000 Series NX-OS Inter-VSAN Routing Configuration Guide).

Caution If the currently active zoneset contains IVR zones, activating the zoneset from a switch where IVR is not enabled disrupts IVR traffic to and from that VSAN. We strongly recommend that you always activate the zoneset from an IVR-enabled switch to avoid disrupting IVR traffic.

Note The pWWN of the virtual target does not appear in the zoning end devices database in Fabric Manager. If you want to zone the virtual device with a pWWN, you must enter it in the Add Member to Zone dialog box when creating a zone. However, if the device alias is in enhanced mode, the virtual device names appear in the device alias database in the Fabric Manager zoning window. In this case, users can choose to select either the device alias name or enter the pWWN in the Add Member to Zone dialog box.

For more information, see the Adding Zone Members, on page 51 section.

Note Set the device alias mode to **enhanced** when using SDV (because the pWWN of a virtual device could change).For example, SDV is enabled on a switch and a virtual device is defined. SDV assigns a pWWN for the virtual device, and it is zoned based on the pWWN in a zone. If you later disable SDV, this configuration is lost. If you reenable SDV and create the virtual device using the same name, there is no guarantee that it will get the same pWWN again. You will have to rezone the pWWN-based zone. However, if you perform zoning based on the device-alias name, there are no configuration changes required if or when the pWWN changes.Be sure you understand how device alias modes work before enabling them. Refer to Distributing Device Alias Services, on page 143 for details and requirements about device alias modes.

To create a zoneset to include several zones, follow these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **zoneset name Zoneset1 vsan 3**

Example:

```
switch(config-zoneset)#
```

Configures a zoneset called Zoneset1.

Tip To activate a zoneset, you must first create the zone and a zoneset.

Step 3 switch(config-zoneset)# **member Zone1**

Adds Zone1 as a member of the specified zoneset (Zoneset1).

Tip If the specified zone name was not previously configured, this command will return the Zone not present error message.

Step 4 switch(config-zoneset)# **zone name InlineZone1**

Example:

```
switch(config-zoneset-zone)#
```

Adds a zone (InlineZone1) to the specified zoneset (Zoneset1).

Tip Execute this step only if you need to create a zone from a zoneset prompt.

Step 5 switch(config-zoneset-zone)# **member fcid 0x111112**

Example:

```
switch(config-zoneset-zone)#
```

Adds a new member (FC ID 0x111112) to the new zone (InlineZone1).

Tip Execute this step only if you need to add a member to a zone from a zoneset prompt.

Filtering Zones, Zone Sets, and Device Aliases Based on Name

To filter the zones, zone sets or device aliases, follow these steps:

Step 1 Click the Zone icon in the toolbar (see Figure 11: Zone Icon, on page 49).

Step 2 Enter a filter condition, such as *zo1*, in the Filter text box.

Step 3 Click **Go**.

Adding Multiple Zones to Multiple Zone Sets

To add multiple zones to multiple zone sets, follow these steps:

Step 1 Click the Zone icon in the toolbar (see Figure 11: Zone Icon, on page 49).

Step 2 From the tree view, select **Zoneset**.

Step 3 Use the Ctrl key to select multiple end devices.

Step 4 Right-click and then select **Add to Zoneset**.

Step 5 Use the Ctrl key to select multiple zones from the pop-up window displayed.

Step 6 Click **Add**.
Selected zones are added to the selected zone sets.

Zone Enforcement

Zoning can be enforced in two ways: soft and hard. Each end device (N port or NL port) discovers other devices in the fabric by querying the name server. When a device logs in to the name server, the name server returns the list of other devices that can be accessed by the querying device. If an Nx port does not know about the FCIDs of other devices outside its zone, it cannot access those devices.

In soft zoning, zoning restrictions are applied only during interaction between the name server and the end device. If an end device somehow knows the FCID of a device outside its zone, it can access that device.

Hard zoning is enforced by the hardware on each frame sent by an Nx port. As frames enter the switch, source-destination IDs are compared with permitted combinations to allow the frame at wirespeed. Hard zoning is applied to all forms of zoning.

Note Hard zoning enforces zoning restrictions on every frame, and prevents unauthorized access.

Switches in the Cisco MDS 9000 Series support both hard and soft zoning.

ZoneSet Distribution

You can distribute full zone sets using one of two methods: one-time distribution at the EXEC mode level or full zoneset distribution at the configuration mode level.

You can distribute full zone sets using one of two methods: one-time distribution or full zone set distribution.

Table 5: Zone Set Distribution zoneset distribution Command Differences , on page 70 lists the differences between these distribution methods.

Table 5: Zone Set Distribution zoneset distribution Command Differences

One-Time Distribution zoneset distribute vsan Command (EXEC Mode)	Full Zone Set Distribution zoneset distribute full vsan Command (Configuration Mode)
Distributes the full zoneset immediately.	Does not distribute the full zoneset immediately.
Does not distribute the full zoneset information along with the active zoneset during activation, deactivation, or merge process.	Remembers to distribute the full zoneset information along with the active zoneset during activation, deactivation, and merge processes.

Tip You do not have to issue the **copy running-config startup-config** command to store the active zoneset. However, you need to issue the **copy running-config startup-config** command to explicitly store full zone sets. If there is more than one switch in a fabric, the **copy running-config startup-config fabric** command should be issued. The **fabric** keyword causes the **copy running-config startup-config** command to be issued on all the switches in the fabric, and also saves the full zone information to the startup-config on all the switches in the fabric. This is important in the event of a switch reload or power cycle.

Enabling Full Zoneset Distribution

All switches in the Cisco MDS 9000 Series distribute active zone sets when new E port links come up or when a new zoneset is activated in a VSAN. The zoneset distribution takes effect while sending merge requests to the adjacent switch or while activating a zoneset.

To enable full zoneset and active zoneset distribution to all switches on a per VSAN basis, follow these steps:

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

Step 2 switch(config)# **zoneset distribute full vsan 33**
Enables sending a full zoneset along with an active zoneset.

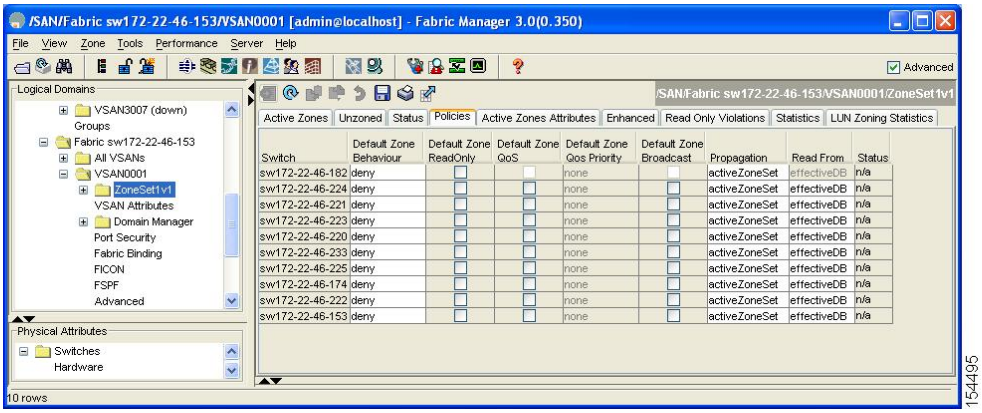
Enabling Full Zoneset Distribution Using Fabric Manager

To enable full zone set and active zone set distribution to all switches on a per VSAN basis using Fabric Manager, follow these steps:

Step 1 Expand a **VSAN** and select a zone set in the Logical Domains pane.
You see the zone set configuration in the Information pane. The Active Zones tab is the default.

Step 2 Click the **Policies** tab.
You see the configured policies for the zone (see Figure 27: Configured Policies for the Zone, on page 71).

Figure 27: Configured Policies for the Zone



Switch	Default Zone Behaviour	Default Zone ReadOnly	Default Zone QoS	Default Zone Qos Priority	Default Zone Broadcast	Propagation	Read From	Status
sw172-22-46-182	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-224	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-221	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-223	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-220	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-233	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-225	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-174	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-222	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a
sw172-22-46-153	deny	☐	☐	none	☐	activeZoneSet	effectiveDB	n/a

Step 3 In the **Propagation** column, choose fullZoneset from the drop-down menu.

Step 4 Click **Apply Changes** to propagate the full zone set.

Enabling a One-Time Distribution

Use the **zoneset distribute vsan** *vsan-id* command in EXEC mode to perform this distribution.

```
switch# zoneset distribute vsan 2
Zoneset distribution initiated. check zone status
```

This procedure command only distributes the full zoneset information; it does not save the information to the startup configuration. You must explicitly save the running configuration to the startup configuration issue the **copy running-config startup-config** command to save the full zoneset information to the startup configuration.

Note The **zoneset distribute vsan** *vsan-id* commandone-time distribution of the full zone set is supported in **interop 2** and **interop 3** modes, not in **interop 1** mode.

Use the **show zone status vsan** *vsan-id* command to check the status of the one-time zoneset distribution request.

```
switch# show zone status vsan 9
VSAN: 9 default-zone: deny distribute: full Interop: default
mode: enhanced merge-control: allow
session: none
hard-zoning: enabled broadcast: enabled
smart-zoning: disabled
rscn-format: fabric-address
activation overwrite control:disabled
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 2002584 bytes
Zonesets:4 Zones:7004 Aliases: 0 Attribute-groups: 1
Active Zoning Database :
DB size: 94340 bytes
Name: zoneset-hac13-200 Zonesets:1 Zones:176
Current Total Zone DB Usage: 2096924 / 2097152 bytes (99 % used)
Pending (Session) DB size:
Full DB Copy size: 0 bytes
Active DB Copy size: 0 bytes
SFC size: 0 / 2097152 bytes (0 % used)
Status: Activation completed at 17:28:04 UTC Jun 16 2014
```

Enabling a One-Time Distribution Using Fabric Manager

You can perform a one-time distribution of inactive, unmodified zone sets throughout the fabric. To propagate a one-time distribution of the full zone set using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Edit Local Full Zone Database dialog box.

Step 2 Click the appropriate zone from the list in the left pane.

Step 3 Click **Distribute** to distribute the full zone set across the fabric.

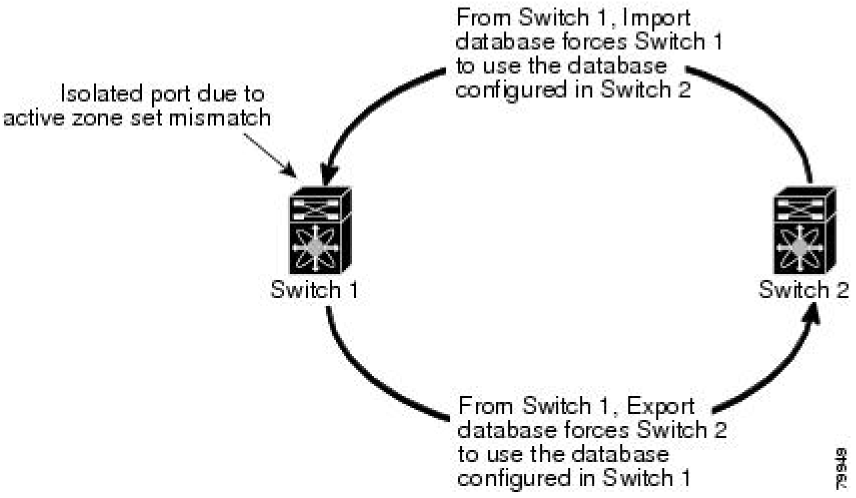
About Recovering from Link Isolation

When two switches in a fabric are merged using a TE or E port, these TE and E ports may become isolated when the active zoneset databases are different between the two switches or fabrics. When a TE port or an E port become isolated, you can recover that port from its isolated state using one of three options:

- Import the neighboring switch's active zoneset database and replace the current active zoneset (see Figure 28: Importing and Exporting the Database , on page 73.
- Export the current database to the neighboring switch.

- Manually resolve the conflict by editing the full zoneset, activating the corrected zoneset, and then bringing up the link.

Figure 28: Importing and Exporting the Database


From Switch 1, Import database forces Switch 1 to use the database configured in Switch 2
Isolated port due to active zone set mismatch
Switch 1
Switch 2
From Switch 1, Export database forces Switch 2 to use the database configured in Switch 1
79949

Importing and Exporting Zone Sets

Note Issue the **import** and **export** commands from a single switch. Importing from one switch and exporting from another switch can lead to isolation again.

To import or export the zoneset information from or to an adjacent switch, follow these steps:

Step 1 switch# **zoneset import interface fc1/3 vsan 2**
Imports the zoneset from the adjacent switch connected through the fc 1/3 interface for VSAN 2.

Step 2 switch# **zoneset import interface fc1/3 vsan 2-5**
Imports the zoneset from the adjacent switch connected through the fc 1/3 interface for VSANs ranging from 2 through 5.

Step 3 switch# **zoneset export vsan 5**
Exports the zoneset to the adjacent switch connected through VSAN 5.

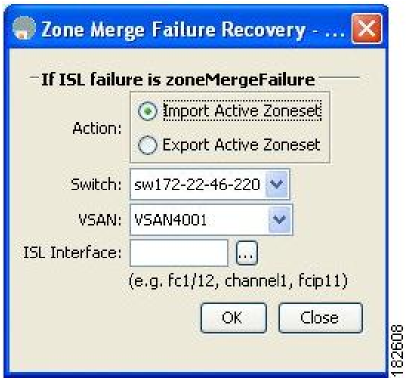
Step 4 switch# **zoneset export vsan 5-8**
Exports the zoneset to the adjacent switch connected through the range of VSANs 5 through 8.

Importing and Exporting Zone Sets Using Fabric Manager

To import or export the zone set information from or to an adjacent switch using Fabric Manager, follow these steps:

Step 1 Choose **Tools** > **Zone Merge Fail Recovery**.
You see the Zone Merge Failure Recovery dialog box (see Figure 29: Zone Merge Failure Recovery Dialog Box, on page 74).

Figure 29: Zone Merge Failure Recovery Dialog Box



Zone Merge Failure Recovery - ...

If ISL failure is zoneMergeFailure

Action: ● Import Active Zoneset ○ Export Active Zoneset

Switch: sw172-22-46-220

VSAN: VSAN4001

ISL Interface:

(e.g. fc1/12, channel1, fcip11)

Step 2 Click the **Import Active Zoneset** or the **Export Active Zoneset** radio button.

Step 3 Select the switch from which to import or export the zone set information from the drop-down list.

Step 4 Select the VSAN from which to import or export the zone set information from the drop-down list.

Step 5 Select the interface to use for the import process.

Step 6 Click **OK** to import or export the active zone set.
Issue the **import** and **export** commands from a single switch. Importing from one switch and exporting from another switch can lead to isolation again.

Zoneset Duplication

You can make a copy and then edit it without altering the existing active zoneset. You can copy an active zoneset from the bootflash: directory, volatile: directory, or slot0, to one of the following areas:

- To the full zoneset
- To a remote location (using FTP, SCP, SFTP, or TFTP)

The active zoneset is not part of the full zoneset. You cannot make changes to an existing zoneset and activate it, if the full zoneset is lost or is not propagated.

Caution Copying an active zoneset to a full zoneset may overwrite a zone with the same name, if it already exists in the full zoneset database.

Copying Zone Sets

On the Cisco MDS Series switches, you cannot edit an active zoneset. However, you can copy an active zoneset to create a new zoneset that you can edit.

Caution If the Inter-VSAN Routing (IVR) feature is enabled and if IVR zones exist in the active zoneset, then a zoneset copy operation copies all the IVR zones to the full zone database. To prevent copying to the IVR zones, you must explicitly remove them from the full zoneset database before performing the copy operation. For more information on the IVR feature see the Cisco MDS 9000 Series NX-OS Inter-VSAN Routing Configuration Guide .

To make a copy of a zoneset, follow this step:

Step 1 switch# **zone copy active-zoneset full-zoneset vsan 2**

Example:

```
Please enter yes to proceed.(y/n)  [n]? y
```

Makes a copy of the active zoneset in VSAN 2 to the full zoneset.

Step 2 switch# **zone copy vsan 3 active-zoneset scp://guest@myserver/tmp/active_zoneset.txt**
Copies the active zone in VSAN 3 to a remote location using SCP.

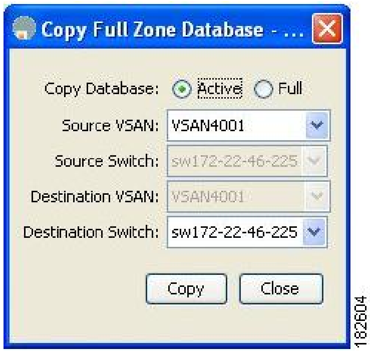
Copying Zone Sets Using Fabric Manager

To make a copy of a zone set using Fabric Manager, follow these steps:

Step 1 Choose **Edit** > **Copy Full Zone Database**.

You see the Copy Full Zone Database dialog box (see Figure 30: Copy Full Zone Database Dialog Box, on page 76).

Figure 30: Copy Full Zone Database Dialog Box



Copy Database: ● Active ○ Full

Source VSAN: VSAN4001

Source Switch: sw172-22-46-225

Destination VSAN: VSAN4001

Destination Switch: sw172-22-46-225

Step 2 Click the **Active** or the **Full** radio button, depending on which type of database you want to copy.

Step 3 Select the source VSAN from the drop-down list.

Step 4 If you selected **Copy Full**, select the source switch and the destination VSAN from those drop-down lists.

Step 5 Select the destination switch from the drop-down list.

Step 6 Click **Copy** to copy the database.

About Backing Up and Restoring Zones

You can back up the zone configuration to a workstation using TFTP. This zone backup file can then be used to restore the zone configuration on a switch. Restoring the zone configuration overwrites any existing zone configuration on a switch.

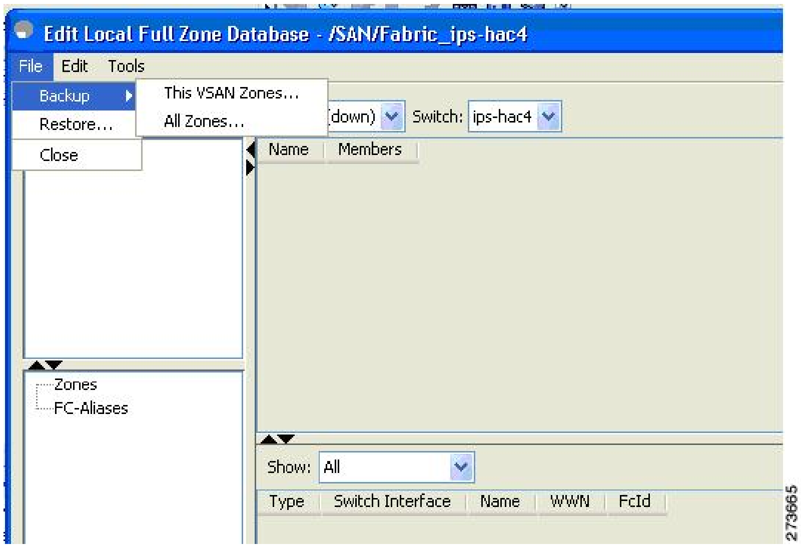
Backing Up Zones Using Fabric Manager

To back up the full zone configuration using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**. You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**. You see the Edit Local Full Zone Database dialog box for the selected VSAN (see Figure 31: Edit Local Full Zone Database, on page 77).

Figure 31: Edit Local Full Zone Database



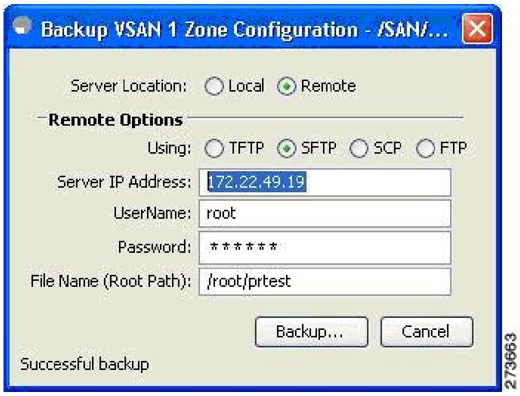
Edit Local Full Zone Database - /SAN/Fabric_ips-hac4

(down) Switch: ips-hac4

Show: All

Step 3 Choose **File** > **Backup** > **This VSAN Zones** to back up the existing zone configuration to a workstation using TFTP, SFTP, SCP, or FTP. You see the Backup Zone Configuration dialog box (see Figure 32: Backup Zone Configuration Dialog Box, on page 77).

Figure 32: Backup Zone Configuration Dialog Box



Backup VSAN 1 Zone Configuration - /SAN/...

Server Location: ○ Local ● Remote

Remote Options

Using: ○ TFTP ● SFTP ○ SCP ○ FTP

Server IP Address: 172.22.49.19

UserName: root

Password: ******

File Name (Root Path): /root/prtest

Successful backup

You can edit this configuration before backing up the data to a remote server.

Step 4 Provide the following Remote Options information to back up data onto a remote server:

a) **Using—**Select the protocol.

b) **Server IP Address—**Enter the IP adress of the server.

c) **UserName—**Enter the name of the user.

d) **Password—**Enter the password for the user.

e) **File Name(Root Path)—**Enter the path and the filename.

Step 5 Click **Backup** or click Cancel to close the dialog box without backing up.

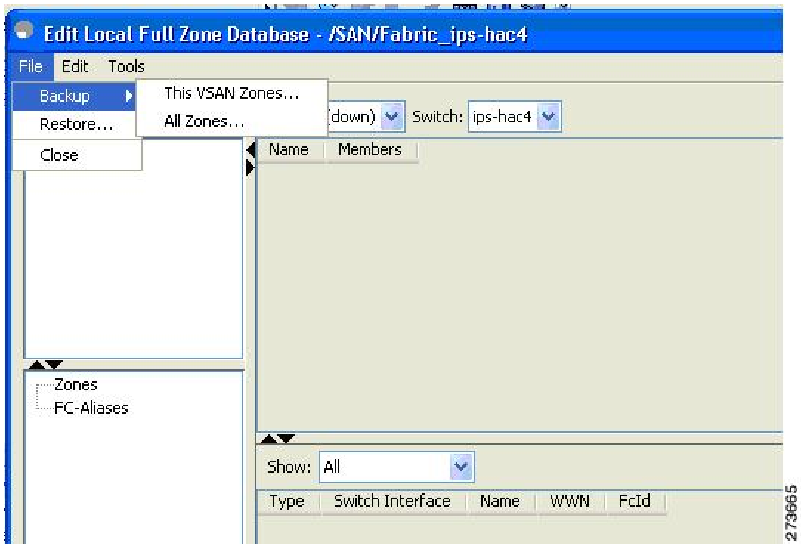
Restoring Zones

To restore the full zone configuration using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**. You see the Select VSAN dialog box.

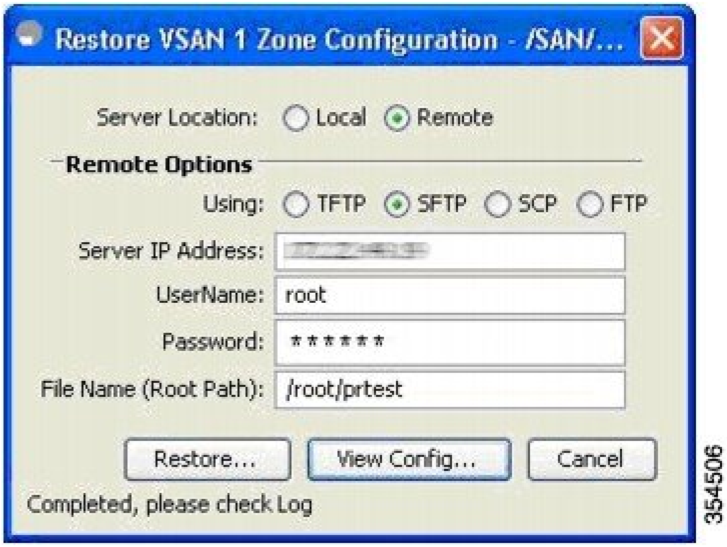
Step 2 Select a VSAN and click **OK**. You see the Edit Local Full Zone Database dialog box for the selected VSAN (see Figure 33: Edit Local Full Zone Database, on page 78).

Figure 33: Edit Local Full Zone Database



Step 3 Choose **File** > **Restore** to restore a saved zone configuration using TFTP, SFTP, SCP or FTP. You see the Restore Zone Configuration dialog box (see Figure 34: Restore Zone Configuration Dialog Box, on page 79).

Figure 34: Restore Zone Configuration Dialog Box



Restore VSAN 1 Zone Configuration - /SAN/...

Server Location: ○ Local ● Remote

Remote Options

Using: ○ TFTP ● SFTP ○ SCP ○ FTP

Server IP Address: [redacted]

UserName: root

Password: ******

File Name (Root Path): /root/prtest

Restore... | View Config... | Cancel

Completed, please check Log

You can edit this configuration before restoring it to the switch.

Step 4 Provide the following Remote Options information to restore data from a remote server:

a) **Using—**Select the protocol.

b) **Server IP Address—**Enter the IP address of the server.

c) **UserName—**Enter the name of the user.

d) **Password—**Enter the password for the user.

e) **File Name—**Enter the path and the filename.

Step 5 Click **Restore** to continue or click Cancel to close the dialog box without restoring.

Note Click **View Config** to see information on how the zone configuration file from a remote server will be restored. When you click **Yes** in this dialog box, you will be presented with the CLI commands that are executed. To close the dialog box, click **Close**.

Note Backup and Restore options are available to switches that run Cisco NX-OS Release 4.1(3a) or later.

Renaming Zones, Zone Sets, and Aliases

Note Backup option is available to switches that run Cisco NX-OS Release 4.1(3) or later. Restore option is only supported on Cisco Fabric Manager Release 4.1(3) or later.

To rename a zone, zone set, fcalias, or zone-attribute-group, follow these steps:

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

Step 2 switch(config)# **zoneset rename oldname newname vsan 2**
Renames a zone set in the specified VSAN.

Step 3 switch(config)# **zone rename oldname newname vsan 2**
Renames a zone in the specified VSAN.

Step 4 switch(config)# **fcalias rename oldname newname vsan 2**
Renames a fcalias in the specified VSAN.

Step 5 switch(config)# **zone-attribute-group rename oldname newname vsan 2**
Renames a zone attribute group in the specified VSAN.

Step 6 switch(config)# **zoneset activate name newname vsan 2**
Activates the zone set and updates the new zone name in the active zone set.

Renaming Zones, Zone Sets, and Aliases Using Fabric Manager

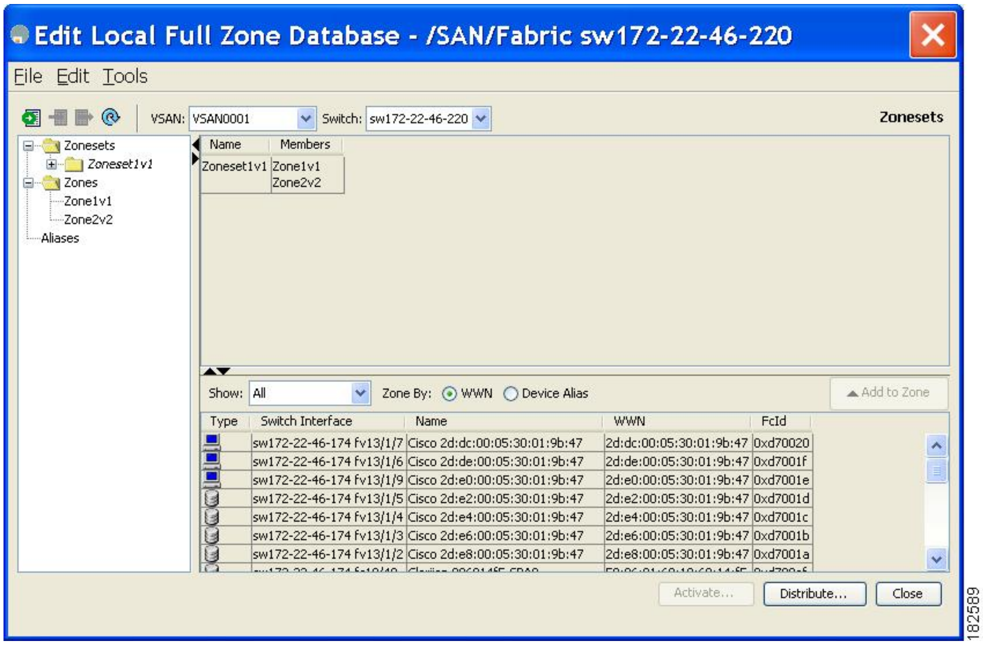
To rename a zone, zone set, or alias using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.

You see the Edit Local Full Zone Database dialog box for the selected VSAN (see Figure 35: Edit Local Full Zone Database Dialog Box, on page 81).

Figure 35: Edit Local Full Zone Database Dialog Box



VSAN: VSAN0001 Switch: sw172-22-46-220

Name	Members
Zoneset1v1	Zone1v1 Zone2v2

Show: All Zone By: ● WWN ○ Device Alias

Type	Switch Interface	Name	WWN	FcId
🖥	sw172-22-46-174 fv13/1/7	Cisco 2d:dc:00:05:30:01:9b:47	2d:dc:00:05:30:01:9b:47	0xd70020
🖥	sw172-22-46-174 fv13/1/6	Cisco 2d:de:00:05:30:01:9b:47	2d:de:00:05:30:01:9b:47	0xd7001f
🖥	sw172-22-46-174 fv13/1/9	Cisco 2d:e0:00:05:30:01:9b:47	2d:e0:00:05:30:01:9b:47	0xd7001e
🛢	sw172-22-46-174 fv13/1/5	Cisco 2d:e2:00:05:30:01:9b:47	2d:e2:00:05:30:01:9b:47	0xd7001d
🛢	sw172-22-46-174 fv13/1/4	Cisco 2d:e4:00:05:30:01:9b:47	2d:e4:00:05:30:01:9b:47	0xd7001c
🛢	sw172-22-46-174 fv13/1/3	Cisco 2d:e6:00:05:30:01:9b:47	2d:e6:00:05:30:01:9b:47	0xd7001b
🛢	sw172-22-46-174 fv13/1/2	Cisco 2d:e8:00:05:30:01:9b:47	2d:e8:00:05:30:01:9b:47	0xd7001a
🛢	[illegible]	[illegible]	[illegible]	[illegible]

Step 3 Click a zone or zone set in the left pane.

Step 4 Choose **Edit** > **Rename**.
An edit box appears around the zone or zone set name.

Step 5 Enter a new name.

Step 6 Click **Activate** or **Distribute**.

Cloning Zones, Zone Sets, FC Aliases, and Zone Attribute Groups

To clone a zone, zoneset, fcalias, or zone-attribute-group, follow these steps:

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

Step 2 switch(config)# **zoneset clone oldname newnamevsan 2**
Clones a zoneset in the specified VSAN.

Step 3 switch(config)# **zone clone oldname newname vsan 2**
Clones a zone in the specified VSAN.

Step 4 switch(config)# **fcalias clone oldname newnamevsan 2**
Clones a fcalias in the specified VSAN.

Step 5 switch(config)# **zone-attribute-group clone oldname newname vsan 2**
Clones a zone attribute group in the specified VSAN.

Step 6 switch(config)# **zoneset activate name newname vsan 2**
Activates the zoneset and updates the new zone name in the active zoneset.

Cloning Zones, Zone Sets, FC Aliases, and Zone Attribute Groups Using Fabric Manager

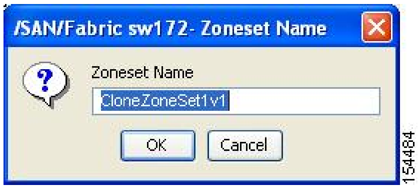
To clone a zone, zone set, fcalias, or zone attribute group, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Choose **Edit** > **Clone**.
You see the Clone Zoneset dialog box (see Figure 36: Clone Zoneset Dialog Box, on page 82). The default name is the word **Clone** followed by the original name.

Figure 36: Clone Zoneset Dialog Box


/SAN/Fabric sw172- Zoneset Name

Zoneset Name: CloneZoneSet1v1

Step 4 Change the name for the cloned entry.

Step 5 Click **OK** to save the new clone.
The cloned database now appears along with the original database.

Migrating a Non-MDS Database

To use the Zone Migration Wizard to migrate a non-MDS database using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Migrate Non-MDS Database**.
You see the Zone Migration Wizard.

Step 2 Follow the prompts in the wizard to migrate the database.

Clearing the Zone Server Database

You can clear all configured information in the zone server database for the specified VSAN.

To clear the zone server database, use the following command:

```
switch# clear zone database vsan 2
```

Note To clear the zone server database, refer to the Cisco MDS 9000 Series NX-OS Fabric Configuration Guide.

Note After issuing a **clear zone database** command, you must explicitly issue the **copy running-config startup-config** to ensure that the running configuration is used when the switch reboots.

Note Clearing a zoneset only erases the full zone database, not the active zone database.

Note After clearing the zone server database, you must explicitly **copy the running configuration to the startup configuration** to ensure that the running configuration is used when the switch reboots.

Advanced Zone Attributes

About Zone-Based Traffic Priority

The zoning feature provides an additional segregation mechanism to prioritize select zones in a fabric and set up access control between devices. Using this feature, you can configure the quality of service (QoS) priority as a zone attribute. You can assign the QoS traffic priority attribute to be high, medium, or low. By default, zones with no specified priority are implicitly assigned a low priority. Refer to the Cisco MDS 9000 NX-OS Series Quality of Service Configuration Guide for more information.

To use this feature, you need to obtain the ENTERPRISE_PKG license (refer to the Cisco NX-OS Series Licensing Guide) and you must enable QoS in the switch (refer to the Cisco MDS 9000 Series NX-OS Quality of Service Configuration Guide).

This feature allows SAN administrators to configure QoS in terms of a familiar data flow identification paradigm. You can configure this attribute on a zone-wide basis rather than between zone members.

⚠ **Caution** If zone-based QoS is implemented in a switch, you cannot configure the interop mode in that VSAN.

Configuring Zone-Based Traffic Priority

To configure the zone priority, follow these steps:

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

Step 2 switch(config)# **zone name QosZone vsan 2**

Example:

```
switch(config-zone)#
```

Configures an alias name (QosZone) and enters zone configuration submode.

Step 3 switch(config-zone)# **attribute-group qos priority high**

Example:

Configures this zone to assign high priority QoS traffic to each frame matching this zone in enhanced mode.

Step 4 switch(config-zone)# **attribute qos priority** {**high** | **low** | **medium**}
Configures this zone to assign QoS traffic to each frame matching this zone.

Step 5 switch(config-zone)# **exit**

Example:

```
switch(config)#
```

Returns to configuration mode.

Step 6 switch(config)# **zoneset name QosZoneset vsan 2**

Example:

```
switch(config-zoneset)#
```

Configures a zoneset called QosZoneset for the specified VSAN (vsan 2) and enters zoneset configuration submode.

Tip To activate a zoneset, you must first create the zone and a zoneset.

Step 7 switch(config-zoneset)# **member QosZone**
Adds QosZone as a member of the specified zoneset (QosZoneset).

Tip If the specified zone name was not previously configured, this command will return the Zone not present error message.

Step 8 switch(config-zoneset)# **exit**

Example:

```
switch(config)#
```

Returns to configuration mode.

Step 9 switch(config)# **zoneset activate name QosZoneset vsan 2**
Activates the specified zoneset.

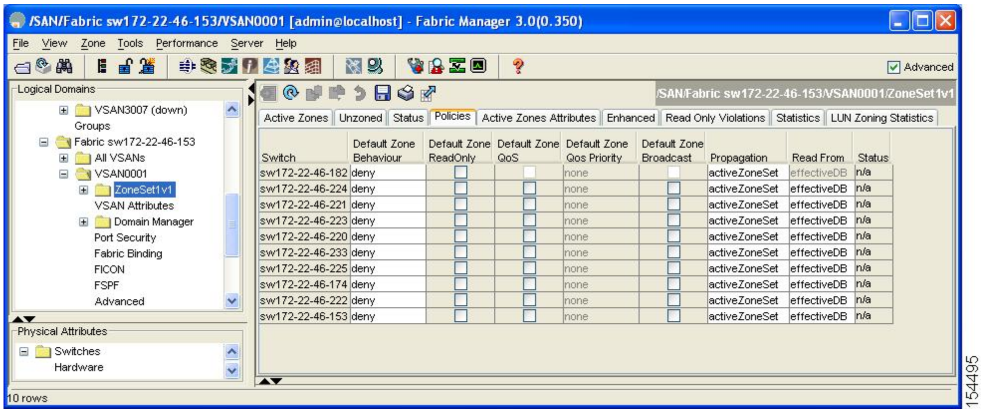
Configuring Zone-Based Traffic Priority Using Fabric Manager

To configure the zone priority using Fabric Manager, follow these steps:

Step 1 Expand a **VSAN** and then select a zone set in the Logical Domains pane.

Step 2 Click the **Policies** tab in the Information pane.
You see the Zone policy information in the Information pane (see Figure 37: Zone Policies Tab in the Information Pane, on page 85).

Figure 37: Zone Policies Tab in the Information Pane



Switch	Default Zone Behaviour	Default Zone ReadOnly	Default Zone QoS	Default Zone Qos Priority	Default Zone Broadcast	Propagation	Read From	Status
sw172-22-46-182	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-224	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-221	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-223	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-220	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-233	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-225	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-174	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-222	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a
sw172-22-46-153	deny	□	□	none	□	activeZoneSet	effectiveDB	n/a

Step 3 Use the check boxes and drop-down menus to configure QoS on the default zone.

Step 4 Click **Apply Changes** to save the changes.

Configuring Default Zone QoS Priority Attributes

QoS priority attribute configuration changes take effect when you activate the zoneset of the associated zone.

Note If a member is part of two zones with two different QoS priority attributes, the higher QoS value is implemented. This situation does not arise in the VSAN-based QoS as the first matching entry is implemented.

To configure the QoS priority attributes for a default zone, follow these steps:

Step 1 switch# **configure terminal**

Example:

```
switch(config)#
```

Enters configuration mode.

Step 2 switch(config)# **zone default-zone vsan 1**

Example:

```
switch(config-default-zone)#
```

Enters the default zone configuration submode.

Step 3 switch(config-default-zone)# **attribute qos priority high**
Sets the QoS priority attribute for frames matching these zones.

Step 4 switch(config-default-zone)# **no attribute qos priority high**
Removes the QoS priority attribute for the default zone and reverts to default low priority.

Configuring Default Zone QoS Priority Attributes Using Fabric Manager

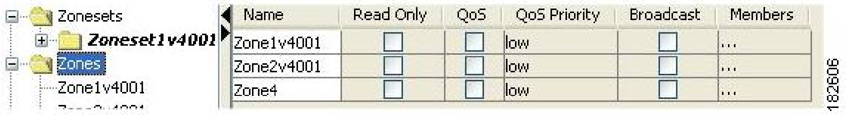
To configure the QoS priority attributes for a default zone using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Choose **Edit** > **Edit Default Zone Attributes** to configure the default zone QoS priority attributes (see Figure 38: QoS Priority Attributes, on page 87).

Figure 38: QoS Priority Attributes



Name	Read Only	QoS	QoS Priority	Broadcast	Members
Zone1v4001	□	□	low	□	...
Zone2v4001	□	□	low	□	...
Zone4	□	□	low	□	...

Step 4 Check the **Permit QoS Traffic with Priority** check box and set the Qos Priority drop-down menu to **low**, **medium**, or **high**.

Step 5 Click **OK** to save these changes.

Configuring the Default Zone Policy

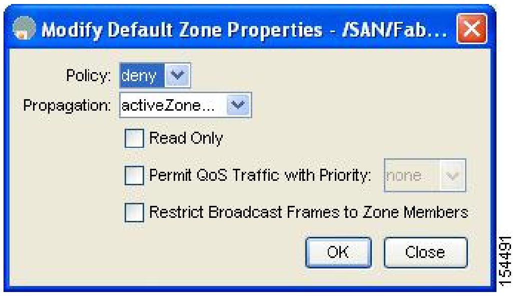
To permit or deny traffic in the default zone using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Choose **Edit** > **Edit Default Zone Attributes** to configure the default zone QoS priority attributes.
You see the Modify Default Zone Properties dialog box (see Figure 39: Modify Default Zone Properties Dialog Box, on page 87).

Figure 39: Modify Default Zone Properties Dialog Box



Modify Default Zone Properties - /SAN/Fab...

Policy: deny
Propagation: activeZone...
□ Read Only
□ Permit QoS Traffic with Priority: none
□ Restrict Broadcast Frames to Zone Members

Step 4 Set the Policy drop-down menu to **permit** to permit traffic in the default zone, or set it to **deny** to block traffic in the default zone.

Step 5 Click **OK** to save these changes.

About Broadcast Zoning

Note Broadcast zoning is not supported on the Cisco Fabric Switch for HP c-Class BladeSystem and the Cisco Fabric Switch for IBM BladeCenter.

You can configure broadcast frames in the basic zoning mode. By default, broadcast zoning is disabled and broadcast frames are sent to all Nx ports in the VSAN. When enabled, broadcast frames are only sent to Nx ports in the same zone, or zones, as the sender. Enable broadcast zoning when a host or storage device uses this feature.

Table identifies the rules for the delivery of broadcast frames.

Table 6: Broadcasting Requirements

Active Zoning?	Broadcast Enabled?	Frames Broadcast?	Comments
Yes	Yes	Yes	Broadcast to all Nx ports that share a broadcast zone with the source of broadcast frames.
No	Yes	Yes	Broadcast to all Nx ports.
Yes	No	No	Broadcasting is disabled.

Tip If any NL port attached to an FL port shares a broadcast zone with the source of the broadcast frame, then the frames are broadcast to all devices in the loop.

Caution If broadcast zoning is enabled on a switch, you cannot configure the interop mode in that VSAN.

Configuring Broadcast Zoning

In basic zoning mode

Note Zone broadcast is not supported from Cisco NX-OS Release 5.x and later.

To broadcast frames in the basic zoning mode, follow these steps:

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

Step 2 switch(config)# **zone broadcast enable vsan 2**
Broadcasts frames for the specified VSAN.

Step 3 switch(config)# **no zone broadcast enable vsan 3**
Disables (default) broadcasting for the specified VSAN.

Step 4 switch(config)# **zone name BcastZone vsan 2**
Creates a broadcast zone in the specified VSAN and enters zone configuration submode.

Step 5 switch(config-zone)# **member pwwn 21:00:00:20:37:f0:2e:4d**
Adds the specified member to this zone.

Step 6 switch(config-zone)# **attribute broadcast**
Specifies this zone to be broadcast to other devices.

Step 7 switch(config-zone)# **end**

Example:

```
switch# show zone vsan 2
```

Example:

```
zone name bcast-zone vsan 2
```

Example:

```
attribute broadcast
```

Example:

```
pwwn 21:00:00:e0:8b:0b:66:56
```

Example:

```
pwwn 21:00:00:20:37:f0:2e:4d
```

Displays the broadcast configuration.

In default zoning mode

To configure the **broadcast** attribute for a default zone, follow these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **zone default-zone vsan 1**
Enters the default zone configuration submode.

Step 3 switch(config-default-zone)# **attribute broadcast**
Sets broadcast attributes for the default zone.

Step 4 switch(config-default-zone)# **no attribute broadcast**
Reverts the default zone attributes to read-write (default).

About Smart Zoning

Smart zoning implements hard zoning of large zones with fewer hardware resources than was previously required. The traditional zoning method allows each device in a zone to communicate with every other device in the zone. The administrator is required to manage the individual zones according to the zone configuration guidelines. Smart zoning eliminates the need to create a single initiator to single target zones. By analyzing device-type information in the FCNS, useful combinations can be implemented at the hardware level by the Cisco MDS NX-OS software, and the combinations that are not used are ignored. For example, initiator-target pairs are configured, but not initiator-initiator. The device is treated as unknown if:

- The FC4 types are not registered on the device.
- During Zone Convert, the device is not logged into the fabric.
- The zone is created, however, initiator, target, or initiator and target is not specified.

The device type information of each device in a smart zone is automatically populated from the Fibre Channel Name Server (FCNS) database as host, target, or both. This information allows more efficient utilisation of switch hardware by identifying initiator-target pairs and configuring those only in hardware. In the event of a special situation, such as a disk controller that needs to communicate with another disk controller, smart zoning defaults can be overridden by the administrator to allow complete control.

Note

- Smart Zoning can be enabled at VSAN level but can also be disabled at zone level.
- Smart zoning is not supported on VSANs that have DMM, IOA, or SME applications enabled on them.

Smart Zoning Member Configuration

Table displays the supported smart zoning member configurations.

Table 7: Smart Zoning Configuration

Feature	Supported
PWWN	Yes
FCID	Yes
FCalias	Yes
Device-alias	Yes
Interface	No
IP address	No
Symbolic nodename	No
FWWN	No
Domain ID	No

Enabling Smart Zoning on a VSAN

To configure the **smart zoning** for a VSAN, follow these steps:

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

Step 2 switch(config)# **zone smart-zoning enable vsan 1**
Enables smart zoning on a VSAN.

Step 3 switch(config)# no **zone smart-zoning enable vsan 1**
Disables smart zoning on a VSAN.

Setting Default Value for Smart Zoning

To set the default value, follow these steps:

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

Step 2 switch(config)# system default zone smart-zone enable
Enables smart zoning on a VSAN that are created based on the specified default value.

Step 3 switch(config)# no system default zone smart-zone enable
Disables smart zoning on a VSAN.

Converting Zones Automatically to Smart Zoning

To fetch the device-type information from nameserver and to add that information to the member, follow the steps below: This can be performed at zone, zoneset, FCalias, and VSAN levels. After the zoneset is converted to smart zoning, you need to activate zoneset.

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

Step 2 switch(config)# zone convert smart-zoning fcalias name <alias-name> vsan <vsan no>
Fetches the device type information from the nameserver for the fcalias members.

Note When the zone convert command is run, the FC4-Type should be SCSI-FCP. The SCSI-FCP has bits which determines whether the device is an initiator or target. If initiator and target are both set, the device is treated as both.

Step 3 switch(config)# zone convert smart-zoning zone name <zone name> vsan <vsan no>
Fetches the device type information from the nameserver for the zone members.

Step 4 switch(config)# zone convert smart-zoning zoneset name <zoneset name> vsan <vsan no>
Fetches the device type information from the nameserver for all the zones and fcalias members in the specified zoneset.

Step 5 switch(config)# zone convert smart-zoning vsan <vsan no>
Fetches the device type information from the nameserver for all the zones and fcalias members for all the zonesets present in the VSAN.

Step 6 switch(config)# show zone smart-zoning auto-conv status vsan 1
Displays the previous auto-convert status for a VSAN.

Step 7 switch(config)# show zone smart-zoning auto-conv log errors
Displays the error-logs for smart-zoning auto-convert.

What to Do Next

Use the show fcns database command to check if the device is initiator, target or both:

```
switch# show fcns database
VSAN 1:
--------------------------------------------------------------------------
FCID TYPE PWWN (VENDOR) FC4-TYPE:FEATURE
--------------------------------------------------------------------------
0x9c0000 N 21:00:00:e0:8b:08:96:22 (Company 1) scsi-fcp:init
0x9c0100 N 10:00:00:05:30:00:59:1f (Company 2) ipfc
```

```
0x9c0200 N 21:00:00:e0:8b:07:91:36 (Company 3) scsi-fcp:init
0x9c03d6 NL 21:00:00:20:37:46:78:97 (Company 4) scsi-fcp:target
```

Configuring Device Types for Zone Members

To configure the device types for zone members, follow these step:

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

Step 2 switch(config-zoneset-zone)# **member device-alias** *name* **both**
Configures the device type for the device-alias member as both. For every supported member-type, init, target, and both are supported.

Step 3 switch(config-zoneset-zone)# **member pwwn** *number* **target**
Configures the device type for the pwwn member as target. For every supported member-type, init, target, and both are supported.

Step 4 switch(config-zoneset-zone)# **member fcid** *number*
Configures the device type for the FCID member. There is no specific device type that is configured. For every supported member-type, init, target, and both are supported.

Note When there is no specific device type configured for a zone member, at the backend, zone entries that are generated are created as device type both.

Removing Smart Zoning Configuration

To remove the smart zoning configuration, follow this steps:

Step 1 switch(config)# **clear zone smart-zoning fcalias name** *alias-name* **vsan** *number*
Removes the device type configuration for all the members of the specified fcalias.

Step 2 switch(config)# **clear zone smart-zoning zone name** *zone name* **vsan** *number*
Removes the device type configuration for all the members of the specified zone.

Step 3 switch(config)# **clear zone smart-zoning zoneset name** *zoneset name* **vsan** *number*
Removes the device type configuration for all the members of the zone and fcalias for the specified zoneset.

Step 4 switch(config)# **clear zone smart-zoning vsan** *number*
Removes the device type configuration for all the members of the zone and fcalias of all the specified zonesets in the VSAN.

Disabling Smart Zoning at Zone Level in the Basic Zoning Mode

To disable smart zoning at the zone level for a VSAN in basic zoning mode, follow these steps:

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

Step 2 switch(config)# **zone name zone1 vsan 1**
Configures a zone name.

Step 3 switch(config-zone)# **attribute disable-smart-zoning**
Disables Smart Zoning for the selected zone.

Note This command only disables the smart zoning for the selected zone and does not remove the device type configurations.

Disabling Smart Zoning at Zone Level for a VSAN in the Enhanced Zoning Mode

To disable smart zoning at the zone level for a VSAN in enhanced zoning mode, follow these steps:

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

Step 2 switch(config)# **zone-attribute-group name disable-sz vsan 1**
Creates an enhanced zone session.

Step 3 switch(config-attribute-group)#**disable-smart-zoning**
Disables Smart Zoning for the selected zone.

Note This command only disables the smart zoning for the selected zone and does not remove the device type configurations.

Step 4 switch(config-attribute-group)# **zone name prod vsan 1**
Configures a zone name.

Step 5 switch(config-zone)# **attribute-group disable-sz**
Configures to assign a group-attribute name for the selected zone.

Step 6 switch(config-zone)# **zone commit vsan 1**
Commits zoning changes to the selected VSAN.

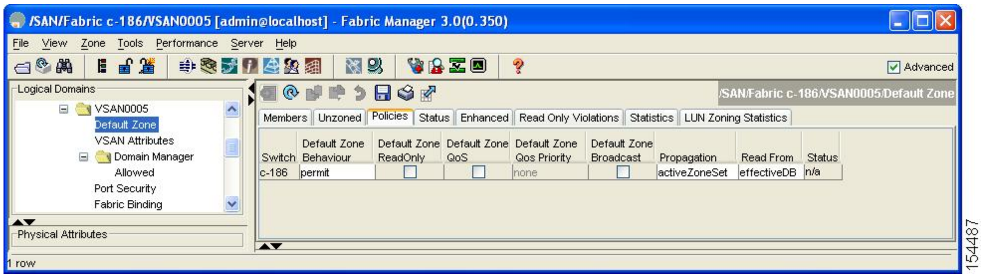
Disabling Smart Zoning at Zone Level Using Fabric Manager

To broadcast frames in the basic zoning mode using Fabric Manager, follow these steps:

Step 1 Expand a **VSAN** and then select a zone set in the Logical Domains pane.

Step 2 Click the **Policies** tab in the Information pane.
You see the Zone policy information in the Information pane.

Figure 40: Zone Policy Information



Switch	Default Zone Behaviour	Default Zone ReadOnly	Default Zone QoS	Default Zone Qos Priority	Default Zone Broadcast	Propagation	Read From	Status
c-186	permit	□	□	none	□	activeZoneSet	effectiveDB	n/a

Step 3 Check the **Broadcast** check box to enable broadcast frames on the default zone.

Step 4 Click **Apply** Changes to save these changes.

About LUN Zoning

Logical unit number (LUN) zoning is a feature specific to switches in the Cisco MDS 9000 Series.

Caution LUN zoning can only be implemented in Cisco MDS 9000 Series switches. If LUN zoning is implemented in a switch, you cannot configure the interop mode in that switch.

A storage device can have multiple LUNs behind it. If the device port is part of a zone, a member of the zone can access any LUN in the device. With LUN zoning, you can restrict access to specific LUNs associated with a device.

Note When LUN 0 is not included within a zone, then, as per standards requirements, control traffic to LUN 0 (for example, REPORT_LUNS, INQUIRY) is supported, but data traffic to LUN 0 (for example, READ, WRITE) is denied.

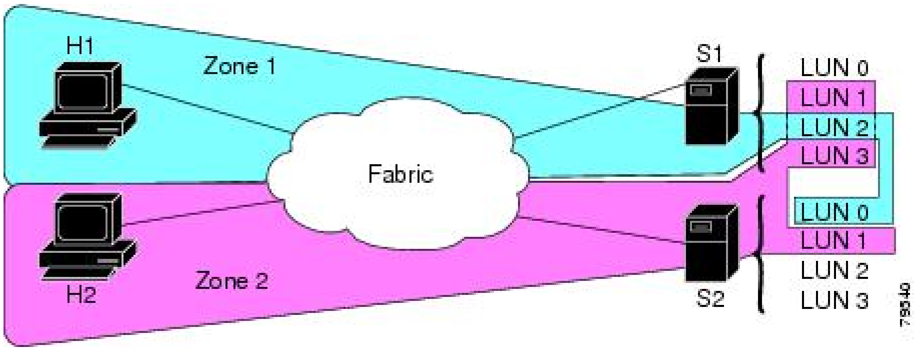
- Host H1 can access LUN 2 in S1 and LUN 0 in S2. It cannot access any other LUNs in S1 or S2.
- Host H2 can access LUNs 1 and 3 in S1 and only LUN 1 in S2. It cannot access any other LUNs in S1 or S2.

Note Unzoned LUNs automatically become members of the default zone.

Note LUN zoning is not supported from Cisco MDS NX-OS Release 5.x and later.

Figure 41: LUN Zoning Access, on page 96 shows a LUN-based zone example.

Figure 41: LUN Zoning Access



Configuring a LUN-Based Zone

To configure a LUN-based zone, follow these steps:

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

Step 2 switch(config)# **zone name LunSample vsan 2**
Configures a zone called LunSample for the specified VSAN (vsan 2) and enters zone configuration submode.

Step 3 switch(config-zone)# **member pwwn 10:00:00:23:45:67:89:ab lun 0x64**
Configures a zone member based on the specified pWWN and LUN value.

Note The CLI interprets the LUN identifier value as a hexadecimal value whether or not the **0x** prefix is included. LUN 0x64 in hex format corresponds to 100 in decimal format.

Step 4 (Optional) switch(config-zone)# **member fcid 0x12465 lun 0x64**
Configures a zone member based on the FC ID and LUN value.

Configuring a LUN-Based Zone Using Fabric Manager

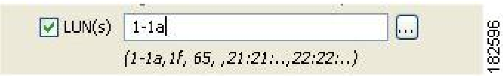
To configure a LUN-based zone using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Click the zone where you want to add members and click the **Insert** icon.
You see the Add Member to Zone dialog box.

Figure 42: Add Member to Zone Dialog Box



☑ LUN(s) 1-1a ...

(1-1a,1f, 65, ,21:21:..,22:22:..)

Step 4 Click either the **WWN** or **FCID** radio button from the Zone By options to create a LUN-based zone.

Step 5 Check the **LUN** check box and click the browse button to configure LUNs.

Step 6 Click **Add** to add this LUN-based zone.

Assigning LUNs to Storage Subsystems

LUN masking and mapping restricts server access to specific LUNs. If LUN masking is enabled on a storage subsystem and if you want to perform additional LUN zoning in a Cisco MDS 9000 Series switch, obtain the LUN number for each host bus adapter (HBA) from the storage subsystem and then configure the LUN-based zone procedure provided in the Configuring a LUN-Based Zone, on page 96.

Note Refer to the relevant user manuals to obtain the LUN number for each HBA.

Caution If you make any errors when assigning LUNs, you might lose data.

About Read-Only Zones

By default, an initiator has both read and write access to the target's media when they are members of the same Fibre Channel zone. The read-only zone feature allows members to have only read access to the media within a read-only Fibre Channel zone.

You can also configure LUN zones as read-only zones. Any zone can be identified as a read-only zone. By default all zones have read-write permission unless explicitly configured as a read-only zone.

Follow these guidelines when configuring read-only zones:

- If read-only zones are implemented, the switch prevents write access to user data within the zone.
- If two members belong to a read-only zone and to a read-write zone, the read-only zone takes priority and write access is denied.
- LUN zoning can only be implemented in Cisco MDS 9000 Series switches. If LUN zoning is implemented in a switch, you cannot configure interop mode in that switch.
- Read-only volumes are not supported by some operating system and file system combinations (for example, Windows NT or Windows 2000 and NTFS file system). Volumes within read-only zones are not available to such hosts. However, if these hosts are already booted when the read-only zones are activated, then read-only volumes are available to those hosts.

The read-only zone feature behaves as designed if either the FAT16 or FAT32 file system is used with the previously mentioned Windows operating systems.

Note Read-only zones are not supported from Cisco MDS NX-OS Release 5.x and later.

Configuring Read-Only Zones

To configure read-only zones, follow these steps:

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

Step 2 switch(config)# **zone name Sample2 vsan 2**
Configures a zone called Sample2 for the specified VSAN (vsan 2) and enters zone configuration submode.

Step 3 switch(config-zone)# **attribute read-only**
Sets read-only attributes for the Sample2 zone.

Note The default is read-write for all zones.

Step 4 (Optional) switch(config-zone)# **no attribute read-only**
Reverts the Sample2 zone attributes to read-write.

Configuring Read-Only Zones For a Default Zone

To configure the **read-only** option for a default zone, follow these steps:

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

Step 2 switch(config)# **zone default-zone vsan 1**
Enters the default zone configuration submode.

Step 3 switch(config-default-zone)# **attribute read-only**
Sets read-only attributes for the default zone.

Step 4 (Optional) switch(config-default-zone)# **no attribute read-only**
Reverts the default zone attributes to read-write (default).

Configuring Read-Only Zones Using Fabric Manager

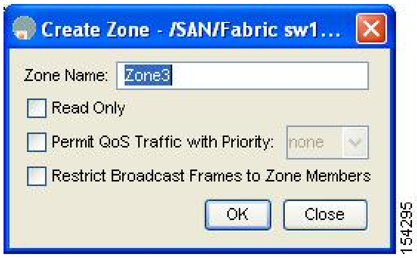
To configure read-only zones using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Edit Local Full Zone Database**.
You see the Select VSAN dialog box.

Step 2 Select a VSAN and click **OK**.
You see the Edit Local Full Zone Database dialog box for the selected VSAN.

Step 3 Click **Zones** in the left pane and click the **Insert** icon to add a zone.
You see the Create Zone Dialog Box.

Figure 43: Create Zone Dialog Box



Create Zone - /SAN/Fabric sw1...

Zone Name: Zone3

□ Read Only

□ Permit QoS Traffic with Priority: none

□ Restrict Broadcast Frames to Zone Members

Step 4 Check the **Read Only** check box to create a read-only zone.

Step 5 Click **OK**.
To configure the **read-only** option for a default zone, see Configuring the Default Zone Policy, on page 87 section.

Displaying Zone Information

You can view any zone information by using the **show** command. If you request information for a specific object (for example, a specific zone, zoneset, VSAN, or alias, or keywords such as **brief** or **active**), only information for the specified object is displayed. If you do not request specific information, all available information is displayed.

Displays Zone Information for All VSANs

```
switch# show zone
zone name Zone3 vsan 1
  pwwn 21:00:00:20:37:6f:db:dd
  pwwn 21:00:00:20:37:9c:48:e5
zone name Zone2 vsan 2
  fwwn 20:41:00:05:30:00:2a:1e
  fwwn 20:42:00:05:30:00:2a:1e
  fwwn 20:43:00:05:30:00:2a:1e
zone name Zone1 vsan 1
  pwwn 21:00:00:20:37:6f:db:dd
  pwwn 21:00:00:20:37:a6:be:2f
  pwwn 21:00:00:20:37:9c:48:e5
  fcalias Alias1
zone name Techdocs vsan 3
  ip-address 10.15.0.0 255.255.255.0
zone name Zone21 vsan 5
  pwwn 21:00:00:20:37:a6:be:35
  pwwn 21:00:00:20:37:a6:be:39
  fcid 0xe000ef
  fcid 0xe000e0
  symbolic-nodename iqn.test
  fwwn 20:1f:00:05:30:00:e5:c6
  fwwn 12:12:11:12:11:12:12:10
  interface fc1/5 swwn 20:00:00:05:30:00:2a:1e
  ip-address 12.2.4.5 255.255.255.0
  fcalias name Alias1 vsan 1
    pwwn 21:00:00:20:37:a6:be:35
zone name Zone2 vsan 11
  interface fc1/5 pwwn 20:4f:00:05:30:00:2a:1e
zone name Zone22 vsan 6
  fcalias name Alias1 vsan 1
    pwwn 21:00:00:20:37:a6:be:35
zone name Zone23 vsan 61
  pwwn 21:00:00:04:cf:fb:3e:7b lun 0000
```

Displays Zone Information for a Specific VSAN

```
switch# show zone vsan 1
zone name Zone3 vsan 1
  pwwn 21:00:00:20:37:6f:db:dd
  pwwn 21:00:00:20:37:9c:48:e5
zone name Zone2 vsan 1
    fwwn 20:4f:00:05:30:00:2a:1e
    fwwn 20:50:00:05:30:00:2a:1e
    fwwn 20:51:00:05:30:00:2a:1e
    fwwn 20:52:00:05:30:00:2a:1e
    fwwn 20:53:00:05:30:00:2a:1e
zone name Zone1 vsan 1
  pwwn 21:00:00:20:37:6f:db:dd
  pwwn 21:00:00:20:37:a6:be:2f
  pwwn 21:00:00:20:37:9c:48:e5
  fcalias Alias1
```

Use the **show zoneset** command to view the configured zonesets.

Displays Configured Zoneset Information

```
switch# show zoneset vsan 1
zoneset name ZoneSet2 vsan 1
  zone name Zone2 vsan 1
    fwwn 20:4e:00:05:30:00:2a:1e
    fwwn 20:4f:00:05:30:00:2a:1e
    fwwn 20:50:00:05:30:00:2a:1e
    fwwn 20:51:00:05:30:00:2a:1e
    fwwn 20:52:00:05:30:00:2a:1e
  zone name Zone1 vsan 1
    pwwn 21:00:00:20:37:6f:db:dd
    pwwn 21:00:00:20:37:a6:be:2f
    pwwn 21:00:00:20:37:9c:48:e5
    fcalias Alias1
zoneset name ZoneSet1 vsan 1
  zone name Zone1 vsan 1
    pwwn 21:00:00:20:37:6f:db:dd
    pwwn 21:00:00:20:37:a6:be:2f
    pwwn 21:00:00:20:37:9c:48:e5
    fcalias Alias1
```

Displays Configured Zoneset Information for a Range of VSANs

```
switch# show zoneset vsan 2-3
zoneset name ZoneSet2 vsan 2
  zone name Zone2 vsan 2
    fwwn 20:52:00:05:30:00:2a:1e
    fwwn 20:53:00:05:30:00:2a:1e
    fwwn 20:54:00:05:30:00:2a:1e
    fwwn 20:55:00:05:30:00:2a:1e
    fwwn 20:56:00:05:30:00:2a:1e
  zone name Zone1 vsan 2
    pwwn 21:00:00:20:37:6f:db:dd
    pwwn 21:00:00:20:37:a6:be:2f
    pwwn 21:00:00:20:37:9c:48:e5
    fcalias Alias1
zoneset name ZoneSet3 vsan 3
  zone name Zone1 vsan 1
    pwwn 21:00:00:20:37:6f:db:dd
    pwwn 21:00:00:20:37:a6:be:2f
    pwwn 21:00:00:20:37:9c:48:e5
    fcalias Alias1
```

Use the **show zone name** command to display members of a specific zone.

Displays Members of a Zone

```
switch# show zone name Zone1
zone name Zone1 vsan 1
  pwwn 21:00:00:20:37:6f:db:dd
  pwwn 21:00:00:20:37:a6:be:2f
  pwwn 21:00:00:20:37:9c:48:e5
  fcalias Alias1
```

Use the **show fcalias** command to display fcalias configuration.

Displays fcalias Configuration

```
switch# show fcalias vsan 1
fcalias name Alias2 vsan 1
fcalias name Alias1 vsan 1
  pwwn 21:00:00:20:37:6f:db:dd
  pwwn 21:00:00:20:37:9c:48:e5
```

Use the **show zone member** command to display all zones to which a member belongs using the FC ID.

Displays Membership Status

```
switch# show zone member pwwn 21:00:00:20:37:9c:48:e5
           VSAN: 1
zone Zone3
zone Zone1
fcalias Alias1
```

Use the **show zone statistics** command to display the number of control frames exchanged with other switches.

Displays Zone Statistics

```
switch# show zone statistics
Statistics For VSAN: 1
**********************************
Number of Merge Requests Sent: 24
Number of Merge Requests Recvd: 25
Number of Merge Accepts Sent: 25
Number of Merge Accepts Recvd: 25
Number of Merge Rejects Sent: 0
Number of Merge Rejects Recvd: 0
Number of Change Requests Sent: 0
Number of Change Requests Recvd: 0
Number of Change Rejects Sent: 0
Number of Change Rejects Recvd: 0
Number of GS Requests Recvd: 0
Number of GS Requests Rejected: 0
Statistics For VSAN: 2
**********************************
Number of Merge Requests Sent: 4
Number of Merge Requests Recvd: 4
Number of Merge Accepts Sent: 4
Number of Merge Accepts Recvd: 4
Number of Merge Rejects Sent: 0
Number of Merge Rejects Recvd: 0
Number of Change Requests Sent: 0
Number of Change Requests Recvd: 0
Number of Change Rejects Sent: 0
Number of Change Rejects Recvd: 0
Number of GS Requests Recvd: 0
Number of GS Requests Rejected: 0
```

Displays LUN Zone Statistics

```
switch# show zone statistics lun-zoning
LUN zoning statistics for VSAN: 1
************************************************************
S-ID: 0x123456, D-ID: 0x22222, LUN: 00:00:00:00:00:00:00:00
------------------------------------------------------------
Number of Inquiry commands received:            10
Number of Inquiry data No LU sent:               5
Number of Report LUNs commands received:        10
Number of Request Sense commands received:       1
Number of Other commands received:               0
Number of Illegal Request Check Condition sent:  0
S-ID: 0x123456, D-ID: 0x22222, LUN: 00:00:00:00:00:00:00:01
------------------------------------------------------------
Number of Inquiry commands received:             1
Number of Inquiry data No LU sent:               1
Number of Request Sense commands received:       1
Number of Other commands received:               0
Number of Illegal Request Check Condition sent:  0
```

Displays LUN Zone Statistics

```
Need the latest output
switch# show zone statistics read-only-zoning
Read-only zoning statistics for VSAN: 2
************************************************************
```

```
S-ID: 0x33333, D-ID: 0x11111, LUN: 00:00:00:00:00:00:00:64
------------------------------------------------------------
Number of Data Protect Check Condition Sent:    12
```

Displays Active Zone Sets

```
switch# show zoneset active
zoneset name ZoneSet1 vsan 1
  zone name zone1 vsan 1
    fcid 0x080808
    fcid 0x090909
    fcid 0x0a0a0a
  zone name zone2 vsan 1
  * fcid 0xef0000 [pwwn 21:00:00:20:37:6f:db:dd]
  * fcid 0xef0100 [pwwn 21:00:00:20:37:a6:be:2f]
```

Displays Brief Descriptions of Zone Sets

```
switch# show zoneset brief
zoneset name ZoneSet1 vsan 1
  zone zone1
  zone zone2
```

Displays Active Zones

```
switch# show zone active
zone name Zone2 vsan 1
* fcid 0x6c01ef [pwwn 21:00:00:20:37:9c:48:e5]
zone name IVRZ_IvrZone1 vsan 1
  pwwn 10:00:00:00:77:99:7a:1b
* fcid 0xce0000 [pwwn 10:00:00:00:c9:2d:5a:dd]
zone name IVRZ_IvrZone4 vsan 1
* fcid 0xce0000 [pwwn 10:00:00:00:c9:2d:5a:dd]
* fcid 0x6c01ef [pwwn 21:00:00:20:37:9c:48:e5]
zone name Zone1 vsan 1667
  fcid 0x123456
zone name $default_zone$ vsan 1667
```

Displays Active Zone Sets

```
switch# show zoneset active
zoneset name ZoneSet4 vsan 1
  zone name Zone2 vsan 1
  * fcid 0x6c01ef [pwwn 21:00:00:20:37:9c:48:e5]
  zone name IVRZ_IvrZone1 vsan 1
    pwwn 10:00:00:00:77:99:7a:1b
  * fcid 0xce0000 [pwwn 10:00:00:00:c9:2d:5a:dd]
zoneset name QosZoneset vsan 2
  zone name QosZone vsan 2
  attribute qos priority high
  * fcid 0xce0000 [pwwn 10:00:00:00:c9:2d:5a:dd]
  * fcid 0x6c01ef [pwwn 21:00:00:20:37:9c:48:e5]
Active zoneset vsan 1667
  zone name Zone1 vsan 1667
    fcid 0x123456
  zone name $default_zone$ vsan 1667
```

Displays Zone Status

```
switch(config)# show zone status
VSAN: 1 default-zone: deny distribute: active only Interop: default
mode: basic merge-control: allow
session: none
hard-zoning: enabled broadcast: disabled
smart-zoning: disabled
rscn-format: fabric-address
activation overwrite control:disabled
Default zone:
```

```
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 4 bytes
Zonesets:0 Zones:0 Aliases: 0
Active Zoning Database :
Database Not Available
Current Total Zone DB Usage: 4 / 2097152 bytes (0 % used)
Pending (Session) DB size:
Full DB Copy size: n/a
Active DB Copy size: n/a
SFC size: 4 / 2097152 bytes (0 % used)
Status:
VSAN: 8 default-zone: deny distribute: full Interop: default
mode: basic merge-control: allow
session: none
hard-zoning: enabled broadcast: disabled
smart-zoning: disabled
rscn-format: fabric-address
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 1946498 bytes
Zonesets:6 Zones:8024 Aliases: 0
Active Zoning Database :
DB size: 150499 bytes
Name: zoneset-1000 Zonesets:1 Zones:731
Current Total Zone DB Usage: 2096997 / 2097152 bytes (99 % used)
Pending (Session) DB size:
Full DB Copy size: n/a
Active DB Copy size: n/a
SFC size: 2096997 / 2097152 bytes (99 % used)
Status: Zoneset distribution failed [Error: Fabric changing Dom 33]:
at 17:05:06 UTC Jun 16 2014
VSAN: 9 default-zone: deny distribute: full Interop: default
mode: enhanced merge-control: allow
session: none
hard-zoning: enabled broadcast: enabled
smart-zoning: disabled
rscn-format: fabric-address
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 2002584 bytes
Zonesets:4 Zones:7004 Aliases: 0 Attribute-groups: 1
Active Zoning Database :
DB size: 94340 bytes
Name: zoneset-hac13-200 Zonesets:1 Zones:176
Current Total Zone DB Usage: 2096924 / 2097152 bytes (99 % used)
Pending (Session) DB size:
Full DB Copy size: 0 bytes
Active DB Copy size: 0 bytes
SFC size: 0 / 2097152 bytes (0 % used)
Status: Activation completed at 17:28:04 UTC Jun 16 2014
VSAN: 12 default-zone: deny distribute: full Interop: default
mode: enhanced merge-control: allow
session: none
hard-zoning: enabled broadcast: enabled
smart-zoning: disabled
rscn-format: fabric-address
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 84 bytes
Zonesets:0 Zones:1 Aliases: 0 Attribute-groups: 1
Active Zoning Database :
DB size: 144 bytes
Name: zs1 Zonesets:1 Zones:2
Current Total Zone DB Usage: 228 / 2097152 bytes (0 % used)
Pending (Session) DB size:
Full DB Copy size: 0 bytes
Active DB Copy size: 0 bytes
SFC size: 0 / 2097152 bytes (0 % used)
```

```
Status: Commit completed at 14:39:33 UTC Jun 27 201
```

Use the **show zone** command to display the zone attributes for all configured zones.

Displays Zone Statistics

```
switch# show zone
zone name lunSample vsan 1                 <-----------------Read-write attribute
zone name ReadOnlyZone vsan 2
    attribute read-only                    <-----------------Read-only attribute
```

Use the **show running** and **show zone active** commands to display the configured interface-based zones.

Displays the Interface-Based Zones

```
switch# show running zone name if-zone vsan 1
      member interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2
      member fwwn 20:4f:00:0c:88:00:4a:e2
      member interface fc2/1 swwn 20:00:00:05:30:00:4a:9e
      member pwwn 22:00:00:20:37:39:6b:dd
```

Displays the fWWNs and Interfaces in an Active Zone

```
switch# show zone active zone name if-zone vsan 1
  * fcid 0x7e00b3 [interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2]
  * fcid 0x7e00b1 [interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2]
  * fcid 0x7e00ac [interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2]
  * fcid 0x7e00b3 [fwwn 20:4f:00:0c:88:00:4a:e2]
  * fcid 0x7e00b1 [fwwn 20:4f:00:0c:88:00:4a:e2]
  * fcid 0x7e00ac [fwwn 20:4f:00:0c:88:00:4a:e2]
    interface fc2/1 swwn 20:00:00:05:30:00:4a:9e
```

A similar output is also available on the remote switch (see the following example).

Displays the Local Interface Active Zone Details for a Remote Switch

```
switch# show zone active zone name if-zone vsan 1
   * fcid 0x7e00b3 [interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2]
  * fcid 0x7e00b1 [interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2]
  * fcid 0x7e00ac [interface fc2/15 swwn 20:00:00:0c:88:00:4a:e2]
  * fcid 0x7e00b3 [fwwn 20:4f:00:0c:88:00:4a:e2]
  * fcid 0x7e00b1 [fwwn 20:4f:00:0c:88:00:4a:e2]
  * fcid 0x7e00ac [fwwn 20:4f:00:0c:88:00:4a:e2]
    interface fc2/1 swwn 20:00:00:05:30:00:4a:9e
```

Displays the Zone Status for a VSAN

```
switch(config)# show zone status vsan 1
VSAN: 1 default-zone: deny distribute: active only Interop: default
mode: basic merge-control: allow
session: none
hard-zoning: enabled broadcast: disabled
smart-zoning: disabled
rscn-format: fabric-address
activation overwrite control:disabled
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 4 bytes
Zonesets:0 Zones:0 Aliases: 0
Active Zoning Database :
Database Not Available
Current Total Zone DB Usage: 4 / 2097152 bytes (0 % used)
Pending (Session) DB size:
Full DB Copy size: n/a
Active DB Copy size: n/a
SFC size: 4 / 2097152 bytes (0 % used)
Status:
```

Displays the Zone Policy for a VSAN

```
switch# show zone policy vsan 1
Vsan: 1
   Default-zone: deny
   Distribute: full
   Broadcast: enable
   Merge control: allow
   Generic Service: read-write
   Smart-zone: enabled
```

Displays How to Create a Zone Attribute-Group to for a VSAN in the Enhanced Mode to Disable Smart Zoning at an Individual Zone Level

Note After the attribute-group is created, it needs to be applied to any zones requiring smart zoning to be disabled.

```
config# zone-attribute-group name <name> vsan 1
config-attribute-group# disable-smart-zoning
config-attribute-group# exit
config# zone commit vsan 1
```

Displays how to Auto-convert Zones

```
config# show zoneset vsan 1
zoneset name ZSv1 vsan 1
  zone name ddasZone vsan 1
    device-alias Init1
    device-alias Init2
    device-alias Init3
    device-alias Target1
config# zone convert smart-zoning vsan 1
smart-zoning auto_convert initiated. This operation can take few minutes. Please wait..
config# show zoneset vsan1
zoneset name ZSv1 vsan 1
  zone name ddasZone vsan 1
    device-alias Init1  init
    device-alias Init2  init
    device-alias Init3  init
    device-alias Target1 target
```

Displays how to Clear Device type Configuration for Members

```
config# show zoneset vsan 1
zoneset name ZSv1 vsan 1
  zone name ddasZone vsan 1
    device-alias Init1  init
    device-alias Init2  init
    device-alias Init3  init
    device-alias Target1 target
config# clear zone smart-zoning vsan1
config# show zoneset vsan 1
zoneset name ZSv1 vsan 1
  zone name ddasZone vsan 1
    device-alias Init1
    device-alias Init2
    device-alias Init3
    device-alias Target1
```

Enhanced Zoning

The zoning feature complies with the FC-GS-4 and FC-SW-3 standards. Both standards support the basic zoning functionalities explained in the previous section and the enhanced zoning functionalities described in this section.

About Enhanced Zoning

Table 8: Advantages of Enhanced Zoning , on page 107 lists the advantages of the enhanced zoning feature in all switches in the Cisco MDS 9000 Series.

Table 8: Advantages of Enhanced Zoning

Basic Zoning	Enhanced Zoning	Enhanced Zoning Advantages
Administrators can make simultaneous configuration changes. Upon activation, one administrator can overwrite another administrator's changes.	Performs all configurations within a single configuration session. When you begin a session, the switch locks the entire fabric to implement the change.	One configuration session for the entire fabric to ensure consistency within the fabric.
If a zone is part of multiple zonesets, you create an instance of this zone in each zoneset.	References to the zone are used by the zonesets as required once you define the zone.	Reduced payload size as the zone is referenced. The size is more pronounced with bigger databases.
The default zone policy is defined per switch. To ensure smooth fabric operation, all switches in the fabric must have the same default zone setting.	Enforces and exchanges the default zone setting throughout the fabric.	Fabric-wide policy enforcement reduces troubleshooting time.
To retrieve the results of the activation on a per switch basis, the managing switch provides a combined status about the activation. It does not identify the failure switch.	Retrieves the activation results and the nature of the problem from each remote switch.	Enhanced error reporting eases the troubleshooting process.
To distribute the zoning database, you must reactivate the same zoneset. The reactivation may affect hardware changes for hard zoning on the local switch and on remote switches.	Implements changes to the zoning database and distributes it without reactivation.	Distribution of zone sets without activation avoids hardware changes for hard zoning in the switches.
The MDS-specific zone member types (IPv4 address, IPv6 address, symbolic node name, and other types) may be used by other non-Cisco switches. During a merge, the MDS-specific types can be misunderstood by the non-Cisco switches.	Provides a vendor ID along with a vendor-specific type value to uniquely identify a member type.	Unique vendor type.

Basic Zoning	Enhanced Zoning	Enhanced Zoning Advantages
The fWWN-based zone membership is only supported in Cisco interop mode.	Supports fWWN-based membership in the standard interop mode (interop mode 1).	The fWWN-based member type is standardized.

Changing from Basic Zoning to Enhanced Zoning

To change to the enhanced zoning mode from the basic mode, follow these steps:

Step 1 Verify that all switches in the fabric are capable of working in the enhanced mode.
If one or more switches are not capable of working in enhanced mode, then your request to move to enhanced mode is rejected.

Step 2 Set the operation mode to enhanced zoning mode. By doing so, you will automatically start a session, acquire a fabric wide lock, distribute the active and full zoning database using the enhanced zoning data structures, distribute zoning policies and then release the lock. All switches in the fabric then move to the enhanced zoning mode.

Tip After moving from basic zoning to enhanced zoning, we recommend that you save the running configuration.

Changing from Enhanced Zoning to Basic Zoning

The standards do not allow you to move back to basic zoning. However, Cisco MDS switches allow this move to enable you to downgrade and upgrade to other Cisco SAN-OS or Cisco NX-OS releases.

To change to the basic zoning mode from the enhanced mode, follow these steps:

Step 1 Verify that the active and full zoneset do not contain any configuration that is specific to the enhanced zoning mode.
If such configurations exist, delete them before proceeding with this procedure. If you do not delete the existing configuration, the Cisco NX-OS software automatically removes them.

Step 2 Set the operation mode to basic zoning mode. By doing so, you will automatically start a session, acquire a fabric wide lock, distribute the zoning information using the basic zoning data structure, apply the configuration changes and release the lock from all switches in the fabric. All switches in the fabric then move to basic zoning mode.

Note If a switch running Cisco SAN-OS Release 2.0(1b) and NX-OS 4(1b) or later, with enhanced zoning enabled is downgraded to Cisco SAN-OS Release 1.3(4), or earlier, the switch comes up in basic zoning mode and cannot join the fabric because all the other switches in the fabric are still in enhanced zoning mode.

Enabling Enhanced Zoning

By default, the enhanced zoning feature is disabled in all switches in the Cisco MDS 9000 Series.

To enable enhanced zoning in a VSAN, follow these steps:

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

Step 2 switch(config)# **zone mode enhanced vsan 3000**
Enables enhanced zoning in the specified VSAN.

Step 3 switch(config)# **no zone mode enhanced vsan 150**
Disables enhanced zoning in the specified VSAN.

Enabling Enhanced Zoning Using Fabric Manager

To enable enhanced zoning in a VSAN using Fabric Manager, follow these steps:

Step 1 Expand a VSAN and then select a zone set in the Logical Domains pane.
You see the zone set configuration in the Information pane.

Step 2 Click the **Enhanced** tab.
You see the current enhanced zoning configuration.

Step 3 From the Action drop-down menu, choose **enhanced** to enable enhanced zoning in this VSAN.

Step 4 Click **Apply Changes** to save these changes.

Modifying the Zone Database

Modifications to the zone database is done within a session. A session is created at the time of the first successful configuration command. On creation of a session, a copy of the zone database is created. Any changes done within the session are performed on this copy of the zoning database. These changes in the copy zoning database are not applied to the effective zoning database until you commit the changes. Once you apply the changes, the session is closed.

If the fabric is locked by another user and for some reason the lock is not cleared, you can force the operation and close the session. You must have permission (role) to clear the lock in this switch and perform the operation on the switch from where the session was originally created.

To commit or discard changes to the zoning database in a VSAN, follow these steps:

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

Step 2 switch(config)# **zone commit vsan 2**

Applies the changes to the enhanced zone database and closes the session.

Step 3 switch(config)# **zone commit vsan 3 force**

Forcefully applies the changes to the enhanced zone database and closes the session created by another user.

Step 4 switch(config)# **no zone commit vsan 2**

Discards the changes to the enhanced zone database and closes the session.

Step 5 switch(config)# **no zone commit vsan 3 force**

Forcefully discards the changes to the enhanced zone database and closes the session created by another user.

Note You do not have to issue the **copy running-config startup-config** command to store the active zoneset. However, you need to issue the **copy running-config startup-config** command to explicitly store full zone sets. If there is more than one switch in a fabric, the **copy running-config startup-config fabric** command should be issued. The **fabric** keyword causes the **copy running-config startup-config** command to be issued on all the switches in the fabric, and also saves the full zone information to the startup-config on all the switches in the fabric. This is important in the event of a switch reload or power cycle.

Enabling Automatic Zone Pending Diff Display

To enable the display of pending-diff and subsequent confirmation on issuing a zone commit in enhanced mode, follow these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# zone confirm-commit enable vsan vsan-id

Enables the confirm-commit option for zone database for a given VSAN.

Step 3 switch(config-zone)# zone commit vsan 12

If the zone confirm-commit command is enabled for a VSAN, on committing the pending database, the pending-diff is displayed on the console and the user is prompted for Yes or No. If the zone confirm-commit command is disabled, the pending-diff is not displayed and the user is not prompted for Yes or No.

Step 4 switch(config)# **no zone commit vsan 12**

If the zone confirm-commit command is enabled for a VSAN, on discarding the pending database, the pending-diff is displayed on the console and the user is prompted for Yes or No. If the zone confirm-commit command is disabled, the pending-diff is not displayed and the user is not prompted for Yes or No.

Releasing Zone Database Locks

To release the session lock on the zoning database on the switches in a VSAN, use the **no zone commit vsan** command from the switch where the database was initially locked.

```
switch# configure terminal
switch(config)# no zone commit vsan 2
```

If session locks remain on remote switches after using the **no zone commit vsan** command, you can use the **clear zone lock vsan** command on the remote switches.

```
switch# clear zone lock vsan 2
```

Note We recommend using the **no zone commit vsan** command first to release the session lock in the fabric. If that fails, use the **clear zone lock vsan** command on the remote switches where the session is still locked.

Creating Attribute Groups

In enhanced mode, you can directly configure attributes using attribute groups.

To configure attribute groups, follow these steps:

Step 1 Create an attribute group.

Example:

```
switch# confgure terminal
switch(config)# zone-attribute-group name SampleAttributeGroup vsan 2
switch(config-attribute-group)#
```

Step 2 Add the attribute to an attribute-group object.

Example:

```
switch(config-attribute-group)# readonly
switch(config-attribute-group)# broadcast
switch(config-attribute-group)# qos priority medium
readonly and broadcast commands are not supported from 5.2 release onwards.
```

Step 3 Attach the attribute-group to a zone.

Example:

```
switch(config)# zone name Zone1 vsan 2
switch(config-zone)# attribute-group SampleAttributeGroup
switch(config-zone)# exit
switch(config)#
```

Step 4 Activate the zoneset.

Example:

```
switch(config)# zoneset activate name Zoneset1 vsan 2
```

The attribute-groups are expanded and only the configured attributes are present in the active zoneset.

To configure attribute groups, refer to the Cisco MDS 9000 Series NX-OS Fabric Configuration Guide.

Merging the Database

The merge behavior depends on the fabric-wide merge control setting:

- Restrict—If the two databases are not identical, the ISLs between the switches are isolated.
- Allow—The two databases are merged using the merge rules specified in the Table 9: Database Zone Merge Status , on page 112.

Table 9: Database Zone Merge Status

Local Database	Adjacent Database	Merge Status	Results of the Merge
The databases contain zone sets with the same name[1] but different zones, aliases, and attributes groups.	Successful.	The union of the local and adjacent databases.	

Local Database	Adjacent Database	Merge Status	Results of the Merge
The databases contains a zone, zone alias, or zone attribute group object with same name[1] but different members. **Note** .In the enhanced zoning mode, the active zoneset does not have a name in interop mode 1. The zoneset names are only present for full zone sets.	Failed.	ISLs are isolated.	
Empty.	Contains data.	Successful.	The adjacent database information populates the local database.
Contains data.	Empty.	Successful.	The local database information populates the adjacent database.

[1] In the enhanced zoning mode, the active zoneset does not have a name in interop mode 1. The zoneset names are only present for full zone sets.

Caution Remove all non-PWWN-type zone entries on all MDS switches running Cisco SAN-OS prior to merging fabrics if there is a Cisco MDS 9020 switch running FabricWare in the adjacent fabric.

Merge Process

When two Fibre Channel (FC) switches that have already been configured with active zonesets and are not yet connected are brought together with an Extended ISL (EISL) link, the zonesets merge. However, steps must be taken to ensure zone consistency before configuring and activating new zones.

Best Practices

When a zone merge occurs, as long as there is not competing information, each switch learns the others zones. Each switch then has three configuration entities. The switches have:

- The saved configuration in NVRAM. This is the configuration as it was the last time the **copy running-configuration startup-configuration** command was issued.
- The running configuration. This represents the configuration brought into memory upon the last time the MDS was brought up, plus any changes that have been made to the configuration. With reference to the zoning information, the running configuration represents the configurable database, known as the full database.
- The configured zoning information from the running configuration plus the zoning information learned from the zone merge. This combination of configured and learned zone information is the active zoneset.

The merge process operates as follows:

1. The software compares the protocol versions. If the protocol versions differ, then the ISL is isolated.
2. If the protocol versions are the same, then the zone policies are compared. If the zone policies differ, then the ISL is isolated.
3. If the zone merge options are the same, then the comparison is implemented based on the merge control setting.
   a. If the setting is restrict, the active zoneset and the full zoneset should be identical. Otherwise the link is isolated.
   b. If the setting is allow, then the merge rules are used to perform the merge.

When an MDS is booted, it comes up with the configuration previously saved in NVRAM. If you configured the switch after loading the configuration from NVRAM, there is a difference between the bootup and running configuration until the running configuration is saved to the startup configuration. This can be likened to having a file on the local hard drive of your PC. The file is saved and static, but if you open the file and edit, there exists a difference between the changed file and the file that still exists on saved storage. Only when you save the changes, does the saved entity look represent the changes made to the file.

When zoning information is learned from a zone merge, this learned information is not part of the running configuration. Only when the **zone copy active-zoneset full-zoneset vsan X** command is issued, the learned information becomes incorporated into the running configuration. This is key because when a zone merge is initiated by a new EISL link or activating a zoneset, the zoneset part is ignored by the other switch and the member zone information is considered topical.

Caution The **zone copy** command will delete all fcalias configuration.

Example

For example, you have two standalone MDS switches, already in place and each with their own configured zone and zoneset information. Switch 1 has an active zoneset known as set A, and Switch 2 has an active zoneset known as set B. Within set A on Switch 1 is zone 1, and on Switch 2, set B has member zone 2. When an ISL link is created between these two switches, each sends their zoneset including their zone information to the other switch. On a merge, the switch will select zoneset name with the higher ASCII value and then merge their zone member. After the merge, both switches will have a zoneset name set B with zone member zone 1 and zone 2.

Everything should be still working for all of the devices in zone 1 and zone 2. To add a new zone, you have to create a new zone, add the new zone to the zoneset, and then activate the zoneset.

Step-by-step, the switches are booted up and have no zoning information. You need to create the zones on the switches and add them to the zonesets.

Basic mode: When zones are in basic mode, refer to the sample command outputs below.

1 Create zone and zoneset. Activate on Switch 1.

```
Switch1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Switch1#(config)# vsan database
Switch1#(config-vsan-db)# vsan 100
Switch1#(config-vsan-db)# exit

Switch1#(config)# zone name zone1 vsan 100
Switch1#(config-zone)# member pwwn 11:11:11:11:11:11:11:1a
Switch1#(config-zone)# member pwwn 11:11:11:11:11:11:11:1b
Switch1#(config-zone)# exit

Switch1#(config)# zoneset name setA vsan 100
Switch1#(config-zoneset)# member zone1
Switch1#(config-zoneset)# exit

Switch1#(config)# zoneset activate name setA vsan 100
Zoneset activation initiated. check zone status
Switch1#(config)# exit

Switch1# show zoneset active vsan 100
zoneset name setA vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1bSwitch1#
```

2 Create zone and zoneset. Activate on Switch 2.

```
Switch2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Switch2#(config)# vsan database
Switch2#config-vsan-db)# vsan 100
Switch2#(config-vsan-db)# exit

Switch2#(config)# zone name zone2 vsan 100
Switch2#(config-zone)# member pwwn 22:22:22:22:22:22:22:2a
Switch2#(config-zone)# member pwwn 22:22:22:22:22:22:22:2b
Switch2#(config-zone)# exit

Switch2#(config)# zoneset name setB vsan 100
Switch2#(config-zoneset)# member zone2
Switch2#(config-zoneset)# exit

Switch2#(config)# zoneset activate name setB vsan 100
Zoneset activation initiated. check zone status
Switch2#(config)# exit

Switch2# show zoneset active vsan 100
```

```
zoneset name setB vsan 100
zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
```

3 Bring ISL link up and verify zone merge on Switch 1.

```
Switch1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch1(config)# interface fc1/5
Switch1(config-if)# no shutdown
Switch1(config-if)# exit
Switch1(config)# exit
```

Note Note Ensure that vsan 100 is allowed on ISL.

```
Switch1# show zoneset active vsan 100
zoneset name setB vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

Switch1# show zoneset vsan 100
zoneset name setA vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
```

4 Bring ISL link up and verify zone merge on Switch 2.

```
Switch2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch2(config)# int fc2/5
Switch2(config-if)# no shut
Switch2(config-if)# exit
Switch2(config)# exit

Switch2# show zoneset active vsan 100 zoneset name setB vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

Switch2# show zoneset vsan 100zoneset name setB vsan 100
zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
```

Note The name of the newly merged zoneset will be the name of the zoneset with alphabetically higher value. In the given example, the active zoneset is setB. To avoid future zoneset activation problems, the **zone copy active-zoneset full-zoneset vsan** *100* command should be given, at this point on the switch. Examine if the command is given, and how the new zoning information is handled.

When the zone copy command is issued, it adds the learned zone information, zone 2 in this case, to the running configuration. If zone 2 has not been copied from residing in memory to copied into the running configuration, zone 2 information is not pushed back out.

Note The **zone copy** command will delete all fcalias configuration.

Running-Configuration of Switch1 (before issuing the **zone copy active-zoneset full-zoneset vsan** *100* command).

```
Switch1# show run | b "Active Zone Database Section for vsan 100"
!Active Zone Database Section for vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zoneset name setB vsan 100
member zone1
member zone2

zoneset activate name setB vsan 100
do clear zone database vsan 100
!Full Zone Database Section for vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zoneset name setA vsan 100
member zone1
```

Running-Configuration of Switch1 (after issuing the "zone copy active-zoneset full-zoneset vsan 100" command)

```
Switch1# zone copy active-zoneset full-zoneset vsan 100
WARNING: This command may overwrite common zones in the full zoneset. Do you want to continue?
 (y/n) [n] y

Switch1# show run | b "Active Zone Database Section for vsan 100"
!Active Zone Database Section for vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zoneset name setB vsan 100
member zone1
member zone2

zoneset activate name setB vsan 100
do clear zone database vsan 100
!Full Zone Database Section for vsan 100
zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zoneset name setA vsan 100
member zone1

zoneset name setB vsan 100
member zone1
member zone2
```

Running-Configuration of Switch2 (before issuing the "zone copy active-zoneset full-zoneset vsan 100" command)

```
Switch2# show run | b "Active Zone Database Section for vsan 100"
!Active Zone Database Section for vsan 100
zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zoneset name setB vsan 100
member zone2
member zone1

zoneset activate name setB vsan 100
do clear zone database vsan 100
!Full Zone Database Section for vsan 100
zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2
apwwn 22:22:22:22:22:22:22:2b
zoneset name setB vsan 100
member zone2
```

Running-Configuration of Switch2 (after issuing the "zone copy active-zoneset full-zoneset vsan 100" command)

```
Switch2# zone copy active-zoneset full-zoneset vsan 100
WARNING: This command may overwrite common zones in the full zoneset. Do you want to continue?
 (y/n) [n] y

Switch2# show run | b "Active Zone Database Section for vsan 100"
!Active Zone Database Section for vsan 100
zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zoneset name setB vsan 100
member zone2
member zone1

zoneset activate name setB vsan 100
do clear zone database vsan 100
!Full Zone Database Section for vsan 100
zone name zone2 vsan 100
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zone name zone1 vsan 100
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zoneset name setB vsan 10
0member zone2
member zone1
```

Referring back to the three entities of configuration, they are as follows on zone 1 before the zone merge:

- Saved configuration: nothing since zone information has not been saved by issuing the copy run start command.

- Running configuration: consists of zone 1.
- Configured and learned information: consists of zone 1.

After the zone merge, the entities are:

- Saved configuration: nothing has been saved.
- Running configuration: consists of zone 1.
- Configured and learned information: consists of zone 1 and zone 2.

Zone 2 has not become part of the running configuration. Zone 2 has been learned, and is in the active zoneset. Only when the **zone copy active-zoneset full-zoneset vsan** *100* command is issued, zone 2 becomes copied from being learned to added to the running configuration. The configuration looks as follows after the command is issued:

Note The **zone copy** command will delete all fcalias configuration.

- Saved configuration: nothing has been saved.
- Running configuration: consists of zone 1 and zone 2.
- Configured and learned information: consists of zone 1 and zone 2.

Commands

By default zone in basic mode will only distribute active zoneset database only, this command was introduced in 1.0.4 SAN-OS will propagate active zoneset and full zoneset database:

zoneset distribute full vsan *vsan_id*

If the zone update or zoneset activation is going on, the above command must be explicitly enabled on each VSAN on every switch.

Enhanced mode: When zones are in enhanced mode, refer to the sample command outputs below.

1 Create zones and zoneset. Activate on Switch1.

```
Switch1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch1(config)# vsan database
Switch1(config-vsan-db)# vsan 200
Switch1(config-vsan-db)# zone mode enhanced vsan 200
WARNING: This command would distribute the zoning database of this switch throughout the
 fabric. Do you want to continue? (y/n) [n] y
Set zoning mode command initiated.
Check zone status
Switch1(config-vsan-db)# zone name zone1 vsan 200
Enhanced zone session has been created. Please 'commit' the changes when done.
Switch1(config-zone)# member pwwn 11:11:11:11:11:11:11:1a
Switch1(config-zone)# member pwwn 11:11:11:11:11:11:11:1b
Switch1(config-zone)# zoneset name SetA vsan 200
Switch1(config-zoneset)# member zone1
Switch1(config-zoneset)# zoneset activate name SetA vsan 200
Switch1(config)# zone commit vsan 200
Commit operation initiated. Check zone status
Switch1(config)# exit
Switch1# show zoneset activate vsan 200
zoneset name SetA vsan 200
zone name zone1 vsan 200
```

```
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
Switch1# show zoneset vsan 200
zoneset name SetA vsan 200
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
```

2 Create zones and zoneset. Activate on Switch2.

```
Switch2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch2(config)# vsan database
Switch2(config-vsan-db)# vsan 200
Switch2(config-vsan-db)# zone mode enhanced vsan 200
WARNING: This command would distribute the zoning database of this switch throughout the
 fabric. Do you want to continue? (y/n) [n] y
Set zoning mode command initiated. Check zone status
Switch2(config)# zone name zone2 vsan 200
Enhanced zone session has been created. Please 'commit' the changes when done.
Switch2(config-zone)# member pwwn 22:22:22:22:22:22:22:2a
Switch2(config-zone)# member pwwn 22:22:22:22:22:22:22:2b
Switch2(config-zone)# zoneset name SetB vsan 200
Switch2(config-zoneset)# member zone2
Switch2(config-zoneset)# zoneset act name SetB vsan 200
Switch2(config)# zone commit vsan 200
Commit operation initiated. Check zone status
Switch2(config)# exit
Switch2# show zoneset activate vsan 200
zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
Switch2# show zoneset vsan 200
zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
```

3 Bring ISL link up and verify zone merge on Switch1.

```
Switch1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch1(config)# interface fc4/1
Switch1(config-if)# no shutdown
Switch1(config-if)# exit
Switch1(config)# exit

Switch1(config-if)# show zoneset activate vsan 200
zoneset name SetB vsan 200
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
Switch1(config-if)# show zoneset vsan 200
zoneset name SetA vsan 200
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b

zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
```

Note Unlike basic mode, the entire zone database is merged in the case of enhanced mode, wherein Switch1 has the information of zonesets originally configured in Switch2 and vice versa.

4 Bring ISL link up and verify zone merge on Switch2. After bringing up ISL between two switches:

```
Switch2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch2(config)# interface fc4/1
Switch2(config-if)# no shutdown
Switch2(config-if)# exit
Switch2(config)# exit

Switch2(config-zoneset)# show zoneset activate vsan 200
zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
Switch2(config-zoneset)# show zoneset vsan 200
zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b

zoneset name SetA vsan 200
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
```

5 Execute the **zone copy** command for enhanced zone.

Switch 1

```
Switch1# zone copy active-zoneset full-zoneset vsan 200
WARNING: This command may overwrite common zones in the full zoneset. Do you want to
continue? (y/n) [n] y
Switch1(config-if)# show zoneset activate vsan 200
zoneset name SetB vsan 200
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
Switch1(config-if)# show zoneset vsan 200
zoneset name SetB vsan 200
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
```

Switch 2

```
Switch2# zone copy active-zoneset full-zoneset vsan 200
WARNING: This command may overwrite common zones in the full zoneset. Do you want to
continue? (y/n) [n] y
Switch2(config-zoneset)# show zoneset activate vsan 200
zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
```

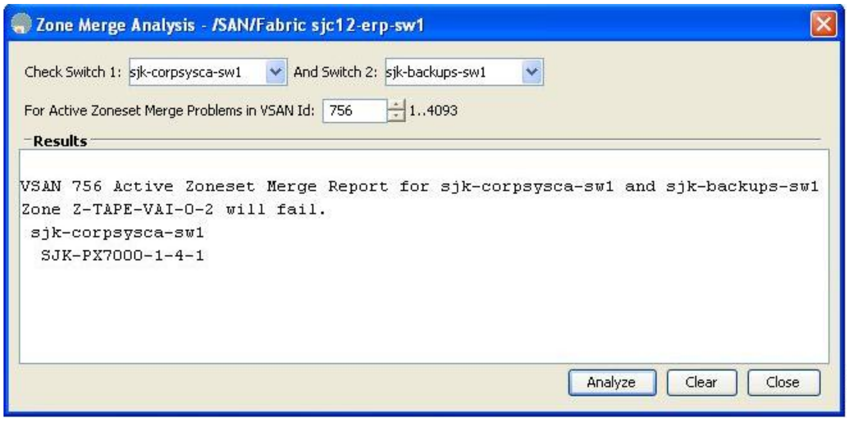
```
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
Switch2(config-zoneset)# show zoneset vsan 200
zoneset name SetB vsan 200
zone name zone2 vsan 200
pwwn 22:22:22:22:22:22:22:2a
pwwn 22:22:22:22:22:22:22:2b
zone name zone1 vsan 200
pwwn 11:11:11:11:11:11:11:1a
pwwn 11:11:11:11:11:11:11:1b
```

Analyzing a Zone Merge

To perform a zone merge analysis using Fabric Manager, follow these steps:

Step 1 Choose **Zone** > **Merge Analysis**.
You see the Zone Merge Analysis dialog box.

Figure 44: Zone Merge Analysis Dialog Box



Zone Merge Analysis - /SAN/Fabric sjc12-erp-sw1

Check Switch 1: sjk-corpsysca-sw1 And Switch 2: sjk-backups-sw1

For Active Zoneset Merge Problems in VSAN Id: 756 1..4093

Results

```
VSAN 756 Active Zoneset Merge Report for sjk-corpsysca-sw1 and sjk-backups-sw1
Zone Z-TAPE-VAI-0-2 will fail.
 sjk-corpsysca-sw1
  SJK-PX7000-1-4-1
```

Step 2 Select the first switch to be analyzed from the Check Switch 1 drop-down list.

Step 3 Select the second switch to be analyzed from the And Switch 2 drop-down list.

Step 4 Enter the VSAN ID where the zone set merge failure occurred in the For Active Zoneset Merge Problems in VSAN Id field.

Step 5 Click **Analyze** to analyze the zone merge.

Step 6 Click **Clear** to clear the analysis data in the Zone Merge Analysis dialog box.

Configuring Zone Merge Control Policies

To configure merge control policies, follow these steps:

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

Step 2 switch(config)# **zone merge-control restrict vsan 4**
Configures a restricted merge control setting for this VSAN.

Step 3 switch(config)# **no zone merge-control restrict vsan 2**
Defaults to using the allow merge control setting for this VSAN.

Step 4 switch(config)# **zone commit vsan 4**
Commits the changes made to VSAN 4.

To configure merge control policies, refer to the Cisco MDS 9000 Series NX-OS Fabric Configuration Guide.

Preventing Zones From Flooding FC2 Buffers

By using the **zone fc2 merge throttle enable** command you can throttle the merge requests that are sent from zones to FC2 and prevent zones from flooding FC2 buffers. This command is enabled by default. This command can be used to prevent any zone merge scalability problem when you have a lot of zones. Use the **show zone status** command to view zone merge throttle information.

Permitting or Denying Traffic in the Default Zone

To permit or deny traffic in the default zone, follow these steps:

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

Step 2 switch(config)# **zone default-zone permit vsan 5**
Permits traffic flow to default zone members.

Step 3 switch(config)# **no zone default-zone permit vsan 3**
Denies traffic flow to default zone members and reverts to factory default.

Step 4 switch(config)# **zone commit vsan 5**
Commits the changes made to VSAN 5.

Broadcasting a Zone

You can specify an enhanced zone to restrict broadcast frames generated by a member in this zone to members within that zone. Use this feature when the host or storage devices support broadcasting.

Note broadcast command is not supported from 5.x release onwards.

Table 10: Broadcasting Requirements , on page 124 identifies the rules for the delivery of broadcast frames.

Table 10: Broadcasting Requirements

Active Zoning?	Broadcast Enabled?	Frames Broadcast?
Yes	Yes	Yes
No	Yes	Yes
Yes	No	No
Contains data.	Empty.	Successful.

Tip If any NL port attached to an FL port shares a broadcast zone with the source of the broadcast frame, then the frames are broadcast to all devices in the loop.

To broadcast frames in the enhanced zoning mode, follow these steps:

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

Step 2 switch(config)# **zone-attribute-group name BroadcastAttr vsan 2**
Configures the zone attribute group for the required VSAN.

Step 3 switch(config)# **no zone-attribute-group name BroadAttr vsan 1**
Removes the zone attribute group for the required VSAN.

Step 4 switch(config-attribute-group)# **broadcast**
Creates a broadcast attribute for this group and exits this submode.

Step 5 switch(config-attribute-group)# **no broadcast**
Removes broadcast attribute for this group and exits this submode.

Step 6 switch(config)# **zone name BroadcastAttr vsan 2**
Configures a zone named BroadcastAttr in VSAN 2.

Step 7 switch(config-zone)# **member pwwn 21:00:00:e0:8b:0b:66:56**
Adds the specified members to this zone and exits this submode.

Step 8 switch(config)# **zone commit vsan 1**
Applies the changes to the enhanced zone configuration and exits this submode.

Step 9 switch# **show zone vsan 1**
Displays the broadcast configuration

Configuring System Default Zoning Settings

You can configure default settings for default zone policies, full zone distribution, and generic service permissions for new VSANs on the switch. To configure switch-wide default settings, follow these steps:

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

Step 2 switch(config)# **system default zone default-zone permit**
Configures permit as the default zoning policy for new VSANs on the switch.

Step 3 switch(config)# **system default zone distribute full**
Enables full zone database distribution as the default for new VSANs on the switch.

Step 4 switch(config)# **system default zone gs** {**read** | **read-write**}
Configures read only or read-write (default) as the default generic service permission for new VSANs on the switch.

Note Since VSAN 1 is the default VSAN and is always present on the switch, the **system default zone** commands have no effect on VSAN 1.

Configuring Zone Generic Service Permission Settings

Zone generic service permission setting is used to control zoning operation through generic service (GS) interface. The zone generic service permission can be read-only, read-write or none (deny).

To configure generic service (GS) settings, follow these steps:

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

Step 2 switch(config)# **zone gs** {**read** | **read-write**}**vsan 3000**
Configures gs permission value as read only or read-write in the specified VSAN.

Displaying Enhanced Zone Information

You can view any zone information by using the **show** command.

Displays the Active Zoneset Information for a Specified VSAN

```
switch(config)# show zoneset active vsan 1
zoneset name qoscfg vsan 1
  zone name qos1 vsan 1
  * fcid 0xe80200 [pwwn 50:08:01:60:01:5d:51:11]
  * fcid 0xe60000 [pwwn 50:08:01:60:01:5d:51:10]
  * fcid 0xe80100 [pwwn 50:08:01:60:01:5d:51:13]

  zone name qos3 vsan 1
  * fcid 0xe80200 [pwwn 50:08:01:60:01:5d:51:11]
  * fcid 0xe60100 [pwwn 50:08:01:60:01:5d:51:12]
  * fcid 0xe80100 [pwwn 50:08:01:60:01:5d:51:13]

  zone name sb1 vsan 1
  * fcid 0xe80000 [pwwn 20:0e:00:11:0d:10:dc:00]
  * fcid 0xe80300 [pwwn 20:0d:00:11:0d:10:da:00]
  * fcid 0xe60200 [pwwn 20:13:00:11:0d:15:75:00]
  * fcid 0xe60300 [pwwn 20:0d:00:11:0d:10:db:00]
```

Displays the ZoneSet Information or a Specified VSAN

```
switch(config)# show zoneset vsan 1
zoneset name qoscfg vsan 1
  zone name qos1 vsan 1
    zone-attribute-group name qos1-attr-group vsan 1
    pwwn 50:08:01:60:01:5d:51:11
    pwwn 50:08:01:60:01:5d:51:10
    pwwn 50:08:01:60:01:5d:51:13

  zone name qos3 vsan 1
    zone-attribute-group name qos3-attr-group vsan 1
    pwwn 50:08:01:60:01:5d:51:11
    pwwn 50:08:01:60:01:5d:51:12
    pwwn 50:08:01:60:01:5d:51:13

  zone name sb1 vsan 1
    pwwn 20:0e:00:11:0d:10:dc:00
    pwwn 20:0d:00:11:0d:10:da:00
    pwwn 20:13:00:11:0d:15:75:00
    pwwn 20:0d:00:11:0d:10:db:00
```

Displays the Zone Attribute Group Information for a Specified VSAN

```
switch# show zone-attribute-group vsan 2
zone-attribute-group name $default_zone_attr_group$ vsan 2
  read-only
  qos priority high
  broadcast
zone-attribute-group name testattgp vsan 2
  read-only
  broadcast
  qos priority high
```

Displays the fcalias Information for the Specified VSAN

```
switch# show fcalias vsan 2
fcalias name testfcalias vsan 2
 pwwn 21:00:00:20:37:39:b0:f4
 pwwn 21:00:00:20:37:6f:db:dd
 pwwn 21:00:00:20:37:a6:be:2f
```

Displays the Zone Status for the Specified VSAN

```
switch(config)# show zone status vsan 1
VSAN: 1 default-zone: deny distribute: active only Interop: default
mode: basic merge-control: allow
session: none
hard-zoning: enabled broadcast: disabled
smart-zoning: disabled
rscn-format: fabric-address
activation overwrite control:disabled
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 4 bytes
Zonesets:0 Zones:0 Aliases: 0
Active Zoning Database :
Database Not Available
Current Total Zone DB Usage: 4 / 2097152 bytes (0 % used)
Pending (Session) DB size:
Full DB Copy size: n/a
Active DB Copy size: n/a
SFC size: 4 / 2097152 bytes (0 % used)
Status:
```

Displays the Pending ZoneSet Information for the VSAN to be Committed

```
switch# show zoneset pending vsan 2
No pending info found
```

Displays the Pending Zone Information for the VSAN to be Committed

```
switch# show zone pending vsan 2
No pending info found
```

Displays the Pending Zone Information for the VSAN to be Committed

```
switch# show zone-attribute-group pending vsan 2
No pending info found
```

Displays the Pending Active ZoneSet Information for the VSAN to be Committed

```
switch# show zoneset pending active vsan 2
No pending info found
```

Displays the Difference Between the Pending and Effective Zone Information for the Specified VSAN

```
switch# show zone pending-diff vsan 2
zone name testzone vsan 2
   -  member pwwn 21:00:00:20:37:4b:00:a2
   +  member pwwn 21:00:00:20:37:60:43:0c
```

Exchange Switch Support (ESS) defines a mechanism for two switches to exchange various supported features.

Displays the ESS Information for All Switches in the Specified VSAN

```
switch# show zone ess vsan 2
ESS info on VSAN 2 :
    Domain : 210, SWWN : 20:02:00:05:30:00:85:1f, Cap1 : 0xf3, Cap2 : 0x0
```

Displays the Pending fcalias Information for the VSAN to be Committed

```
switch# show fcalias pending vsan 2
No pending info found
```

Compacting the Zone Database for Downgrading

Prior to Cisco SAN-OS Release 6.2(7), only 8000 zones are supported per VSAN. If you add more than 8000 zones to a VSAN, a configuration check is registered to indicate that downgrading to a previous release could cause you to lose the zones over the limit. To avoid the configuration check, delete the excess zones and compact the zone database for the VSAN. If there are 8000 zones or fewer after deleting the excess zones, the compacting process assigns new internal zone IDs and the configuration can be supported by Cisco SAN-OS Release 6.2(5) or earlier. Perform this procedure for every VSAN on the switch with more than 8000 zones.

Note A merge failure occurs when a switch supports more than 8000 zones per VSAN but its neighbor does not. Also, zoneset activation can fail if the switch has more than 8000 zones per VSAN and not all switches in the fabric support more than 8000 zones per VSAN.

To delete zones and compact the zone database for a VSAN, follow these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **no zone name ExtraZone vsan 10**

Deletes a zone to reduce the number of zones to 8000 or fewer.

Step 3 switch(config)# **zone compact vsan 10**

Compacts the zone database for VSAN 10 to recover the zone ID released when a zone was deleted.

To compact the zone database for downgrading, refer to the Cisco MDS 9000 Series NX-OS Fabric Configuration Guide.

Zone and ZoneSet Analysis

To better manage the zones and zone sets on your switch, you can display zone and zoneset information using the **show zone analysis** command.

Full Zoning Analysis

```
switch# show zone analysis vsan 1
Zoning database analysis vsan 1
 Full zoning database
   Last updated at: 15:57:10 IST Feb 20 2006
   Last updated by: Local [ CLI ]
   Num zonesets: 1
   Num zones: 1
   Num aliases: 0
   Num attribute groups: 0
   Formattted size: 36 bytes / 2048 Kb
 Unassigned Zones: 1
   zone name z1 vsan 1
```

Note The maximum size of the full zone database per VSAN is 4096 KB.

Active Zoning Database Analysis

```
switch(config-zone)# show zone analysis active vsan 1
Zoning database analysis vsan 1
  Active zoneset: qoscfg
    Activated at: 14:40:55 UTC Mar 21 2014
    Activated by: Local [ CLI ]
    Default zone policy: Deny
    Number of devices zoned in vsan: 8/8 (Unzoned: 0)
    Number of zone members resolved: 10/18 (Unresolved: 8)
    Num zones: 4
    Number of IVR zones: 0
    Number of IPS zones: 0
    Formatted size: 328 bytes / 4096 Kb
```

Note The maximum size of the zone database per VSAN is 4096 KB.

ZoneSet Analysis

```
switch(config-zone)# show zone analysis zoneset qoscfg vsan 1
Zoning database analysis vsan 1
  Zoneset analysis: qoscfg
    Num zonesets: 1
    Num zones: 4
    Num aliases: 0
    Num attribute groups: 1
    Formatted size: 480 bytes / 4096 Kb
```

Displays the Zone Status

```
switch(config-zone)# show zone status
VSAN: 1 default-zone: deny distribute: active only Interop: default
mode: basic merge-control: allow
session: none
hard-zoning: enabled broadcast: disabled
smart-zoning: disabled
rscn-format: fabric-address
activation overwrite control:disabled
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 4 bytes
Zonesets:0 Zones:0 Aliases: 0
Active Zoning Database :
Database Not Available
Current Total Zone DB Usage: 4 / 2097152 bytes (0 % used)
Pending (Session) DB size:
Full DB Copy size: n/a
Active DB Copy size: n/a
SFC size: 4 / 2097152 bytes (0 % used)
Status:
VSAN: 8 default-zone: deny distribute: full Interop: default
mode: basic merge-control: allow
session: none
hard-zoning: enabled broadcast: disabled
smart-zoning: disabled
rscn-format: fabric-address
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 1946498 bytes
```

```
Zonesets:6 Zones:8024 Aliases: 0
Active Zoning Database :
DB size: 150499 bytes
Name: zoneset-1000 Zonesets:1 Zones:731
Current Total Zone DB Usage: 2096997 / 2097152 bytes (99 % used)
Pending (Session) DB size:
Full DB Copy size: n/a
Active DB Copy size: n/a
SFC size: 2096997 / 2097152 bytes (99 % used)
Status: Zoneset distribution failed [Error: Fabric changing Dom 33]:
at 17:05:06 UTC Jun 16 2014
VSAN: 9 default-zone: deny distribute: full Interop: default
mode: enhanced merge-control: allow
session: none
hard-zoning: enabled broadcast: enabled
smart-zoning: disabled
rscn-format: fabric-address
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 2002584 bytes
Zonesets:4 Zones:7004 Aliases: 0 Attribute-groups: 1
Active Zoning Database :
DB size: 94340 bytes
Name: zoneset-hac13-200 Zonesets:1 Zones:176
Current Total Zone DB Usage: 2096924 / 2097152 bytes (99 % used)
Pending (Session) DB size:
Full DB Copy size: 0 bytes
Active DB Copy size: 0 bytes
SFC size: 0 / 2097152 bytes (0 % used)
Status: Activation completed at 17:28:04 UTC Jun 16 2014
VSAN: 12 default-zone: deny distribute: full Interop: default
mode: enhanced merge-control: allow
session: none
hard-zoning: enabled broadcast: enabled
smart-zoning: disabled
rscn-format: fabric-address
Default zone:
qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
DB size: 84 bytes
Zonesets:0 Zones:1 Aliases: 0 Attribute-groups: 1
Active Zoning Database :
DB size: 144 bytes
Name: zs1 Zonesets:1 Zones:2
Current Total Zone DB Usage: 228 / 2097152 bytes (0 % used)
Pending (Session) DB size:
Full DB Copy size: 0 bytes
Active DB Copy size: 0 bytes
SFC size: 0 / 2097152 bytes (0 % used)
Status: Commit completed at 14:39:33 UTC Jun 27 201
```

Displaying the System Defalult Zone

```
switch(config)# show system default zone
system default zone default-zone deny
system default zone distribute active only
system default zone mode basic
system default zone gs read-write
system default zone smart-zone disabled
```

See the Cisco MDS 9000 Series Command Reference for the description of the information displayed in the command output.

Zoning Best Practice

A Cisco Multilayer Director Switch (MDS) uses a special kind of memory called Ternary Content Addressable Memory (TCAM) on its Fibre Channel (FC) linecards. This special memory provides an Access Control List

(ACL) type of function for Cisco MDS. The process that controls this functionality is called the ACLTCAM. The E/TE ports (Inter Switch Links - ISLs) and F (Fabric) ports have their own programming, which is unique to their respective port types.

TCAM Regions

TCAM is divided into several regions of various sizes. The main regions and the type of programming contained in each region are described in Table 11: TCAM Regions , on page 131:

Table 11: TCAM Regions

Region	Programming Type
Region 1 - TOP SYS	Fabric-Login, Port-Login, Diagnostics features (10%-20%)
Region 2 - SECURITY	Security, Interop-Mode-4 features, IVR ELS capture (5%-10%)
Region 3 - Zoning	Zoning features, including IVR (50%-75%)
Region 4 - Bottom[2]	PLOGI,ACC, and FCSP trap, ISL, ECHO-permit (10%-20%)

[2] When a hard-zoning failure occurs, Region 4 (bottom region) is used to program wildcard entries to allow any-to-any communication.

The TCAM is allocated on a per-module and per-forwarding engine (fwd-eng) basis.

The TCAM space on fabric switches is significantly less than that on most director-class FC linecards.

When a port comes online, some amount of basic programming is needed on that port. This programming differs according to the port type. This basic programming is minimal and does not consume many TCAM entries. Typically, programming is performed on inputs such that frames entering the switch are subject to this programming and frames egressing the switch are not.

Zoning Types

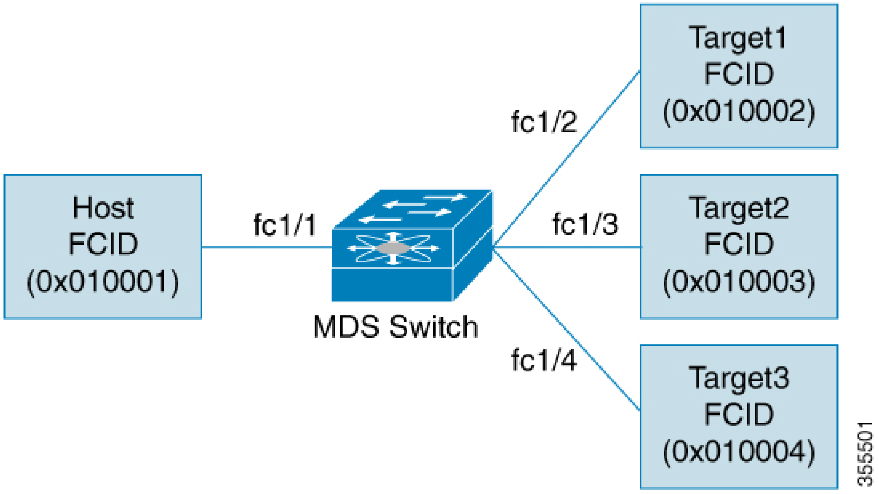
The Cisco MDS platform uses two types of zoning - 'Hard' and 'Soft' zoning.

Soft zoning - In this mode only control plane traffic is policed by the switch supervisor services. In particular, the Fibre Channel Name Server (FCNS) will limit the list of permitted devices in an FCNS reply to only those that are in the zone configuration. However, the end device data plane traffic is unpoliced. This means a rogue end device may connect to other devices it is not zoned with.

Hard zoning - In this mode both control plane and data plane traffic are policed. Control plane traffic is policed by the switch supervisor and data plane traffic is policed on each ingress port with hardware assistance. The policing rules are set by the zoneset which programmed into each linecard. The destination of each frame is checked by hardware and, if it is not permitted by zoning, it is dropped. In this mode any device can only communicate with end devices it is authorized to.

By default, both types of zoning are enabled, with hard zoning used in priority over soft zoning. In the event that the user disables hard zoning or the system is unable to use hard zoning due to hardware resource exhaustion it will be disabled and the system will fall back to use soft zoning

The following example shows how Cisco MDS programs TCAM on a port:



The following example shows a zone in the active zone set for a VSAN. This is the basic programming that exists on an interface because of Hard zoning.

```
zone1
member host (FCID 0x010001)
member target1 (FCID 0x010002)
```

In such a scenario, the following is the ACL programming:

```
fc1/1 - Host interface
Entry#    Source ID      Mask      Destination ID        Mask      Action
1         010001         ffffff    010002(target1)       ffffff    Permit
2         000000         000000    000000                000000    Drop
fc1/2 - Target1 interface
Entry#    Source ID      Mask      Destination ID        Mask       Action
1         010002         ffffff    010001(Host)          ffffff     Permit
2         000000         000000    000000                000000     Drop
```

Note In addition to what is provided here, additional programming exists.

The mask indicates which parts of the FCIDs are matched with the input frame. So, when there is a mask 0xffffff, the entire FCID is considered when matching it to the ACL entry. If the mask is 0x000000, none of it is considered because, by default, it will match all the FCIDs.

In the above programming example, note that when a frame is received on fc1/1, and if it has a source ID(FCID) of 0x010001(the host) and a destination ID(FCID) of 0x010002(Target1), it will be permitted and routed to the destination. If it is any other end-to-end communication, it will be dropped.

The following example shows another scenario where zoning is changed:

```
zone1
member host (FCID 010001)
member target1 (FCID 010002)
member target2 (FCID 010003)
member target3 (FCID 010004)
```

In such a scenario, the following is the ACL programming:

```
fc1/1 Host interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010001         ffffff    010002(target1)         ffffff  Permit
2         010001         ffffff    010003(target2)         ffffff  Permit
3         010001         ffffff    010004(target3)         ffffff  Permit
4         000000         000000    000000                  000000  Drop
fc1/2 - Target1 interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010002         ffffff    010001(host)            ffffff  Permit
2         010002         ffffff    010003(target2)         ffffff  Permit
3         010002         ffffff    010004(target3)         ffffff  Permit
4         000000         000000    000000                  000000  Drop
fc1/3 - Target2 interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010003         ffffff    010001(host)            ffffff  Permit
2         010003         ffffff    010002(target1)         ffffff  Permit
3         010003         ffffff    010004(target3)         ffffff  Permit
4         000000         000000    000000                  000000  Drop
fc1/4 - Target3 interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010004         ffffff    010001(host)            ffffff  Permit
2         010004         ffffff    010002(target1)         ffffff  Permit
3         010004         ffffff    010003(target2)         ffffff  Permit
4         000000         000000    000000                  000000  Drop
```

The above example demonstrates that the number of TCAM entries consumed by a zone (N) is equal to N*(N-1). So, a zone with four members would have used a total of 12 TCAM entries (4*3 = 12).

The above example shows two entries in each of the target interfaces (fc1/2-fc1/4) that are probably not needed since it is usually not advantageous to zone multiple targets together. For example, in fc1/2, there is an entry that permits Target1 to communicate with Target2, and an entry that permits Target1 to communicate with Target3.

As these entries are not needed and could even be detrimental, they should be avoided. You can avoid the addition of such entries by using single-initiator or single-target zones (or use Smart Zoning).

Note If the same two devices are present in more than one zone in a zone set, TCAM programming will not be repeated.

The following example shows a zone that is changed to three separate zones:

```
zone1
member host (FCID 010001)
member target1 (FCID 010002)
zone2
member host (FCID 010001)
member target2 (FCID 010003)
zone3
member host (FCID 010001)
member target3 (FCID 010004)
```

In such a scenario, the following is the ACL programming:

```
fc1/1 - Host interface - This would look the same
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010001         ffffff    010002(target1)         ffffff  Permit
2         010001         ffffff    010003(target2)         ffffff  Permit
3         010001         ffffff    010004(target3)         ffffff  Permit
4         000000         000000    000000                  000000  Drop
fc1/2 - Target1 interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010002         ffffff    010001(host)            ffffff  Permit
```

```
2         000000         000000    000000                  000000  Drop
fc1/3 - Target2 interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010003         ffffff    010001(host)            ffffff  Permit
2         000000         000000    000000                  000000  Drop
fc1/4 - Target3 interface
Entry#    Source ID      Mask      Destination ID          Mask    Action
1         010004         ffffff    010001(host)            ffffff  Permit
2         000000         000000    000000                  000000  Drop
```

Note that in the above example, the target-to-target entries are not found, and that six of the 12 entries are no longer programmed. This results in lesser use of TCAM and better security (only the host can communicate with the three targets, and the targets themselves can communicate only with one host, and not with each other).

Forwarding Engines

TCAM is allocated to individual forwarding engines and forwarding engines are assigned a group of ports. Director-class Fibre Channel modules have more TCAM space than fabric switches. The number of forwarding engines, the ports assigned to each forwarding engine, and the amount of TCAM allocated to each forwarding engine is hardware dependent.

The following example shows an output from Cisco MDS 9148S:

```
RTP-SAN-15-10-9148s-1# show system internal acltcam-soc tcam-usage
TCAM Entries:
=============
                  Region1   Region2    Region3     Region4   Region5   Region6
Mod Fwd   Dir     TOP SYS  SECURITY    ZONING      BOTTOM    FCC DIS   FCC ENA
    Eng         Use/Total Use/Total  Use/Total    Use/Total Use/Total Use/Total
--- ---  ------ --------- --------  ----------  --------  --------  --------

1   1    INPUT     19/407     1/407      1/2852 *    4/407     0/0       0/0
1   1    OUTPUT     0/25      0/25       0/140       0/25      0/12      1/25
1   2    INPUT     19/407     1/407      0/2852 *    4/407     0/0       0/0
1   2    OUTPUT     0/25      0/25       0/140       0/25      0/12      1/25
1   3    INPUT     19/407     1/407      0/2852 *    4/407     0/0       0/0
1   3    OUTPUT     0/25      0/25       0/140       0/25      0/12      1/25
------------------------------------------
* 1024 entries are reserved for LUN Zoning purpose.
```

The above example indicates the following:

- There are three forwarding engines, 1 through 3.
- Since there are 48 ports on Cisco MDS 9148 switches, each forwarding engine handles 16 ports.
- Each forwarding engine has 2852 entries in region 3 (the zoning region) for input. This is the main region used, and consequently, has the largest amount of available entries.
- Forwarding engine 3 has only one entry that is currently in use out of the total 2852 in the zoning region.

The following example shows the output from Cisco MDS 9710 switch with a 2/4/8/10/16 Gbps Advanced Fibre Channel Module (DS–X9448–768K9):

```
F241-15-09-9710-2# show system internal acl tcam-usage
TCAM Entries:
=============
                  Region1   Region2    Region3     Region4   Region5   Region6
Mod Fwd   Dir     TOP SYS  SECURITY    ZONING      BOTTOM    FCC DIS   FCC ENA
    Eng         Use/Total Use/Total  Use/Total    Use/Total Use/Total Use/Total
--- ---  ------ --------- --------  ----------  --------  --------  --------

1   0    INPUT     55/19664    0/9840     0/49136*   17/19664    0/0       0/0
1   0    OUTPUT    13/4075    0/1643     0/11467     0/4075     6/1649   21/1664
1   1    INPUT     52/19664    0/9840     2/49136*   14/19664    0/0       0/0
```

```
1   1    OUTPUT     7/4078    0/1646     0/11470     0/4078    6/1652    5/1651
1   2    INPUT     34/19664    0/9840     0/49136*   10/19664   0/0        0/0
1   2    OUTPUT     5/4078    0/1646     0/11470     0/4078    6/1652    1/1647
1   3    INPUT     34/19664    0/9840     0/49136*   10/19664   0/0        0/0
1   3    OUTPUT     5/4078    0/1646     0/11470     0/4078    6/1652    1/1647
1   4    INPUT     34/19664    0/9840     0/49136*   10/19664   0/0        0/0
1   4    OUTPUT     5/4078    0/1646     0/11470     0/4078    6/1652    1/1647
1   5    INPUT     34/19664    0/9840     0/49136*   10/19664   0/0        0/0
1   5    OUTPUT     5/4078    0/1646     0/11470     0/4078    6/1652    1/1647
...
```

The above example indicates the following:

- There are six forwarding engines, 0 through 5.
- Since there are 48 ports on a Cisco MDS DS–X9448–768K9 module, each forwarding engine handles eight ports.
- Each forwarding engine has 49136 entries in region 3 (the zoning region) for input. This is the main region that is used, and consequently, has the largest amount of available entries.
- Forwarding engine 2 has only two entries that are currently in use out of the total 49136 in the zoning region.

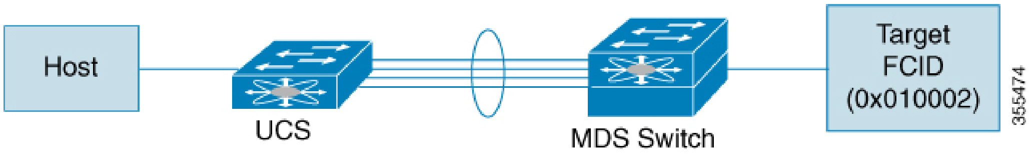
Note The commands that are used to view TCAM usage on fabric switches are different from the ones used for director–class switches. For MDS 9148, MDS 9148S, and MDS 9250i fabric switches, use the **show system internal acltcam-soc tcam-usage** command. For director class switches, MDS 9396S, and 32 Gbps fabric switches, use the **show system internal acl tcam-usage** command.

F and TF Port Channels

Note We do not recommend using interface, fWWN, or domain-ID based zoning for devices that are connected to the edge Cisco N-Port Virtualization (NPV) switches.

F port channels provide fault tolerance and performance benefits on connections to N-Port Virtualization (NPV) switches, including Cisco UCS Fabric Interconnects (FIs). F port channels present unique challenges to ACL TCAM programming. When F ports are aggregated into a port channel, ACL TCAM programming is repeated on each member interface. Consequently, these types of port channels multiply the amount of TCAM entries needed. Because of this, it is imperative that the member interfaces are allocated as optimally as possible, and that zoning best practices are also followed. If you also consider the fact that these F port channels can contain 100+ host logins, TCAM can easily be exceeded, especially for fabric switches if best practices are not followed.

The following is a sample topology:



This example assumes that the port channel (PC) contains 8 interfaces, fc1/1-fc1/8.

In addition, the following two zones are active:

```
zone1
member host (host 0x010001)
member target1 (target1 0x010002)
zone2
member host (host 0x010001)
member target2 (target2 0x010003)
```

In such a scenario, the following ACL programming will be present on each member of the PC:

```
fc1/1(through fc1/8)  (port-channel)
Entry#    Source ID     Mask         Destination ID         Mask             Action
1         010001       ffffff        010002(target1)       ffffff            Permit
2         010001       ffffff        010003(target2)       ffffff            Permit
3         000000       000000        000000                000000            Drop
```

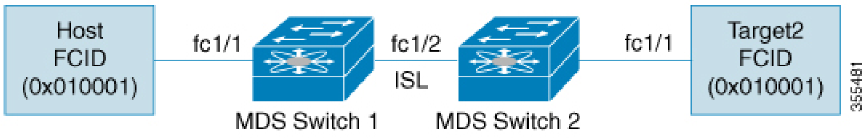
The above example shows the ACL TCAM programming that will be duplicated on each member of the F port-channel. Consequently, if a lot of programming is required because of a large number of FLOGIs on the F port channel, or a large number of devices are zoned with the devices on the F port channel, TCAM can be exhausted on a forwarding engine. The following are the best practices for efficient use of TCAM with respect to F ports and F port-channels:

- Distribute port-channel member interfaces into different forwarding engines, especially on fabric switches.
- If TCAM usage is still too high in the case of port-channel with a large number of interfaces, then split the port-channel into two separate port-channels each with half the interfaces. This will still provide redundancy but will reduces the number of FLOGIs per individual port-channel and thus reduce TCAM usage.
- Distribute member interfaces into different linecards on director-class switches.
- Distribute member interfaces into forwarding engines with lower TCAM zoning region usage.
- Use single-initiator zones, single-target zones, or Smart Zoning.

E and TE Port Channels and IVR

E port channels provide Inter Switch Links (ISLs) between fabric switches. Typically, there is minimal TCAM programming on these types of interfaces. Therefore, besides placing them into different linecards, and perhaps port groups on director-class switches, there is a little more to be done. However, when the Inter VSAN Routing (IVR) feature is being deployed, extensive TCAM programming can exist on ISLs because the IVR topology transitions from one VSAN to another. Consequently, most of the considerations that apply on F/TF port channels will be applicable here too.

The following is an example of a topology:



In this topology:

- Both Cisco MDS 9148S-1 and MDS 9148S-2 are in the IVR VSAN topology:

```
MDS9148S-1 vsan 1 and vsan 2
MDS9148S-2 vsan 2 and vsan 3
```

- IVR NAT is configured.
- VSAN 2 is the transit VSAN.

```
FCIDs per VSAN:
            VSAN 1  VSAN 2  VSAN 3
Host        010001  210001  550002
Target1    440002  360002  030001
```

Note Domains 0x44 in VSAN 1, 0x21 and 0x36 in VSAN 2, and 0x55 in VSAN 3 are virtual domains created by IVR NAT.

- The following is the IVR zoning topology:

```
ivr zone zone1
member host vsan 1
member target1 vsan3
```

- The following is the ACL TCAM programming for the IVR zoning topology:

```
MDS9148S-1  fc1/1(Host) - VSAN 1
Entry#    Source ID        Mask      Destination ID          Mask    Action
1         010001(host)     ffffff    440002(target1)         ffffff  Permit
           - Forward to fc1/2
       - Rewrite the following information:
         VSAN to 2
         Source ID to 210001
         Destination ID to 360002
2         000000         000000    000000                  000000  Drop
MDS9148S-1  fc1/2(ISL) - VSAN 2
Entry#    Source ID            Mask      Destination ID          Mask    Action
1         360002(Target1)      ffffff    210001(host)            ffffff  Permit
       - Forward to fc1/2
       - Rewrite the following information:
         VSAN to 1
         Source ID to 440002
         Destination ID to 010001
MDS9148S-2 fc1/2(ISL) - VSAN 2
Entry#    Source ID        Mask      Destination ID          Mask    Action
1         210001(host)     ffffff    360002(target1)         ffffff  Permit
       - Forward to fc1/2
       - Rewrite the following information:
         VSAN to 3
         Source ID to 550002
         Destination ID to 030001
MDS9148S-2  fc1/1(Target1) - VSAN 3
Entry#    Source ID            Mask      Destination ID          Mask    Action
1         030001(Target1)      ffffff    550002(host)            ffffff  Permit
       - Forward to fc1/2
       - Rewrite the following information:
         VSAN to 2
         Source ID to 360002
         Destination ID to 210001
2         000000          000000    000000                   000000  Drop
```

Note Besides the entries in this example, there are other entries that IVR adds to capture important frames such as PLOGIs, PRILIs, and ABTS.

The programming on the host and target1 ports is similar to the way it is without IVR, except that the FCIDs and VSANs are explicitly forwarded to an egress port and are rewritten to values that are appropriate for the transit VSAN (VSAN 2). These forwarding and rewrite entries are separate and are not included in the TCAM-usage values.

However, now, on the ISLs in both the switches, programming that did not exist earlier is present. When frames from Host to Target1 are received by Cisco MDS 9148S-2 fc1/2, they are rewritten to the values in VSAN 3 where the target resides. In the reverse direction, when frames from Target1 to the Host are received by Cisco MDS 9148S-1 fc1/2, they are rewritten to the values in VSAN 1 where the Host resides. Thus, for each VSAN transition on an ISL (that typically occurs across a transit VSAN) there will be TCAM programming for each device in the IVR zone set.

Consequently, most of the best practices followed for the F and TF port channels should be followed to ensure that TCAM is utilized as efficiently as possible for the following purposes:

Note Unlike F and TF port-channels, the ACLTCAM programming on ISLs will be the same quantity regardless if the ISLs are part of a port-channel or not. If there are "n" ISLs between two MDS switches, then it doesn't matter if they are in one port-channel, two port-channels or just individual links. The ACLTCAM programming will be the same.

- Distribute port-channel member interfaces into different forwarding engines, especially on fabric switches.
- Distribute member interfaces into different linecards on director-class switches.
- Distribute member interfaces into forwarding engines with lower TCAM zoning region usage.
- Use single-initiator zones, single-target zones, or Smart Zoning.

Enhancing Zone Server Performance

Zone Server-Fibre Channel Name Server Shared Database

This options provides a shared database for the Zone Server and the Fibre Channel Name Sever (FCNS) to interact with one another. Sharing a database reduces the dependency of the FCNS on the zone server to manage soft zoning.

Note By default, the Zone Server- FCNS Shared Database option is enabled.

Enabling the Zone Server-FCNS Shared Database

To enable the Zone Server-FCNS shared database, perform the following steps:

Step 1 Enter the configuration mode:
switch # **configure terminal**

Step 2 Enable database sharing for an active zone set in VSAN 1:
switch(config)# **zoneset capability active mode shared-db vsan 1**

Enabling Zone Server-FCNS Shared Database
This example shows how to enable database sharing for the active zoneset in VSAN 1 only:

```
switch(config)# zoneset capability active mode shared-db vsan 1
SDB Activation success
```

Disabling Zone Server-FCNS shared database

To disable an active zone set in VSAN 1, perform the following step:

Step 1 Enter global configuration mode:
switch# **configure terminal**

Step 2 Disable an active zone set in VSAN 1:
switch(config)# **no zoneset capability active mode shared-db vsan 1**

Disabling Zone Server-FCNS Shared Database
This example shows how to disable database sharing for the active zone set in VSAN 1:

```
switch(config)# no zoneset capability active mode shared-db vsan 1
SDB Deactivation success
```

Zone Server SNMP Optimization

This option enables zone server-scaling enhancements for Simple Network Management Protocol (SNMP) operations, such that the zone server is not utilized for every zone query issued by the SNMP.

Note By default, the Zone Server-SNMP Optimization option is enabled..

Enabling Zone Server SNMP Optimization

To enable zone server-scaling enhancements for SNMP operations, perform the following procedure:

Step 1 Enter the configuration mode:
switch # **configure terminal**

Step 2 Enable zone server-SNMP optimization:
switch(config)# **zone capability shared-db app snmp**

Step 3 Display the status of the configuration:
switch(config)# **show running | i shared-db**

Enabling Zone Server- SNMP Optimizations
This example shows how to enable zone server-SNMP optimization:

```
switch(config)# zone capability shared-db app snmp
```

Disabling Zone Server SNMP Optimization

To disable zone server-SNMP optimizations, perform the following procedure:

Step 1 Di the configuration mode:
switch # **configure terminal**

Step 2 Disable the zone server-SNMP optimizations:
switch(config)# **no zone capability shared-db app snmp**

Disabling Zone Server- SNMP Optimizations
This example shows how to disable zone server-SNMP optimization:

```
switch(config)# no zone capability shared-db app snmp
```

Zone Server Delta Distribution

This feature helps distribute the difference in the zone changes between the existing zone database and the updated zone database across all the switches in a fabric. This distribution of delta changes helps avoid large payload distribution across switches whenever a zone database in modified.

Note

- By default, the Zone Server Delta Distribution feature is disabled and functions in enhanced mode only.
- All the switches in a fabric should have the Zone Server Delta Distribution feature enabled. If a switch is added to the fabric with Zone Server Delta Distribution feature disabled, it will disable the Zone Server Delta Distribution feature on all the switches in the fabric.
- The Zone Server Delta Distribution feature is supported only on Cisco MDS switches, beginning from Cisco MDS NX-OS Release 7.3(0)D1(1).
- The Zone Server Delta Distribution feature is not available on Interactive Voice Response (IVR)-enabled VSANs.

Enabling Zone Server Delta Distribution

To enable the distribution of data changes in a zone server, perform the following procedure:

Step 1 Enter the configuration mode:
switch # **configure terminal**

Step 2 Enable the distribution of data changes in a zone in enhanced mode:
switch(config)# **zone capability mode enhanced distribution diffs-only**

Step 3 Display the status of delta distribution (changes in data) in a fabric:
switch(config)# **show running | include diffs-only**

Enabling Zone Server Delta Distribution
This example shows how to enable distribution of changes in data in a Zone Server:

```
switch(config)# zone capability mode enhanced distribution diffs-only
```

Disabling Zone Server Delta Distribution

To disable the distribution of data changes in a zone server, perform the following procedure:

Step 1 Enter the configuration mode:
switch # **configure terminal**

Step 2 Disable the distribution of data changes in a zone:
switch(config)# **no zone capability mode enhanced distribution diffs-only**

Disabling Zone Server Delta Distribution

This example shows how to disable distribution of changes in data in a Zone Server:

```
switch(config)# no zone capability mode enhanced distribution diffs-only
```

Default Settings

Table lists the default settings for basic zone parameters.

Table 12: Default Basic Zone Parameters

Parameter	Default
Default zone policy	Denied to all members.
Full zone set distribute	The full zone set is not distributed.
Zone-based traffic priority	Low.
Broadcast frames	Unsupported.
Enhanced zoning	Disabled.
Smart zoning	Disabled.

CHAPTER 6

Distributing Device Alias Services

All the switches in the Cisco MDS 9000 Family support Distributed Device Alias Services (device alias) on a per-virtual storage area network (VSAN) basis and on a fabric-wide basis. Device alias distribution allows you to move host bus adapters (HBAs) between VSANs without manually re-entering alias names.

This chapter includes the following sections:

Understanding Device Aliases

While the port WWN (pWWN) of a device has to be specified to configure different features (zoning, QoS, and port security) in a Cisco MDS 9000 Family switch, you must assign the correct device name each time you configure these features. An incorrect device name may cause unexpected results. You can avoid this if you define a user-friendly name for a pWWN and use this name in all of the configuration commands, as required. These user-friendly names are referred to as *device aliases* in this chapter.

Device Alias Modes

A device alias supports two modes, basic mode and enhanced mode.

- When a device alias runs in the basic mode, all the applications function in a manner that is similar to the applications on the 3.0 switches. When you configure the basic mode using device aliases, the application immediately expands to pWWNs. This operation continues until the mode is changed to enhanced.

- When a device alias runs in the enhanced mode, all the applications accept the device alias configuration in the native format. The applications store the device alias name in the configuration and distribute it in the device alias format instead of expanding to pWWN. The applications track the device alias database changes and take the necessary actions to enforce the changes.

A native device alias configuration is not accepted in the interop mode VSAN. IVR zone set activation fails in the interop mode VSANs if the corresponding twilight zones being injected are native device alias members.

- When the device-alias is in basic mode, and you try to add a device alias member to a zone, it will be added as a pWWN member and not as a device alias member. Therefore, when you change the pWWN for the device alias entry it does not get updated. You should manually edit the zones containing that device alias by removing the old entry and reconfiguring the zones with the same device alias and then activating it.This update occurs in enhanced device alias mode. In this mode, since the configuration is accepted in the native form, when the pWWN for the device alias is changed, the zones containing that device alias are automatically updated with the new pWWN.

Changing Mode Settings

When a device alias mode is changed from basic mode to enhanced mode, the corresponding applications are informed about the change. The applications then start accepting the device alias-based configuration in the native format.

Note Because the device alias was previously running in the basic mode, the applications do not have any prior native device alias configuration.

The applications check for an existing device alias configuration in the native format. If the device alias is in the native format, the applications reject the request, and the device alias mode cannot be changed to basic.

All the native device alias configurations (both on local and remote switches) must be explicitly removed, or all the device alias members must be replaced with the corresponding pWWNs before changing the mode back to basic.

Device Alias Mode Distribution

If device alias distribution is turned on, it is distributed to the other switches in the network whenever there is a change in the mode. You cannot change the mode from basic to enhanced unless all the switches are upgraded to Release 3.1. The device alias enhancements will not apply unless the entire fabric is upgraded to Release 3.1.

Note After all the switches are upgraded to Release 3.1, you cannot automatically convert to enhanced mode. The switches do not have to be changed to enhanced mode; you can continue working in the basic mode.

Device Alias Diffs-Only Distribution

From the Cisco MDS NX-OS Release 7.3(0)D1(1), the Device Alias Diffs-Only Distribution feature is supported on the Cisco MDS switches.

When this feature is enabled on all the switches in a fabric, only the session commands are sent across the fabric instead of the entire database, which helps ensure better scalability.

DDAS supports 20,000 entries when all the switches in a fabric have the Device Alias Diffs-Only Distribution feature enabled. Note that this feature is enabled by default.

Note Ensure that all the switches in a fabric are running Cisco MDS NX-OS Release 7.3(0)D1(1) with the Device Alias Diffs-Only feature enabled.

Configuring Device Alias Diffs-Only Distribution

To configure the Device Alias Diff-Only Distribution feature, follow these steps:

Step 1 switch# configure terminal
Enters configuration mode.

Step 2 switch(config)# device-alias distribute diffs-only
Enable the distribution of diffs only on the switch.
This example shows how to enable and display the Device Alias Diffs-Only Distribution feature status on a switch:

Example:

```
switch(config)# device-alias distribute diffs-only
switch(config)# show device-alias status
Fabric Distribution: Enabled
Diffs-only Distribution: Enabled
Database:- Device Aliases 1  Mode: Basic
   Checksum: 0x43a9fe35852e91354543d712c3ec9d3
```

Displaying Device Alias Diffs-Only Distribution Status
This example shows the device alias status during an active session when the Device Alias Diffs-Only Distribution feature is enabled on a switch and in a fabric:

Example:

```
switch(config-device-alias-db)# show device-alias status
Fabric Distribution: Enabled
Diffs-only Distribution: Disabled
Database:- Device Aliases 0 Mode: Basic
Checksum: 0xf6bd6b3389b87233d462029172c8612
Locked By:- User "CLI/SNMPv3:admin" SWWN 20:00:54:7f:ee:1c:2d:40
Pending Database:- Device Aliases 1 Mode: Basic
Diffs-only Distribution capability in the fabric: Enabled

Diffs-only distribution in Session: Enabled
```

This example shows the device alias status during an active session when the Device Alias Diff-Only Distribution feature is disabled on a switch and in a fabric:

Example:

```
switch(config-device-alias-db)# show device-alias status
Fabric Distribution: Enabled
Diffs-only Distribution: Disabled
Database:- Device Aliases 0 Mode: Basic
Checksum: 0xf6bd6b3389b87233d462029172c8612
Locked By:- User "CLI/SNMPv3:admin" SWWN 20:00:54:7f:ee:1c:2d:40
Pending Database:- Device Aliases 1 Mode: Basic
Diffs-only Distribution capability in the fabric: Disabled
SWWN which doesnot support Diffs-only Distribution:
20:00:54:7f:ee:1c:2d:40
20:00:54:7f:e1:1c:2c:40
Diffs-only distribution in Session: Disabled
```

Note The status of *Diffs-only distribution in session* does not change during a session.

Step 3 switch(config)# no device-alias distribute diffs-only

Disables Device Alias Diffs-Only Distribution

This example shows how to disable and display the Device Alias Diffs-Only Distribution feature status on a switch:

Example:

```
switch(config)# no device-alias distribute diffs-only
switch(config)# show device-alias status
Fabric Distribution: Enabled
Diffs-only Distribution: Disabled
Database:- Device Aliases 1  Mode: Basic
           Checksum: 0x43a9fe35852e91354543d712c3ec9d3
```

Merging Device Alias with the Diffs-Only Distribution Feature Enabled

Device alias merge failure occurs in the following scenarios:

- When a switch configured with more than 12,000 entries and enabled with the Device Alias Diffs-Only Distribution feature is added to a fabric, that does not support the feature.
- When a switch with disabled Device Alias Diff-Only Distribution feature is added to a fabric, that is configured with more than 12,000 entries and enabled with the Device Alias Diffs-Only feature.

Displaying Merge Failure

This example displays device alias merge failure when one of the fabrics does not support more than 12,000 entries:

```
switch(config)# show cfs merge status name device-alias
Physical-fc Merge Status: Failed [ Wed Jan 20 10:00:34 2016 ]
Failure Reason: One of the merging fabrics cannot support more than 12Kdevice-al
iases
```

Note The Diffs-Only Distribution feature should be enabled on all the switches in a fabric for the device alias entries (more than 12,000) to be supported. If the Diffs-Only Distribution feature is not enabled on all the switches in a fabric, we recommend that you do not configure more than 12,000 entries.

Merging Device Alias in Different Modes

If two fabrics are running different device alias modes, the device alias merge fails. There is no automatic conversion of one mode to the other during the merge process. You will need to resolve the issue.

Note Release 3.0 switches run in basic mode.

At the application level, a merger takes place between the applications and the fabric. For example, zone merge occurs when the E port is up, and the IVR,PSM/DPVM merge occurs due to CFS. This merge is completely independent of the device alias merge.

If an application running on an enhanced fabric has a native device alias configuration, the application must fail the merge even if the other fabric is can support the native device alias-based configuration, but is running in the basic mode. You will need to resolve the issue. After the device alias merge issue is resolved, each application must be fixed accordingly.

The following issue occurs when there is a device alias database mismatch in the switches that are a part of the same fabric:

The device alias associated to a pWWN is present in the port security/DPVM database even if the respective device alias member is not present in the switch. The device alias associated to a pWWN is missing in the port security/DPVM database even if the respective device alias member is present in the switch.

Resolving Merge Failure and Device Alias Mode Mismatch

If two fabrics are running in different modes and the device alias merge fails between the fabrics, the conflict can be resolved by selecting one mode or the other. If you choose the enhanced mode, ensure that all the switches are running at least the Release 3.1 version. Otherwise, the enhanced mode cannot be turned on. If you choose the basic mode, the applications running on the enhanced fabric have to comply with the device alias merge.

The device alias merge fails because of mode mismatch, but the application merge succeeds if it does not have any native device alias configurations.

If a native device alias configuration is attempted on an application from a Release 3.1 switch, the commit must be rejected because of device alias mode mismatch on some of the applications.

Note The applications should not accept any native device alias configuration over SNMP if the device alias is running in the basic mode on that particular switch.

Note Confcheck will be added when the enhanced mode is turned on and removed when it is turned off. Applications should add confcheck if they have a device alias configuration in the native format, and remove it after the configuration is removed.

Device Alias Features

Device aliases have the following features:

- Device alias information is independent of your VSAN configuration.
- Device alias configuration and distribution is independent of the zone server and the zone server database.
- You can import legacy zone alias configurations without losing data.
- The device alias application uses the Cisco Fabric Services (CFS) infrastructure to enable efficient database management and distribution. Device aliases use the coordinated distribution mode and the fabric-wide distribution scope (refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*).
- When you configure zones, IVR zones, or QoS features using device aliases, and if you display these configurations, you will automatically see that the device aliases are displayed along with their respective pWWNs.

Device Alias Requirements

Device aliases have the following requirements:

- You can only assign device aliases to pWWNs.
- The mapping between the pWWN and the device alias to which it is mapped must have a one-to-one relationship. A pWWN can be mapped to only one device alias and vice versa.
- A device alias name is restricted to 64 alphanumeric characters and may include one or more of the following characters:
    - a to z and A to Z
    - 1 to 9
    - - (hyphen) and _ (underscore)
    - $ (dollar sign) and ^ (up caret)

Note If the device-alias name is 64 characters in length, the DPVM and other application databases do not update properly. Restrict the number of characters in the device-alias name to 63.

Zone Aliases Versus Device Aliases

Table 13: Comparison Between Zone Aliases and Device Aliases , on page 149 compares the configuration differences between zone-based alias configuration and device alias configuration.

Table 13: Comparison Between Zone Aliases and Device Aliases

Zone-Based Aliases	Device Aliases
Aliases are limited to the specified VSAN.	You can define device aliases without specifying the VSAN number. You can also use the same definition in one or more VSANs without any restrictions.
Zone aliases are part of the zoning configuration. The alias mapping cannot be used to configure other features.	Device aliases can be used with any feature that uses the pWWN.
You can use any zone member type to specify the end devices.	Only pWWNs are supported along with new device aliases such as IP addresses.
Configuration is contained within the Zone Server database and is not available to other features.	Device aliases are not restricted to zoning. Device alias configuration is available to the FCNS, zone, fcping, traceroute, and IVR applications.
FC aliases are not displayed with the associated WWNs in the show command outputs like show zoneset active, show flogi database, and show fcns database.	Device aliases are displayed with the associated WWNs in the show command outputs like show zoneset active, show flogi database, and show fcns database.
FC aliases are not distributed as part of active zoneset and are only distributed as part of full zone database as per the FC standards.	Device Aliases are distributed through CFS.

Device Alias Databases

The device alias feature uses two databases to accept and implement device alias configurations.

- Effective database—The database currently used by the fabric.
- Pending database—Your subsequent device alias configuration changes are stored in the pending database.

If you modify the device alias configuration, you need to commit or discard the changes as the fabric remains locked during this period.

This section includes the following sections:

Creating Device Aliases

To a create a device alias in the pending database, follow these steps:

Step 1

```
switch# config t
switch(config)#
```

Enters configuration mode.

Step 2 switch(config)# **device-alias database**
switch(config-device-alias-db)#

Enters the pending database configuration submode.

Step 3 switch(config-device-alias-db)# **device-alias name Device1 pwwn 21:01:00:e0:8b:2e:80:93**
Specifies a device name (Device1) for the device that is identified by its pWWN. Starts writing to the pending database and simultaneously locks the fabric as this is the first-issued device alias configuration command.

Step 4 switch(config-device-alias-db)# **no device-alias name Device1**
Removes the device name (Device1) for the device that is identified by its pWWN.

Step 5 switch(config-device-alias-db)# **device-alias rename Device1 Device2**
Renames an existing device alias (Device1) with a new name (Device2).

To display the device alias configuration, use the **show device-alias name** command.

```
switch# show device-alias name x
device-alias name x pwwn 21:01:00:e0:8b:2e:80:93
```

About Device Alias Distribution

By default, device alias distribution is enabled. The device alias feature uses the coordinated distribution mechanism to distribute the modifications to all switches in a fabric.

If you have not committed the changes and you disable distribution, then a commit task will fail.

Displays a Failed Status

```
switch# show
 device-alias status
Fabric Distribution: Disabled
Database:- Device Aliases 25
Status of the last CFS operation issued from this switch:
==========================================================
Operation: Commit
Status: Failed (Reason: Operation is not permitted as the fabric distribution is
 currently disabled.)
```

Note From the Cisco MDS NX-OS Release 6.2.9 onwards, the ASCII configuration replay takes longer time for DDAS (Distributing Device Alias Services) without the write erase command.

About Creating a Device Alias

When you perform the first device alias task (regardless of which device alias task), the fabric is automatically locked for the device alias feature. Once you lock the fabric, the following situations apply:

- No other user can make any configuration changes to this feature.

- A copy of the effective database is obtained and used as the pending database. Modifications from this point on are made to the pending database. The pending database remains in effect until you commit the modifications to the pending database or discard (**abort**) the changes to the pending database.

About Device Alias Configuration Best Practices

As a part of the device-alias configuration best practices, the following guidelines need to be adopted within a device-alias session:

If a device-alias name is reused while configuring a rename command, then the command fails and gets moved to the rejected list.

Displays the rejected device-alias command

```
switch(config-device-alias-db)# device-alias name dev10 pwwn 10:10:10:10:10:10:10:10
switch(config-device-alias-db)# device-alias rename dev10 new-dev10
Command rejected. Device-alias reused in current session :dev10
Please use 'show device-alias session rejected' to display the rejected set of commands and
 for the device-alias best-practices recommendation.
switch(config-device-alias-db)#
```

If a PWWN is reused while configuring an add or delete command, then the command fails and gets moved to the rejected list.

Displays the rejected device-alias command

```
switch(config-device-alias-db)# device-alias name dev11 pwwn 11:11:11:11:11:11:11:11
switch(config-device-alias-db)# no device-alias name dev11
Command rejected. Pwwn reused in current session: 11:11:11:11:11:11:11:11 is mapped to
device-alias dev11
Please use 'show device-alias session rejected' to display the rejected set of commands and
 for the device-alias best-practices recommendation.
switch(config-device-alias-db)#
```

If a device-alias name is reused in an add command which was earlier being renamed in a rename command, the command fails and gets moved to the rejected list.

```
switch(config-device-alias-db)# device-alias rename da3 new-da3
switch(config-device-alias-db)# device-alias name da3 pwwn 2:2:2:2:3:3:3:3
Command rejected. Device-alias name reused in current session: da3
Please use 'show device-alias session rejected' to display the rejected set of commands and
 for the device-alias best-practices recommendation.
switch(config-device-alias-db)#
```

Displays the rejected device-alias command

The rejected set of commands can be displayed using the show device-alias session rejected command.

```
switch(config-device-alias-db)# show device-alias session rejected
To avoid command rejections, within a device alias session
Do not reuse:
a) a device alias name while configuring a rename command
b) a PWWN while configuring an add or delete command
c) a device alias name already renamed while configuring add command

Rejected commands must be committed in a separate device alias session
which may cause traffic interruption for those devices. Plan accordingly.
Refer to this command in the NX-OS Command Reference Guide
for more information about device alias configuration best practices

Rejected Command List
```

```
---------------------
device-alias rename dev10 new-dev10
no device-alias name dev11
device-alias name da3 pwwn 02:02:02:03:03:03:03
switch(config-device-alias-db)# #
```

Committing Changes

If you commit the changes made to the pending database, the following events occur:

1. The pending database contents overwrites the effective database contents.
2. The pending database is emptied of its contents.
3. The fabric lock is released for this feature.

To commit the changes, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **device-alias commit**
Commits the changes made to the currently active session.

Whenever a switch in the fabric gets locked and goes for a blank commit, the following warning is displayed:

```
WARNING: Device-alias DB is empty in this switch.
Initiating a commit from this switch will clear [wipe out] Device-alias DB across all the
switches in the fabric, losing Device-alias full DB config permanently.
Do you want to continue? (y/n) [n]
```

Note Once the "device-alias commit" is done the running configuration has been modified on all switches participating in device-alias distribution. You can then use the "copy running-config startup-config fabric" command to save the running-config to the startup-config on all the switches in the fabric.

Enabling the Device Alias Pending Diff Display

To enable the display of the pending-diff and the subsequent confirmation on issuing a device-alias commit, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# device-alias confirm-commit
Enables the confirm commit option for device- alias.

Step 3 switch(config)# device-alias commit

```
The following device-alias changes are about to be committed
+ device-alias name Device1 pwwn 21:01:00:e0:8b:2e:80:93
Do you want to continue? (y/n) [n] y
```

If the device-alias confirm-commit command is enabled, on committing the pending database, the pending-diff is displayed on the console and user is prompted for Yes or No. If the device -alias confirm-commit command is disabled, the pending-diff is not displayed and the user is not prompted for Yes or No.

Discarding Changes

If you discard the changes made to the pending database, the following events occur:

1. The effective database contents remain unaffected.
2. The pending database is emptied of its contents.
3. The fabric lock is released for this feature.

To discard the device alias session, perform this task:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **device-alias abort**
Discards the currently active session.

To display the status of the discard operation, use the show **device alias status** command.

```
switch# show
 device-alias status
Fabric Distribution: Enabled
Database:- Device Aliases 24
Status of the last CFS operation issued from this switch:
==========================================================
Operation: Abort
Status: Success
```

Fabric Lock Override

If you have performed a device alias task and have forgotten to release the lock by either committing or discarding the changes, an administrator can release the lock from any switch in the fabric. If the administrator performs this task, your changes to the pending database are discarded and the fabric lock is released.

Tip The changes are only available in the volatile directory and are subject to being discarded if the switch is restarted.

To clear device-alias session, use the **clear device-alias session** command in CONFIGURATION mode.

```
switch(config)# clear device-alias session
```

To verify the status of the clear operation, use the **show device-alias session status** command.

```
switch(config)# show device-alias session status
Last Action Time Stamp     : None
Last Action                : None
Last Action Result         : None
Last Action Failure Reason : none
```

Clearing Database Content

To clear all the database content, use the clear device-alias database command in CONFIGURATION mode.

```
switch(config)# clear device-alias database
To verify the status of the clear device-alias database
command, use the show device-alias database
command.
switch(config)# show device-alias database
```

Clearing Statistics

To clear all the statistics, use the clear device-alias statistics command in CONFIGURATION mode.

```
switch# clear device-alias statistics
```

Disabling and Enabling Device Alias Distribution

To disable or enable the device alias distribution, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **no device-alias distribute**
Disables the distribution.

Step 3 switch(config)# **device-alias distribute**
Enables the distribution (default).

To display the status of device alias distribution, use the **show device-alias status** command (see the following examples).

Displays Device Alias Status When Distribution Is Enabled

```
switch# show
device-alias status
Fabric Distribution: Enabled <-------------------------------Distribution is enabled
Database:-Device Aliases 24
Locked By:-User “Test” SWWN 20:00:00:0c:cf:f4:02:83<-Lock holder's user name and switch ID
Pending Database:- Device Aliases 24
Status of the last CFS operation issued from this switch:
==========================================================
Operation: Enable Fabric Distribution
Status: Success
```

Displays Device Alias Status When Distribution Is Disabled

```
switch# show
 device-alias status
Fabric Distribution: Disabled
Database:- Device Aliases 24
Status of the last CFS operation issued from this switch:
==========================================================
Operation: Disable Fabric Distribution
Status: Success
```

About Legacy Zone Alias Configuration Conversion

You can import legacy zone alias configurations to use this feature without losing data, if they satisfy the following restrictions:

- Each zone alias has only one member.
- The member type is pWWN.
- The name and definition of the zone alias should not be the same as any existing device alias name.

If any name conflict exists, the zone aliases are not imported.

Tip Ensure to copy any required zone aliases to the device alias database as required by your configuration.

When an import operation is complete, the modified alias database is distributed to all other switches in the physical fabric when you perform the **commit** operation. At this time if you do not want to distribute the configuration to other switches in the fabric, you can perform the **abort** operation and the merge changes are completely discarded.

This section includes the following topics:

Importing a Zone Alias

To import the zone alias for a specific VSAN, follow these steps:

SUMMARY STEPS

1. switch# **config t**
2. switch(config)# **device-alias import fcalias vsan 3**

DETAILED STEPS

	Command or Action	Purpose
Step 1	switch# **config t** **Example:** `switch(config)#`	Enters configuration mode.
Step 2	switch(config)# **device-alias import fcalias vsan 3**	Imports the fcalias information for the specified VSAN. To display device alias information in zone sets, use the **show zoneset** command (see the following examples).

Displays the Device Aliases in the Zone Set Information

```
switch# show zoneset
zoneset name s1 vsan 1
  zone name z1 vsan 1
    pwwn 21:01:00:e0:8b:2e:80:93 [x] <---------------Device alias displayed for each pWWN.
    pwwn 21:00:00:20:37:39:ab:5f [y]
zone name z2 vsan 1
    pwwn 21:00:00:e0:8b:0b:66:56 [SampleName]
    pwwn 21:00:00:20:37:39:ac:0d [z]
```

Displays the Device Aliases in the Active Zone Set

```
switch# show
 zoneset active
zoneset name s1 vsan 1
  zone name z1 vsan 1
  * fcid 0x670100 [pwwn 21:01:00:e0:8b:2e:80:93] [x]
    pwwn 21:00:00:20:37:39:ab:5f [y]
  zone name z2 vsan 1
  * fcid 0x670200 [pwwn 21:00:00:e0:8b:0b:66:56] [SampleName]
    pwwn 21:00:00:20:37:39:ac:0d [z]
```

Device Alias Statistics Cleanup

Use the **clear device-name statistics** command to clear device alias statistics (for debugging purposes):

```
switch# clear device-alias statistics
```

Database Merge Guidelines

For information about CFS merge support, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* for detailed concepts.

When merging two device alias databases, follow these guidelines:

- Verify that two device aliases with different names are not mapped to the same pWWN.

- Verify that two different pWWNs are not mapped to the same device aliases.
- Verify that the combined number of device aliases in both databases cannot exceed 8191 (8K) in fabrics running SAN-OS Release 3.0(x) and earlier, and 20K in fabrics running SAN-OS Release 3.1(x) and later. If the combined number of device entries exceeds the supported limit, then the merge will fail.
- Ensure the device -alias mode is similar for the both the fabrics being merged.

Device Alias Configuration Verification

You can view device alias information by using the **show device-alias** command. See the following examples.

Displays All Configured Device Aliases from the Effective Database

```
switch# show
device-alias database
device-alias name SampleName pwwn 21:00:00:e0:8b:0b:66:56
device-alias name x pwwn 21:01:00:e0:8b:2e:80:93
Total number of entries = 2
```

Displays the Pending Database with No Modifications

```
switch# show
device-alias database pending
There are no pending changes
```

Displays the Pending Database with Modifications

```
switch# show
device-alias database pending
device-alias name x pwwn 21:01:00:e0:8b:2e:80:93
device-alias name SampleName pwwn 21:00:00:e0:8b:0b:66:56
device-alias name y pwwn 21:00:00:20:37:39:ab:5f
device-alias name z pwwn 21:00:00:20:37:39:ac:0d
Total number of entries = 4
```

Displays the Specified Device Name in the Pending Database

```
switch# show
device-alias name x pending
device-alias name x pwwn 21:01:00:e0:8b:2e:80:93
```

Displays the Specified pWWN in the Pending Database

```
switch# show
device-alias pwwn 21:01:00:e0:8b:2e:80:93 pending
device-alias name x pwwn 21:01:00:e0:8b:2e:80:93
```

Displays the Difference Between the Pending and Effective Databases

```
switch# show
device-alias database pending-diff
- device-alias name Doc pwwn 21:01:02:03:00:01:01:01
+ device-alias name SampleName pwwn 21:00:00:e0:8b:0b:66:56
```

Displays the Specified pWWN

```
switch# show
device-alias pwwn 21:01:01:01:01:11:01:01
device-alias name Doc pwwn 21:01:01:01:01:11:01:01
```

Displays the Device Alias in the FLOGI Database

```
switch# show flogi database
---------------------------------------------------------------------------
INTERFACE  VSAN    FCID            PORT NAME               NODE NAME
---------------------------------------------------------------------------
fc2/9      1     0x670100  21:01:00:e0:8b:2e:80:93  20:01:00:e0:8b:2e:80:93
                           [x
] <-------------------------------------------Device alias name
fc2/12     1     0x670200  21:00:00:e0:8b:0b:66:56  20:00:00:e0:8b:0b:66:56
                           [SampleName
] <--------------------------------Device alias name
Total number of flogi = 2
```

Displays the Device Alias in the FCNS Database

```
switch# show fcns database
VSAN 1:
--------------------------------------------------------------------------
FCID        TYPE  PWWN                    (VENDOR)        FC4-TYPE:FEATURE
--------------------------------------------------------------------------
0x670100    N     21:01:00:e0:8b:2e:80:93 (Qlogic)        scsi-fcp:init
                  [x
]
0x670200    N     21:00:00:e0:8b:0b:66:56 (Qlogic)        scsi-fcp:init
                  [SampleName
]
Total number of entries = 2
```

Displays the fcping Statistics for the Specified Device Alias

```
switch# fcping device-alias x vsan 1
28 bytes from 21:01:00:e0:8b:2e:80:93 time = 358 usec
28 bytes from 21:01:00:e0:8b:2e:80:93 time = 226 usec
28 bytes from 21:01:00:e0:8b:2e:80:93 time = 372 usec
```

Displays the fctrace Information for the Specified Device Alias

```
switch# fctrace device-alias x vsan 1
Route present for : 21:01:00:e0:8b:2e:80:93
20:00:00:05:30:00:4a:e2(0xfffc67)
```

Where available, device aliases are displayed regardless of a member being configured using a **device-alias** command or a zone-specific **member pwwn** command.

Displays Statistics for the Device Alias Application

```
switch# show
device-alias statistics
        Device Alias Statistics
===========================================
Lock requests sent: 2
Database update requests sent: 1
Unlock requests sent: 1
Lock requests received: 1
Database update requests received: 1
Unlock requests received: 1
```

```
Lock rejects sent: 0
Database update rejects sent: 0
Unlock rejects sent: 0
Lock rejects received: 0
Database update rejects received: 0
Unlock rejects received: 0
Merge requests received: 0
Merge request rejects sent: 0
Merge responses received: 2
Merge response rejects sent: 0
Activation requests received: 0
Activation request rejects sent: 0
Activation requests sent: 2
Activation request rejects received: 0
```

Default Settings

Table 14: Default Device Alias Parameters , on page 159 lists the default settings for device alias parameters.

Table 14: Default Device Alias Parameters

Parameters	Default
Database in use	Effective database.
Database to accept changes	Pending database.
Device alias fabric lock state	Locked with the first device alias task.

Resolving Device Alias Merge Failures

The most common device-alias merge failure issues occur when merging databases. When a device-alias merge fails, we recommend that you review the syslog messages on the switch in which the merge was initiated in order to identify the issues. The application server in each fabric that is responsible for the merge is indicated by the term Merge Master in the messages.

In this example, the syslog messages indicate that the merge failed as a result of a database mismatch:

```
2007 Apr  9 15:52:42 switch-1 %CFS-3-MERGE_FAILED: Merge failed for app device-alias, local
 switch wwn 20:00:00:0d:ec:2f:c1:40,ip 172.20.150.38, remote switch wwn
20:00:00:0d:ec:04:99:40, ip 172.20.150.30
2007 Apr  9 15:52:42 switch-1 %DEVICE-ALIAS-3-MERGE_FAILED: Databases could not be merged
due to mismatch.
```

Note Use the **device-alias distribute** command to initiate a merge or remerge of device-alias databases. Use the **device-alias commit** command to *push* a switch's device-alias database to all the other switches in a fabric. If the switches whose device-alias databases are not merged (more than one merge master is shown in the output of the **show cfs merge status name device-alias** command), then the **device-alias commit** command causes the device-alias databases that are not merged to be overwritten.

Device Alias Best Practices

This section lists the best practices that you should follow when creating and using device aliases:

- Device aliases should be used to simplify the management of world wide names (WWNs) whenever possible. It is easier to identify devices with aliases rather than with WWNs. Hence, you should assign aliases to WWNs to easily identify the WWNs.
- Device-alias names are case-sensitive.
- Operate device aliases in Enhanced mode whenever possible. In Enhanced mode, applications accept a device-alias name in its *native* format, rather than expanding the alias to a port world wide name (pWWN). Because applications such as zone server, Inter-VSAN Routing (IVR), Port Security Manager (PSM), and Dynamic Port VSAN Membership automatically track and enforce device-alias membership changes, you have a single point of change.

  Note Interop mode VSANs do not accept Enhanced mode configurations.

- Preplan device-alias configurations and implement a consistent naming convention.
- Keep documented backups of all device-alias configurations.
- Plan for what the final device-alias database should be after the merge, before attempting to resolve merge failures. This can prevent traffic disruptions caused by accidentally overwriting device-alias entries.

  Caution Avoid performing a *blank commit* to resolve Cisco Fabric Services (CFS) merge failures. A blank commit overwrites the device-alias databases on all the switches with the device-alias database on the local switch.

  Note A blank commit is a device-alias commit that is used when there are no changes (including mode changes), or when it is okay to overwrite the device-alias databases on the remote switches with the local switch’s device-alias database.

  Device alias mismatches might occur because of the following reasons:

  - Duplicate Device-Alias Names—Same device-alias name, but different pWWNs. In such a scenario, the **show device-alias merge status** command displays the reason for the merge failure as `Reason: Another device-alias already present with the same name.`
  - Duplicate pWWNs—Different device-alias names, but same pWWN. In such a scenario, the **show device-alias merge status** command displays the reason for the merge failure as `Reason: Another device-alias already present with the same pwwn.`

Note Each time device-alias changes are committed, the running configuration should be copied to the startup configuration on all the switches that were updated. Use the **copy running-config startup-config fabric** command to copy the running configuration to the startup configuration for all the switches in the fabric. If you do not copy the running configuration to the startup configuration after the device-alias changes are committed, and if the switch reloads, or loses power and restarts, the startup configuration will not have the correct device-alias database and merge failure will occur.

Resolving Device Alias Mismatches

If a switch with an existing device-alias database is being added to an existing fabric, conflicts might arise because of the following reasons:

- The same device-alias name is used, but with different pWWNs.
- The same pWWN is used, but with different device-alias names.

To resolve duplicate device-alias names, perform these steps:

Step 1 Run the **show cfs merge status name device-alias** command to review the CFS or device-alias merge failure syslogs to confirm that the merge failed:

```
switch-1# show cfs merge status name device-alias

Physical-fc Merge Status: Failed
[Sun Sep 25 14:45:55 2016]
Failure Reason: Another device-alias already present with the same pwwn

Local Fabric
--------------------------------------------------------------------------------
Switch WWN              IP Address
--------------------------------------------------------------------------------
20:00:54:7f:ee:1b:0e:b0 10.127.103.211        [Merge Master] <<< Merge Master#1
                         [switch-1]

Total number of switches = 1

Remote Fabric
--------------------------------------------------------------------------------
Switch WWN              IP Address
--------------------------------------------------------------------------------
20:00:54:7f:ee:1b:0e:50 10.197.111.54         [Merge Master] <<< Merge Master#2

Total number of switches = 1
```

Note A properly merged device-alias application should only show a single merge master. If there is more than one merge master, as shown in the above example, it indicates that the device-alias databases are not merged.

Step 2 Use the **no device-alias distribute** command on the switch in which the merge failure occurred in order to disable the device-alias distribution:

```
switch-1# configure terminal
switch-1(config)# no device-alias distribute
```

Step 3 Resolve merge failure on the switch. See Resolving Merge Failures, on page 162 section.

Resolving Merge Failures

This section provides information about how to resolve merge failures.

Resolving Duplicate Device Alias Names (Same Device Alias Name, Different pWWNs)

Note A device-alias name is considered to be duplicate when the same device-alias name is used to point to different pWWNs.

To verify if a duplicate device-alias name exists in fabrics, perform these steps:

Step 1 Run the **show device-alias merge status** command to identify if the reason for the merge failure is a database mismatch:

```
switch# show device-alias merge status
     Result: Failure
     Reason: Another device-alias already present with the same name
```

Note A properly merged device-alias application should only show a single merge master. If there is more than one merge master, as shown in the above example, it indicates that the device-alias databases are not merged.

Step 2 Review the CFS or the device-alias merge failure syslog to confirm that the merge failed. Alternatively, run the **show cfs merge status name device-alias** command to view the status of the merge:

```
switch# show cfs merge status name device-alias
Physical-fc  Merge Status: Failed [ Mon Apr  9 15:57:58 2007 ] <===Merge status
      Local Fabric
     -------------------------------------------------------------------------
      Switch WWN                 IP Address
     -------------------------------------------------------------------------
      20:00:00:0d:ec:2f:c1:40  172.20.150.38       [Merge Master] <<< Merge Master#1
                               switch-1
     Total number of switches = 1

      Remote Fabric
     -------------------------------------------------------------------------
      Switch WWN                 IP Address
     -------------------------------------------------------------------------
```

```
 20:00:00:0d:ec:04:99:40  172.20.150.30       [Merge Master] <<< Merge Master#2
                          switch-2
Total number of switches = 1
```

Step 3 Depending on the Cisco MDS NX-OS release your switch is using, run one of the following commands:

- Cisco MDS NX-OS Release 8.1(1) and later releases

  Run the **show device-alias merge conflicts** command to display the device alias and pWWNs that are causing the merge failure.

  Note Run the **show device-alias merge conflicts** command from a switch listed as a merge master.

  In the following example, the same device-alias name, A1, is assigned to two different pWWNs—a pWWN on a local switch and a pWWN on a peer switch:

  ```
  switch-1# show device-alias merge conflicts
  Merge Status : Failure
  Peer Switch SWWN : 20:00:00:0d:ec:24:f5:00
  Conflicts :
  1. Conflicting Pwwns : 1
  -------------------------------------------------------------------------
  Local PWWN     Peer PWWN    Device-alias
  -------------------------------------------------------------------------
  pwwn 0:01:01:01:01:01:01:02  pwwn :01:01:01:01:01:01:03  A1
  ```

- Cisco MDS NX-OS Release 7.3 and earlier releases

  Compare the device-alias databases manually to identify the duplicate device-alias names.

  In the following example, the same device-alias name, A1, is assigned to two different pWWNs—a pWWN on a local switch and a pWWN on a peer switch.

  From merge master#1:

  ```
  switch-1# show device-alias database
  ...output trimmed to show only mismatched device-alias
  device-alias name A1 pwwn 21:01:01:01:01:01:01:02

  switch-2# show device-alias database
  ...output trimmed to show only mismatched device-alias
  device-alias name A1 pwwn 21:01:01:01:01:01:01:03
  ```

Step 4 Run the **device-alias name** *name* **pwwn** *id* command to change the pWWN on one of the switches to match the pWWN on the other switch.

Note Perform this step after device-alias distribution is disabled by running the **no device-alias distribute** command.

In the following example, the pWWN 21:01:01:01:01:01:01:02 on switch-1 is changed to match the pWWN 21:01:01:01:01:01:01:03 on switch-2:

```
switch-1# configure
Enter configuration commands, one per line. End with CNTL/Z.
```

```
switch-1(config)# device-alias database
switch-1(config-device-alias-db)# no device-alias name A1
switch-1(config-device-alias-db)# show device-alias database | i A1
switch-1(config-device-alias-db)# device-alias name A1 pwwn 21:01:01:01:01:01:01:03
switch-1(config-device-alias-db)# show device-alias database | i A1
device-alias name A1 pwwn 21:01:01:01:01:01:01:03
```

Step 5 If there are more duplicate device-alias names, perform step Step 3, on page 163 and step Step 4, on page 163 to resolve the duplicate device-alias names issue.

Step 6 Use the **device-alias distribute** command to enable the device-alias distribution and initiate a merge:

```
switch-1(config)# device-alias distribute
```

Step 7 Use the **show cfs merge status name device-alias** command to verify in the output if the merge was successful.

Resolving Duplicate pWWNs (Different Device Alias Names, Same pWWN)

To verify that the same pWWN is mapped to different device-alias names in fabrics, perform these steps:

Step 1 Run the **show device-alias merge status** command to identify if the reason for the merge failure is a database mismatch:

```
switch# show device-alias merge status
     Result: Failure
Reason: Another device-alias already present with the same pwwn.
```

Note A properly merged device-alias application should only show a single merge master. If there is more than one merge master, as shown in the above example, it indicates that the device-alias databases are not merged.

Step 2 Review the CFS or the device-alias merge failure syslog to confirm that the merge failed. Alternatively, run the **show cfs merge status name device-alias** command to view the status of the merge:

```
switch# show cfs merge status name device-alias
Physical-fc  Merge Status: Failed [ Mon Apr  9 15:57:58 2007 ] <===Merge status
      Local Fabric
     -------------------------------------------------------------------------
      Switch WWN                IP Address
     -------------------------------------------------------------------------
      20:00:00:0d:ec:2f:c1:40  172.20.150.38       [Merge Master] <<< Merge Master#1
                               switch-1
     Total number of switches = 1

      Remote Fabric
     -------------------------------------------------------------------------
      Switch WWN                IP Address
     -------------------------------------------------------------------------
      20:00:00:0d:ec:04:99:40  172.20.150.30       [Merge Master] <<< Merge Master#2
                               switch-2
```

```
Total number of switches = 1
```

Step 3 Depending on the Cisco MDS NX-OS release your switch is using, run one of the following commands:

- Cisco MDS NX-OS Release 8.1(1) and later releases

  Use the **show device-alias merge conflicts** command to display the device alias and pWWNs that are causing a merge failure. Use the **no device-alias distribute** command, followed by the **device-alias distribute** command to update the information about the merge conflicts.

  Note Run the **show device-alias merge conflicts** command from a switch listed as a merge master.

  In the following example, the pWWN 21:01:01:01:01:01:01:02 is mapped to device-alias A3 on switch-1, and to device-alias A1 on switch-2:

```
switch-1# show device-alias merge conflicts
Merge Status : Failure
Peer Switch SWWN : 20:00:00:0d:ec:24:f5:00
Conflicts :
1. Conflicting Device-aliases : 1
-------------------------------------------------------------------------
Local Device-alias  Peer Device-alias   PWWN
-------------------------------------------------------------------------
A3  A1   pwwn    21:01:01:01:01:01:01:02
```

- Cisco MDS NX-OS Release 7.3 and earlier releases

  Compare the device-alias databases manually to identify the pWWNs that are causing a merge failure.

  On the switches where the merge failed in step Step 1, on page 164, use the **show device-alias database** command to identify if a pWWN that is mapped to two different device-alias names exists.

  In this example, the pWWN 21:01:01:01:01:01:01:02 is mapped to the device-alias A3 on switch-1 and to the device-alias A1 on switch-2:

```
switch-1# show device-alias database
device-alias name A3 pwwn 21:01:01:01:01:01:01:02
Total number of entries = 1

switch-2# show device-alias database
device-alias name A1 pwwn 21:01:01:01:01:01:01:02
```

Step 4 Run the **device-alias name** *name* **pwwn** *id* command to change the device-alias name on one of the switches to match the device-alias name on the other switch.

Note Perform this step after device-alias distribution is disabled by running the **no device-alias distribute** command.

In the following example, the device-alias name A3 on switch-1 is changed to match the device-alias name A1 on switch-2:

```
switch-1# configure
Enter configuration commands, one per line. End with CNTL/Z.
switch-1(config)# device-alias database
```

```
switch-1(config-device-alias-db)# no device-alias name A3
switch-1(config-device-alias-db)# device-alias name A1 pwwn 21:01:01:01:01:01:01:02
```

Step 5 If there are more duplicate device-alias names, perform step Step 3, on page 165 and step Step 4, on page 165 to resolve the duplicate device-alias names issue.

Step 6 Use the **device-alias distribute** command to enable the device-alias distribution and initiate a merge:

```
switch-1(config)# device-alias distribute
```

Step 7 Use the **show cfs merge status name device-alias** command to verify in the output if the merge was successful.

Resolving Mode Mismatch

The Device Alias feature can operate in either Basic or Enhanced mode. If the modes are different in two fabrics, CFS merge between the fabrics fails.

To verify that the device-alias mode is different in two fabrics, perform these steps:

Step 1 Review the CFS or device-alias merge failure syslog to confirm that the merge failed. Alternatively, run the **show cfs merge status name device-alias** command to view the status of the merge.

```
switch# show cfs merge status name device-alias
Physical-fc  Merge Status: Failed [ Mon Apr  9 15:57:58 2007 ] <===Merge status
      Local Fabric
     -------------------------------------------------------------------------
      Switch WWN               IP Address
     -------------------------------------------------------------------------
      20:00:00:0d:ec:2f:c1:40  172.20.150.38       [Merge Master] <<< Merge Master#1
                              switch-1
     Total number of switches = 1
      Remote Fabric
     -------------------------------------------------------------------------
      Switch WWN               IP Address
     -------------------------------------------------------------------------
      20:00:00:0d:ec:04:99:40  172.20.150.30       [Merge Master] <<< Merge Master#2
                              switch-2
  Total number of switches = 1
```

Step 2 Use the **show device-alias merge status** command to verify that the reason for the merge failure is a mode mismatch. If there is a mode mismatch, the reason that is displayed in the output is either "`Databases could not be merged due to mode mismatch`" or "`One of the merging fabrics cannot support device-alias Enhanced mode.`"

```
switch# show device-alias merge status
     Result: Failure
     Reason: Databases could not be merged due to mode mismatch.
```

Step 3 Use the **show device-alias status** command to verify the device-alias mode for each of the fabric.
In this example, switch-1 is running in Enhanced mode, while switch-2 is running in Basic mode:

```
switch-1# show device-alias status
Fabric Distribution: Enabled
Database:- Device Aliases 2 Mode: Enhanced

switch-2# show device-alias status
     Fabric Distribution: Enabled
     Database:- Device Aliases 2 Mode: Basic
```

Step 4 Use the **no device-alias distribute** command to disable device-alias distribution after you detect mismatched device-alias modes.

Step 5 Depending on the mode you want to change in the switch, use either the **device-alias mode enhanced** command to change the switch mode to Enhanced, or use the **no device-alias mode enhanced** command to change the switch mode to Basic mode (default mode).

Note If you want to change the device-alias mode from Enhanced to Basic, but an application contains a device-alias configuration in the native format, the device-alias mode cannot be changed until you explicitly remove all the native device-alias configurations or replace all the device-alias members with the corresponding pWWNs.

Step 6 Use the **device-alias distribute** command to enable the device-alias distribution and initiate a merge.

Resolving a Validation Failure

If the merger of device aliases takes place without any conflicts, the resultant device-alias database is validated with the registered applications on each switch in both the fabrics being merged. If an application fails the validation of the merged database for any reason, the device-alias merge fails.

To verify that the device-alias database merge is failing because of an application-validation failure, perform these steps:

Step 1 Review the CFS or device-alias merge failure syslog to confirm that the merge failed. Alternatively, run the **show cfs merge status name device-alias** command to view the status of the merge.

Step 2 Use the **show device-alias merge status** command to verify that the reason for the merge failure is an application-validation failure:

```
switch# show device-alias merge status
     Result: Failure
     Reason: This is a non device-alias error.
```

Step 3 Examine the syslog messages. The syslog for the switch in which the validation is rejected and the syslog for the switch managing the merge show relevant error messages.

This example shows a sample message on a switch in which the validation is rejected:

```
2007 Apr 10 00:00:06 switch-2 %DEVICE-ALIAS-3-MERGE_VALIDATION_REJECTED:
Failed SAP: 110 Reason: inter-VSAN zone member cannot be in more than one
VSAN Expln:
```

This example shows the syslog message on a switch that is managing the merge, and in which the validation is rejected:

```
2007 Apr  9 16:41:22 switch-1 %DEVICE-ALIAS-3-MERGE_VALIDATION_FAILED: Failed
SWWN: 20:00:00:0d:ec:04:99:40 Failed SAP: 110 Reason: inter-VSAN zone member cannot be in more than
 one
VSAN Expln:
```

Step 4 Use the **show device-alias internal validation-info** command on the switch managing the merge, and examine the output.
This example shows that SAP 110 on switch 20:00:00:0d:ec:04:99:40 (switch-2) rejected the validation. The status message shows the reason for the failure along with the system application number:

```
switch# show device-alias internal validation-info
     Validation timer:    0s
 Per SAP Info Table:
    ===================
       SAPS:  0
     MTS Buffer Array Details:
     =========================
       Buffers:  0
     Local Status:
     =============
       Num Reqs Sent:  0 20:00:00:0d:ec:04:99:40
       Num SAPs Done:  0
       Failed SAP   :  0    Status: success    Expln:
     Remote Status:
     ==============
       CFS Resp Rcvd: TRUE
       Failed SWWN  : 20:00:00:0d:ec:04:99:40
SAP : 110 Status: inter-VSAN zone member cannot be in more than one VSAN <=== Status
       Expln:
```

Step 5 Use the **show system internal mts sup sap number description** command to find the application that rejected the configuration on the switch that rejected the validation.
In this example, the application that rejected the device-alias validation was the IVR process.

```
switch# show system internal mts sup sap 110 description
IVR-SAP
```

Step 6 Analyze the device-alias validation failure. This analysis is dependent on the application that failed the validation as well as the device-alias database configuration.

In this example, IVR is failing the validation. To troubleshoot this problem, begin by reviewing the device-alias databases that are being merged. Use the **show device-alias database** command from the switch managing the merge for each fabric.

```
switch# show device-alias database
device-alias name A1 pwwn 21:01:01:01:01:01:01:01
device-alias name A2 pwwn 21:01:01:01:01:01:01:02 => Pre-merge: A2 defined on switch-1
Total number of entries = 2

switch# show device-alias database
device-alias name A1 pwwn 21:01:01:01:01:01:01:01 => Pre-merge: A2 not defined on switch-2
Total number of entries = 1
Because IVR is enabled on switch-2, review the IVR zone set.
switch# show ivr zoneset
zoneset name s1
   zone name z1
       pwwn 21:01:01:01:01:01:01:02 vsan    1 autonomous-fabric-id  1
       device-alias A2              vsan    2 autonomous-fabric-id  1
```

Prior to the database merge, device-alias A2 is not defined on switch-2. Because of the merge between switch-1 and switch-2, device-alias A2 becomes available on switch-2, and A2 is mapped to pWWN 21:01:01:01:01:01:01:02.

The device alias-based member A2 in the IVR zone z1 is resolved and mapped to pWWN 21:01:01:01:01:01:01:02, and is a member of VSAN 2. However, pWWN 21:01:01:01:01:01:01:02 is already a member of VSAN 1. The mapping that occurs because of the device-alias merge makes the IVR configuration illegal. The same pWWN cannot be a member of multiple VSANs.

In the case when IVR configuration is illegal, the pWWN in VSAN 2 is defined using the device alias (A2), while the member in VSAN 1 is defined using the actual pWWN. The IVR detects this situation and rejects the device-alias validation. As a result, the device-alias merge fails.

Resolving Database Conflicts

If an entry in the device-alias database conflicts with the configuration of a registered application, the device-alias database commit fails the validation process. Correct either the device-alias database or the application configuration.
To determine the application that failed the validation and the reason for the failure, perform these steps:

Step 1 Use the **device-alias commit** command to view the output.
This example shows that the commit failed because there is a conflict between the device-alias database and an application configuration:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# device-alias commit
inter-VSAN zone member cannot be in more than one VSAN ===> reason for commit failure
```

Step 2 Determine which application configuration is in conflict with the device-alias database by reviewing the syslogs for the switch in which the commit was issued.

This example shows that SAP 110 (IVR) on sWWN 20:00:00:0d:ec:04:99:40 (switch-2) has rejected the validation, and therefore, the device-alias commit has failed:

```
2007 Apr 10 11:54:24 switch-1 %DEVICE-ALIAS-3-VALIDATION_FAILED: Failed=>Validation Status
SWWN: 20:00:00:0d:ec:04:99:40 Failed SAP: 110 Reason: inter-VSAN zone ==>Switch and SAP member cannot
 be in more than one VSAN Expln:                         ==>Reason
2007 Apr 10 11:54:24 switch-1 %DEVICE-ALIAS-3-COMMIT_FAILED: Failed to  ==>Commit status commit the
 pending database: inter-VSAN zone member cannot be in more ==>Reason than one VSAN
```

Step 3 Review the syslog on the switch in which the validation is rejected.

This example shows that the following syslog is printed on switch-2:

```
2007 Apr 10 19:13:08 switch-2 %DEVICE-ALIAS-3-VALIDATION_REJECTED: Failed
SAP: 110 Reason: inter-VSAN zone member cannot be in more than one VSAN ==>SAP and reason
```

Step 4 Compare the existing device-alias database (including the desired changes) and the application configuration to find the conflict.

This example uses the **show device-alias database** and **show ivr zoneset** commands along with the console logs of the device-alias database changes made prior to the commit. The comparison shows that the definition of the new device-alias A2 results in the resolution of the enhanced device-alias member A2 in the IVR zone z1 to pWWN 21:01:01:01:01:01:01:02, which is already a member of zone z1. The pWWN is directly defined as a member of VSAN 1, while the enhanced device-alias A2 is defined as a member of VSAN 2. This configuration is not allowed in the IVR. The IVR detects the configuration problem and rejects the device-alias database validation.

```
switch# show device-alias database          ===> existing device alias database
device-alias name A1 pwwn 21:01:01:01:01:01:01:01
Total number of entries = 1
switch# show ivr zoneset                    ===> display existing IVR zone set
zoneset name s1
zone name z1
pwwn 21:01:01:01:01:01:01:02  vsan    1 autonomous-fabric-id  1
       device-alias A2               vsan    2 autonomous-fabric-id  1
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# device-alias database
switch(config-device-alias-db)# device-alias name A2 pwwn 21:01:01:01:01:01:01:02
switch(config-device-alias-db)# exit
switch(config)# device-alias commit
inter-VSAN zone member cannot be in more than one VSAN
```

Step 5 Correct the conflict by making adjustments to the application configuration, or by making changes to the device-alias database, and running the **device-alias commit** command again.

Verifying the Device-Alias Database Status

This section provides information about verifying the device-alias database status.

Table 15: Verifying the Device-Alias Database Status

Command Name	Description
show cfs merge status name device-alias	Displays information about the status of the CFS merge for the device-alias database.
show device-alias database	Displays the entire device-alias database.
show device-alias internal validation info	Displays information about the status of the validation process (part of a commit or merge).
show device-alias merge conflicts	Displays the device-alias names or pWWNs causing a merge failure in Cisco MDS NX-OS Release 8.1(1) and later releases.
show device-alias merge status	Displays the result of the device-alias merge operation and the reason for the result.
show device-alias session status	Returns the status of the last CFS command, such as **clear**, **commit**, or **terminate**. The results of the last used CFS command and reason fields help identify the reason for the failure.
show device-alias status	Displays configuration information for the device-alias service, including whether fabric distribution is enabled, the number of device aliases in the database, lock information, and the database mode (Basic or Enhanced).

CHAPTER 7

Configuring Fibre Channel Routing Services and Protocols

Fabric Shortest Path First (FSPF) is the standard path selection protocol used by Fibre Channel fabrics. The FSPF feature is enabled by default on all Fibre Channel switches. Except in configurations that require special consideration, you do not need to configure any FSPF services. FSPF automatically calculates the best path between any two switches in a fabric. Specifically, FSPF is used to:

- Dynamically compute routes throughout a fabric by establishing the shortest and quickest path between any two switches.
- Select an alternative path in the event of the failure of a given path. FSPF supports multiple paths and automatically computes an alternative path around a failed link. It provides a preferred route when two equal paths are available.

This chapter provides details on Fibre Channel routing services and protocols. It includes the following sections:

About FSPF

FSPF is the protocol currently standardized by the T11 committee for routing in Fibre Channel networks. The FSPF protocol has the following characteristics and features:

- Supports multipath routing.
- Bases path status on a link state protocol.

- Routes hop by hop, based only on the domain ID.
- Runs only on E ports or TE ports and provides a loop free topology.
- Runs on a per VSAN basis. Connectivity in a given VSAN in a fabric is guaranteed only for the switches configured in that VSAN.
- Uses a topology database to keep track of the state of the links on all switches in the fabric and associates a cost with each link.
- Guarantees a fast reconvergence time in case of a topology change. Uses the standard Dijkstra algorithm, but there is a static dynamic option for a more robust, efficient, and incremental Dijkstra algorithm. The reconvergence time is fast and efficient as the route computation is done on a per VSAN basis.

FSPF Examples

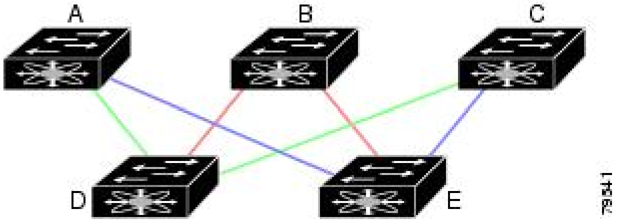
This section provides examples of topologies and applications that demonstrate the benefits of FSPF.

Note The FSPF feature can be used on any topology.

Fault Tolerant Fabric

Figure 45: Fault Tolerant Fabric, on page 174 depicts a fault tolerant fabric using a partial mesh topology. If a link goes down anywhere in the fabric, any switch can still communicate with all others in the fabric. In the same way, if any switch goes down, the connectivity of the rest of the fabric is preserved.

Figure 45: Fault Tolerant Fabric



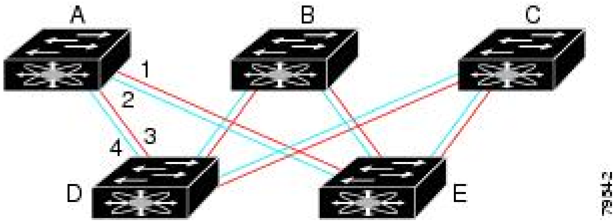
For example, if all links are of equal speed, the FSPF calculates two equal paths from A to C: A-D-C (green) and A-E-C (blue).

Redundant Links

To further improve on the topology in Figure 45: Fault Tolerant Fabric, on page 174, each connection between any pair of switches can be replicated; two or more links can be present between a pair of switches Figure 46: Fault Tolerant Fabric with Redundant Links, on page 175 shows this arrangement. Because switches in the Cisco MDS 9000 Family support PortChanneling, each pair of physical links can appear to the FSPF protocol as one single logical link.

By bundling pairs of physical links, FSPF efficiency is considerably improved by the reduced database size and the frequency of link updates. Once physical links are aggregated, failures are not attached to a single link but to the entire PortChannel. This configuration also improves the resiliency of the network. The failure of a link in a PortChannel does not trigger a route change, thereby reducing the risks of routing loops, traffic loss, or fabric downtime for route reconfiguration.

Figure 46: Fault Tolerant Fabric with Redundant Links



For example, if all links are of equal speed and no PortChannels exist, the FSPF calculates four equal paths from A to C: A1-E-C, A2-E-C, A3-D-C, and A4-D-C. If PortChannels exist, these paths are reduced to two.

Failover Scenarios for PortChannels and FSPF Links

The SmartBits traffic generator was used to evaluate the scenarios displayed in Figure 47: Failover Scenario Using Traffic Generators, on page 175. Two links between switch 1 and switch 2 exist as either equal-cost ISLs or PortChannels. There is one flow from traffic generator 1 to traffic generator 2. The traffic was tested at 100 percent utilization at 1 Gbps in two scenarios:

- Disabling the traffic link by physically removing the cable (see Table 16: Physically Removing the Cable for the SmartBits Scenario , on page 175).
- Shutting down the links in either switch 1 or switch 2 (see Table 17: Shutting Down the links in Switch for the SmartBits Scenario , on page 176).

Figure 47: Failover Scenario Using Traffic Generators

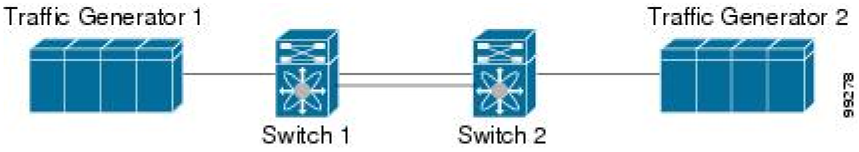


Table 16: Physically Removing the Cable for the SmartBits Scenario

PortChannel Scenario		FSPF Scenario (Equal cost ISL)	
Switch 1	Switch 2	Switch 1	Switch 2
110 msec (~2K frame drops)		130+ msec (~4k frame drops)	
100 msec (hold time when a signal loss is reported as mandated by the standard)			

Table 17: Shutting Down the links in Switch for the SmartBits Scenario

PortChannel Scenario		**FSPF Scenario (Equal cost ISL)**	
Switch 1	Switch 2	Switch 1	Switch 2
~0 msec (~8 frame drops)	110 msec (~2K frame drops)	130+ msec (~4K frame drops)	
No hold time needed	Signal loss on switch 1	No hold time needed	Signal loss on switch 1

FSPF Global Configuration

By default, FSPF is enabled on switches in the Cisco MDS 9000 Family.

Some FSPF features can be globally configured in each VSAN. By configuring a feature for the entire VSAN, you do not have to specify the VSAN number for every command. This global configuration feature also reduces the chance of typing errors or other minor configuration errors.

Note FSPF is enabled by default. Generally, you do not need to configure these advanced features.

Caution The default for the backbone region is 0 (zero). You do not need to change this setting unless your region is different from the default. If you are operating with other vendors using the backbone region, you can change this default to be compatible with those settings.

This section includes the following topics:

About SPF Computational Hold Times

The SPF computational hold time sets the minimum time between two consecutive SPF computations on the VSAN. Setting this to a small value means that FSPF reacts faster to any fabric changes by recomputing paths on the VSAN. A small SPF computational hold time uses more switch CPU time.

About Link State Record Defaults

Each time a new switch enters the fabric, a link state record (LSR) is sent to the neighboring switches, and then flooded throughout the fabric. Table 18: LSR Default Settings , on page 177 displays the default settings for switch responses.

Table 18: LSR Default Settings

LSR Option	Default	Description
Acknowledgment interval (RxmtInterval)	5 seconds	The time a switch waits for an acknowledgment from the LSR before retransmission.
Refresh time (LSRefreshTime)	30 minutes	The time a switch waits before sending an LSR refresh transmission.
Maximum age (MaxAge)	60 minutes	The time a switch waits before dropping the LSR from the database.

The LSR minimum arrival time is the period between receiving LSR updates on this VSAN. Any LSR updates that arrive before the LSR minimum arrival time are discarded.

The LSR minimum interval time is the frequency at which this switch sends LSR updates on a VSAN.

Configuring FSPF on a VSAN

To configure an FSPF feature for the entire VSAN, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fspf config vsan 1**
Enters FSPF global configuration mode for the specified VSAN.

Step 3 switch-config-(fspf-config)# **spf static**
Forces static SPF computation for the dynamic (default) incremental VSAN.

Step 4 switch-config-(fspf-config)# **spf hold-time 10**
Configures the hold time between two route computations in milliseconds (msec) for the entire VSAN. The default value is 0.

Note If the specified time is shorter, the routing is faster. However, the processor consumption increases accordingly.

Step 5 switch-config-(fspf-config)# **region 7**
Configures the autonomous region for this VSAN and specifies the region ID (7).

Resetting FSPF to the Default Configuration

To return the FSPF VSAN global configuration to its factory default, follow these steps:

Step 1
```
switch# config terminal
switch(config)#
```
Enters configuration mode.

Step 2
```
switch(config)# no fspf config vsan 3
```
Deletes the FSPF configuration for VSAN 3.

Enabling or Disabling FSPF

To enable or disable FSPF routing protocols, follow these steps:

Step 1
```
switch# config terminal
switch(config)#
```
Enters configuration mode.

Step 2
```
switch(config)# fspf enable vsan 7
```
Enables the FSPF routing protocol in VSAN 7.

Step 3
```
switch(config)# no fspf enable vsan 5
```
Disables the FSPF routing protocol in VSAN 5.

Clearing FSPF Counters for the VSAN

To clear the FSPF statistics counters for the entire VSAN, follow this step:

```
switch# clear fspf counters vsan 1
```
Clears the FSPF statistics counters for the specified VSAN. If an interface reference is not specified, all counters are cleared.

FSPF Interface Configuration

Several FSPF commands are available on a per-interface basis. These configuration procedures apply to an interface in a specific VSAN.

This section includes the following topics:

About FSPF Link Cost

FSPF tracks the state of links on all switches in the fabric, associates a cost with each link in its database, and then chooses the path with a minimal cost. The cost associated with an interface can be administratively changed to implement the FSPF route selection. The integer value to specify cost can range from 1 to 30000. The default cost for 1 Gbps is 1000 and for 2 Gbps is 500.

Configuring FSPF Link Cost

To configure FSPF link cost, follow these steps:

Step 1

```
switch# config t
switch(config)#
```

Enters configuration mode.

Step 2

```
switch(config)# interface fc1/4
switch(config-if)#
```

Configures the specified interface, or if already configured, enters configuration mode for the specified interface.

Step 3

```
switch(config-if)# fspf cost 5 vsan 90
```

Configures the cost for the selected interface in VSAN 90.

About Hello Time Intervals

You can set the FSPF Hello time interval to specify the interval between the periodic hello messages sent to verify the health of the link. The integer value can range from 1 to 65,535 seconds.

Note This value must be the same in the ports at both ends of the ISL.

Configuring Hello Time Intervals

To configure the FSPF Hello time interval, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **interface fc1/4**
switch(config-if)#

Configures the specified interface, or if already configured, enters configuration mode for the specified interface.

Step 3 switch(config-if)# **fspf hello-interval 15 vsan 175**
switch(config-if)#

Specifies the hello message interval (15 seconds) to verify the health of the link in VSAN 175. The default is 20 seconds.

About Dead Time Intervals

You can set the FSPF dead time interval to specify the maximum interval for which a hello message must be received before the neighbor is considered lost and removed from the database. The integer value can range from 1 to 65,535 seconds.

Note This value must be the same in the ports at both ends of the ISL.

- An error is reported at the command prompt if the configured dead time interval is less than the hello time interval
- During a software upgrade, ensure that the fspf dead-interval is greater than the ISSU downtime (80 seconds). If the fspf dead-interval is lesser than the ISSU downtime, the software upgrade fails and the following error is displayed:

```
Service "fspf" returned error: Dead interval for interface is less than ISSU upgrade time.
```

Configuring Dead Time Intervals

To configure the FSPF dead time interval, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2

```
switch(config)# interface fc1/4
switch(config-if)#
```

Configures the specified interface, or if already configured, enters configuration mode for the specified interface.

Step 3

```
switch(config-if)# fspf dead-interval 25 vsan 7
switch(config-if)#
```

Specifies the maximum interval for VSAN 7 before which a hello message must be received on the selected interface before the neighbor is considered lost. The default is 80 seconds.

About Retransmitting Intervals

You can specify the time after which an unacknowledged link state update should be transmitted on the interface. The integer value to specify retransmit intervals can range from 1 to 65,535 seconds.

Note This value must be the same on the switches on both ends of the interface.

Configuring Retransmitting Intervals

To configure the FSPF retransmit time interval, follow these steps:

Step 1

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

Enters configuration mode.

Step 2

```
switch(config)# interface fc1/4
switch(config-if)#
```

Configures the specified interface, or if already configured, enters configuration mode for the specified interface.

Step 3

```
switch(config-if)# fspf retransmit-interval 15 vsan 12
switch(config-if)#
```

Specifies the retransmit time interval for unacknowledged link state updates in VSAN 12. The default is 5 seconds.

About Disabling FSPF for Specific Interfaces

You can disable the FSPF protocol for selected interfaces. By default, FSPF is enabled on all E ports and TE ports. This default can be disabled by setting the interface as passive.

Note FSPF must be enabled at both ends of the interface for the protocol to work.

Disabling FSPF for Specific Interfaces

You can disable the FSPF protocol for selected interfaces. By default, FSPF is enabled on all E ports and TE ports. This default can be disabled by setting the interface as passive.

To disable FSPF for a specific interface, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **interface fc1/4**
switch(config-if)#

Configures a specified interface, or if already configured, enters configuration mode for the specified interface.

Step 3 switch(config-if)# **fspf passive vsan 1**
switch(config-if)#

Disables the FSPF protocol for the specified interface in the specified VSAN.

Step 4 switch(config-if)# **no fspf passive vsan 1**
switch(config-if)#

Reenables the FSPF protocol for the specified interface in the specified VSAN.

You can disable the FSPF protocol for selected interfaces. By default, FSPF is enabled on all E ports and TE ports. This default can be disabled by setting the interface as passive.

Clearing FSPF Counters for an Interface

To clear the FSPF statistics counters for an interface, follow this step:

switch# **clear fspf counters vsan 200 interface fc1/1**
Clears the FSPF statistics counters for the specified interface in VSAN 200.

FSPF Routes

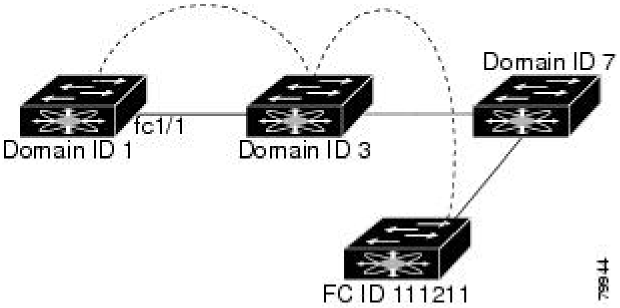
FSPF routes traffic across the fabric, based on entries in the FSPF database. These routes can be learned dynamically, or configured statically.

This section includes the following topics:

About Fibre Channel Routes

Each port implements forwarding logic, which forwards frames based on its FC ID. Using the FC ID for the specified interface and domain, you can configure the specified route (for example FC ID 111211 and domain ID 3) in the switch with domain ID 1 (see Figure 48: Fibre Channel Routes, on page 183).

Figure 48: Fibre Channel Routes



Note Other than in VSANs, runtime checks are not performed on configured and suspended static routes.

About Broadcast and Multicast Routing

Broadcast and multicast in a Fibre Channel fabric uses the concept of a distribution tree to reach all switches in the fabric.

FSPF provides the topology information to compute the distribution tree. Fibre Channel defines 256 multicast groups and one broadcast address for each VSAN. Switches in the Cisco MDS 9000 Family only use broadcast routing. By default, they use the principal switch as the root node to derive a loop-free distribution tree for multicast and broadcast routing in a VSAN.

Caution All switches in the fabric should run the same multicast and broadcast distribution tree algorithm to ensure the same distribution tree.

To interoperate with other vendor switches (following FC-SW3 guidelines), the SAN-OS and NX-OS 4.1(1b) and later software uses the lowest domain switch as the root to compute the multicast tree in interop mode.

About Multicast Root Switch

By default, the **native** (non-interop) mode uses the principal switch as the root. If you change the default, be sure to configure the same mode in all switches in the fabric. Otherwise, multicast traffic could encounter potential loop and frame-drop problems.

Note The operational mode can be different from the configured interop mode. The interop mode always uses the lowest domain switch as the root.

Use the **mcast root lowest vsan** command to change the multicast root from the principal switch to lowest domain switch.

Setting the Multicast Root Switch

To use the lowest domain switch for the multicast tree computation, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **mcast root lowest vsan 1**
Uses the lowest domain switch to compute the multicast tree.

Step 3 switch(config)# **mcast root principal vsan 1**
Defaults to using the principal switch to compute the multicast tree.

To display the configured and operational multicast mode and the selected root domain, use the **show mcast** command.

```
switch# show mcast vsan 1
Multicast root for VSAN 1
       Configured root mode : Principal switch
       Operational root mode : Principal switch
       Root Domain ID : 0xef(239)
```

In-Order Delivery

In-Order Delivery (IOD) of data frames guarantees frame delivery to a destination in the same order that they were sent by the originator.

Some Fibre Channel protocols or applications cannot handle out-of-order frame delivery. In these cases, switches in the Cisco MDS 9000 Family preserve frame ordering in the frame flow. The source ID (SID), destination ID (DID), and optionally the originator exchange ID (OX ID) identify the flow of the frame.

On any given switch with IOD enabled, all frames received by a specific ingress port and destined to a certain egress port are always delivered in the same order in which they were received.

Use IOD only if your environment cannot support out-of-order frame delivery.

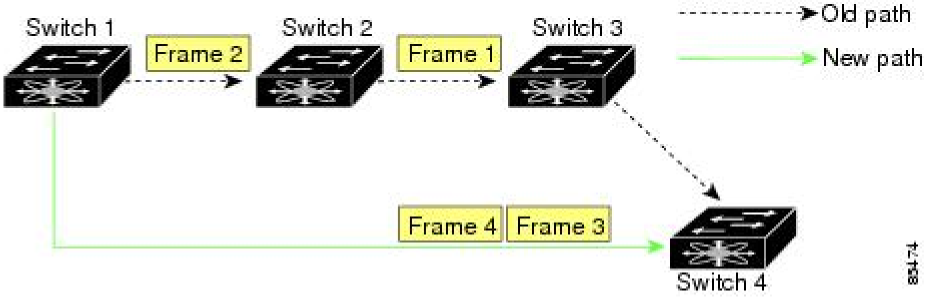
Tip If you enable the in-order delivery feature, the graceful shutdown feature is not implemented.

This section includes the following topics:

About Reordering Network Frames

When you experience a route change in the network, the new selected path may be faster or less congested than the old route.

Figure 49: Route Change Delivery



In Figure 49: Route Change Delivery, on page 185, the new path from Switch 1 to Switch 4 is faster. In this scenario, Frame 3 and Frame 4 may be delivered before Frame 1 and Frame 2.

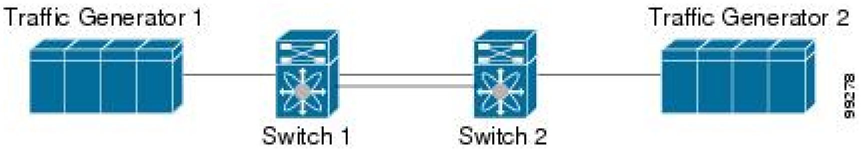
If the in-order guarantee feature is enabled, the frames within the network are treated as follows:

- Frames in the network are delivered in the order in which they are transmitted.
- Frames that cannot be delivered in order within the network latency drop period are dropped inside the network.

About Reordering PortChannel Frames

When a link change occurs in a PortChannel, the frames for the same exchange or the same flow can switch from one path to another faster path.

Figure 50: Link Congestion Delivery



In Figure 50: Link Congestion Delivery, on page 186 , the port of the old path (red dot) is congested. In this scenario, Frame 3 and Frame 4 can be delivered before Frame 1 and Frame 2.

The in-order delivery feature attempts to minimize the number of frames dropped during PortChannel link changes when the in-order delivery is enabled by sending a request to the remote switch on the PortChannel to flush all frames for this PortChannel.

Note Both switches on the PortChannel must be running Cisco SAN-OS Release 3.0(1) for this IOD enhancement. For earlier releases, IOD waits for the switch latency period before sending new frames.

When the in-order delivery guarantee feature is enabled and a PortChannel link change occurs, the frames crossing the PortChannel are treated as follows:

- Frames using the old path are delivered before new frames are accepted.
- The new frames are delivered through the new path after the switch latency drop period has elapsed and all old frames are flushed.

Frames that cannot be delivered in order through the old path within the switch latency drop period are dropped. See the Configuring the Drop Latency Time, on page 188.

About Enabling In-Order Delivery

You can enable the in-order delivery feature for a specific VSAN or for the entire switch. By default, in-order delivery is disabled on switches in the Cisco MDS 9000 Family.

Tip We recommend that you only enable this feature when devices that cannot handle any out-of-order frames are present in the switch. Load-balancing algorithms within the Cisco MDS 9000 Family ensure that frames are delivered in order during normal fabric operation. The load-balancing algorithms based on source FC ID, destination FC ID, and exchange ID are enforced in hardware without any performance degradation. However, if the fabric encounters a failure and this feature is enabled, the recovery will be delayed because of an intentional pausing of fabric forwarding to purge the fabric of resident frames that could potentially be forwarded out-of-order.

Enabling In-Order Delivery Globally

To ensure that the in-order delivery parameters are uniform across all VSANs on an MDS switch, enable in-order delivery globally.

Only enable in-order delivery globally if this is a requirement across your entire fabric. Otherwise, enable IOD only for the VSANs that require this feature.

Note Enable in-order delivery on the entire switch before performing a downgrade to Cisco MDS SAN-OS Release 1.3(3) or earlier.

To enable in-order delivery for the switch, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **in-order-guarantee**
Enables in-order delivery in the switch.

Step 3 switch(config)# **no in-order-guarantee**
Reverts the switch to the factory defaults and disables the in-order delivery feature.

Enabling In-Order Delivery for a VSAN

When you create a VSAN, that VSAN automatically inherits the global in-order-guarantee value. You can override this global value by enabling or disabling in-order-guarantee for the new VSAN.

To use the lowest domain switch for the multicast tree computation, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **in-order-guarantee vsan 3452**
Enables in-order delivery in VSAN 3452.

Step 3 switch(config)# **no in-order-guarantee vsan 101**
Reverts the switch to the factory defaults and disables the in-order delivery feature in VSAN 101.

Displaying the In-Order Delivery Status

Use the **show in-order-guarantee** command to display the present configuration status:

```
switch# show in-order-guarantee
global inorder delivery configuration:guaranteed
VSAN specific settings
vsan 1 inorder delivery:guaranteed
vsan 101 inorder delivery:not guaranteed
vsan 1000 inorder delivery:guaranteed
vsan 1001 inorder delivery:guaranteed
vsan 1682 inorder delivery:guaranteed
vsan 2001 inorder delivery:guaranteed
vsan 2009 inorder delivery:guaranteed
vsan 2456 inorder delivery:guaranteed
vsan 3277 inorder delivery:guaranteed
vsan 3451 inorder delivery:guaranteed
vsan 3452 inorder delivery:guaranteed
```

Configuring the Drop Latency Time

You can change the default latency time for a network, a specified VSAN in a network, or for the entire switch.

To configure the network and the switch drop latency time, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fcdroplatency network 5000**
Configures network drop latency time to be 5000 msec for the network. The valid range is 0 to 60000 msec. The default is 2000 msec.

Note The network drop latency must be computed as the sum of all switch latencies of the longest path in the network.

Step 3 switch(config)# **fcdroplatency network 6000 vsan 3**
Configures network drop latency time to be 6000 msec for VSAN 3.

Step 4 switch(config)# **no fcdroplatency network 4500**
Removes the current fcdroplatecy network configuration (4500) and reverts the switch to the factory defaults.

Displaying Latency Information

You can view the configured latency parameters using the **show fcdroplatency** command (see Displays Administrative Distance, on page 188).

Displays Administrative Distance

```
switch# show fcdroplatency
```

```
switch latency value:500 milliseconds
global network latency value:2000 milliseconds
VSAN specific network latency settings
vsan 1 network latency:5000 milliseconds
vsan 2 network latency:2000 milliseconds
vsan 103 network latency:2000 milliseconds
vsan 460 network latency:500 milliseconds
```

Flow Statistics Configuration

Flow statistics count the ingress traffic in the aggregated statistics table. You can collect two kinds of statistics:

- Aggregated flow statistics to count the traffic for a VSAN.
- Flow statistics to count the traffic for a source and destination ID pair in a VSAN.

This section includes the following topics:

About Flow Statistics

If you enable flow counters, you can enable a maximum of 1 K entries for aggregate flow and flow statistics for Generation 1 modules, and 2 K entries for Generation 2 modules. Be sure to assign an unused flow index to a module for each new flow. Flow indexes can be repeated across modules. The number space for flow index is shared between the aggregate flow statistics and the flow statistics.

Generation 1 modules allow a maximum of 1024 flow statements per module. Generation 2 modules allow a maximum of 2048-128 flow statements per module.

Note For each session, fcflow counter will increment only on locally connected devices and should be configured on the switch where the initiator is connected.

Counting Aggregated Flow Statistics

To count the aggregated flow statistics for a VSAN, follow these steps:

Step 1 switch# config t
switch(config)#

Enters configuration mode.

Step 2 switch(config)# fcflow stats aggregated module 1 index 1005 vsan 1
switch(config)#

Enables the aggregated flow counter.

Step 3 switch(config)# no fcflow stats aggregated module 1 index 1005 vsan 1
switch(config)#

Disables the aggregated flow counter.

Counting Individual Flow Statistics

To count the flow statistics for a source and destination FC ID in a VSAN, follow these steps:

Step 1 switch# config t
switch(config)#

Enters configuration mode.

Step 2 switch(config)# fcflow stats module 1 index 1 0x145601 0x5601ff 0xffffff vsan 1
switch(config)#

Enables the flow counter.

Note The source ID and the destination ID are specified in FC ID hex format (for example, 0x123aff). The mask can be one of 0xff0000 or 0xffffff.

Step 3 switch(config)# no fcflow stats aggregated module 2 index 1001 vsan 2
switch(config)#

Disables the flow counter.

Clearing FIB Statistics

Use the **clear fcflow stats** command to clear the aggregated flow counter (see Examples Clears Aggregated Flow Counters, on page 190 and Clears Flow Counters for Source and Destination FC IDs, on page 190).

Clears Aggregated Flow Counters

```
switch# clear fcflow stats aggregated module 2 index 1
```

Clears Flow Counters for Source and Destination FC IDs

```
switch# clear fcflow stats module 2 index 1
```

Displaying Flow Statistics

Use the **show fcflow stats** commands to view flow statistics (see Example Displays Aggregated Flow Details for the Specified Module, on page 190 to Displays Flow Index Usage for the Specified Module, on page 191).

Displays Aggregated Flow Details for the Specified Module

```
switch# show fcflow stats aggregated module 6
```

```
Idx  VSAN frames        bytes
---- ---- --------    -------
1  800   20185860     1211151600
```

Displays Flow Details for the Specified Module

```
switch# show fcflow stats module 6
Idx   VSAN   DID    SID    Mask        frames      bytes
---- -----  --------      ------     -----     -----   ------
2   800   0x520400    0x530260   0xffffff      20337793 1220267580
```

Displays Flow Index Usage for the Specified Module

```
switch# show fcflow stats usage module 6
Configured flows for module 6: 1-2
```

Displaying Global FSPF Information

Displays FSPF Information for a Specified VSAN, on page 191 displays global FSPF information for a specific VSAN:

- Domain number of the switch.
- Autonomous region for the switch.
- Min_LS_arrival: minimum time that must elapse before the switch accepts LSR updates.
- Min_LS_interval: minimum time that must elapse before the switch can transmit an LSR.

Tip If the Min_LS_interval is higher than 10 seconds, the graceful shutdown feature is not implemented.

- LS_refresh_time: interval time lapse between refresh LSR transmissions.
- Max_age: maximum time aa LSR can stay before being deleted.

Displays FSPF Information for a Specified VSAN

```
switch# show fspf vsan 1
FSPF routing for VSAN 1
FSPF routing administration status is enabled
FSPF routing operational status is UP
It is an intra-domain router
Autonomous region is 0
SPF hold time is 0 msec
MinLsArrival = 1000 msec , MinLsInterval = 5000 msec
Local Domain is 0x65(101)
Number of LSRs = 3, Total Checksum = 0x0001288b
Protocol constants :
   LS_REFRESH_TIME = 1800 sec
   MAX_AGE         = 3600 sec
Statistics counters :
   Number of LSR that reached MaxAge = 0
   Number of SPF computations        = 7
   Number of Checksum Errors         = 0
   Number of Transmitted packets :  LSU 65 LSA 55 Hello 474 Retranmsitted LSU 0
   Number of received packets :  LSU 55 LSA 60 Hello 464 Error packets 10
```

Displaying the FSPF Database

Displays FSPF Database Information, on page 192 displays a summary of the FSPF database for a specified VSAN. If other parameters are not specified, all LSRs in the database are displayed:

- LSR type
- Domain ID of the LSR owner
- Domain ID of the advertising router
- LSR age
- LSR incarnation member
- Number of links

You could narrow the display to obtain specific information by issuing additional parameters for the domain ID of the LSR owner. For each interface, the following information is also available:

- Domain ID of the neighboring switch
- E port index
- Port index of the neighboring switch
- Link type and cost

Displays FSPF Database Information

```
switch# show fspf database vsan 1
FSPF Link State Database for VSAN 1 Domain 0x0c(12)
LSR Type                = 1
Advertising domain ID   = 0x0c(12)
LSR Age                 = 1686
LSR Incarnation number  = 0x80000024
LSR Checksum            = 0x3caf
Number of links         = 2
 NbrDomainId      IfIndex   NbrIfIndex    Link Type         Cost
-----------------------------------------------------------------------------
   0x65(101) 0x0000100e     0x00001081               1          500
   0x65(101) 0x0000100f     0x00001080               1          500
FSPF Link State Database for VSAN 1 Domain 0x65(101)
LSR Type                = 1
Advertising domain ID   = 0x65(101)
LSR Age                 = 1685
LSR Incarnation number  = 0x80000028
LSR Checksum            = 0x8443
Number of links         = 6
 NbrDomainId      IfIndex   NbrIfIndex    Link Type         Cost
-----------------------------------------------------------------------------
   0xc3(195) 0x00001085     0x00001095               1          500
   0xc3(195) 0x00001086     0x00001096               1          500
   0xc3(195) 0x00001087     0x00001097               1          500
   0xc3(195) 0x00001084     0x00001094               1          500
    0x0c(12) 0x00001081     0x0000100e               1          500
    0x0c(12) 0x00001080     0x0000100f               1          500
FSPF Link State Database for VSAN 1 Domain 0xc3(195)
LSR Type                = 1
Advertising domain ID   = 0xc3(195)
LSR Age                 = 1686
LSR Incarnation number  = 0x80000033
LSR Checksum            = 0x6799
Number of links         = 4
```

```
 NbrDomainId      IfIndex   NbrIfIndex    Link Type         Cost
-----------------------------------------------------------------------------
    0x65(101) 0x00001095     0x00001085               1          500
    0x65(101) 0x00001096     0x00001086               1          500
    0x65(101) 0x00001097     0x00001087               1          500
    0x65(101) 0x00001094     0x00001084               1          500
```

Displaying FSPF Interfaces

Displays FSPF Interface Information, on page 193 displays the following information for each selected interface.

- Link cost
- Timer values
- Neighbor's domain ID (if known)
- Local interface number
- Remote interface number (if known)
- FSPF state of the interface
- Interface counters

Displays FSPF Interface Information

```
switch# show fspf vsan 1 interface fc1/1
FSPF interface fc1/1 in VSAN 1
FSPF routing administrative state is active
Interface cost is 500
Timer intervals configured, Hello 20 s, Dead 80 s, Retransmit 5 s
FSPF State is FULL
Neighbor Domain Id is 0x0c(12), Neighbor Interface index is 0x0f100000
Statistics counters :
   Number of packets received : LSU  8  LSA  8  Hello 118  Error packets 0
   Number of packets transmitted : LSU  8  LSA  8  Hello 119  Retransmitted LSU 0
   Number of times inactivity timer expired for the interface = 0
```

Default Settings

Table 19: Default FSPF Settings , on page 193 lists the default settings for FSPF features.

Table 19: Default FSPF Settings

Parameters	Default
FSPF	Enabled on all E ports and TE ports.
SPF computation	Dynamic.
SPF hold time	0.
Backbone region	0.

Parameters	Default
Acknowledgment interval (RxmtInterval)	5 seconds.
Refresh time (LSRefreshTime)	30 minutes.
Maximum age (MaxAge)	60 minutes.
Hello interval	20 seconds.
Dead interval	80 seconds.
Distribution tree information	Derived from the principal switch (root node).
Routing table	FSPF stores up to 16 equal cost paths to a given destination.
Load balancing	Based on destination ID and source ID on different, equal cost paths.
In-order delivery	Disabled.
Drop latency	Disabled.
Static route cost	If the cost (metric) of the route is not specified, the default is 10.
Remote destination switch	If the remote destination switch is not specified, the default is direct.
Multicast routing	Uses the principal switch to compute the multicast tree.

CHAPTER 8

Configuring Dense Wavelength Division Multiplexing

This chapter includes the following topics:

About DWDM

Dense Wavelength-Division Multiplexing (DWDM) multiplexes multiple optical carrier signals on a single optical fiber. DWDM uses different wavelengths to carry various signals.

To establish a DWDM link, both ends of an Inter Switch Link (ISL) need to be connected with DWDM SFPs (small form-factor pluggable) at each end of the link. To identify a DWDM link, Fabric Manager discovers the connector type on the Fiber Channel (FC) ports. If the ISL link is associated with the FC ports at each end, then the FC port uses DWDM SFP to connect the links.

Fabric Manager Server discovers FC ports with DWDM SFPs and the ISLs associated with the FC ports. The Fabric Manager Client displays ISL with DWDM attribute on the topology map.

Note The Fabric Shortest Path First (FSPF) database only displays an ISL link, which is connected with DWDM SFPs at both ends.

Configuring X2 DWDM Transceiver Frequency

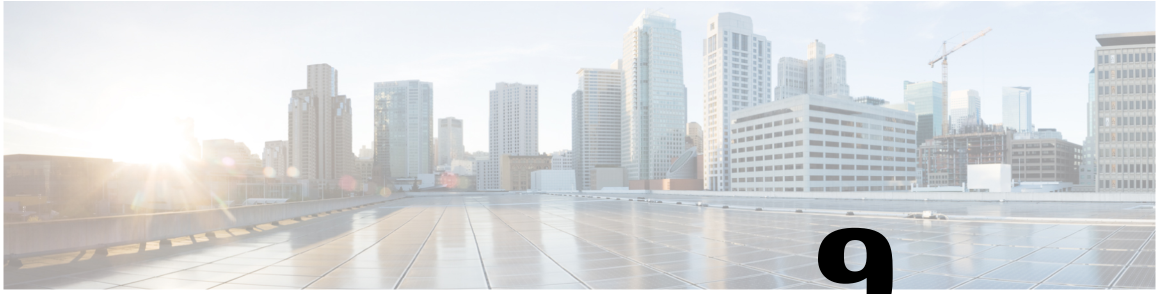
To configure X2 DWDM transceiver frequency for a module, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# **module** *1* **transceiver-frequency x2-eth**
Configures the link to fuction as X2 Ethernet.

Step 3 switch(config)# **module** *1* **transceiver-frequency x2-fc**
Configures (default) the link to function as X2 FC.

Note This feature is not supported in other than MDS 9134 modules. In MDS 9134 modules, the 10-Gigabit Ethernet ports must be in down state when you configure the X2 transceiver frequency.



CHAPTER 9

Managing FLOGI, Name Server, FDMI, and RSCN Databases

This chapter describes the fabric login (FLOGI) database, the name server features, the Fabric-Device Management Interface, and Registered State Change Notification (RSCN) information provided in the Cisco MDS 9000 Family. It includes the following sections:

About FLOGI

In a Fibre Channel fabric, each host or disk requires an Fibre Channel ID. Use the **show flogi** command to verify if a storage device is displayed in the FLOGI table as in the next section. If the required device is displayed in the FLOGI table, the fabric login is successful. Examine the FLOGI database on a switch that is directly connected to the host HBA and connected ports.

Displaying FLOGI Details

To view the FLOGI database details, use the show flogi database command. See Examples Displays Details on the FLOGI Database , on page 197 to Displays the FLOGI Database by FC ID, on page 198.

Displays Details on the FLOGI Database

```
switch# show flogi database
---------------------------------------------------------------------------
```

```
INTERFACE  VSAN    FCID            PORT NAME               NODE NAME
---------------------------------------------------------------------------
sup-fc0    2     0xb30100  10:00:00:05:30:00:49:63  20:00:00:05:30:00:49:5e
fc9/13     1     0xb200e2  21:00:00:04:cf:27:25:2c  20:00:00:04:cf:27:25:2c
fc9/13     1     0xb200e1  21:00:00:04:cf:4c:18:61  20:00:00:04:cf:4c:18:61
fc9/13     1     0xb200d1  21:00:00:04:cf:4c:18:64  20:00:00:04:cf:4c:18:64
fc9/13     1     0xb200ce  21:00:00:04:cf:4c:16:fb  20:00:00:04:cf:4c:16:fb
fc9/13     1     0xb200cd  21:00:00:04:cf:4c:18:f7  20:00:00:04:cf:4c:18:f7
Total number of flogi = 6.
```

Displays the FLOGI Database by Interface

```
switch# show flogi database interface fc1/11
INTERFACE   VSAN    FCID        PORT NAME                   NODE NAME
----------  ------  ---------   -----------------------     ---------------------
fc1/11      1       0xa002ef    21:00:00:20:37:18:17:d2     20:00:00:20:37:18:17:d2
fc1/11      1       0xa002e8    21:00:00:20:37:38:a7:c1     20:00:00:20:37:38:a7:c1
fc1/11      1       0xa002e4    21:00:00:20:37:6b:d7:18     20:00:00:20:37:6b:d7:18
fc1/11      1       0xa002e2    21:00:00:20:37:18:d2:45     20:00:00:20:37:18:d2:45
fc1/11      1       0xa002e1    21:00:00:20:37:39:90:6a     20:00:00:20:37:39:90:6a
fc1/11      1       0xa002e0    21:00:00:20:37:36:0b:4d     20:00:00:20:37:36:0b:4d
fc1/11      1       0xa002dc    21:00:00:20:37:5a:5b:27     20:00:00:20:37:5a:5b:27
fc1/11      1       0xa002da    21:00:00:20:37:18:6f:90     20:00:00:20:37:18:6f:90
fc1/11      1       0xa002d9    21:00:00:20:37:5b:cf:b9     20:00:00:20:37:5b:cf:b9
fc1/11      1       0xa002d6    21:00:00:20:37:46:78:97     0:00:00:20:37:46:78:97
Total number of flogi = 10.
```

Displays the FLOGI Database by VSAN

```
switch# show flogi database vsan 1
---------------------------------------------------------------------------
INTERFACE  VSAN    FCID            PORT NAME               NODE NAME
---------------------------------------------------------------------------
fc1/3      1     0xef02ef  22:00:00:20:37:18:17:d2  20:00:00:20:37:18:17:d2
fc1/3      1     0xef02e8  22:00:00:20:37:38:a7:c1  20:00:00:20:37:38:a7:c1
fc1/3      1     0xef02e4  22:00:00:20:37:6b:d7:18  20:00:00:20:37:6b:d7:18
fc1/3      1     0xef02e2  22:00:00:20:37:18:d2:45  20:00:00:20:37:18:d2:45
fc1/3      1     0xef02e1  22:00:00:20:37:39:90:6a  20:00:00:20:37:39:90:6a
fc1/3      1     0xef02e0  22:00:00:20:37:36:0b:4d  20:00:00:20:37:36:0b:4d
fc1/3      1     0xef02dc  22:00:00:20:37:5a:5b:27  20:00:00:20:37:5a:5b:27
fc1/3      1     0xef02da  22:00:00:20:37:18:6f:90  20:00:00:20:37:18:6f:90
fc1/3      1     0xef02d9  22:00:00:20:37:5b:cf:b9  20:00:00:20:37:5b:cf:b9
fc1/3      1     0xef02d6  22:00:00:20:37:46:78:97  20:00:00:20:37:46:78:97
Total number of flogi = 10.
```

Displays the FLOGI Database by FC ID

```
switch# show flogi database fcid 0xef02e2
---------------------------------------------------------------------------
INTERFACE  VSAN    FCID            PORT NAME               NODE NAME
---------------------------------------------------------------------------
fc1/3      1     0xef02e2  22:00:00:20:37:18:d2:45  20:00:00:20:37:18:d2:45
Total number of flogi = 1.
```

For more information, see the Default Company ID List, on page 286 and refer to the “Loop Monitoring” section in the *Cisco MDS 9000 Family Troubleshooting Guide*.

Name Server

The name server functionality maintains a database containing the attributes for all hosts and storage devices in each VSAN. Name servers allow a database entry to be modified by a device that originally registered the information.

The proxy feature is useful when you want to modify (update or delete) the contents of a database entry that was previously registered by a different device.

This section includes the following topics:

Bulk Notification Sent from the Name Server

In order to improve the performance of the Fibre Channel protocols on the Cisco MDS 9000 switch, the name server optimizes the remote entry change notifications by sending multiple notifications in one MTS payload. Nearly 10 other components that receive this MTS notification would have to function on the single bulk notification instead of multiple notifications.

Enabling Name Server Bulk Notification

For NX-OS Release 6.2(1) to 6.2(7), bulk notification is disabled by default. Enabling this feature in one switch has no bearing on the other switches in the same fabric.

Note From NX-OS Release 6.2(9) onwards, bulk notification is enabled by default.

Restrictions

- Whenever the intelligent applications such as the DMM, IOA, and SME are enabled, the bulk notification feature is not supported.
- Any configuration present in the FC-Redirect, conflicts with the bulk notification feature.

Note The above restrictions are applicable only to release 6.2.7.

To enable the name server bulk notification, follow these steps for NX-OS Release 6.2(1) to 6.2(7):

Step 1 switch# **config t**

Enters configuration mode.

Step 2 switch(config)# **fcns bulk-notify**

switch(config)#

Enables the transmission of multiple name server entry change notification in one Messaging and Transaction Services (MTS) payload.

Disabling Name Server Bulk Notification

To disable the name server bulk notification, follow these steps for NX-OS Release 6.2(1) to 6.2(7):

Step 1 switch# **config t**
Enters configuration mode.

Step 2 switch(config)# **no fcns bulk-notify**
switch(config)#

Disables the transmission of multiple name server entry change notification in one Messaging and Transaction Services (MTS) payload.

Disabling Name Server Bulk Notification for NX-OS Release 6.2(9)

To disable the name server bulk notification, follow these steps for NX-OS Release 6.2(9) and later:

Step 1 switch# **config t**
Enters configuration mode.

Step 2 switch(config)# **fcns no-bulk-notify**
switch(config)#

Disables the transmission of multiple name server entry change notification in one Messaging and Transaction Services (MTS) payload.

Re-enabling Name Server Bulk Notification

To re-enable once it is disabled already for NX-OS Release 6.2(9) and later, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# **no fcns no-bulk-notify**
switch(config)#

Re-enables the transmission of multiple name server entry change notification in one Messaging and Transaction Services (MTS) payload.

Name Server Proxy Registration

All name server registration requests are sent from the same port with a parameter that is registered or changed. If the port that does not have the parameter, then the request is rejected.

This authorization enables WWNs to register specific parameters for another node.

Registering Name Server Proxies

To register the name server proxy, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fcns proxy-port 21:00:00:e0:8b:00:26:d0 vsan 2**
Configures a proxy port for the specified VSAN.

About Rejecting Duplicate pWWN

By FC standard, NX-OS will accept a login on any interface of a pwwn that is already logged in on the same switch, same vsan and same fcdomain. To prevent the same pwwn from logging in the same switch on a different interface, use the port security feature.

By default, any future flogi (with duplicate pwwn) on different switch in the same vsan, will be rejected and previous FLOGI retained, which does not follow FC standards. If you disable this option, any future flogi (with duplicate pwwn) on different switch in the same VSAN, would be allowed to succeed by deleting previous FCNS entry

Rejecting Duplicate pWWNs

To reject duplicate pWWNs, follow these steps:

Step 1 switch# **configure terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fcns reject-duplicate-pwwn vsan 1**
Any future flogi (with duplicate pwwn) on different switch, will be rejected and previous FLOGI retained. (default)

Step 3 switch(config)# **no fcns reject-duplicate-pwwn vsan 1**
Any future flogi (with duplicate pwwn) on different switch, will be allowed to succeed by deleting earlier FCNS entry.

But you can still see the earlier entry in FLOGI database in the other switch.

Name Server Database Entries

The name server stores name entries for all hosts in the FCNS database. The name server permits an Nx port to register attributes during a PLOGI (to the name server) to obtain attributes of other hosts. These attributes are deregistered when the Nx port logs out either explicitly or implicitly.

In a multiswitch fabric configuration, the name server instances running on each switch shares information in a distributed database. One instance of the name server process runs on each switch.

Optimizing Name Server Database Sync

If an end device doesn't register FC4 feature with Name Server database, VHBA (also called scsi-target) component would perform PRLI to the end device to discover FC4 feature and register with Name Server on behalf of end device. This discovery from VHBA was performed both for locally connected devices

as well as remotely connected devices. This discovery was unnecessary for remotely connected devices because, Name Server would get FC4 feature of remotely connected devices through regular Name Server sync protocol. So, the default behavior of VHBA component has been modified to discover only locally connected devices. To modify this behavior, follow these steps:

Step 1 switch(config)# scsi-target discovery
Enables a switch to discover fc4-feature for

remote devices also. But this would not be

the default behavior if the users reload or switchover the switch.

Step 2 switch(config)# scsi-target discovery local-only
Switches back to the default behavior.

Verifying the Number of Name Server Database Entries

To Verify the number of name server database entries, follow these steps:

Step 1 switch# show fcns internal info global
Displays the number of device entries in the name server database.

Step 2 switch# show fcns internal info
Displays the number of devices in the name server database at the end of the output.

Displaying Name Server Database Entries

Use the **show fcns** command to display the name server database and statistical information for a specified VSAN or for all VSANs (see Examples Displays the Name Server Database, on page 203 to Displays the Name Server Statistics, on page 204).

Displays the Name Server Database

```
switch# show fcns database
--------------------------------------------------------------------------
FCID        TYPE  PWWN                    (VENDOR)        FC4-TYPE:FEATURE
--------------------------------------------------------------------------
0x010000    N     50:06:0b:00:00:10:a7:80                   scsi-fcp fc-gs
0x010001    N     10:00:00:05:30:00:24:63 (Cisco)           ipfc
0x010002    N     50:06:04:82:c3:a0:98:52 (Company 1)       scsi-fcp 250
0x010100    N     21:00:00:e0:8b:02:99:36 (Company A)       scsi-fcp
0x020000    N     21:00:00:e0:8b:08:4b:20 (Company A)
0x020100    N     10:00:00:05:30:00:24:23 (Cisco)         ipfc
0x020200    N     21:01:00:e0:8b:22:99:36 (Company A)       scsi-fcp
```

Displays the Name Server Database for the Specified VSAN

```
switch# show fcns database vsan 1
VSAN 1:
--------------------------------------------------------------------------
FCID        TYPE  PWWN                    (VENDOR)        FC4-TYPE:FEATURE
--------------------------------------------------------------------------
0x030001    N     10:00:00:05:30:00:25:a3 (Cisco)         ipfc
0x030101    NL    10:00:00:00:77:99:60:2c (Interphase)
0x030200    N     10:00:00:49:c9:28:c7:01
0xec0001    NL    21:00:00:20:37:a6:be:14 (Seagate)       scsi-fcp
Total number of entries = 4
```

Displays the Name Server Database Details

```
switch# show fcns database detail
------------------------
VSAN:1     FCID:0x030001
------------------------
port-wwn (vendor)     :10:00:00:05:30:00:25:a3 (Cisco)
node-wwn              :20:00:00:05:30:00:25:9e
class                 :2,3
node-ip-addr          :0.0.0.0
ipa                   :ff ff ff ff ff ff ff ff
fc4-types:fc4_features:ipfc
symbolic-port-name    :
symbolic-node-name    :
port-type             :N
port-ip-addr          :0.0.0.0
fabric-port-wwn       :00:00:00:00:00:00:00:00
hard-addr             :0x000000
------------------------
VSAN:1     FCID:0xec0200
------------------------
port-wwn (vendor)     :10:00:00:5a:c9:28:c7:01
node-wwn              :10:00:00:5a:c9:28:c7:01
class                 :3
node-ip-addr          :0.0.0.0
ipa                   :ff ff ff ff ff ff ff ff
```

```
fc4-types:fc4_features:
symbolic-port-name    :
symbolic-node-name    :
port-type             :N
port-ip-addr          :0.0.0.0
fabric-port-wwn       :22:0a:00:05:30:00:26:1e
hard-addr             :0x000000
Total number of entries = 2
```

Displays the Name Server Statistics

```
switch# show fcns statistics

registration requests received = 27
deregistration requests received = 0
queries received = 57
queries sent = 10
reject responses sent = 14
RSCNs received = 0
RSCNs sent = 0
```

FDMI

Cisco MDS 9000 Family switches provide support for the Fabric-Device Management Interface (FDMI) functionality, as described in the FC-GS-4 standard. FDMI enables management of devices such as Fibre Channel host bus adapters (HBAs) through in-band communications. This addition complements the existing Fibre Channel name server and management server functions.

Using the FDMI functionality, the Cisco NX-OS software can extract the following management information about attached HBAs and host operating systems without installing proprietary host agents:

- Manufacturer, model, and serial number
- Node name and node symbolic name
- Hardware, driver, and firmware versions
- Host operating system (OS) name and version number

All FDMI entries are stored in persistent storage and are retrieved when the FDMI process is started.

Displaying FDMI

Use the **show fdmi** command to display the FDMI database information (see Examples Displays All HBA Management Servers, on page 204 to Displays Details for the Specified HBA Entry, on page 205).

Displays All HBA Management Servers

```
switch# show fdmi database
Registered HBA List for VSAN 1
  10:00:00:00:c9:32:8d:77
  21:01:00:e0:8b:2a:f6:54
switch# show fdmi database detail
Registered HBA List for VSAN 1
-------------------------------
HBA-ID: 10:00:00:00:c9:32:8d:77
-------------------------------
Node Name        :20:00:00:00:c9:32:8d:77
```

```
Manufacturer     :Emulex Corporation
Serial Num       :0000c9328d77
Model            :LP9002
Model Description:Emulex LightPulse LP9002 2 Gigabit PCI Fibre Channel Adapter
Hardware Ver     :2002606D
Driver Ver       :SLI-2 SW_DATE:Feb 27 2003, v5-2.20a12
ROM Ver          :3.11A0
Firmware Ver     :3.90A7
OS Name/Ver      :Window 2000
CT Payload Len   :1300000
  Port-id: 10:00:00:00:c9:32:8d:77
-------------------------------
HBA-ID: 21:01:00:e0:8b:2a:f6:54
-------------------------------
Node Name        :20:01:00:e0:8b:2a:f6:54
Manufacturer     :QLogic Corporation
Serial Num       :\74262
Model            :QLA2342
Model Description:QLogic QLA2342 PCI Fibre Channel Adapter
Hardware Ver     :FC5010409-10
Driver Ver       :8.2.3.10 Beta 2 Test 1 DBG (W2K VI)
ROM Ver          :1.24
Firmware Ver     :03.02.13.
OS Name/Ver      :500
CT Payload Len   :2040
  Port-id: 21:01:00:e0:8b:2a:f6:54
```

Displays HBA Details for a Specified VSAN

```
switch# show fdmi database detail vsan 1
Registered HBA List for VSAN 1
-------------------------------
HBA-ID: 10:00:00:00:c9:32:8d:77
-------------------------------
Node Name        :20:00:00:00:c9:32:8d:77
Manufacturer     :Emulex Corporation
Serial Num       :0000c9328d77
Model            :LP9002
Model Description:Emulex LightPulse LP9002 2 Gigabit PCI Fibre Channel Adapter
Hardware Ver     :2002606D
Driver Ver       :SLI-2 SW_DATE:Feb 27 2003, v5-2.20a12
ROM Ver          :3.11A0
Firmware Ver     :3.90A7
OS Name/Ver      :Window 2000
CT Payload Len   :1300000
  Port-id: 10:00:00:00:c9:32:8d:77
-------------------------------
HBA-ID: 21:01:00:e0:8b:2a:f6:54
-------------------------------
Node Name        :20:01:00:e0:8b:2a:f6:54
Manufacturer     :QLogic Corporation
Serial Num       :\74262
Model            :QLA2342
Model Description:QLogic QLA2342 PCI Fibre Channel Adapter
Hardware Ver     :FC5010409-10
Driver Ver       :8.2.3.10 Beta 2 Test 1 DBG (W2K VI)
ROM Ver          :1.24
Firmware Ver     :03.02.13.
OS Name/Ver      :500
CT Payload Len   :2040
  Port-id: 21:01:00:e0:8b:2a:f6:54
```

Displays Details for the Specified HBA Entry

```
switch# show fdmi database detail hba-id 21:01:00:e0:8b:2a:f6:54 vsan 1
Node Name        :20:01:00:e0:8b:2a:f6:54
Manufacturer     :QLogic Corporation
Serial Num       :\74262
Model            :QLA2342
Model Description:QLogic QLA2342 PCI Fibre Channel Adapter
Hardware Ver     :FC5010409-10
Driver Ver       :8.2.3.10 Beta 2 Test 1 DBG (W2K VI)
ROM Ver          :1.24
Firmware Ver     :03.02.13.
OS Name/Ver      :500
CT Payload Len   :2040
  Port-id: 21:01:00:e0:8b:2a:f6:54
```

RSCN

The Registered State Change Notification (RSCN) is a Fibre Channel service that informs hosts about changes in the fabric. Hosts can receive this information by registering with the fabric controller (through SCR). These notifications provide a timely indication of one or more of the following events:

- Disks joining or leaving the fabric.
- A name server registration change.
- A new zone enforcement.
- IP address change.
- Any other similar event that affects the operation of the host.

This section includes the following topics:

About RSCN Information

Apart from sending these events to registered hosts, a switch RSCN (SW-RSCN) is sent to all reachable switches in the fabric.

Note The switch sends an RSCN to notify registered nodes that a change has occurred. It is up to the nodes to query the name server again to obtain the new information. The details of the changed information are not delivered by the switch in the RSCN sent to the nodes.

Displaying RSCN Information

Use the **show rscn** command to display RSCN information (see Examples Displays Register Device Information, on page 206 and Displays RSCN Counter Information, on page 207).

Displays Register Device Information

```
switch# show rscn scr-table vsan 1
SCR table for VSAN: 1
---------------------------------------------
FC-ID         REGISTERED FOR
---------------------------------------------
0x1b0300      fabric detected rscns
Total number of entries = 1
```

Note The SCR table is not configurable. It is populated when hosts send SCR frames with RSCN information. If hosts do not receive RSCN information, then the **show rscn scr-table** command will not return entries.

Displays RSCN Counter Information

```
switch(config)# show rscn statistics vsan 106
Statistics for VSAN: 106
-------------------------
Number of SCR received          = 0
Number of SCR ACC sent          = 0
Number of SCR RJT sent          = 0
Number of RSCN received         = 0
Number of RSCN sent             = 0
Number of RSCN ACC received     = 0
Number of RSCN ACC sent         = 0
Number of RSCN RJT received     = 0
Number of RSCN RJT sent         = 0
Number of SW-RSCN received      = 0
Number of SW-RSCN sent          = 0
Number of SW-RSCN ACC received  = 0
Number of SW-RSCN ACC sent      = 0
Number of SW-RSCN RJT received  = 0
Number of SW-RSCN RJT sent      = 0
Number of CSWR received         = 3137
Number of CSWR sent             = 0
Number of CSWR ACC received     = 0
Number of CSWR ACC sent         = 3137
Number of CSWR RJT received     = 0
Number of CSWR RJT sent         = 0
Number of CSWR RJT not sent     = 0
```

multi-pid Option

If the RSCN **multi-pid** option is enabled, then RSCNs generated to the registered Nx ports may contain more than one affected port IDs. In this case, zoning rules are applied before putting the multiple affected port IDs together in a single RSCN. By enabling this option, you can reduce the number of RSCNs. For example: Suppose you have two disks (D1, D2) and a host (H) connected to switch 1. Host H is registered to receive RSCNs. D1, D2 and H belong to the same zone. If disks D1 and D2 are online at the same time, then one of the following applies:

- The **multi-pid** option is disabled on switch 1: two RSCNs are generated to host H—one for the disk D1 and another for disk D2.
- The **multi-pid** option is enabled on switch 1: a single RSCN is generated to host H, and the RSCN payload lists the affected port IDs (in this case, both D1 and D2).

Note Some Nx ports may not understand multi-pid RSCN payloads. If not, disable the RSCN **multi-pid** option.

Configuring the multi-pid Option

To configure the **multi-pid** option, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **rscn multi-pid vsan 105**
Sends RSCNs in a multi-pid format for VSAN 105.

Suppressing Domain Format SW-RSCNs

A domain format SW-RSCN is sent whenever the local switch name or the local switch management IP address changes. This SW-RSCN is sent to all other domains and switches over the ISLs. The remote switches can issue GMAL and GIELN commands to the switch that initiated the domain format SW-RSCN to determine what changed. Domain format SW-RSCNs can cause problems with some non-Cisco MDS switches (refer to the).

To suppress the transmission of these SW RSCNs over an ISL, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **rscn suppress domain-swrscn vsan 105**
Suppresses transmission of domain format SW-RSCNs for VSAN 105.

Note You cannot suppress transmission of port address or area address format RSCNs.

Coalesced SW-RSCN

In order to improve the performance of the Fibre Channel protocols on the Cisco MDS 9000 switch, SW-RSCNs are delayed, collected and sent as a single coalesced SW-RSCN to all the switches in the fabric in a single Fibre Channel exchange.

Enabling Coalesced SW-RSCNs

Restrictions

- All the switches in the fabric should be running Cisco MDS 6.2(7) and above.
- This feature does not have interoperability with non-Cisco MDS switches.

To enable the coalesced SW-RSCNs, follow these step:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# rscn coalesce swrscn vsan 1
switch(config)#

Enables coalescing of Switch Registered State Change Notification (SWRSCN) in VSAN 1. The default delay is 500 milliseconds.

Step 3 switch(config)# rscn coalesce swrscn vsan 1 delay 800
switch(config)#

Enables coalescing of Switch Registered State Change Notification (SWRSCN) in VSAN 1. Delays the SW-RSCNs maximum by 800 milliseconds.

Note All the switches running 6.2(7) and above are capable of processing coalesced SW-RSCN by default, but they are capable of sending coalesced SW-RSCN only after enabling through CLI.

Disabling Coalesced SW-RSCNs

To disable the coalesced SW-RSCNs, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# no rscn coalesce swrscn vsan 1
switch(config)#

Disables coalescing of Switch Registered State Change Notification (SWRSCN) in VSAN 1.

Clearing RSCN Statistics

You can clear the counters and later view the counters for a different set of events. For example, you can keep track of how many RSCNs or SW-RSCNs are generated on a particular event (such as ONLINE or OFFLINE events). You can use these statistics to monitor responses for each event in the VSAN.

Use the **clear rscn statistics** command to clear the RSCN statistics for the specified VSAN.

```
switch# clear rscn statistics vsan 1
```

After clearing the RSCN statistics, you can view the cleared counters by issuing the **show rscn** command.

```
switch# show rscn statistics vsan 1
Statistics for VSAN: 1
-------------------------
Number of SCR received         = 0
Number of SCR ACC sent         = 0
Number of SCR RJT sent         = 0
Number of RSCN received        = 0
Number of RSCN sent            = 0
Number of RSCN ACC received    = 0
Number of RSCN ACC sent        = 0
Number of RSCN RJT received    = 0
Number of RSCN RJT sent        = 0
Number of SW-RSCN received     = 0
Number of SW-RSCN sent         = 0
Number of SW-RSCN ACC received = 0
Number of SW-RSCN ACC sent     = 0
Number of SW-RSCN RJT received = 0
Number of SW-RSCN RJT sent     = 0
Number of CSWR received        = 0
Number of CSWR sent            = 0
Number of CSWR ACC received    = 0
Number of CSWR ACC sent        = 0
Number of CSWR RJT received    = 0
Number of CSWR RJT sent        = 0
Number of CSWR RJT not sent    = 0
```

RSCN Timer Configuration Distribution Using CFS

Because the timeout value for each switch is configured manually, a misconfiguration occurs when different switches time out at different times. This means different N ports in a network can receive RSCNs at different times. Cisco Fabric Services (CFS) alleviates this situation by automatically distributing configuration information to all switches in a fabric. This also reduces the number of SW-RSCNs.

RSCN supports two modes, distributed and nondistributed. In distributed mode, RSCN uses CFS to distribute configuration to all switches in the fabric. In nondistributed mode, only the configuration commands on the local switch are affected.

Note All configuration commands are not distributed. Only the **rscn event-tov tov vsan vsan** command is distributed.

The RSCN timer is registered with CFS during initialization and switchover. For high availability, if the RSCN timer distribution crashes and restarts or a switchover occurs, it resumes normal functionality from the state prior to the crash or switchover.

Note Before performing a downgrade, make sure that you revert the RCSN timer value in your network to the default value. Failure to do so will disable the links across your VSANs and other devices.

Compatibility across various Cisco MDS NX-OS releases during an upgrade or downgrade is supported by **conf-check** provided by CFS. If you attempt to downgrade from Cisco MDS SAN-OS Release 3.0, you are prompted with a **conf-check** warning. You are required to disable RSCN timer distribution support before you downgrade.

By default, the RSCN timer distribution capability is disabled and is therefore compatible when upgrading from any Cisco MDS SAN-OS release earlier than Release 3.0.

Configuring the RSCN Timer

RSCN maintains a per-VSAN event list queue, where the RSCN events are queued as they are generated. When the first RSCN event is queued, a per VSAN timer starts. Upon time-out, all the events are dequeued and coalesced RSCNs are sent to registered users. The default timer values minimize the number of coalesced RSCNs sent to registered users. Some deployments require smaller event timer values to track changes in the fabric.

Note The RSCN timer value must be the same on all switches in the VSAN. See the RSCN Timer Configuration Distribution, on page 212.

Note Before performing a downgrade, make sure that you revert the RCSN timer value in your network to the default value. Failure to do so will disable the links across your VSANs and other devices.

To configure the RSCN timer, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **rscn distribute**
Enables RSCN timer configuration distribution.

Step 3 switch(config)# **rscn event-tov 300 vsan 10**
Sets the event time-out value in milliseconds for the selected VSAN. In this example, the event time-out value is set to 300 milliseconds for VSAN 12. The range is 0 to 2000 milliseconds. Setting a zero (0) value disables the timer.

Step 4 switch(config)# **no rscn event-tov 300 vsan 10**
Reverts to the default value (2000 milliseconds for Fibre Channel VSANs or 1000 milliseconds for FICON VSANs).

Step 5 switch(config)# **rscn commit vsan 10**
Commits the RSCN timer configuration to be distributed to the switches in VSAN 10.

Verifying the RSCN Timer Configuration

You verify the RSCN timer configuration using the **show rscn event-tov vsan** command.

```
switch# show rscn event-tov vsan 10
Event TOV : 1000 ms
```

RSCN Timer Configuration Distribution

Because the timeout value for each switch is configured manually, a misconfiguration occurs when different switches time out at different times. This means different N-ports in a network can receive RSCNs at different times. Cisco Fabric Services (CFS) infrastructure alleviates this situation by automatically distributing the RSCN timer configuration information to all switches in a fabric. This also reduces the number of SW-RSCNs. Refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .

RSCN supports two modes, distributed and nondistributed. In distributed mode, RSCN uses CFS to distribute configuration to all switches in the fabric. In nondistributed mode, only the configuration commands on the local switch are affected.

Note All configuration commands are not distributed. Only the **rscn event-tov tov vsan vsan** command is distributed.

Note Only the RSCN timer configuration is distributed.

The RSCN timer is registered with CFS during initialization and switchover. For high availability, if the RSCN timer distribution crashes and restarts or a switchover occurs, it resumes normal functionality from the state prior to the crash or switchover.

Note You can determine the compatibility when downgrading to an earlier Cisco MDS NX-OS release using **show incompatibility system** command. You must disable RSCN timer distribution support before downgrading to an earlier release.

Note By default, the RSCN timer distribution capability is disabled and is compatible when upgrading from any Cisco MDS SAN-OS release earlier than 3.0.

Note For CFS distribution to operate correctly for the RSCN timer configuration, all switches in the fabric must be running Cisco SAN-OS Release 3.0(1) or later, or Cisco NX-OS 4.1(1b).

This section includes the following topics:

Enabling RSCN Timer Configuration Distribution

To enable RSCN timer configuration distribution, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **rscn distribute**
Enables RSCN timer distribution.

Step 3 switch(config)# **no rscn distribute**
Disables (default) RSCN timer distribution.

Locking the Fabric

The first action that modifies the database creates the pending database and locks the feature in the VSAN. Once you lock the fabric, the following situations apply:

- No other user can make any configuration changes to this feature.
- A copy of the configuration database becomes the pending database along with the first active change.

Committing the RSCN Timer Configuration Changes

If you commit the changes made to the active database, the configuration is committed to all the switches in the fabric. On a successful commit, the configuration change is applied throughout the fabric and the lock is released.

To commit RSCN timer configuration changes, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **rscn commit vsan 10**
Commits the RSCN timer changes.

Discarding the RSCN Timer Configuration Changes

If you discard (abort) the changes made to the pending database, the configuration database remains unaffected and the lock is released.

To discard RSCN timer configuration changes, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **rscn abort vsan 10**
Discards the RSCN timer changes and clears the pending configuration database.

Clearing a Locked Session

If you have changed the RSCN timer configuration and have forgotten to release the lock by either committing or discarding the changes, an administrator can release the lock from any switch in the fabric. If the administrator performs this task, your changes to the pending database are discarded and the fabric lock is released.

Tip The pending database is only available in the volatile directory and are subject to being discarded if the switch is restarted.

To use administrative privileges and release a locked DPVM session, use the **clear rscn session vsan** command in EXEC mode.

```
switch# clear rscn session vsan 10
```

Displaying RSCN Configuration Distribution Information

Use the **show cfs application name rscn** command to display the registration status for RSCN configuration distribution.

```
switch# show cfs application name rscn
 Enabled        : Yes
 Timeout        : 5s
 Merge Capable  : Yes
 Scope          : Logical
```

Use the **show rscn session status vsan** command to display session status information for RSCN configuration distribution.

Note A merge failure results when the RSCN timer values are different on the merging fabrics.

```
switch# show rscn session status vsan 1
Session Parameters for VSAN: 1
-------------------------------
Last Action                : Commit
Last Action Result         : Success
Last Action Failure Reason : None
```

Use the **show rscn pending** command to display the set of configuration commands that would take effect when you commit the configuration.

Note The pending database includes both existing and modified configuration.

```
switch# show rscn pending
rscn event-tov 2000 ms vsan 1
rscn event-tov 2000 ms vsan 2
rscn event-tov 300 ms vsan 10
```

Use the **show rscn pending-diff** command to display the difference between pending and active configurations. The following example shows the time-out value for VSAN 10 was changed from 2000 milliseconds (default) to 300 milliseconds.

```
switch# show rscn pending-diff
- rscn event-tov 2000 ms vsan 10
+ rscn event-tov 300 ms vsan 10
```

Default Settings

Table 20: Default RSCN Settings , on page 215 lists the default settings for RSCN.

Table 20: Default RSCN Settings

Parameters	Default
RSCN timer value	2000 milliseconds for Fibre Channel VSANs1000 milliseconds for FICON VSANs
RSCN timer configuration distribution	Disabled

Enabling Port Pacing

For detailed information, refer to the *Cisco MDS 9000 Family NX-OS System Management* .

CHAPTER 10

Discovering SCSI Targets

This chapter describes the SCSI LUN discovery feature provided in switches in the Cisco MDS 9000 Family. It includes the following sections:

About SCSI LUN Discovery

Small Computer System Interface (SCSI) targets include disks, tapes, and other storage devices. These targets do not register logical unit numbers (LUNs) with the name server.

The name server requires LUN information for the following reasons:

- To display LUN storage device information so an NMS can access this information.
- To report device capacity, serial number, and device ID information.
- To register the initiator and target features with the name server.

The SCSI LUN discovery feature uses the local domain controller Fibre Channel address. It uses the local domain controller as the source FC ID, and performs SCSI INQUIRY, REPORT LUNS, and READ CAPACITY commands on SCSI devices.

The SCSI LUN discovery feature is initiated on demand, through CLI or SNMP. This information is also synchronized with neighboring switches, if those switches belong to the Cisco MDS 9000 Family.

This section includes the following topics:

About Starting SCSI LUN Discovery

SCSI LUN discovery is done on demand.

Only Nx ports that are present in the name server database and that are registered as FC4 Type = SCSI_FCP are discovered.

Starting SCSI LUN Discovery

To start SCSI LUN discovery, follow one of these steps:

Step 1 switch# **discover scsi-target local os all**

Example:

```
discovery started
```

Discovers local SCSI targets for all operating systems (OS). The operating system options are **aix**, **all**, **hpux**, **linux**, **solaris**, or **windows**

Step 2 switch# **discover scsi-target remote os aix**

Example:

```
discovery started
```

Discovers remote SCSI targets assigned to the AIX OS.

Step 3 switch# **discover scsi-target vsan 1 fcid 0x9c03d6**

Example:

```
discover scsi-target vsan 1 fcid 0x9c03d6
VSAN:    1 FCID: 0x9c03d6 PWWN: 00:00:00:00:00:00:00:00
PRLI RSP: 0x01 SPARM: 0x0012
SCSI TYPE: 0 NLUNS: 1
Vendor: Company 4 Model: ST318203FC    Rev: 0004
Other: 00:00:02:32:8b:00:50:0a
```

Discovers SCSI targets for the specified VSAN (1) and FC ID (0x9c03d6).

Step 4 switch# **discover scsi-target custom-list os linux**

Example:

```
discovery started
```

Discovers SCSI targets from the customized list assigned to the Linux OS.

About Initiating Customized Discovery

Customized discovery consists of a list of VSAN and domain pairs that are selectively configured to initiate a discovery. The domain ID is a number from 0 to 255 in decimal or a number from 0x0 to 0xFF in hex.

Use the **custom-list** option to initiate this discovery.

Initiating Customized Discovery

To initiate a customized discovery, follow one of these steps:

Step 1 switch# **discover custom-list add vsan 1 domain 0X123456**
Adds the specified entry to the custom list.

Step 2 switch# **discover custom-list delete vsan 1 domain 0X123456**
Deletes the specified domain ID from the custom list.

Displaying SCSI LUN Information

Use the **show scsi-target** and **show fcns database** commands to display the results of the discovery. See Examples Displays the Discovered Targets, on page 219 to Displays Automatically Discovered Targets, on page 221.

Displays the Discovered Targets

```
switch# show scsi-target status
discovery completed
```

Note This command takes several minutes to complete, especially if the fabric is large or if several devices are slow to respond.

Displays the FCNS Database

```
switch# show fcns database
VSAN 1:
---------------------------------------------------------------------------
FCID        TYPE  PWWN                     (VENDOR)        FC4-TYPE:FEATURE
---------------------------------------------------------------------------
0xeb0000    N     21:01:00:e0:8b:2a:f6:54  (Qlogic)        scsi-fcp:init
0xeb0201    NL    10:00:00:00:c9:32:8d:76  (Emulex)        scsi-fcp:init
Total number of entries = 2
VSAN 7:
---------------------------------------------------------------------------
FCID        TYPE  PWWN                     (VENDOR)        FC4-TYPE:FEATURE
---------------------------------------------------------------------------
0xed0001    NL    21:00:00:04:cf:fb:42:f8  (Seagate)       scsi-fcp:target
Total number of entries = 1
VSAN 2002:
---------------------------------------------------------------------------
FCID        TYPE  PWWN                     (VENDOR)        FC4-TYPE:FEATURE
---------------------------------------------------------------------------
0xcafe00    N     20:03:00:05:30:00:2a:20  (Cisco)         FICON:CUP
Total number of entries = 1
```

Displays the Discovered Target Disks

```
switch# show scsi-target disk
--------------------------------------------------------------------------------
VSAN    FCID        PWWN                      VENDOR    MODEL             REV
--------------------------------------------------------------------------------
1       0x9c03d6    21:00:00:20:37:46:78:97   Company 4 ST318203FC        0004
1       0x9c03d9    21:00:00:20:37:5b:cf:b9   Company 4 ST318203FC        0004
1       0x9c03da    21:00:00:20:37:18:6f:90   Company 4 ST318203FC        0004
1       0x9c03dc    21:00:00:20:37:5a:5b:27   Company 4 ST318203FC        0004
1       0x9c03e0    21:00:00:20:37:36:0b:4d   Company 4 ST318203FC        0004
1       0x9c03e1    21:00:00:20:37:39:90:6a   Company 4 ST318203 CLAR18   3844
1       0x9c03e2    21:00:00:20:37:18:d2:45   Company 4 ST318203 CLAR18   3844
1       0x9c03e4    21:00:00:20:37:6b:d7:18   Company 4 ST318203 CLAR18   3844
1       0x9c03e8    21:00:00:20:37:38:a7:c1   Company 4 ST318203FC        0004
1       0x9c03ef    21:00:00:20:37:18:17:d2   Company 4 ST318203FC        0004
```

Displays the Discovered LUNs for All Operating Systems

```
switch# show scsi-target lun os all
ST336607FC from SEAGATE (Rev 0006)
FCID is 0xed0001 in VSAN 7, PWWN is 21:00:00:04:cf:fb:42:f8
--------------------------------------------------------------------------------
OS  LUN    Capacity Status  Serial Number    Device-Id
           (MB)
--------------------------------------------------------------------------------
WIN 0x0    36704    Online  3JA1B9QA00007338 C:1 A:0 T:3 20:00:00:04:cf:fb:42:f8
AIX 0x0    36704    Online  3JA1B9QA00007338 C:1 A:0 T:3 20:00:00:04:cf:fb:42:f8
SOL 0x0    36704    Online  3JA1B9QA00007338 C:1 A:0 T:3 20:00:00:04:cf:fb:42:f8
LIN 0x0    36704    Online  3JA1B9QA00007338 C:1 A:0 T:3 20:00:00:04:cf:fb:42:f8
HP  0x0    36704    Online  3JA1B9QA00007338 C:1 A:0 T:3 20:00:00:04:cf:fb:42:f8
```

Displays the Discovered LUNs for the Solaris OS

```
switch# show scsi-target lun os solaris
ST336607FC from SEAGATE (Rev 0006)
FCID is 0xed0001 in VSAN 7, PWWN is 21:00:00:04:cf:fb:42:f8
--------------------------------------------------------------------------------
OS  LUN    Capacity Status  Serial Number    Device-Id
           (MB)
--------------------------------------------------------------------------------
SOL 0x0    36704    Online  3JA1B9QA00007338 C:1 A:0 T:3 20:00:00:04:cf:fb:42:f8
```

The following command displays the port WWN that is assigned to each OS (Windows, AIX, Solaris, Linux, or HPUX)

Displays the pWWNs for each OS

```
switch# show scsi-target pwwn
------------------------------
OS     PWWN
------------------------------
WIN    24:91:00:05:30:00:2a:1e
AIX    24:92:00:05:30:00:2a:1e
SOL    24:93:00:05:30:00:2a:1e
LIN    24:94:00:05:30:00:2a:1e
HP     24:95:00:05:30:00:2a:1e
```

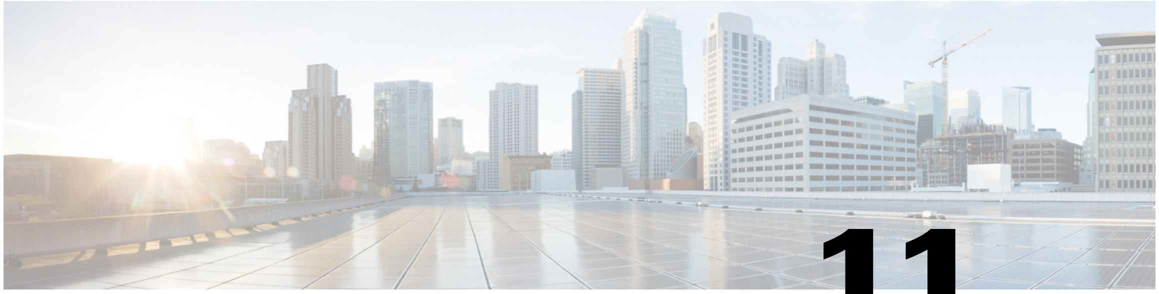
Displays Customized Discovered Targets

```
switch# show scsi-target custom-list
---------------
VSAN    DOMAIN
---------------
1       56
```

Use the **show scsi-target auto-poll** command to verify automatic discovery of SCSI targets that come online. The internal uuid number indicates that a CSM or an IPS module is in the chassis.

Displays Automatically Discovered Targets

```
switch(config)# show scsi-target auto-poll
name server polling is enabled
auto-polling is disabled, poll_start:0 poll_count:0 poll_type:0
USERS OF AUTO POLLING
---------------------
```



CHAPTER 11

Configuring FICON

Fibre Connection (FICON) interface capabilities enhance the Cisco MDS 9000 Family by supporting both open systems and mainframe storage network environments. The control unit port (CUP) also is supported which allows in-band management of the switch from FICON processors.

This chapter includes the following sections:

About FICON

The Cisco MDS 9000 Family supports the Fibre Channel Protocol (FCP), FICON, iSCSI, and FCIP capabilities within a single, high-availability platform (see Figure 51: Shared System Storage Network, on page 224).

The FICON feature is not supported on:

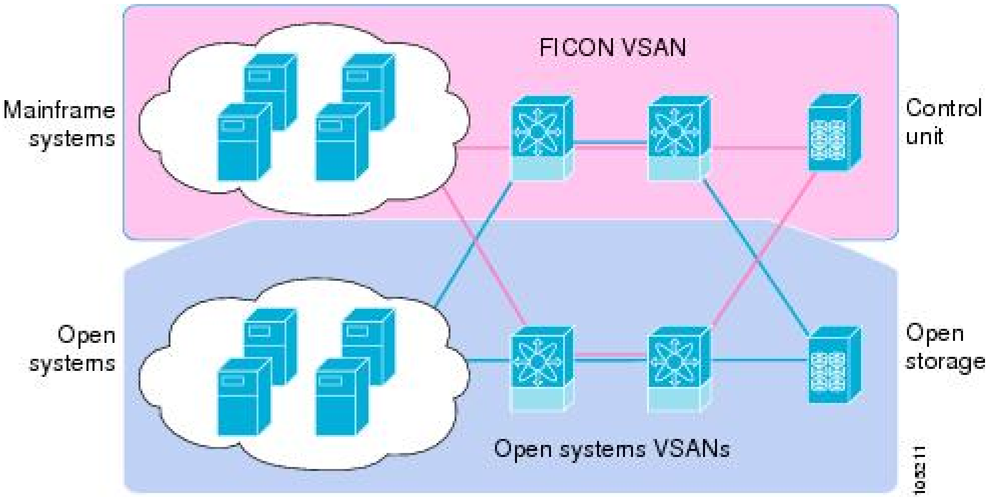
- Cisco MDS 9120 switches
- Cisco MDS 9124 switches
- Cisco MDS 9140 switches

- The 32-port Fibre Channel switching module
- Cisco Fabric Switch for HP c-Class BladeSystem
- Cisco Fabric Switch for IBM BladeSystem

FCP and FICON are different FC4 protocols and their traffic is independent of each other. Devices using these protocols should be isolated using VSANs.

The fabric binding feature helps prevent unauthorized switches from joining the fabric or disrupting current fabric operations (refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide*). The Registered Link Incident Report (RLIR) application provides a method for a switch port to send an LIR to a registered Nx port.

Figure 51: Shared System Storage Network



This section includes the following topics:

FICON Requirements

The FICON feature has the following requirements:

- You can implement FICON features in the following switches:
    - Any switch in the Cisco MDS 9500 Series
    - Any switch in the Cisco MDS 9200 Series (including the Cisco MDS 9222i Multiservice Modular Switch)
    - Cisco MDS 9134 Multilayer Fabric Switch
    - MDS 9000 Family 18/4-Port Multiservice Module

- You need the MAINFRAME_PKG license to configure FICON parameters.
- To extend your FICON configuration over a WAN link using FCIP, you need the appropriate SAN_EXTN_OVER_IP license for the module you are using. For more information, refer to the *Cisco NX-OS Family Licensing Guide* .

MDS-Specific FICON Advantages

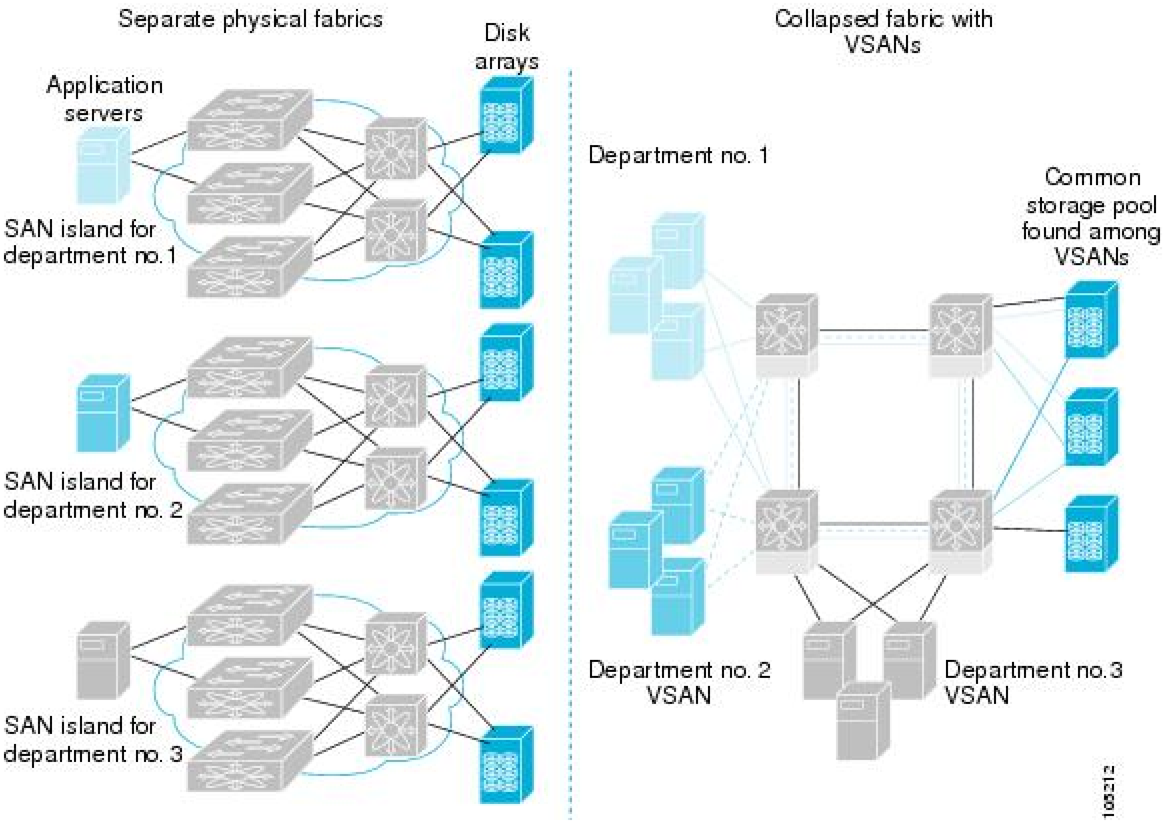
This section explains the additional FICON advantages in Cisco MDS switches and includes the following topics:

Fabric Optimization with VSANs

Generally, separate physical fabrics have a high level of switch management and have a higher implementation cost. The ports in each island also may be over-provisioned depending on the fabric configuration.

By using the Cisco MDS-specific VSAN technology, you can have greater efficiency between these physical fabrics by lowering the cost of over-provisioning and reducing the number of switches to be managed. VSANs also help you to move unused ports nondisruptively and provide a common redundant physical infrastructure (see Figure 52: VSAN-Specific Fabric Optimization, on page 225).

Figure 52: VSAN-Specific Fabric Optimization


Separate physical fabrics
Disk arrays
Application servers
SAN island for department no.1
SAN island for department no. 2
SAN island for department no. 3
Collapsed fabric with VSANs
Department no. 1
Common storage pool found among VSANs
Department no. 2 VSAN
Department no.3 VSAN
105212

VSANs enable global SAN consolidation by allowing you to convert existing SAN islands into virtual SAN islands on a single physical network. It provides hardware-enforced security and separation between applications or departments to allow coexistence on a single network. It also allows virtual rewiring to consolidate your storage infrastructure. You can move assets between departments or applications without the expense and disruption of physical relocation of equipment.

Note While you can configure VSANs in any Cisco MDS switch, you only can enable FICON inupto eight of these VSANs. The number of VSANs configured depends on the platform.

Mainframe users can think of VSANs as being like FICON LPARs in the MDS SAN fabric. You can partition switch resources into FICON LPARs (VSANs) that are isolated from each other, in much the same way that you can partition resources on a zSeries or DS8000. Each VSAN has its own set of fabric services (such as fabric server and name server), FICON CUP, domain ID, Fabric Shortest Path First (FSPF) routing, operating mode, IP address, and security profile.FICON LPARs can span line cards and are dynamic in size. For example, one FICON LPAR with 10 ports can span 10 different line cards. FICON LPARs can also include ports on more than one switch in a cascaded configuration. The consistent fairness of the Cisco MDS 9000 switching architecture means that “all ports are created equal,” simplifying provisioning by eliminating the “local switching” issues seen on other vendors’ platforms.Addition of ports to a FICON LPAR is a nondisruptive process. The maximum number of ports for a FICON LPAR is 255 due to FICON addressing limitations.

FCIP Support

The multilayer architecture of the Cisco MDS 9000 Family enables a consistent feature set over a protocol-agnostic switch fabric. Cisco MDS 9500 Series and 9200 Series switches transparently integrate Fibre Channel, FICON, and Fibre Channel over IP (FCIP) in one system. The FICON over FCIP feature enables cost-effective access to remotely located mainframe resources. With the Cisco MDS 9000 Family platform, storage replication services such as IBM PPRC and XRC can be extended over metro to global distances using ubiquitous IP infrastructure which simplifies business continuance strategies.

Refer to the *Cisco MDS 9000 Family NX-OS IP Services Configuration Guide* .

PortChannel Support

The Cisco MDS implementation of FICON provides support for efficient utilization and increased availability of Inter-Switch Links (ISLs) necessary to build stable large-scale SAN environments. PortChannels ensure an enhanced ISL availability and performance in Cisco MDS switches.

Refer to the *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide* for more information on PortChannels.

VSANs for FICON and FCP Mixing

Cisco MDS 9000 Family FICON-enabled switches simplify deployment of even the most complex mixed environments. Multiple logical FICON, Z-Series Linux/FCP, and Open-Systems Fibre Channel Protocol (FCP) fabrics can be overlaid onto a single physical fabric by simply creating VSANs as required for each service. VSANs provide both hardware isolation and protocol specific fabric services, eliminating the complexity and potential instability of zone-based mixed schemes.

By default, the FICON feature is disabled in all switches in the Cisco MDS 9000 Family. When the FICON feature is disabled, FC IDs can be allocated seamlessly. Mixed environments are addressed by the Cisco

NX-OS software. The challenge of mixing FCP and FICON protocols are addressed by Cisco MDS switches when implementing VSANs.

Switches and directors in the Cisco MDS 9000 Family support FCP and FICON protocol mixing at the port level. If these protocols are mixed in the same switch, you can use VSANs to isolate FCP and FICON ports.

Tip When creating a mixed environment, place all FICON devices in one VSAN (other than the default VSAN) and segregate the FCP switch ports in a separate VSAN (other than the default VSAN). This isolation ensures proper communication for all connected devices.

Cisco MDS-Supported FICON Features

The Cisco MDS 9000 Family FICON features include:

- Flexibility and investment protection—The Cisco MDS 9000 Family shares common switching and service modules across the Cisco MDS 9500 Series and the 9200 Series.

  Refer to the *Cisco MDS 9500 Series Hardware Installation Guide* and the *Cisco MDS 9200 Series Hardware Installation Guide.*

- High-availability FICON-enabled director—The Cisco MDS 9500 Series combines nondisruptive software upgrades, stateful process restart and failover, and full redundancy of all major components for a new standard in director-class availability. It supports up to 528 autosensing, 4/2/1-Gbps, 10-Gbps, FICON or FCP ports in any combination in a single chassis. Refer to the *Cisco MDS 9000 Family NX-OS High Availability and Redundancy Configuration Guide*.

- Infrastructure protection—Common software releases provide infrastructure protection across all Cisco MDS 9000 platforms. Refer to the *Cisco MDS 9000 Family NX-OS Software Upgrade and Downgrade Guide*

- VSAN technology—The Cisco MDS 9000 Family provides VSAN technology for hardware-enforced, isolated environments within a single physical fabric for secure sharing of physical infrastructure and enhanced FICON mixed support. See Configuring and Managing VSANs, on page 7

- Port-level configurations—There are BB_credits, beacon mode, and port security for each port. Refer to the *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide* for information about buffer-to-buffer credits, beacon LEDs, and trunking.

- Alias name configuration—Provides user-friendly aliases instead of the WWN for switches and attached node devices. See

- Comprehensive security framework—The Cisco MDS 9000 Family supports RADIUS and TACACS+ authentication, Simple Network Management Protocol Version 3 (SNMPv3), role-based access control, Secure Shell Protocol (SSH), Secure File Transfer Protocol (SFTP), VSANs, hardware-enforced zoning, ACLs, fabric binding, Fibre Channel Security Protocol (FC-SP), LUN zoning, read-only zones, and VSAN-based access control. Refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide* for information about RADIUS, TACACS+, FC-SP, and DHCHAP.

  Note LUN zoning and read-only zones are not supported from Cisco MDS NX-OS Release 5.x and later.

- Traffic encryption—IPSec is supported over FCIP. You can encrypt FICON and Fibre Channel traffic that is carried over FCIP. Refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide*
- Local accounting log—View the local accounting log to locate FICON events. For more information about MSCHAP authentication, and local AAA services, refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide*

  .
- Unified storage management—Cisco MDS 9000 FICON-enabled switches are fully IBM CUP standard compliant for in-band management using the IBM S/A OS/390 I/O operations console. See the CUP In-Band Management, on page 268.
- Port address-based configurations—Configure port name, blocked or unblocked state, and the prohibit connectivity attributes can be configured on the ports. See the Configuring FICON Ports, on page 248.
- You can display the following information:
  - Individual Fibre Channel ports, such as the port name, port number, Fibre Channel address, operational state, type of port, and login data.
  - Nodes attached to ports.
  - Port performance and statistics.
- Configuration files—Store and apply configuration files. See the FICON Configuration Files, on page 257.
- FICON and Open Systems Management Server features if installed. —See the VSANs for FICON and FCP Mixing, on page 226.
- Enhanced cascading support—See the CUP In-Band Management, on page 268.
- Date and time—Set the date and time on the switch. See the Allowing the Host to Control the Timestamp , on page 244.
- Configure SNMP trap recipients and community names—See the Configuring SNMP Control of FICON Parameters, on page 245.
- Call Home configurations—Configure the director name, location, description, and contact person. Refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide.*
- Configure preferred domain ID, FC ID persistence, and principal switch priority—For information about configuring domain parameters, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .
- Sophisticated SPAN diagnostics—The Cisco MDS 9000 Family provides industry-first intelligent diagnostics, protocol decoding, and network analysis tools as well as integrated Call Home capability for added reliability, faster problem resolution, and reduced service costs. For information about monitoring network traffic using SPAN, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*
- Configure R_A_TOV, E_D_TOV— See the Cisco MDS-Supported FICON Features.
- Director-level maintenance tasks—Perform maintenance tasks for the director including maintaining firmware levels, accessing the director logs, and collecting data to support failure analysis. For information about monitoring system processes and logs refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*

- Port-level incident alerts—Display and clear port-level incident alerts. See the Clearing RLIR Information, on page 256.

FICON Cascading

The Cisco MDS NX-OS software allows multiple switches in a FICON network. To configure multiple switches, you must enable and configure fabric binding in that switch and refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide*).

FICON VSAN Prerequisites

To ensure that a FICON VSAN is operationally up, be sure to verify the following requirements:

- Set the default zone to permit, if you are not using the zoning feature. See the .
- Enable in-order delivery on the VSAN. See Configuring Fibre Channel Routing Services and Protocols, on page 173
- Enable (and if required, configure) fabric binding on the VSAN. For more information about Fabric Binding, refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide* .
- Verify that conflicting persistent FC IDs do not exist in the switch. For information about configuring domain parameters, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .
- Verify that the configured domain ID and requested domain ID match. For information about configuring domain parameters, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .
- Add the CUP (area FE) to the zone, if you are using zoning. See the CUP In-Band Management, on page 268.

If any of these requirements are not met, the FICON feature cannot be enabled.

FICON Port Numbering

With reference to the FICON feature, ports in Cisco MDS switches are identified by a statically defined 8-bit value known as the *port number*. A maximum of 255 port numbers are available. You can use the following port numbering schemes:

- Default port numbers based on the chassis type
- Reserved port numbers

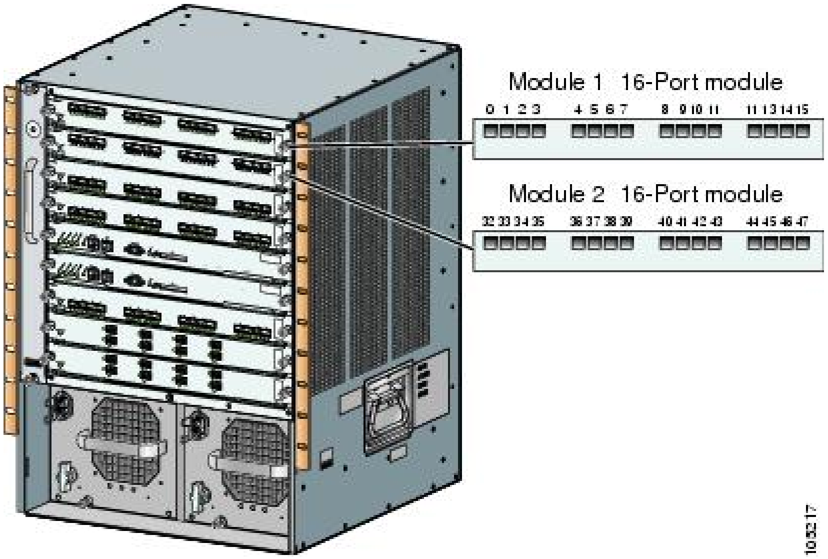
This section includes the following topics:

Note You must enable FICON on the switch before reserving FICON port number (see the About Enabling FICON on a VSAN, on page 237).

Default FICON Port Numbering Scheme

Default FICON port numbers are assigned by the Cisco MDS NX-OS software based on the module and the slot in the chassis. The first port in a switch always starts with a zero (0) (see Figure 53: Default FICON Port Number in Numbering on the Cisco MDS 9000 Family Switch, on page 230).

Figure 53: Default FICON Port Number in Numbering on the Cisco MDS 9000 Family Switch



The default FICON port number is assigned based on the front panel location of the port and is specific to the slot in which the module resides. Thirty-two (32) port numbers are assigned to each slot on all Cisco MDS 9000 Family switches except for the Cisco MDS 9513 Director, which has 16 port numbers assigned for each slot. These default numbers are assigned regardless of the module's physical presence in the chassis, the port status (up or down), or the number of ports on the module (4, 12, 16, 24, or 48). If a module has fewer ports than the number of port numbers assigned to the slot, then the excess port numbers are unused. If a module has more ports than the number of port numbers assigned to the slot, the excess ports cannot be used for FICON traffic unless you manually assign the port numbers.

Note You can use the **ficon slot assign port-numbers** command to make use of any Follow the steps in Assigning FICON Port Numbers to Slots, on page 234 to make use of excess ports by manually assigning more port numbers to the slots. Before doing this, however, we recommend that you review the default port number assignments for Cisco MDS 9000 switches shown in Table 23: Default FICON Settings , on page 276 Table 21: Default FICON Port Numbering in the Cisco MDS 9000 Family , on page 231, and that you read the following sections to gain a complete understanding of FICON port numbering: About the Reserved FICON Port Numbering Scheme, on page 233, FICON Port Numbering Guidelines, on page 234, and Assigning FICON Port Numbers to Slots, on page 234.

Note Only Fibre Channel, PortChannel, and FCIP ports are mapped to FICON port numbers. Other types of interfaces do not have a corresponding port number.

Table 21: Default FICON Port Numbering in the Cisco MDS 9000 Family , on page 231 lists the default port number assignment for the Cisco MDS 9000 Family of switches and directors.

Table 21: Default FICON Port Numbering in the Cisco MDS 9000 Family

Product	Slot Number	Implemented Port Allocation	To PortChannel/FCIP	Unimplemented Ports	
To Ports	Notes				
Cisco MDS 9200 Series	Slot 1	0 through 31	64 through 89	90 through 253 and port 255	Similar to a switching module.
	Slot 2	32 through 63			
Cisco MDS 9222i Series	Slot 1	0 through 31	64 through 89	90 through 253 and port 255	The first 4, 12, 16, or 24 port numbers in a 4-port, 12-port, 16-port, or 24-port module are used and the rest remain unused. Extra 16 ports on 48-port modules are not allocated numbers.
	Slot 2	32 through 63			
Cisco MDS 9506 Director	Slot 1	0 through 31	128 through 153	154 through 253 and port 255	Supervisor modules are not allocated port numbers.
	Slot 2	32 through 63			
	Slot 3	64 through 95			
	Slot 4	96 through 127			
	Slot 5	None			
	Slot 6	None			
Cisco MDS 9134 Director	Slot 1	0 through 33	34 through 59	60 through 253 and port 255	

Product	Slot Number	Implemented Port Allocation	To PortChannel/FCIP	Unimplemented Ports	
Cisco MDS 9509 Director	Slot 1	0 through 31	224 through 249	250 through 253 and port 255	The first 4, 12, 16, or 24 port numbers in a 4-port, 12-port, 16-port, or 24-port module are used and the rest remain unused. Extra 16 ports on 48-port modules are not allocated port numbers.
	Slot 2	32 through 63			
	Slot 3	64 through 95			
	Slot 4	96 through 127			
	Slot 5	None			Supervisor modules are not allocated port numbers.
	Slot 6	None			
	Slot 7	128 through 159			The first 4, 12, 16, or 24 port numbers are used for a 4-port, 12-port,16-port, or 24-port module and the rest remain unused. Extra 16 ports on 48-port modules are not allocated port numbers.
	Slot 8	160 through 191			
	Slot 9	192 through 223			
Cisco MDS 9513 Director	Slot 1	0 through 15	224 through 249	250 through 253 and port 255	The first 4, 12 or 16 port numbers are used for a 4-port, 12-port or 16-port module and the rest remain unused. Extra ports on 24-port, 32-port, and 48-port modules are not allocated port numbers.
Slot 2	16 through 31				
Slot 3	32 through 47				
Slot 4	48 through 63				
Slot 5	64 through 79				
Slot 6	80 through 95				
Slot 7	None	Supervisor modules are not allocated port numbers.			
Slot 8	None				

Product	Slot Number	Implemented Port Allocation	To PortChannel/FCIP	Unimplemented Ports
Slot 9	96 through 111	The first 4 or 12 port numbers are used for a 4-port or 12-port module and the rest remain unused. Extra ports on 24-port, 32-port, and 48-port modules are not allocated port numbers.		
Slot 10	112 through 127			
Slot 11	128 through 143			
Slot 12	144 through 159			
Slot 13	160 through 175			

Port Addresses

By default, port numbers are the same as port addresses. You can swap the port addresses (see the Port Swapping , on page 260).

You can swap the port addresses by issuing the **ficon swap portnumber** command.

Implemented and Unimplemented Port Addresses

An implemented port refers to any port address that is assigned by default to a slot in the chassis (see Default Settings, on page 276). An unimplemented port refers to any port address that is not assigned by default to a slot in the chassis (see Default Settings, on page 276).

About the Reserved FICON Port Numbering Scheme

A range of 250 port numbers are available for you to assign to all the ports on a switch. Default Settings, on page 276 shows that you can have more than 250 physical ports on a switch and the excess ports do not have port numbers in the default numbering scheme. When you have more than 250 physical ports on your switch, you can have ports without a port number assigned if they are not in a FICON VSAN, or you can assign duplicate port numbers if they are not used in the same FICON VSAN. For example, you can configure port number 1 on interface fc1/1 in FICON VSAN 10 and fc10/1 in FICON VSAN 20.

Note A VSAN can have a maximum of 250 port numbers.

Note FICON port numbers are not changed for ports that are active. You must first disable the interfaces using the **shutdown** command.

Note You can configure port numbers even when no module is installed in the slot.

Installed and Uninstalled Ports

An installed port refers to a port for which all required hardware is present. A specified port number in a VSAN can be implemented, and yet not installed, if any of the following conditions apply:

- The module is not present—For example, if module 1 is not physically present in slot 1 in a Cisco MDS 9509 Director, ports 0 to 31 are considered uninstalled.
- The small form-factor pluggable (SFP) port is not present—For example, if a 16-port module is inserted in slot 2 in a Cisco MDS 9509 Director, ports 48 to 63 are considered uninstalled.
- For slot 1, ports 0 to 31, or 0 to 15 have been assigned. Only the physical port fc1/5 with port number 4 is in VSAN 2. The rest of the physical ports are not in VSAN 2. The port numbers 0 to 249 are considered implemented for any FICON-enabled VSAN. Therefore, VSAN 2 has port numbers 0 to 249 and one physical port, fc1/4. The corresponding physical ports 0 to 3,and 5 to 249 are not in VSAN 2. When the FICON VSAN port address is displayed, those port numbers with the physical ports not in VSAN 2 are not installed (for example, ports 0 to 3, or 5 to 249).

Another scenario is if VSANs 1 through 5 are FICON-enabled, and trunking-enabled interface fc1/1 has VSANs 3 through 10, then port address 0 is uninstalled in VSAN 1 and 2.

- The port is part of a PortChannel—For example, if interface fc 1/1 is part of PortChanne1 5, port address 0 is uninstalled in all FICON VSANs. See Default Settings, on page 276.

FICON Port Numbering Guidelines

The following guidelines apply to FICON port numbers:

- Supervisor modules do not have port number assignments.
- Port numbers do not change based on TE ports. Since TE ports appear in multiple VSANs, chassis-wide unique port numbers should be reserved for TE ports.
- Each PortChannel must be explicitly associated with a FICON port number.
- When the port number for a physical PortChannel becomes uninstalled, the relevant PortChannel configuration is applied to the physical port.
- Each FCIP tunnel must be explicitly associated with a FICON port number. If the port numbers are not assigned for PortChannels or for FCIP tunnels, then the associated ports will not come up.

See the About Port Numbers for FCIP and PortChannel, on page 235.

Assigning FICON Port Numbers to Slots

You can use the **show ficon port-number assign** and **show ficon first-available port-number** commands to determine which port numbers to use.

Caution When you assign, change, or release a port number, the port reloads.

To assign FICON port numbers to a slot, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon slot 3 assign port-numbers 0-15, 48-63**
Reserves FICON port numbers 0 through 15 and 48 through 63 for up to 32 interfaces in slot 3.

Step 3 switch(config)# **ficon slot 3 assign port-numbers 0-15, 17-32**
Reserves FICON port numbers 0 through 15 for the first 16 interfaces and 17 through 32 for the next 16 interfaces in slot 3.

Step 4 switch(config)# **ficon slot 3 assign port-numbers 0-63**
Reserves FICON port numbers 0 through 63 for up to 64 interfaces in slot 3.

Step 5 switch(config)# **ficon slot 3 assign port-numbers 0-15, 56-63**
Changes the reserved FICON port numbers for up to 24 interfaces in slot 3.

Step 6 switch(config)# **no ficon slot 3 assign port-numbers 0-15, 56-63**
(Optional) Releases the FICON port numbers.

Displaying the FICON Port Number Assignments

Use the **show ficon port-numbers assign** command to display the port numbers assigned on the switch.

```
switch# show ficon port-numbers assign
ficon slot 1 assign port-numbers 0-31
ficon slot 2 assign port-numbers 32-63
ficon slot 3 assign port-numbers 64-95
ficon slot 4 assign port-numbers 96-127
ficon logical-port assign port-numbers 128-153
```

Use the **show ficon port-numbers assign slot** command to display the port numbers assigned to a specific slot.

```
switch# show ficon port-numbers assign slot 2
ficon slot 2 assign port-numbers 32-63
```

Use the **show ficon port-numbers assign** command to display the port numbers reserved for logical ports.

```
switch# show ficon port-numbers assign logical-port
ficon logical-port assign port-numbers 128-153
```

About Port Numbers for FCIP and PortChannel

FCIP and PortChannels cannot be used in a FICON-enabled VSAN unless they are explicitly bound to a port number.

See the Configuring FICON Ports, on page 248, and the Reserving FICON Port Numbers for FCIP and PortChannel Interfaces, on page 236, and the Binding Port Numbers to FCIP Interfaces , on page 248.

You can use the default port numbers if they are available (see Table 21: Default FICON Port Numbering in the Cisco MDS 9000 Family , on page 231) or if you reserve port numbers from the pool of port numbers that are not reserved for Fibre Channel interfaces (see the About the Reserved FICON Port Numbering Scheme, on page 233).

To find the first available port number to bind an FCIP or PortChannel interface, use the **show ficon first-available port-number** command (see Displays the Available Port Numbers, on page 270).

Tip The **show ficon vsan portaddress brief** command displays the port number to interface mapping. You can assign port numbers in the PortChannel/FCIP range that are not already assigned to a PortChannel or FCIP interface (see Displays Port Address Information in a Brief Format, on page 270).

Reserving FICON Port Numbers for FCIP and PortChannel Interfaces

You must reserve port numbers for logical interfaces, such as FCIP and PortChannels, if you plan to use them.

To reserve FICON port numbers for logical interfaces, follow these steps:

Step 1

```
switch# config t
switch(config)#
```

Enters configuration mode.

Step 2

```
switch(config)# ficon logical-port assign port-numbers 230-249
```

Reserves port numbers 230 through 249 for FCIP and PortChannel interfaces.

Step 3

```
switch(config)# ficon logical-port assign port-numbers 0xe6-0xf9
```

Reserves port numbers 0xe6 through 0xf9 for FCIP and PortChannel interfaces.

Note You cannot change port numbers that are active. You must disable the interfaces using the **shutdown** command and unbind port numbers using the **no ficon portnumber** command. See the Configuring FICON Ports, on page 248.

Step 4

```
switch(config)# no ficon logical-port assign port-numbers 230-249
```

Releases the port numbers.

Note You cannot release port numbers for interfaces that are active.You must disable the interfaces using the **shutdown** command and unbind port numbers using the **no ficon portnumber** command. See the Configuring FICON Ports, on page 248.

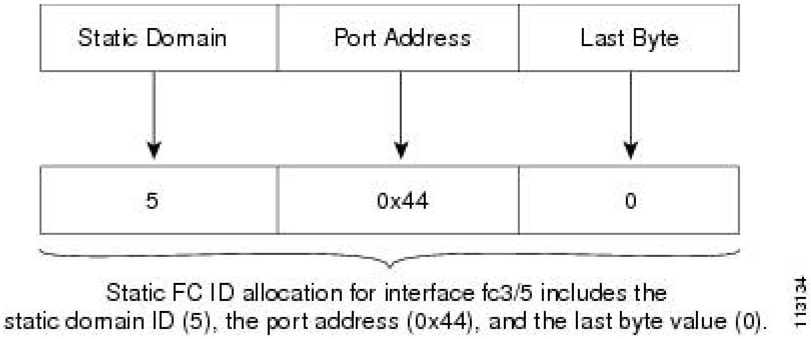
FC ID Allocation

FICON requires a predictable and static FC ID allocation scheme. When FICON is enabled, the FC ID allocated to a device is based on the port address of the port to which it is attached. The port address forms the middle byte of the fabric address. Additionally, the last byte of the fabric address should be the same for all devices in the fabric. By default, the last byte value is 0 and can be configured.

Note You cannot configure persistent FC IDs in FICON-enabled VSANs.

Cisco MDS switches have a dynamic FC ID allocation scheme. When FICON is enabled or disabled on a VSAN, all the ports are shut down and restarted to switch from the dynamic to static FC IDs and vice versa (see Figure 54: Static FC ID Allocation for FICON, on page 237).

Figure 54: Static FC ID Allocation for FICON


Static Domain
Port Address
Last Byte
5
0x44
0
Static FC ID allocation for interface fc3/5 includes the
static domain ID (5), the port address (0x44), and the last byte value (0).
113134

Configuring FICON

By default FICON is disabled in all switches in the Cisco MDS 9000 Family. You can enable FICON on a per VSAN basis by using the Device Manager.

This section includes the following topics:

About Enabling FICON on a VSAN

By default FICON is disabled in all VSANs on the switch.

You can enable FICON on a per VSAN basis in one of the following ways:

- Use the automated **setup ficon** command.

See the Setting Up a Basic FICON Configuration, on page 238.

- Manually address each prerequisite.

See the About FICON, on page 223.

- Use Device Manager.

When you enable the FICON feature in Cisco MDS switches, the following restrictions apply:

- You cannot disable in-order delivery for the FICON-enabled VSAN.
- You cannot disable fabric binding or static domain ID configurations for the FICON-enabled VSAN.
- The load balancing scheme is changed to Source ID (SID)—Destination ID (DID). You cannot change it back to SID—DID—OXID.

- The IPL configuration file is automatically created.

See the About FICON Configuration Files, on page 257.

Tip Using Device Manager, FICON auto-save can be invoked by multiple users logged on to the same FICON-enabled switch. Device Manager performs a periodic auto-save on any FICON-enabled switch causing increments in the FICON key counter. These increments highlight a change that has actually not occurred. To avoid this we recommend that only one instance of Device Manager monitor a FICON-enabled switch.

Enabling FICON on the Switch

By default FICON is disabled in all switches in the Cisco MDS 9000 Family. You can enable FICON on the switch either explicitly or implicitly by enabling FICON on a VSAN. However, disabling FICON on all VSANs does not disable FICON on the switch. You must explicitly disable FICON.

To explicitly enable or disable FICON globally on the switch, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **feature ficon**
Enables FICON globally on the switch.

Step 3 switch(config)# **no feature ficon**
Disables FICON globally on the switch and removes all FICON configuration.

Setting Up a Basic FICON Configuration

This section steps you through the procedure to set up FICON on a specified VSAN in a Cisco MDS 9000 Family switch.

Note Press **Ctrl-C** at any prompt to skip the remaining configuration options and proceed with what is configured until that point.

Tip If you do not want to answer a previously configured question, or if you want to skip answers to any questions, press **Enter**. If a default answer is not available (for example, switch name), the switch uses what was previously configured and skips to the next question.

To enable and set up FICON, follow these steps:

Step 1 Enter the **setup ficon** command at the EXEC command mode.

```
switch# setup ficon
                --- Ficon Configuration Dialog ---
This setup utility will guide you through basic Ficon Configuration
on the system.
Press Enter if you want to skip any dialog. Use ctrl-c at anytime
to skip all remaining dialogs.
```

Step 2 Enter **yes** (the default is **yes**) to enter the basic FICON configuration setup.

```
Would you like to enter the basic configuration dialog (yes/no) [yes]: yes
```

The FICON setup utility guides you through the basic configuration process. Press **Ctrl-C** at any prompt to end the configuration process.

Step 3 Enter the VSAN number for which FICON should be enabled.

```
Enter vsan [1-4093]:2
```

Step 4 Enter **yes** (the default is **yes**) to create a VSAN.

```
vsan 2 does not exist, create it? (yes/no) [yes]: yes
```

Step 5 Enter **yes** (the default is **yes**) to confirm your VSAN choice:

```
Enable ficon on this vsan? (yes/no) [yes]: yes
```

Note At this point, the software creates the VSAN if it does not already exist.

Step 6 Enter the domain ID number for the specified FICON VSAN.

```
Configure domain-id for this ficon vsan (1-239):2
```

Step 7 Enter **yes** (the default is **no**) to set up FICON in cascaded mode. If you enter **no**, skip to step 8 (see the CUP In-Band Management, on page 268).

```
Would you like to configure ficon in cascaded mode: (yes/no) [no]: yes
```

a) Assign the peer WWN for the FICON: CUP.

```
Configure peer wwn (hh:hh:hh:hh:hh:hh:hh:hh): 11:00:02:01:aa:bb:cc:00
```

b) Assign the peer domain ID for the FICON: CUP

```
Configure peer domain (1-239) :4
```

c) Enter **yes** if you wish to configure additional peers (and repeat Steps 7a and 7b). Enter **no**, if you do wish to configure additional peers.

```
Would you like to configure additional peers: (yes/no) [no]: no
```

Step 8 Enter **yes** (the default is **yes**) to allow SNMP permission to modify existing port connectivity parameters (see the Configuring SNMP Control of FICON Parameters, on page 245).

```
Enable SNMP to modify port connectivity parameters? (yes/no) [yes]: yes
```

Step 9 Enter **no** (the default is **no**) to allow the host (mainframe) to modify the port connectivity parameters, if required (see the Allowing the Host to Change FICON Port Parameters, on page 243).

```
Disable Host from modifying port connectivity parameters? (yes/no) [no]: no
```

Step 10 Enter **yes** (the default is **yes**) to enable the **active equals saved** feature (see the Automatically Saving the Running Configuration, on page 246).

```
Disable Host from modifying port connectivity parameters? (yes/no) [no]: no
```

Step 11 Enter **yes** (the default is **yes**) if you wish to configure additional FICON VSANs.

```
Disable Host from modifying port connectivity parameters? (yes/no) [no]: no
```

Step 12 Review and edit the configuration that you have just entered.

Step 13 Enter no (the default is **no**) if you are satisfied with the configuration.

Note For documentation purposes, the following configurations shows three VSANs with different FICON settings. These settings provide a sample output for different FICON scenarios

```
The following configuration will be applied:
fcdomain domain 2 static vsan 1
fcdomain restart disruptive vsan 1
fabric-binding database vsan 1
swwn 11:00:02:01:aa:bb:cc:00 domain 4
fabric-binding activate vsan 1
zone default-zone permit vsan 1
ficon vsan 1
no host port control
fcdomain domain 3 static vsan 2
fcdomain restart disruptive vsan 2
fabric-binding activate vsan 2 force
zone default-zone permit vsan 2
ficon vsan 2
no host port control
no active equals saved
vsan database
vsan 3
fcdomain domain 5 static vsan 3
fcdomain restart disruptive vsan 3
fabric-binding activate vsan 3 force
zone default-zone permit vsan 3
ficon vsan 3
no snmp port control
no active equals saved
Would you like to edit the configuration? (yes/no) [no]: no
```

Step 14 Enter yes (the default is **yes**) to use and save this configuration. The implemented commands are displayed. After FICON is enabled for the specified VSAN, you are returned to the EXEC mode switch prompt.

```
Use this configuration and apply it? (yes/no) [yes]: yes
`fcdomain domain 2 static vsan 1`
`fcdomain restart disruptive vsan 1`
`fabric-binding database vsan 1`
`swwn 11:00:02:01:aa:bb:cc:00 domain 4`
`fabric-binding activate vsan 1`
`zone default-zone permit vsan 1`
```

~~~
`ficon vsan 1`
`no host port control`
`fcdomain domain 3 static vsan 2`
`fcdomain restart disruptive vsan 2`
`fabric-binding activate vsan 2 force`
`zone default-zone permit vsan 2`
`ficon vsan 2`
`no host port control`
`no active equals saved`
~~~

Note If a new VSAN is created, two additional commands are displayed— **vsan database** and **vsan** *number*.

~~~
`vsan database`
`vsan 3`
`in-order-guarantee vsan 3`
`fcdomain domain 2 static vsan 3`
`fcdomain restart disruptive vsan 3`
`fabric-binding activate vsan 3 force`
`zone default-zone permit vsan 3`
`ficon vsan 3`
`no snmp port control`
Performing fast copy config...done.
switch#
~~~

Manually Enabling FICON on a VSAN

Note This section describes the procedure to manually enable FICON on a VSAN. If you have already enabled FICON on the required VSAN using the automated setup (recommended), skip to the Automatically Saving the Running Configuration, on page 246.

To manually enable FICON on a VSAN, follow these steps:

Step 1 switch# **config t**

~~~
switch(config)#
~~~

Enters configuration mode.

Step 2 switch(config)# **vsan database**

~~~
switch(config-vsan-db)# vsan 5
switch(config-vsan-db)# do show vsan usage
4 vsan configured
configured vsans:1-2,5,26
vsans available for configuration:3-4,6-25,27-4093
switch(config-vsan-db)# exit
~~~

Enables VSAN 5.

Step 3 switch(config)# **in-order-guarantee vsan 5**
Activates in-order delivery for VSAN 5.

See Configuring Fibre Channel Routing Services and Protocols, on page 173

Step 4 switch(config)# **fcdomain domain 2 static vsan 2**
Configures the domain ID for VSAN 2.

For information about configuring domain parameters, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .

Step 5 switch(config)# **fabric-binding activate vsan 2 force**
Activates fabric binding on VSAN 2.

Refer to the *Cisco MDS 9000 Family NX-OS Security Configuration Guide*

Step 6 switch(config)# **zone default-zone permit vsan 2**
Sets the default zone to permit for VSAN 2.

See the CUP In-Band Management, on page 268.

Step 7 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 8 switch(config)# **no ficon vsan 6**
Disables the FICON feature on VSAN 6.

Step 9 switch(config-ficon)# **no host port control**
Prohibits mainframe users from moving the switch to an offline state.

See the Allowing the Host to Move the Switch Offline, on page 243.

Configuring the code-page Option

FICON strings are coded in Extended Binary-Coded Decimal Interchange Code (EBCDIC) format. Refer to your mainframe documentation for details on the code page options.

Cisco MDS switches support **international-5**, **france**, **brazil**, **germany**, **italy**, **japan**, **spain-latinamerica**, **uk**, and **us-canada** (default) EBCDIC format options.

Tip This is an optional configuration. If you are not sure of the EBCDIC format to be used, we recommend retaining the **us-canada** (default) option.

To configure the **code-page** option in a VSAN, follow these steps:

Step 1 switch# **config t**
switch(config)#
Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#
Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **code-page italy**
Configures the **italy** EBCDIC format.

Step 4 switch(config-ficon)# **no code-page**
(Optional) Reverts to the factory default of using the **us-canada** EBCDIC format.

Allowing the Host to Move the Switch Offline

By default, hosts are allowed to move the switch to an offline state. To do this, the host sends a "Set offline" command (x'FD') to the CUP.

To allow the host to move the switch to an offline state, follow these steps:

Step 1 switch# **config terminal**
switch(config)#
Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#
Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **no host control switch offline**
Prohibits mainframe users from moving the switch to an offline state.

Step 4 switch(config-ficon)# **host control switch offline**
Allows the host to move the switch to an offline state (default) and shuts down the ports.

Allowing the Host to Change FICON Port Parameters

By default, mainframe users are not allowed to configure FICON parameters on Cisco MDS switches—they can only query the switch.

Use the **host port control** command to permit mainframe users to configure FICON parameters.

To allow the host (mainframe) to configure FICON parameters on the Cisco MDS switch, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **no host port control**
Prohibits mainframe users from configuring FICON parameters on the Cisco MDS switch.

Step 4 switch(config-ficon)# **host port control**
Allows mainframe users to configure FICON parameters on the Cisco MDS switch (default).

Allowing the Host to Control the Timestamp

By default, the clock in each VSAN is the same as the switch hardware clock. Each VSAN in a Cisco MDS 9000 Family switch represents a virtual director. The clock and time present in each virtual director can be different.To maintain separate clocks for each VSAN, the Cisco NX-OS software maintains the difference of the VSAN-specific clock and the hardware-based director clock. When a host (mainframe) sets the time, the Cisco NX-OS software updates this difference between the clocks. When a host reads the clock, it computes the difference between the VSAN-clock and the current director hardware clock and presents a value to the mainframe.

The VSAN-clock current time is reported in the output of **show ficon vsan** *vsan-id*, **show ficon**, and **show accounting log** commands.

To configure host control of the timestamp, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **no host set-timestamp**
Prohibits mainframe users from changing the VSAN-specific clock.

Step 4 switch(config-ficon)# **host set-timestamp**
Allows the host to set the clock on this switch (default).

Clearing the Time Stamp

Note You can clear time stamps only from the Cisco MDS switch—not the mainframe.

Use the **clear ficon vsan** *vsan-id* **timestamp** command in EXEC mode to clear the VSAN clock.

```
switch# clear ficon vsan 20 timestamp
```

Configuring SNMP Control of FICON Parameters

To configure SNMP control of FICON parameters, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **no snmp port control**
Prohibits SNMP users from configuring FICON parameters.

Step 4 switch(config-ficon)# **snmp port control**
Allows SNMP users to configure FICON parameters (default).

About FICON Device Allegiance

FICON requires serialization of access among multiple mainframes, CLI, and SNMP sessions be maintained on Cisco MDS 9000 Family switches by controlling device allegiance for the currently executing session. Any other session is denied permission to perform configuration changes unless the required allegiance is available.

Caution This task discards the currently executing session.

Clearing FICON Device Allegiance

You can clear the current device allegiance by issuing the **clear ficon vsan** *vsan-id* **allegiance** command in EXEC mode.

```
switch# clear ficon vsan 1 allegiance
```

Automatically Saving the Running Configuration

Cisco MDS NX-OS provides an option to automatically save any configuration changes to the startup configuration. This ensures that the new configuration is present after a switch reboot. By default, the Active=Saved **active equals saved** option is automatically enabled on any FICON VSAN.

Table 22: Saving the Active FICON and Switch Configuration , on page 246 displays the results of the **Active = Saved** option **active equals saved** command and the implicit copy from the running configuration to the startup configuration (**copy running start**)**copy running-config startup-config** command in various scenarios.

When the Active=Saved option **active equals saved** command is enabled in any FICON-enabled VSAN in the fabric, then the following apply (see Number 1 and 2 in Table 22: Saving the Active FICON and Switch Configuration , on page 246):

- All configuration changes (FICON-specific or not) are automatically saved to persistent storage (implicit **copy running start**) and stored in the startup configuration.
- FICON-specific configuration changes are immediately saved to the IPL file (see the FICON Configuration Files, on page 257).

If the Active=Saved option **active equals saved** command is not enabled in any FICON-enabled VSAN in the fabric, then FICON-specific configuration changes are not saved in the IPL file and an implicit **copy running startup** command is not issued, you must explicitly save the running configuration to the startup configurationissue the **copy running start** command explicitly (see number 3 in Table 22: Saving the Active FICON and Switch Configuration , on page 246).

Table 22: Saving the Active FICON and Switch Configuration

Number	FICON-enabled VSAN?	active equals saved Enabled?	Implicit copy running start Issued?	Notes
1	Yes	Yes (in all FICON VSANs)	Implicit	FICON changes written to the IPL file. Non-FICON changes saved to startup configuration and persistent storage.

Number	FICON-enabled VSAN?	active equals saved Enabled?	Implicit copy running start Issued?	Notes
2	Yes	Yes (even in one FICON VSAN)	Implicit	FICON changes written to IPL file for only the VSAN that has **active equals saved** option enabled. Non-FICON changes saved to startup configuration and persistent storage.
3	Yes	Not in any FICON VSAN	Not implicit	FICON changes are not written to the IPL file. Non-FICON changes are saved in persistent storage—only if you explicitly issue the **copy running start** command.
4	No	Not applicable		

Note If **active equals saved** is enabled, the Cisco NX-OS software ensures that you do not have to perform the **copy running startup** command for the FICON configuration as well. If your switch or fabric consists of multiple FICON-enabled VSANs, and one of these VSANs have **active equals saved** enabled, changes made to the non-FICON configuration results in all configurations being saved to the startup configuration.

To automatically save the running configuration, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **active equals saved**
Enables the automatic save feature for all VSANs in the switch or fabric.

Step 4 switch(config-ficon)# **no active equals saved**
(Optional) Disables automatic save for this VSAN.

Configuring FICON Ports

You can perform FICON configurations on a per-port address basis in the Cisco MDS 9000 Family switches.

Even if a port is uninstalled, the port address-based configuration is accepted by the Cisco MDS switch. This configuration is applied to the port when the port becomes installed.

This section includes the following topics:

Binding Port Numbers to PortChannels

Caution All port number assignments to PortChannels or FCIP interfaces are lost (cannot be retrieved) when FICON is disabled on all VSANs.

You can bind (or associate) a PortChannel with a FICON port number to bring up that interface.

To bind a PortChannel with a FICON port number, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **interface Port-channel 1**
switch(config-if)#

Enters the PortChannel interface configuration mode.

Step 3 switch(config-if)# **ficon portnumber 234**
Assigns the FICON port number to the selected PortChannel port.

Binding Port Numbers to FCIP Interfaces

You can bind (or associate) an FCIP interface with a FICON port number to bring up that interface.

To bind an FCIP interface with a FICON port number, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch1(config)# **interface fcip 51**
switch1(config-if)#

Creates an FCIP interface (51).

Step 3 switch(config-if)# **ficon portnumber 208**
Assigns the FICON port number to the selected FCIP interface.

Configuring Port Blocking

If you block a port, the port is retained in the operationally down state. If you unblock a port, a port initialization is attempted. When a port is blocked, data and control traffic are not allowed on that port.

Physical Fibre Channel port blocks will continue to transmit an Off-line state (OLS) primitive sequence on a blocked port.

Note The zoning devices within a FICON VSAN can conflict with currently prohibited FICON ports and should not be used. IBM does not recommend using zoning and port prohibition within the same VSAN.

Caution You cannot block or prohibit the CUP port (0XFE).

If a port is shut down, unblocking that port does not initialize the port.

Note The **shutdown**/**no shutdown** port state is independent of the **block**/**no block** port state.

To block or unblock port addresses in a VSAN, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **portaddress 1 - 5**
switch(config-ficon-portaddr)#

Selects port address 1 to 5 for further configuration.

Step 4 switch(config-ficon-portaddr)# **block**
Disables a range of port addresses and retains it in the operationally down state.

Step 5 switch(config-ficon-portaddr)# **no block**

Enables the selected port address and reverts to the factory default of the port address not being blocked.

Port Prohibiting

To prevent implemented ports from talking to each other, configure prohibits between two or more ports. If you prohibit ports, the specified ports are prevented from communicating with each other.

Tip You cannot prohibit a PortChannel or FCIP interface.

Unimplemented ports are always prohibited. In addition, prohibit configurations are always symmetrically applied—if you prohibit port 0 from talking to port 15, port 15 is automatically prohibited from talking to port 0.

Note If an interface is already configured in E or TE mode and you try to prohibit that port, your prohibit configuration is rejected. Similarly, if a port is not up and you prohibit that port, the port is not allowed to come up in E mode or in TE mode.

Configuring the Default State for Port Prohibiting

By default, port prohibiting is disabled on the implemented interfaces on the switch. As of Cisco MDS SAN-OS Release 3.0(2), you can change the default port prohibiting state to enabled in VSANs that you create and then selectively disable port prohibiting on implemented ports, if desired. Also, only the FICON configuration files created after you change the default have the new default setting (see the FICON Configuration Files, on page 257).

To change the default port prohibiting setting for all implemented interfaces on the switch, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon port default-state prohibit-all**
Enables port prohibiting as the default for all implemented interfaces on the switch.

Step 3 switch(config)# **no ficon port default-state prohibit-all**
Disables (default) port prohibiting as the default for all implemented interfaces on the switch.

Configuring Port Prohibiting

To prohibit port addresses in a VSAN, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **portaddress 7**
switch(config-ficon-portaddr)#

Selects port address 7 for further configuration.

Step 4 switch(config-ficon-portaddr)# **prohibit portaddress 3-5**
Prohibits port address 7 in VSAN 2 from talking to ports 3, 4, and 5.

Step 5 switch(config-ficon-portaddr)# **no prohibit portaddress 5**
Removes port address 5 from a previously prohibited state.

Assigning a Port Address Name

To assign a port address name, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **portaddress 7**
switch(config-ficon-portaddr)#

Selects port address 7 for further configuration.

Step 4 switch(config-ficon-portaddr)# **name SampleName**
Assigns a name to the port address.

Note The port address name is restricted to 24 alphanumeric characters.

Step 5 switch(config-ficon-portaddr)# **no name SampleName**

Deletes a previously configured port address name.

About RLIR

The Registered Link Incident Report (RLIR) application provides a method for a switch port to send an Link Incident Record (LIR) to a registered Nx port.

When an LIR is detected in FICON-enabled switches in the Cisco MDS 9000 Family from a RLIR Extended Link Service (ELS), the switch sends that record to the members in its Established Registration List (ERL).

In case of multiswitch topology, a Distribute Registered Link Incident Record (DRLIR) Inter-Link Service (ILS) is sent to all reachable remote domains along with the RLIR ELS. On receiving the DRLIR ILS, the switch extracts the RLIR ELS and sends it to the members of the ERL.

The Nx ports interested in receiving the RLIR ELS send the Link Incident Record Registration (LIRR) ELS request to the management server on the switch. The RLIRs are processed on a per-VSAN basis.

The RLIR data is written to persistent storage when you enter the **copy running-config startup-config** command.

The RLIR data is written to persistent storage when you **copy** the running configuration to the startup configuration.

Specifying an RLIR Preferred Host

As of Cisco MDS SAN-OS Release 3.0(3), you can specify a preferred host to receive RLIR frames. The MDS switch sends RLIR frames to the preferred host only if it meets the following conditions:

- No host in the VSAN is registered for RLIR with the registration function set to “always receive.” If one or more hosts in the VSAN are registered as “always receive,” then RLIR sends only to these hosts and not to the configured preferred host.
- The preferred host is registered with the registration function set to “conditionally receive.”

Note If all registered hosts have the registration function set to “conditionally receive,” then the preferred host receives the RLIR frames.

You can specify only one RLIR preferred host per VSAN. By default, the switch sends RLIR frames to one of the hosts in the VSAN with the register function set to “conditionally receive” if no hosts have the register function set to “always receive.”

To specify the RLIR preferred host for a VSAN, follow these steps:

Step 1

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

Enters configuration mode.

Step 2 switch(config)# **rlir preferred-cond fcid 0x772c00 vsan 5**
Specifies FC ID 0x772c00 as the RLIR preferred host in VSAN 5. (FC ID 0x772c00 is used here as an example.)

Step 3 switch(config)# **no rlir preferred-cond fcid 0x654321 vsan 2**
(Optional) Removes FC ID 0x772c00 as the RLIR preferred host for VSAN 5.

To display the RLIR preferred host configuration, use the **show rlir erl** command.

```
switch# show rlir erl
Established Registration List for VSAN: 5
----------------------------------------------
FC-ID LIRR FORMAT REGISTERED FOR
----------------------------------------------
0x772c00 0x18 conditional receive(*)
0x779600 0x18 conditional receive
0x779700 0x18 conditional receive
0x779800 0x18 conditional receive
Total number of entries = 4
(*) - Denotes the preferred host
```

Displaying RLIR Information

The **show rlir statistics** command displays the complete statistics of LIRR, RLIR, and DRLIR frames. It lists the number of frames received, sent, and rejected. Specify the VSAN ID to obtain VSAN statistics for a specific VSAN. If you do not specify the VSAN ID, then the statistics are shown for all active VSANs (see Examples Displays RLIR Statistics for All VSANs, on page 253 and Displays RLIR Statistics for a Specified VSAN, on page 254).

Displays RLIR Statistics for All VSANs

```
switch# show rlir statistics
Statistics for VSAN: 1
------------------------
Number of LIRR received      = 0
Number of LIRR ACC sent      = 0
Number of LIRR RJT sent      = 0
Number of RLIR sent          = 0
Number of RLIR ACC received  = 0
Number of RLIR RJT received  = 0
Number of DRLIR received     = 0
Number of DRLIR ACC sent     = 0
Number of DRLIR RJT sent     = 0
Number of DRLIR sent         = 0
Number of DRLIR ACC received = 0
Number of DRLIR RJT received = 0
Statistics for VSAN: 100
-------------------------
Number of LIRR received      = 26
Number of LIRR ACC sent      = 26
Number of LIRR RJT sent      = 0
Number of RLIR sent          = 815
Number of RLIR ACC received  = 815
Number of RLIR RJT received  = 0
Number of DRLIR received     = 417
Number of DRLIR ACC sent     = 417
Number of DRLIR RJT sent     = 0
Number of DRLIR sent          = 914
Number of DRLIR ACC received = 828
Number of DRLIR RJT received = 0
```

Displays RLIR Statistics for a Specified VSAN

```
switch# show rlir statistics vsan 4
Statistics for VSAN: 4
-------------------------
Number of LIRR received      = 0
Number of LIRR ACC sent      = 0
Number of LIRR RJT sent      = 0
Number of RLIR sent          = 0
Number of RLIR ACC received  = 0
Number of RLIR RJT received  = 0
Number of DRLIR received     = 0
Number of DRLIR ACC sent     = 0
Number of DRLIR RJT sent     = 0
Number of DRLIR sent         = 0
Number of DRLIR ACC received = 0
Number of DRLIR RJT received = 0
```

The **show rlir erl** command shows the list of Nx ports that are registered to receive the RLIRs with the switch. If the VSAN ID is not specified, the details are shown for all active VSANs (see Examples Displays All ERLs, on page 254 and Displays ERLs for the Specified VSAN, on page 254).

Displays All ERLs

```
switch# show rlir erl
Established Registration List for VSAN: 2
----------------------------------------------
FC-ID       LIRR FORMAT    REGISTERED FOR
----------------------------------------------
0x0b0200    0x18           always receive
Total number of entries = 1
Established Registration List for VSAN: 100
----------------------------------------------
FC-ID       LIRR FORMAT    REGISTERED FOR
----------------------------------------------
0x0b0500    0x18           conditional receive
0x0b0600    0x18           conditional receive
Total number of entries = 2
```

In Displays All ERLs, on page 254, if the Registered For column states that an FC ID is conditional receive, the source port is registered as a valid recipient of subsequent RLIRs. This source port is selected as an RLIR recipient only if no other ERL recipient is selected.

In Displays All ERLs, on page 254, if the Registered For column states that an FC ID is always receive, the source port is registered as a valid recipient of subsequent RLIRs. This source port is always selected as an LIR recipient.

Note If an always receive RLIR is not registered for any N port or if the delivery of an RLIR fails for one of those ports, then the RLIR is sent to a port registered to conditional receive RLIRs.

Displays ERLs for the Specified VSAN

```
switch# show rlir erl vsan 100
Established Registration List for VSAN: 100
----------------------------------------------
FC-ID       LIRR FORMAT    REGISTERED FOR
----------------------------------------------
0x0b0500    0x18           conditional receive
```

```
0x0b0600    0x18            conditional receive
Total number of entries = 2
```

Note In Displays the LIR History, on page 255, through Displays Recent LIRs for a Specified Port Number, on page 255, if the host time stamp (marked by the *) is available, it is printed along with the switch time stamp. If the host time stamp is not available, only the switch time stamp is printed.

Displays the LIR History

```
switch# show rlir history
Link incident history
----------------------------------------------------------------------------
*Host Time Stamp
 Switch Time Stamp          Port   Interface   Link Incident
----------------------------------------------------------------------------
*Sun Nov 30 21:47:28 2003
 Sun Nov 30 13:47:55 2003     2        fc1/2   Implicit Incident
*Sun Nov 30 22:00:47 2003
 Sun Nov 30 14:01:14 2003     2        fc1/2   NOS Received
*Sun Nov 30 22:00:55 2003
 Sun Nov 30 14:01:22 2003     2        fc1/2   Implicit Incident
*Mon Dec 1 20:14:26 2003
 Mon Dec  1 12:14:53 2003     4        fc1/4   Implicit Incident
*Mon Dec 1 20:14:26 2003
 Mon Dec  1 12:14:53 2003     4        fc1/4   Implicit Incident
*Thu Dec 4 04:43:32 2003
 Wed Dec  3 20:43:59 2003     2        fc1/2   NOS Received
*Thu Dec 4 04:43:41 2003
 Wed Dec  3 20:44:08 2003     2        fc1/2   Implicit Incident
*Thu Dec 4 04:46:53 2003
 Wed Dec  3 20:47:20 2003     2        fc1/2   NOS Received
*Thu Dec 4 04:47:05 2003
 Wed Dec  3 20:47:32 2003     2        fc1/2   Implicit Incident
*Thu Dec 4 04:48:07 2003
 Wed Dec  3 20:48:34 2003     2        fc1/2   NOS Received
*Thu Dec 4 04:48:39 2003
 Wed Dec  3 20:49:06 2003     2        fc1/2   Implicit Incident
*Thu Dec 4 05:02:20 2003
 Wed Dec  3 21:02:47 2003     2        fc1/2   NOS Received
...
```

Displays Recent LIRs for a Specified Interface

```
switch# show rlir recent interface fc1/1-4
Recent link incident records
-------------------------------------------------------------------------------
Host Time Stamp           Switch Time Stamp        Port Intf    Link Incident
-------------------------------------------------------------------------------
Thu Dec 4 05:02:29 2003  Wed Dec 3 21:02:56 2003   2    fc1/2   Implicit Incident
Thu Dec 4 05:02:54 2003  Wed Dec 3 21:03:21 2003   4    fc1/4   Implicit Incident
```

Displays Recent LIRs for a Specified Port Number

```
switch# show rlir recent portnumber 1-4
Recent link incident records
--------------------------------------------------------------------------------
Host Time Stamp           Switch Time Stamp        Port Intf     Link Incident
--------------------------------------------------------------------------------
Thu Dec 4 05:02:29 2003  Wed Dec 3 21:02:56 2003   2    fc1/2    Implicit Incident
Thu Dec 4 05:02:54 2003  Wed Dec 3 21:03:21 2003   4    fc1/4    Implicit Incident
```

As of Cisco SAN-OS Release 3.0(3), the **show rlir history** command output includes remote link incidents that are received as DRLIRs from other switches. RLIRs are generated as a result of DRLIRs as in previous Cisco NX-OS releases (see Displays the LIR History as of Cisco SAN-OS Release 3.0(3), on page 256).

Displays the LIR History as of Cisco SAN-OS Release 3.0(3)

```
switch# show rlir history
Link incident history
------------------------------------------------------------------------------------------

 Host Time Stamp         Switch Time Stamp       VSAN   Domain   Port    Intf        Link
Incident       Loc/Rem
------------------------------------------------------------------------------------------

 Sep 20 12:42:44 2006    Sep 20 12:42:44 2006    ****    ****    0x0b    fc1/12      Loss
of sig/sync     LOC
 Reported Successfully to: [0x640001] [0x640201]
 Sep 20 12:42:48 2006    Sep 20 12:42:48 2006    ****    ****    0x0b    fc1/12      Loss
of sig/sync     LOC
 Reported Successfully to: [0x640001] [0x640201]
 *** ** **:**:** ****    Sep 20 12:42:51 2006    1001    230     0x12    ****        Loss
of sig/sync     REM
 Reported Successfully to: [0x640001] [0x640201]
 Sep 20 12:42:55 2006    Sep 20 12:42:55 2006    ****    ****    0x0b    fc1/12      Loss
of sig/sync     LOC
 Reported Successfully to: None [No Registrations]
 *** ** **:**:** ****    Sep 20 12:45:56 2006    1001    230     0x12    ****        Loss
of sig/sync     REM
 Reported Successfully to: None [No Registrations]
 *** ** **:**:** ****    Sep 20 12:45:56 2006    1001    230     0x12    ****        Loss
of sig/sync     REM
 Reported Successfully to: None [No Registrations]
 Sep 20 12:52:45 2006    Sep 20 12:52:45 2006    ****    ****    0x0b    fc1/12      Loss
of sig/sync     LOC
 Reported Successfully to: None [No Registrations]
**** - Info not required/unavailable
```

Clearing RLIR Information

Use the **clear rlir statistics** command to clear all existing statistics for a specified VSAN.

```
switch# clear rlir statistics vsan 1
```

Use the **clear rlir history** command to clear the RLIR history where all link incident records are logged for all interfaces.

```
switch# clear rlir history
```

Use the **clear rlir recent interface** command to clear the most recent RLIR information for a specified interface.

```
switch# clear rlir recent interface fc 1/2
```

Use the **clear rlir recent portnumber** command to clear the most recent RLIR information for a specified port number.

```
switch# clear rlir recent portnumber 16
```

FICON Configuration Files

You can save up to 16 FICON configuration files on each FICON-enabled VSAN (in persistent storage). The file format is proprietary to IBM. These files can be read and written by IBM hosts using the in-band CUP protocol. Additionally, you can use the Cisco MDS CLI to operate on these FICON configuration files.

Note Multiple FICON configuration files with the same name can exist in the same switch, provided they reside in different VSANs. For example, you can create a configuration file named XYZ in both VSAN 1 and VSAN 3.

When you enable the FICON feature in a VSAN, the switches always use the startup FICON configuration file, called IPL. This file is created with a default configuration as soon as FICON is enabled in a VSAN.

Caution When FICON is disabled on a VSAN, all the FICON configuration files are irretrievably lost.

FICON configuration files contain the following configuration for each implemented port address:

- Block
- Prohibit mask
- Port address name

Note Normal configuration files used by Cisco MDS switches include FICON-enabled attributes for a VSAN, port number mapping for PortChannels and FCIP interfaces, port number to port address mapping, port and trunk allowed VSAN configuration for ports, in-order guarantee, static domain ID configuration, and fabric binding configuration.

Refer to the *Cisco MDS 9000 Family NX-OS Fundamentals Configuration Guide* for details on the normal configuration files used by Cisco MDS switches.

This section includes the following topics:

About FICON Configuration Files

Only one user can access the configuration file at any given time:

- If this file is being accessed by user 1, user 2 cannot access this file.
- If user 2 does attempt to access this file, an error is issued to user 2.
- If user 1 is inactive for more than 15 seconds, the file is automatically closed and available for use by any other permitted user.

FICON configuration files can be accessed by any host, SNMP, or CLI user who is permitted to access the switch. The locking mechanism in the Cisco NX-OS software restricts access to one user at a time per file. This lock applies to newly created files and previously saved files. Before accessing any file, you must lock the file and obtain the file key. A new file key is used by the locking mechanism for each lock request. The key is discarded when the lock timeout of 15 seconds expires. The lock timeout value cannot be changed.

Applying the Saved Configuration Files to the Running Configuration

You can apply the configuration from the saved files to the running configuration using the **ficon vsan** *number* **apply file** *filename* command.

```
switch# ficon vsan 2 apply file SampleFile
```

Editing FICON Configuration Files

The configuration file submode allows you to create and edit FICON configuration files. If a specified file does not exist, it is created. Up to 16 files can be saved. Each file name is restricted to eight alphanumeric characters.

To edit the contents of a specified FICON configuration file, follow these steps:

Step 1 switch# **config t**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **ficon vsan 2**
switch(config-ficon)#

Enables FICON on VSAN 2.

Step 3 switch(config-ficon)# **file IplFile1**
switch(config-ficon-file)#

Accesses the FICON configuration file called IplFile1 for VSAN 2. If this file does not exist, it is created.

Note All FICON file names are restricted to eight alphanumeric characters.

Step 4 switch(config-ficon)# **no file IplFileA**
(Optional) Deletes a previously created FICON configuration file.

Step 5 switch(config-ficon-file)# **portaddress 3**
switch(config-ficon-file-portaddr)#

Enters the submode for port address 3 to edit the contents of the configuration file named IplFile1.

Note The running configuration is not applied to the current configuration. The configuration is only applied when the **ficon vsan** *number* **apply file** *filename* command is issued.

Step 6 switch(config-ficon-file-portaddr)# **prohibit portaddress 5**
Edits the content of the configuration file named IplFile1 by prohibiting port address 5 from accessing port address 3.

Step 7 switch(config-ficon-file-portaddr)# **block**
Edits the content of the configuration file named IplFile1 by blocking a range of port addresses and retaining them in the operationally down state.

Step 8 switch(config-ficon-file-portaddr)# **name P3**

Edits the content of the configuration file named IplFile1 by assigning the name P3 to port address 3. If the name did not exist, it is created. If it existed, it is overwritten.

Displaying FICON Configuration Files

Use the **show ficon vsan** *vsan-id* **file all** command to display the contents of all FICON configuration files.

```
switch# show ficon vsan 2 file all
File IPL      is locked
FICON configuration file IPLFILEA in vsan 2
Description:
    Port address 0(0)
        Port name is
        Port is not blocked
        Prohibited port addresses are 250-253,255(0xfa-0xfd,0xff)
    Port address 1(0x1)
        Port name is
        Port is not blocked
        Prohibited port addresses are 250-253,255(0xfa-0xfd,0xff)
Port address 2(0x2)
        Port name is
        Port is not blocked
        Prohibited port addresses are 250-253,255(0xfa-0xfd,0xff)
    Port address 3(0x3)
        Port name is P3
        Port is blocked
        Prohibited port addresses are 5,250-253,255(0x5,0xfa-0xfd,0xff)
..
```

Use the **show ficon vsan** *vsan-id* **file name** command to display the contents of a specific FICON configuration file.

```
switch# show ficon vsan 2 file name IPLfilea
FICON configuration file IPLFILEA in vsan 2
Description:
    Port address 0(0)
        Port name is
        Port is not blocked
        Prohibited port addresses are 250-253,255(0xfa-0xfd,0xff)
    Port address 1(0x1)
        Port name is
        Port is not blocked
        Prohibited port addresses are 250-253,255(0xfa-0xfd,0xff)
    Port address 2(0x2)
        Port name is
        Port is not blocked
        Prohibited port addresses are 250-253,255(0xfa-0xfd,0xff)
    Port address 3(0x3)
        Port name is P3
        Port is blocked
        Prohibited port addresses are 5,250-253,255(0x5,0xfa-0xfd,0xff)
```

Use the **show ficon vsan** *vsan-id* **file name** *filename* **portaddress** command to display the FICON configuration file information for a specific FICON port.

```
switch# show ficon vsan 2 file name IPLfilea portaddress 3
FICON configuration file IPLFILEA in vsan 2
Description:
    Port address 3(0x3)
        Port name is P3
        Port is blocked
        Prohibited port addresses are 5,250-253,255(0x5,0xfa-0xfd,0xff)
```

Copying FICON Configuration Files

Use the **ficon vsan** *vsan-id* **copy file** *existing-file-name save-as-file-name* command in EXEC mode to copy an existing FICON configuration file.

```
switch# ficon vsan 20 copy file IPL IPL3
```

You can see the list of existing configuration files by issuing the **show ficon vsan** *vsan-id* command.

```
switch# show
 ficon vsan 20
Ficon information for VSAN 20
  Ficon is online
  VSAN is active
  Host port control is Enabled
  Host offline control is Enabled
  User alert mode is Disabled
  SNMP port control is Enabled
  Host set director timestamp is Enabled
  Active=Saved is Enabled
  Number of implemented ports are 250
  Key Counter is 5
  FCID last byte is 0
  Date/Time is same as system time (Wed Dec 3 20:10:45.924591 2003)
  Device Allegiance not locked
  Codepage is us-canada
  Saved configuration files
    IPL
    IPL3
```

Port Swapping

The FICON port-swapping feature is only provided for maintenance purposes.

The FICON port-swapping feature causes all configurations associated with *old-port-number* and *new port-number* to be swapped, including VSAN configurations.

Cisco MDS switches allow port swapping for nonexistent ports as follows:

- Only FICON-specific configurations (prohibit, block, and port address mapping) are swapped.
- No other system configuration is swapped.
- All other system configurations are only maintained for existing ports.
- If you swap a port in a module that has unlimited oversubscription ratios enabled with a port in a module that has limited oversubscription ratios, then you may experience a degradation in bandwidth.

Tip If you check the **Active=Saved** check box **active equals saved** is enabled on any FICON VSAN, then the swapped configuration is automatically saved to startup. Otherwise, you must explicitly save the running configuration immediately after swapping the ports.

Once you swap ports, the switch automatically performs the following actions:

- Shuts down both the old and new ports.
- Swaps the port configuration.

If you attempt to bring the port up, you must explicitly shut down the port to resume traffic.

Note To view the latest FICON information, you must click the Refresh button. See the Automatically Saving the Running Configuration, on page 246.

The **ficon swap portnumber** command is only associated with the two ports concerned. You must issue this VSAN-independent command from EXEC mode. Cisco MDS NX-OS checks for duplicate port numbers in a VSAN before performing the port swap.

If you attempt to bring the port up by specifying the **ficon swap portnumber** *old-port-number new-port-number* **after swap noshut** command, you must explicitly issue the **no shutdown** command to resume traffic.

This section includes the following topics:

About Port Swapping

Be sure to follow these guidelines when using the FICON port swapping feature:

- Port swapping is not supported for logical ports (PortChannels, FCIP links). Neither the *old-port-number* nor the *new-port-number* can be a logical port.
- Port swapping is not supported between physical ports that are part of a PortChannel. Neither the *old-port-number* nor the *new-port-number* can be a physical port that is part of a PortChannel.
- Before performing a port swap, the Cisco NX-OS software performs a compatibility check. If the two ports have incompatible configurations, the port swap is rejected with an appropriate reason code. For example, if a port with BB_credits as 25 is being swapped with an OSM port for which a maximum of 12 BB_credits is allowed (not a configurable parameter), the port swapping operation is rejected.
- Before performing a port swap, the Cisco NX-OS software performs a compatibility check to verify the extended BB_credits configuration.
- If ports have default values (for some incompatible parameters), then a port swap operation is allowed and the ports retain their default values.
- Port tracking information is not included in port swapping. This information must be configured separately (refer to the *Cisco MDS 9000 Family NX-OS Quality of Service Configuration Guide*).

Note The 32-port module guidelines also apply for port swapping configurations (Refer to the *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide*).

Swapping Ports

If there are no duplicate port numbers on the switch, you can swap physical Fibre Channel ports, except the port numbers, by following these steps:

Step 1 Issue the **ficon swap portnumber** *old-port-number new-port-number* command in EXEC mode.

Note The **ficon swap portnumber** command might fail if more than one interface on the MDS switch has the same port number as the *old-port-number* or *new-port-number* specified in the command.

The specified ports are operationally shut down.

Step 2 Physically swap the front panel port cables between the two ports.

Step 3 Issue the **no shutdown** command on each port to enable traffic flow.

Note If you specify the **ficon swap portnumber** *old-port-number new-port-number* **after swap noshut** command, the ports are automatically initialized.

Swapping Ports on the Switch with Duplicate Port Numbers

If there are duplicate port numbers on the switch, you can swap physical Fibre Channel ports, including the port numbers, by following these steps:

Step 1 Issue the **ficon swap interface** *old-interface new-interface* command in EXEC mode.
The specified interfaces are operationally shut down.

Step 2 Physically swap the front panel port cables between the two ports.

Step 3 Issue the **no shutdown** command on each port to enable traffic flow.

Note If you specify the **ficon swap interface** *old-interface new-interface* **after swap noshut** command, the ports are automatically initialized.

FICON Tape Acceleration

The sequential nature of tape devices causes each I/O operation to the tape device over an FCIP link to incur the latency of the FCIP link. Throughput drastically decreases as the round-trip time through the FCIP link increases, leading to longer backup windows. Also, after each I/O operation, the tape device is idle until the next I/O arrives. Starting and stopping of the tape head reduces the lifespan of the tape, except when I/O operations are directed to a virtual tape.

Cisco MDS NX-OS software provides acceleration for the following FICON tape write operations:

- The link between mainframe and native tape drives (both IBM and Sun/STK)
- The back-end link between the VSM (Virtual Storage Management) and tape drive (Sun/STK)

FICON tape acceleration over FCIP provides the following advantages:

- Efficiently utilizes the tape device by decreasing idle time
- More sustained throughput as latency increases
- Similar to FCP tape acceleration, and does not conflict with it

Note FICON tape read acceleration over FCIP is supported from Cisco MDS NX-OS Release 5.0(1). For more information refer to the Configuring FICON Tape Read Acceleration, on page 266.

Figure 55: Host Directly Accessing IBM/STK (StorageTek) Library, on page 264 through Figure 58: Host Accessing Peer-to-Peer VTS (Virtual Tape Server), on page 264 show supported configurations:

Figure 55: Host Directly Accessing IBM/STK (StorageTek) Library

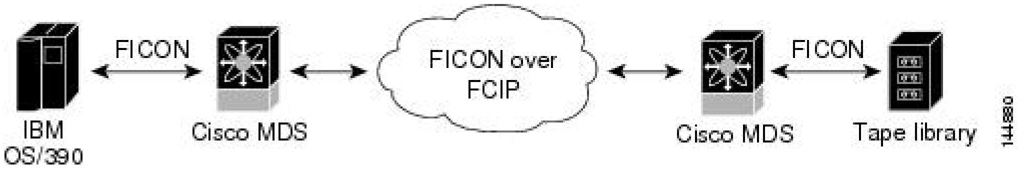


Figure 56: Host Accessing Standalone IBM-VTS (Virtual Tape Server) /STK-VSM (Virtual Shared Memory)

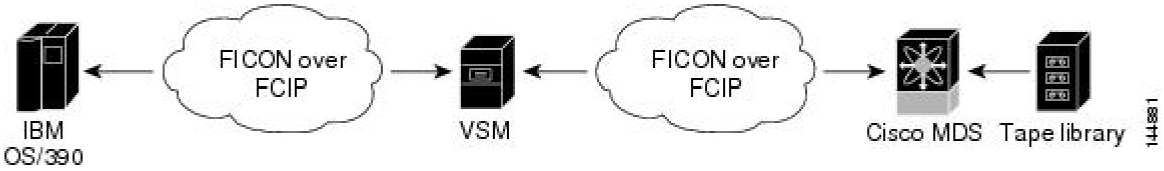


Figure 57: Host Accessing Peer-to-Peer VTS (Virtual Tape Server)

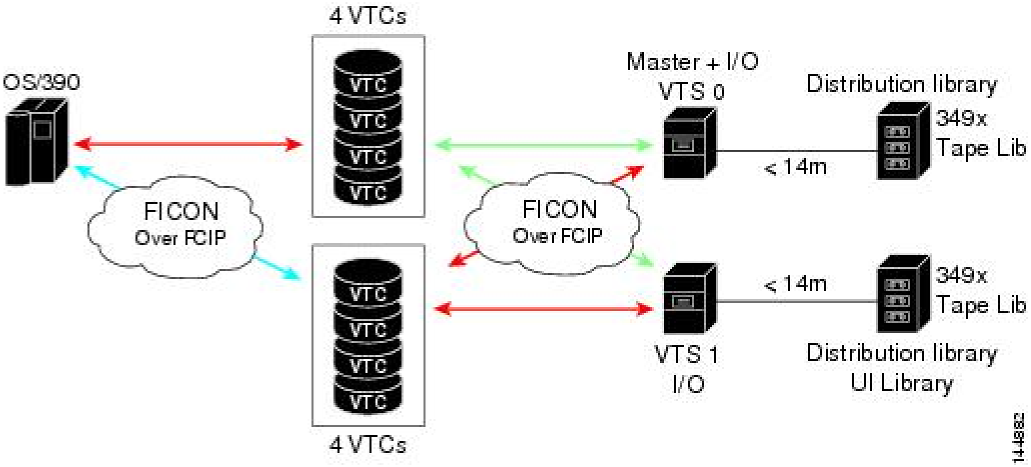
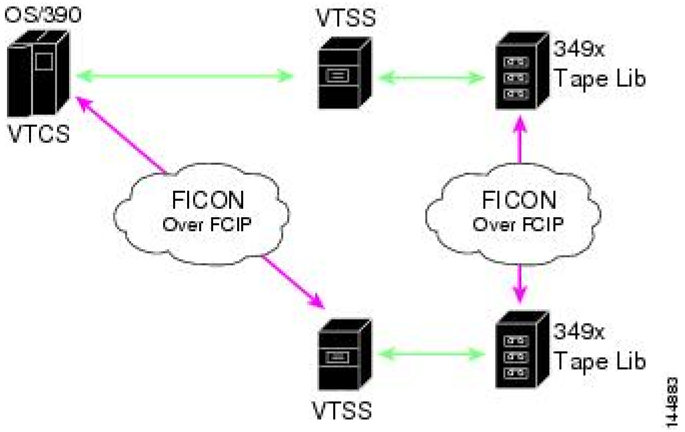


Figure 58: Host Accessing Peer-to-Peer VTS (Virtual Tape Server)



Note For information about FCIP tape acceleration, refer to the *Cisco MDS 9000 Family NX-OS IP Services Configuration Guide* .

Configuring FICON Tape Acceleration

FICON tape acceleration has the following configuration considerations:

- In addition to the normal FICON configuration, FICON tape acceleration must be enabled on both ends of the FCIP interface. If only one end has FICON tape acceleration enabled, acceleration does not occur.
- FICON tape acceleration is enabled on a per VSAN basis.
- FICON tape acceleration cannot function if multiple ISLs are present in the same VSAN (PortChannels or FSPF load balanced).
- You can enable both Fibre Channel write acceleration and FICON tape acceleration on the same FCIP interface.
- Enabling or disabling FICON tape acceleration disrupts traffic on the FCIP interface.

To configure FICON tape acceleration, follow these steps:

Step 1

```
switch# config t
switch(config)#
```

Enters configuration mode.

Step 2

```
switch(config)# interface fcip 2
switch(config-if)#
```

Specifies an FCIP interface and enters interface configuration submode.

Step 3 switch(config-if)# **ficon-tape-accelerator vsan 100**

```
This configuration change will disrupt all traffic on the FCIP interface in all
VSANs.  Do you wish to continue? [no] y
```

Enables FICON tape acceleration over an FCIP interface.

Step 4 switch(config-if)# **no ficon-tape-accelerator vsan 100**

```
This configuration change will disrupt all traffic on the FCIP interface in all
VSANs.  Do you wish to continue? [no] y
```

Disables (default) FICON tape acceleration over an FCIP interface.

What to Do Next

Use the **show running-config** command to verify the FICON tape acceleration over FCIP configuration.

```
switch# show running-config | begin "interface fcip"
interface fcip2
  ficon-tape-accelerator vsan 100
  no shutdown
...
```

Configuring FICON Tape Read Acceleration

All the configuration guidelines and restrictions applicable for FICON tape acceleration are also applicable for FICON tape read acceleration. Both FICON tape acceleration and FICON tape read acceleration can coexist.

To configure FICON tape read acceleration, follow these steps:

Step 1 switch# **config t**
switch(config)#
Enters configuration mode.

Step 2 switch(config)# **interface fcip 2**
switch(config-if)#
Specifies an FCIP interface and enters interface configuration submode.

Step 3 switch(config-if)# **ficon-tape-read-accelerator**

```
This configuration change will disrupt all traffic on the FCIP interface in all
VSANs.  Do you wish to continue? [no]
```

Enables FICON tape read acceleration over an FCIP interface.

Step 4 switch(config-if)# **no ficon-tape-read-accelerator**

```
This configuration change will disrupt all traffic on the FCIP interface in all
VSANs.  Do you wish to continue? [no]
```

Disables (default) FICON tape read acceleration over an FCIP interface.

Configuring XRC Acceleration

IBM z/OS Global Mirror eXtended Remote Copy (XRC) is supported on the MSM-18+4 modules. For XRC to function, XRC acceleration must be enabled on the FCIP tunnel interfaces on both ends. XRC acceleration is disabled by default.

To enable XRC acceleration, follow these steps:

Step 1 switch# **config t**
switch(config)#
Enters the configuration mode.

Step 2 switch(config)# **interface fcip** *2*
switch(config)#
Specifies an FCIP tunnel interface and enters interface configuration submode.

Step 3 switch(config-if)# **ficon-xrc-emulator**
switch(config)#
Enables XRC acceleration over the FCIP interface.

Step 4 switch(config-if)# **no ficon-xrc-emulator**
switch(config)#
Disables (default) XRC acceleration over the FCIP tunnel interface.

Note XRC acceleration and FICON tape acceleration cannot be enabled on the same FCIP tunnel interface and cannot exist in the same VSAN.

Moving a FICON VSAN to an Offline State

Issue the **ficon vsan** *vsan-id* **offline** command in EXEC mode to log out all ports in the VSAN that need to be suspended.

Issue the EXEC-level **ficon vsan** *vsan-id* **online** command in EXEC mode to remove the offline condition and to allow ports to log on again.

Note This command can be issued by the host if the host is allowed to do so (see the Allowing the Host to Move the Switch Offline, on page 243).

CUP In-Band Management

The CUP protocol configures access control and provides unified storage management capabilities from a mainframe computer. Cisco MDS 9000 FICON-enabled switches are fully IBM CUP standard compliant for in-band management using the IBM S/A OS/390 I/O operations console.

Note The CUP specification is proprietary to IBM.

CUP is supported by switches and directors in the Cisco MDS 9000 Family. The CUP function allows the mainframe to manage the Cisco MDS switches.

Host communication includes control functions such as blocking and unblocking ports, as well as monitoring and error reporting functions.

This section includes the following topics:

Placing CUPs in a Zone

To place the CUP in a zone, follow these steps:

Step 1 Set the default zone to permit for the required VSAN.

```
switch# config terminal
switch(config)# zone default-zone permit vsan 20
```

Step 2 Issue the **show fcns database** command for the required VSAN and obtain the required FICON CUP WWN.

```
switch# show fcns database vsan 20
VSAN 20:
--------------------------------------------------------------------------
FCID        TYPE  PWWN                    (VENDOR)        FC4-TYPE:FEATURE
--------------------------------------------------------------------------
0x0d0d00    N     50:06:04:88:00:1d:60:83 (EMC)           FICON:CU
0x0dfe00    N     25:00:00:0c:ce:5c:5e:c2
 (Cisco)         FICON:CUP
0x200400    N     50:05:07:63:00:c2:82:d3 (IBM)           scsi-fcp FICON:CU f..
0x200800    N     50:05:07:64:01:40:15:0f (IBM)           FICON:CH
0x20fe00    N     20:00:00:0c:30:ac:9e:82 (Cisco)         FICON:CUP
Total number of entries = 5
```

Note If more than one FICON:CUP WWN exists in this fabric, be sure to add all the FICON:CUP WWN PWWNs to the required zone. The previous sample output displays multiple FICON:CUP occurrences to indicate a cascade configuration.

Step 3 Add the identified FICON:CUP WWN to the zone database.

```
switch(config)# zone name Zone1 vsan 20
switch(config-zone)# member pwwn 25:00:00:0c:ce:5c:5e:c2
```

Displaying Control Unit Information

Displays Control Unit Information, on page 269 displays configured control device information.

Displays Control Unit Information

```
switch# show ficon control-device sb3
Control Unit Image:0x80b9c2c
VSAN:20 CU:0x20fe00 CUI:0 CUD:0 CURLP:(nil)
ASYNC LP:(nil) MODE:1 STATE:1 CQ LEN:0 MAX:0
PRIMARY LP:   VSAN:0 CH:0x0 CHI:0 CU:0x0 CUI:0
ALTERNATE LP: VSAN:0 CH:0x0 CHI:0 CU:0x0 CUI:0
Logical Path:0x80b9fb4
VSAN:20 CH:0x200600 CHI:15 CU:0x20fe00 CUI:0 STATE:1 FLAGS:0x1
LINK: OH:0x0 OC:0x0 IH:0x0 IC:0x0
DEV:  OH:0x0 OC:0x0 IH:0x0 IC:0x0
SENSE: 00 00 00 00 00 00 00 46
       30 20 00 00 00 00 00 00
       00 00 00 00 00 00 00 00
       00 00 00 00 00 00 00 00
IUI:0x0 DHF:0x0 CCW:0x0 TOKEN:0x0 PCCW:0x0 FCCW:0x0 PTOKEN:0x0 FTOKEN:0x0
CMD:0x0 CCW_FLAGS:0x0 CCW_COUNT:0 CMD_FLAGS:0x0 PRIO:0x0 DATA_COUNT:0
STATUS:0x0 FLAGS:0x0 PARAM:0x0 QTP:0x0 DTP:0x0
CQ LEN:0 MAX:0 DESTATUS:0x0
```

Displaying FICON Information

This section includes the following topics:

Receiving FICON Alerts

In Displays Configured FICON Information, on page 269, the user alert mode is Enabled output confirms that you will receive an alert to indicate any changes in the FICON configuration.

Displays Configured FICON Information

```
switch# show ficon
Ficon information for VSAN 20
  Ficon is online
  VSAN is active
  Host port control is Enabled
  Host offline control is Enabled
  User alert mode is Enabled
  SNMP port control is Enabled
  Host set director timestamp is Enabled
  Active=Saved is Disabled
  Number of implemented ports are 250
  Key Counter is 73723
  FCID last byte is 0
  Date/Time is set by host to Sun Jun 26 00:04:06.991999 1904
  Device allegiance is locked by Host
  Codepage is us-canada
  Saved configuration files
    IPL
    _TSIRN00
```

Displaying FICON Port Address Information

Examples Displays Port Address Information, on page 270 to Displays Port Address Counter Information, on page 270 display FICON Port Address information.

Displays Port Address Information

```
switch# show ficon vsan 2 portaddress
Port Address 1 is not installed in vsan 2
    Port number is 1, Interface is fc1/1
    Port name is
    Port is not admin blocked
    Prohibited port addresses are 0,241-253,255
Port Address 2 is not installed in vsan 2
    Port number is 2, Interface is fc1/2
    Port name is
    Port is not admin blocked
    Prohibited port addresses are 0,241-253,255
...
Port Address 249 is not installed in vsan 2
    Port name is
    Port is not admin blocked
    Prohibited port addresses are 0,241-253,255
Port Address 250 is not installed in vsan 2
    Port name is
    Port is not admin blocked
    Prohibited port addresses are 0,241-253,255
```

Displays the Available Port Numbers

```
switch# show ficon first-available port-number
Port number 129(0x81) is available
```

In Displays Port Address Information in a Brief Format, on page 270, the interface column is populated with the corresponding interface if the port number is installed. If the port number is uninstalled, this space remains blank and indicates an unbound port number. For example, 56 is an unbound port number in Displays Port Address Information in a Brief Format, on page 270.

Displays Port Address Information in a Brief Format

```
switch# show ficon vsan 2 portaddress 50-55 brief
-------------------------------------------------------------------------------
Port    Port    Interface          Admin     Status           Oper   FCID
Address Number                     Blocked                    Mode
-------------------------------------------------------------------------------
50      50      fc2/18              on        fcotAbsent       --     --
51      51      fc2/19              off       fcotAbsent       --     --
52      52      fc2/20              off       fcotAbsent       --     --
53      53      fc2/21              off       fcotAbsent       --     --
54      54      fc2/22              off       notConnected     --     --
55      55      fc2/23              off       up               FL     0xea0000
56      56                          off       up               FL     0xea0000
```

Displays Port Address Counter Information, on page 270 displays the counters in FICON version format 1 (32-bit format)

Displays Port Address Counter Information

```
switch# show ficon vsan 20 portaddress 8 counters
Port Address 8(0x8) is up in vsan 20
    Port number is 8(0x8), Interface is fc1/8
    Version presented 1, Counter size 32b
    242811 frames input, 9912794 words
      484 class-2 frames, 242302 class-3 frames
      0 link control frames, 0 multicast frames
      0 disparity errors inside frames
      0 disparity errors outside frames
      0 frames too big, 0 frames too small
      0 crc errors, 0 eof errors
      0 invalid ordered sets
      0 frames discarded c3
      0 address id errors
    116620 frames output, 10609188 words
      0 frame pacing time
    0 link failures
    0 loss of sync
    0 loss of signal
    0 primitive seq prot errors
    0 invalid transmission words
    1 lrr input, 0 ols input, 5 ols output
    0 error summary
```

Displaying FICON Configuration File Information

Examples Displays the Contents of the Specified FICON Configuration File, on page 271 to Displays the Specified Port Addresses for a FICON Configuration File, on page 272 display FICON configuration file information.

Displays the Contents of the Specified FICON Configuration File

```
switch# show ficon vsan 3 file IPL
FICON configuration file IPL      in vsan 3
    Port address 1
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,81-253,255
    Port address 2
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,81-253,255
    Port address 3
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,81-253,255
    Port address 4
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,81-253,255
...
Port address 80
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,81-253,255
    Port address 254
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,81-253,255
```

Displays All FICON Configuration Files

```
switch# show ficon vsan 2
Ficon information for VSAN 2
  Ficon is enabled
  VSAN is active
  Host control is Enabled
  Host offline control is Enabled
  Clock alert mode is Disabled
  User alert mode is Disabled
  SNMP control is Disabled
  Active=Saved is Disabled
  Number of implemented ports are 250
  Key Counter is 9
  FCID last byte is 0
  Date/Time is same as system time(Sun Dec 14 01:26:30.273402 1980)
  Device Allegiance not locked
  Codepage is us-canada
  Saved configuration files
    IPL
    IPLFILE1
```

Displays the Specified Port Addresses for a FICON Configuration File

```
switch# show ficon vsan 2 file iplfile1 portaddress 1-7
FICON configuration file IPLFILE1 in vsan 2
    Port address 1
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,241-253,255
    Port address 2
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,241-253,255
    Port address 3
        Port name is P3
        Port is not blocked
        Prohibited port addresses are 0,241-253,255
...
    Port address 7
        Port name is
        Port is not blocked
        Prohibited port addresses are 0,241-253,255
```

Displaying the Configured FICON State

If FICON is enabled on a VSAN, you can display the port address information for that VSAN (see Displays the Specified Port Address When FICON Is Enabled, on page 272).

Displays the Specified Port Address When FICON Is Enabled

```
switch# show ficon
 vsan 2 portaddress 55
Port Address 55 is not installed in vsan 2
    Port number is 55, Interface is fc2/23
    Port name is
    Port is not admin blocked
    Prohibited port addresses are 0,241-253,255
    Admin port mode is FL
    Port mode is FL, FCID is 0xea0000
```

Displaying a Port Administrative State

Examples Displays an Administratively Unblocked Port , on page 273 to Displays an Administratively Unblocked Port , on page 273 display the administrative state of a FICON port. If the port is blocked, the **show ficon vsan** *number* **portaddress** *number* command displays the blocked state of the port. If a specific port is prohibited, this command also displays the specifically prohibited port (3) along with the ports that are prohibited by default (0, 241 to 253, and 255). If a name is assigned, that name is also displayed.

Displays an Administratively Unblocked Port

```
switch# show ficon vsan 2 portaddress 2
Port Address 2(0x2) is not installed in vsan 2
    Port number is 2(0x2), Interface is fc1/2
    Port name is
    Port is not admin blocked
    Prohibited port addresses are 0,241-253,255(0,0xf1-0xfd,0xff)
    Admin port mode is auto
    Peer is Unknown
```

Displays an Administratively Blocked Port

```
switch# show ficon vsan 2 portaddress 1
Port Address 2(0x2) is not installed in vsan 2
    Port number is 2(0x2), Interface is fc1/2
    Port name is SampleName
    Port is admin blocked
    Prohibited port addresses are 0,241-253,255(0,0xf1-0xfd,0xff)
    Admin port mode is auto
    Peer is Unknown
```

Displaying Buffer Information

In Displays the History Buffer for the Specified VSAN, on page 273, the Key Counter column displays the 32-bit value maintained by Cisco MDS switches. This value is incremented when any port changes state in that VSAN. The key counter (a 32-bit value) is incremented when a FICON-related configuration is changed. Host programs can increment this value at the start of the channel program and then perform operations on multiple ports. The director history buffer keeps a log of which port address configuration was changed for each key-counter value.

The director history buffer provides a mechanism to determine the change in the port state from the previous time when a value was contained in the key counter.

Displays the History Buffer for the Specified VSAN

```
switch# show ficon vsan 20 director-history
Director History Buffer for vsan 20
---------------------------------------------
Key Counter           Ports Address
                      Changed
---------------------------------------------
74556                 43
74557                 44
74558                 45
74559                 46
74560                 47
74561                 48
74562                 49
74563                 50
74564                 51
74565                 52
74566                 53
74567                 54
74568                 55
74569                 56
74570                 57
74571                 58
74572                 59
74573                 60
74574                 61
74575                 62
```

```
74576                 63
74577                 64
74578
74579
74580                 1-3,5,10,12,14-16,34-40,43-45,47-54,56-57,59-64
74581                 3,5
74582                 64
74583
74584                 1-3,10,12,14-16,34-40,43-45,47-54,56-57,59-64
74585                 1
74586                 2
74587                 3
```

Viewing the History Buffer

In the directory history buffer, the Key Counter column displays the 32-bit value maintained by Cisco MDS switches. This value is incremented when any port changes state in that VSAN. The key counter (a 32-bit value) is incremented when a FICON-related configuration is changed. Host programs can increment this value at the start of the channel program and then perform operations on multiple ports. The director history buffer keeps a log of which port address configuration was changed for each key-counter value.

The director history buffer provides a mechanism to determine the change in the port state from the previous time when a value was contained in the key counter.

Displaying FICON Information in the Running Configuration

Displays the Running Configuration Information, on page 274 displays the FICON-related information in the running configuration.

Displays the Running Configuration Information

```
switch# show running-config
Building Configuration ...
in-order-guarantee
vsan database
  vsan 11 name “FICON11” loadbalancing src-dst-id
  vsan 75 name “FICON75” loadbalancing src-dst-id
fcdomain domain 11 static vsan 11
fcdomain domain 119 static vsan 75
fcdroplatency network 100 vsan 11
fcdroplatency network 500 vsan 75
feature fabric-binding
fabric-binding database vsan 11
  swwn 20:00:00:0d:ec:01:20:c0 domain 10
fabric-binding database vsan 75
  swwn 20:00:00:0d:ec:00:d6:40 domain 117
fabric-binding activate vsan 11
fabric-binding activate vsan 75
ficon vsan 75
interface port-channel 1
  ficon portnumber 0x80
  switchport mode E
snmp-server user mblair network-admin auth md5 0x688fa3a2e51ba5538211606e59ac292
7 priv 0x688fa3a2e51ba5538211606e59ac2927 localizedkey
snmp-server user wwilson network-admin auth md5 0x688fa3a2e51ba5538211606e59ac29
27 priv 0x688fa3a2e51ba5538211606e59ac2927 localizedkey
snmp-server host 171.71.187.101 traps version 2c public udp-port 1163
snmp-server host 172.18.2.247 traps version 2c public udp-port 2162
vsan database
  vsan 75 interface fc1/1
...
interface mgmt0
```

```
  ip address 172.18.47.39 255.255.255.128
  switchport speed 100
  switchport duplex full
no system health
ficon vsan 75
  file IPL
```

Displaying FICON Information in the Startup Configuration

Displays the Startup Configuration, on page 275 displays the FICON-related information in the startup configuration.

Displays the Startup Configuration

```
switch# show startup-config
...
ficon vsan 2
file IPL
```

Displays the Startup Configuration Status, on page 275 displays the switch response to an implicitly-issued copy running start command. In this case, only a binary configuration is saved until you explicitly issue the **copy running start** command again (seeTable 22: Saving the Active FICON and Switch Configuration , on page 246)

Displays the Startup Configuration Status

```
switch# show startup-config
No ASCII config available since configuration was last saved internally
on account of 'active=saved' mode.
Please perform an explicit 'copy running startup` to get ASCII configuration
```

Displaying FICON-Related Log Information

Displays Logging Levels for the FICON Feature, on page 275 and Displays FICON-Related Log File Contents, on page 275 display the logging information for FICON-related configurations.

Displays Logging Levels for the FICON Feature

```
switch# show logging level ficon
Facility        Default Severity        Current Session Severity
--------        ----------------        ------------------------
ficon                  2                        2
0(emergencies)         1(alerts)        2(critical)
3(errors)              4(warnings)      5(notifications)
6(information)         7(debugging)
```

Displays FICON-Related Log File Contents

```
switch# show logging logfile
...
2004 Feb 25 15:38:50 vegas6 %PORT-5-IF_UP: %$VSAN 75: 2004 Wed Feb 25 13:22:04.
131183%$ Interface fc1/8 is up in mode F
 2004 Feb 25 15:38:50 vegas6 %PORT-5-IF_UP: %$VSAN 75: 2004 Wed Feb 25 13:22:04.
131217%$ Interface fc1/9 is up in mode F
...
2004 Feb 25 15:39:09 vegas6 %PORT-5-IF_TRUNK_UP: %$VSAN 75: 2004 Wed Feb 25 13:
22:23.131121%$ Interface fc2/1, vsan 75 is up
```

```
 2004 Feb 25 15:39:09 vegas6 %PORT-5-IF_TRUNK_UP: %$VSAN 75: 2004 Wed Feb 25 13:
22:23.131121%$ Interface fc2/2, vsan 75 is up
 2004 Feb 25 15:39:09 vegas6 %PORT-5-IF_TRUNK_UP: %$VSAN 75: 2004 Wed Feb 25 13:
...
2004 Feb 25 23:22:36 vegas6 %PORT-5-IF_UP: %$VSAN 75: 2004 Wed Feb 25 21:05:42.
99916%$ Interface fc3/6 is up in mode F
 2004 Feb 25 23:22:37 vegas6 %PORT-5-IF_UP: %$VSAN 75: 2004 Wed Feb 25 21:05:43.
...
```

Default Settings

Table 23: Default FICON Settings , on page 276 lists the default settings for FICON features.

Table 23: Default FICON Settings

Parameters	Default
FICON feature	Disabled.
Port numbers	Same as port addresses.
FC ID last byte value	0 (zero).
EBCDIC format option	US-Canada.
Switch offline state	Hosts are allowed to move the switch to an offline state.
Mainframe users	Allowed to configure FICON parameters on Cisco MDS switches.
Clock in each VSAN	Same as the switch hardware clock.
Host clock control	Allows host to set the clock on this switch.
SNMP users	Configure FICON parameters.
Port address	Not blocked
Prohibited ports	Ports90–253 and 255 for the Cisco MDS 9200 Series switches. Ports250–253 and 255 for the Cisco MDS 9500 Series switches.

CHAPTER 12

Advanced Features and Concepts

This chapter describes the advanced features provided in switches in the Cisco MDS 9000 Family. It includes the following sections:

Common Information Model

Common Information Model (CIM) is an object-oriented information model that extends the existing standards for describing management information in a network/enterprise environment.

CIM messages are independent of platform and implementation because they are encoded in N Extensible Markup Language (XML). CIM consists of a specification and a schema. The specification defines the syntax and rules for describing management data and integrating with other management models. The schema provides the actual model descriptions for systems, applications, networks, and devices.

For more information about CIM, refer to the specification available through the Distributed Management Task Force (DMTF) website at the following URL: http://www.dmtf.org/

Note The CIM Functionality and SMI-S is now supported with Cisco Prime Data Center Network Manager (DCNM). Please refer to “Cisco Prime DCNM Installation Guide” and “SMI-S and Web Services Programming Guide, Cisco DCNM for SAN.

Fibre Channel Time-Out Values

You can modify Fibre Channel protocol related timer values for the switch by configuring the following time-out values (TOVs):

- Distributed services TOV (D_S_TOV)—The valid range is from 5,000 to 10,000 milliseconds. The default is 5,000 milliseconds.
- Error detect TOV (E_D_TOV)—The valid range is from 1,000 to 4,000 milliseconds. The default is 2,000 milliseconds. This value is matched with the other end during port initialization.
- Resource allocation TOV (R_A_TOV)—The valid range is from 5,000 to 10,000 milliseconds. The default is 10,000 milliseconds. This value is matched with the other end during port initialization.

Note The fabric stability TOV (F_S_TOV) constant cannot be configured.

This section includes the following topics:

Timer Configuration Across All VSANs

You can modify Fibre Channel protocol related timer values for the switch.

Caution The D_S_TOV, E_D_TOV, and R_A_ TOV values cannot be globally changed unless all VSANs in the switch are suspended.

Note If a VSAN is not specified when you change the timer value, the changed value is applied to all VSANs in the switch.

To configure Fibre Channel timers across all VSANs, follow these steps:

Step 1 switch# **config terminal**
switch(config)

Enters configuration mode.

Step 2 switch(config)# **fctimer R_A_TOV 6000**
Configures the R_A_TOV value for all VSANs to be 6000 msec. This type of configuration is not permitted unless all VSANs are suspended.

Timer Configuration Per-VSAN

You can also issue the fctimer for a specified VSAN to configure different TOV values for VSANs with special links like FC or IP tunnels. You can configure different E_D_TOV, R_A_TOV, and D_S_TOV values for individual VSANs. Active VSANs are suspended and activated when their timer values are changed.

Caution You cannot perform a nondisruptive downgrade to any earlier version that does not support per-VSAN FC timers.

Note This configuration must be propagated to all switches in the fabric—be sure to configure the same value in all switches in the fabric.

If a switch is downgraded to Cisco MDS SAN-OS Release 1.2 or 1.1 after the timer is configured for a VSAN, an error message is issued to warn against strict incompatibilities. Refer to the *Cisco MDS 9000 Family Troubleshooting Guide*.

To configure per-VSAN Fiber Channel timers, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fctimer D_S_TOV 6000 vsan 2**

```
Warning: The vsan will be temporarily suspended when updating the timer value This configuration
would impact whole fabric. Do you want to continue? (y/n) y


Since this configuration is not propagated to other switches, please configure the same value in all
 the switches
```

Configures the D_S_TOV value to be 6000 msec for VSAN 2. Suspends the VSAN temporarily. You have the option to end this command, if required.

About fctimer Distribution

You can enable per-VSAN fctimer fabric distribution for all Cisco MDS switches in the fabric. When you perform fctimer configurations, and distribution is enabled, that configuration is distributed to all the switches in the fabric.

You automatically acquire a fabric-wide lock when you issue the first configuration command after you enabled distribution in a switch. The fctimer application uses the effective and pending database model to store or commit the commands based on your configuration.

Refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* for more information on the CFS application.

Enabling fctimer Distribution

To enable or disable fctimer fabric distribution, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fctimer distribute**
Enables fctimer configuration distribution to all switches in the fabric. Acquires a fabric lock and stores all future configuration changes in the pending database.

Step 3 switch(config)# **no fctimer distribute**
Disables (default) fctimer configuration distribution to all switches in the fabric.

Committing fctimer Changes

When you commit the fctimer configuration changes, the effective database is overwritten by the configuration changes in the pending database and all the switches in the fabric receive the same configuration. When you commit the fctimer configuration changes without implementing the session feature, the fctimer configurations are distributed to all the switches in the physical fabric.

To commit the fctimer configuration changes, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fctimer commit**
Distributes the fctimer configuration changes to all switches in the fabric and releases the lock. Overwrites the effective database with the changes made to the pending database.

Discarding fctimer Changes

After making the configuration changes, you can choose to discard the changes by discarding the changes instead of committing them. In either case, the lock is released.

To discard the fctimer configuration changes, follow these steps:

Step 1 switch# **config terminal**
switch(config)#

Enters configuration mode.

Step 2 switch(config)# **fctimer abort**
Discards the fctimer configuration changes in the pending database and releases the fabric lock.

Fabric Lock Override

If you have performed a fctimer fabric task and have forgotten to release the lock by either committing or discarding the changes, an administrator can release the lock from any switch in the fabric. If the administrator performs this task, your changes to the pending database are discarded and the fabric lock is released.

Tip The changes are only available in the volatile directory and are subject to being discarded if the switch is restarted.

To use administrative privileges and release a locked fctimer session, use the **clear fctimer session** command.

```
switch# clear fctimer session
```

Database Merge Guidelines

For information about CFS merge support, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* .

When merging two fabrics, follow these guidelines:

- Be aware of the following merge conditions:
  - The merge protocol is not implemented for distribution of the fctimer values—you must manually merge the fctimer values when a fabric is merged.The per-VSAN fctimer configuration is distributed in the physical fabric.
  - The fctimer configuration is only applied to those switches containing the VSAN with a modified fctimer value.
  - The global fctimer values are not distributed.
- Do not configure global timer values when distribution is enabled.

Note The number of pending fctimer configuration operations cannot be more than 15. At that point, you must commit or abort the pending configurations before performing any more operations.

Displaying Configured fctimer Values

Use the **show fctimer** command to display the configured fctimer values (see the following examples).

Displays Configured Global TOVs

```
switch# show fctimer

F_S_TOV   D_S_TOV   E_D_TOV   R_A_TOV
----------------------------------------
5000 ms   5000 ms   2000 ms   10000 ms
```

Note The F_S_TOV constant, though not configured, is displayed in the output of the **show fctimer** command.

Displays Configured TOVs for a Specified VSAN

```
switch# show fctimer vsan 10

vsan no.  F_S_TOV   D_S_TOV   E_D_TOV   R_A_TOV
-------------------------------------------------
10        5000 ms   5000 ms   3000 ms   10000 ms
```

Organizationally Unique Identifiers

Organizationally Unique Identifiers (OUIs) are unique 24 bit numbers that identify an organization globally. OUIs are extended by the organisation they are assigned to, to create 48 bit or 60 bit Extended Unique Identifiers (EUIs). Cisco obtains OUIs from IEEE and uses them to construct EUIs. These are assigned and burnt in to each system. A system may have one or more EUIs assigned to it. The EUIs are used in various forms such as MAC addresses, WWNs, SNMP identifiers, and so on.

Cisco MDS NX-OS software has an OUI database based on which certain software functionalities are made available. If a new Cisco device with an unrecognized OUI is added to a fabric, there is a possibility that some of these functionalities might be affected. To avoid this issue, the ability to manually add OUIs to the OUI database using the CLI is available.

Guidelines and Limitations

- ISSU—After an upgrade, there may be instances of duplicate OUIs in the default (built-in) and static (user defined) lists. In such a scenario, we recommend that you compare static OUIs with those in the default list and delete the duplicate static OUIs.
- ISSD—Delete all the configured or static OUIs before performing a downgrade to a release that does not support the **wwn oui** *oui-id* command.

For more information on deleting OUIs, see the Adding and Deleting OUIs, on page 283 section.

Adding and Deleting OUIs

To add an OUI to the OUI database, enter the **wwn oui** *oui-id* command in global configuration mode. To delete an OUI from the OUI database, enter the **no wwn oui** *oui-id* command in global configuration mode.

For detailed information about the **wwn oui** command, see the *Cisco MDS 9000 Family Command Reference* .

Configuration Examples for Adding and Deleting OUIs

Example: Adding and Deleting OUIs

```
switch# configure terminal
switch(config)# wwn oui 0x10001c
switch(config)# no wwn oui 0x10001c
switch(config)# end
```

Example: Displaying OUIs

```
switch# show wwn oui
OUI        Vendor               Default/Static
----------------------------------------------------
0x0000fc   Cisco                Static
0x00000c   Cisco                Default
0x000196   Cisco                Default
0x000197   Cisco                Default
0x0001c7   Cisco                Default
0x0001c9   Cisco                Default
```

World Wide Names

The world wide name (WWN) in the switch is equivalent to the Ethernet MAC address. As with the MAC address, you must uniquely associate the WWN to a single device. The principal switch selection and the allocation of domain IDs rely on the WWN. The WWN manager, a process-level manager residing on the switch's supervisor module, assigns WWNs to each switch.

Cisco MDS 9000 Family switches support three network address authority (NAA) address formats (see Table 24: Standardized NAA WWN Formats , on page 283).

Table 24: Standardized NAA WWN Formats

NAA Address	NAA Type	WWW Format	
IEEE 48-bit address	Type 1 = 0001b	000 0000 0000b	48-bit MAC address
IEEE extended	Type 2 = 0010b	Locally assigned	48-bit MAC address
IEEE registered	Type 5 = 0101b	IEEE company ID: 24 bits	VSID: 36 bits

Caution Changes to the world-wide names should be made by an administrator or individual who is completely familiar with switch operations.

This section includes the following topics:

Displaying WWN Information

Use the **show wwn** commands to display the status of the WWN configuration. See the following examples:

Displays the Status of All WWNs

```
switch# show wwn status
         Type 1 WWNs: Configured:     64 Available:     48 (75%) Resvd.: 16
    Types 2 & 5 WWNs: Configured: 524288 Available: 450560 (85%) Resvd.: 73728
NKAU & NKCR WWN Blks: Configured:   1760 Available:   1760 (100%)
        Alarm Status:      Type1:   NONE Types 2&5:   NONE
```

Displays Specified Block ID Information

```
switch# show wwn status block-id 51

WWNs in this block: 21:00:ac:16:5e:52:00:03 to 21:ff:ac:16:5e:52:00:03
Num. of WWNs:: Configured: 256 Allocated:    0 Available: 256
Block Allocation Status: FREE
```

Displays the WWN for a Specific Switch

```
switch# show wwn switch
Switch WWN is 20:00:ac:16:5e:52:00:00
```

Link Initialization WWN Usage

Exchange Link Protocol (ELP) and Exchange Fabric Protocol (EFP) use WWNs during link initialization. The usage details differ based on the Cisco NX-OS software release.

Both ELPs and EFPs use the VSAN WWN by default during link initialization. However, the ELP usage changes based on the peer switch’s usage:

- If the peer switch ELP uses the switch WWN, then the local switch also uses the switch WWN.
- If the peer switch ELP uses the VSAN WWN, then the local switch also uses the VSAN WWN.

Note As of Cisco SAN-OS Release 2.0(2b), the ELP is enhanced to be compliant with FC-SW-3.

Configuring a Secondary MAC Address

To allocate secondary MAC addresses, follow these steps:

Step 1

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

Enters configuration mode.

Step 2

```
switch(config)# wwn secondary-mac 00:99:55:77:55:55 range 64

This command CANNOT be undone.


Please enter the BASE MAC ADDRESS again: 00:99:55:77:55:55

Please enter the mac address RANGE again: 64

From now on WWN allocation would be based on new MACs.

Are you sure? (yes/no) no

You entered: no. Secondary MAC NOT programmed
```

Configures the secondary MAC address. This command cannot be undone.

FC ID Allocation for HBAs

Fibre Channel standards require a unique FC ID to be allocated to an N port attached to a Fx port in any switch. To conserve the number of FC IDs used, Cisco MDS 9000 Family switches use a special allocation scheme.

Some HBAs do not discover targets that have FC IDs with the same domain and area. Prior to Cisco SAN-OS Release 2.0(1b), the Cisco SAN-OS software maintained a list of tested company IDs that do not exhibit this behavior. These HBAs were allocated with single FC IDs, and for others a full area was allocated.

The FC ID allocation scheme available in Release 1.3 and earlier, allocates a full area to these HBAs. This allocation isolates them to that area and are listed with their pWWN during a fabric login. The allocated FC IDs are cached persistently and are still available in Cisco SAN-OS Release 2.0(1b) (see the FC ID Allocation for HBAs, on page 285).

To allow further scalability for switches with numerous ports, the Cisco NX-OS software maintains a list of HBAs exhibiting this behavior. Each HBA is identified by its company ID (also known known as Organizational Unique Identifier, or OUI) used in the pWWN during a fabric login. A full area is allocated to the N ports with company IDs that are listed, and for the others a single FC ID is allocated. Regardless of the kind (whole area or single) of FC ID allocated, the FC ID entries remain persistent.

This section includes the following topics:

Default Company ID List

All switches in the Cisco MDS 9000 Family that ship with Cisco SAN-OS Release 2.0(1b) or later, or NX-OS 4.1(1) contain a default list of company IDs that require area allocation. Using the company ID reduces the number of configured persistent FC ID entries. You can configure or modify these entries using the CLI.

Caution Persistent entries take precedence over company ID configuration. If the HBA fails to discover a target, verify that the HBA and the target are connected to the same switch and have the same area in their FC IDs, then perform the following procedure:1. Shut down the port connected to the HBA.2. Clear the persistent FC ID entry.3. Get the company ID from the Port WWN.4. Add the company ID to the list that requires area allocation.5. Bring up the port.

The list of company IDs have the following characteristics:

- A persistent FC ID configuration always takes precedence over the list of company IDs. Even if the company ID is configured to receive an area, the persistent FC ID configuration results in the allocation of a single FC ID.
- New company IDs added to subsequent releases are automatically added to existing company IDs.
- The list of company IDs is saved as part of the running and saved configuration.
- The list of company IDs is used only when the fcinterop FC ID allocation scheme is in auto mode. By default, the interop FC ID allocation is set to auto, unless changed.

Tip We recommend that you set the fcinterop FC ID allocation scheme to auto and use the company ID list and persistent FC ID configuration to manipulate the FC ID device allocation.

Use the **fcinterop FCID allocation auto** command to change the FC ID allocation and the **show running-config** command to view the currently allocated mode.

- When you issue a **write erase**, the list inherits the default list of company IDs shipped with a relevant release.

To allocate company IDs, follow these steps:

Step 1 switch# **config terminal**
switch(config)#
Enters configuration mode.

Step 2 switch(config)# **fcid-allocation area company-id 0x003223**
Adds a new company ID to the default list.

Step 3 switch(config)# **no fcid-allocation area company-id 0x00E069**
Deletes a company ID from the default list.

Step 4 switch(config)# **fcid-allocation area company-id 0x003223**
Adds a new company ID to the default list.

Verifying the Company ID Configuration

You can view the configured company IDs by issuing the **show fcid-allocation area** command (see Displays the List of Default and Configured Company IDs, on page 287). Default entries are listed first and the user-added entries are listed next. Entries are listed even if they were part of the default list and you later removed them.

Displays the List of Default and Configured Company IDs

```
switch# show fcid-allocation area
FCID area allocation company id info:
 00:50:2E <-------------------- Default entry
 00:50:8B
 00:60:B0
 00:A0:B8
 00:E0:69
 00:30:AE + <------------------ User-added entry
 00:32:23 +
 00:E0:8B * <------------- Explicitly deleted entry (from the original default list)
Total company ids: 7
+ - Additional user configured company ids.
* - Explicitly deleted company ids from default list.
```

You can implicitly derive the default entries shipped with a specific release by combining the list of Company IDs displayed without any identification with the list of deleted entries.

You can also view or obtain the company IDs in a specific WWN by issuing the **show fcid-allocation company-id-from-wwn** command (see Displays the Company ID for the Specified WWN, on page 287). Some WWN formats do not support company IDs. In these cases, you many need to configure the FC ID persistent entry.

Displays the Company ID for the Specified WWN

```
switch# show fcid-allocation company-id-from-wwn 20:00:00:05:30:00:21:60
Extracted Company ID: 0x000530
```

Switch Interoperability

Interoperability enables the products of multiple vendors to interact with each other. Fibre Channel standards guide vendors towards common external Fibre Channel interfaces.

If all vendors followed the standards in the same manner, then interconnecting different products would become a trivial exercise. However, not all vendors follow the standards in the same way, thus resulting in interoperability modes. This section briefly explains the basic concepts of these modes.

Each vendor has a regular mode and an equivalent interoperability mode, which specifically turns off advanced or proprietary features and provides the product with a more amiable standards-compliant implementation.

Note For more information on configuring interoperability for the Cisco MDS 9000 Family switches, refer to the *Cisco MDS 9000 Family Switch-to-Switch Interoperability Configuration Guide* .

This section includes the following topics:

About Interop Mode

Cisco NX-OS software supports the following four interop modes:

- Mode 1— Standards based interop mode that requires all other vendors in the fabric to be in interop mode.
- Mode 2—Brocade native mode (Core PID 0).
- Mode 3—Brocade native mode (Core PID 1).
- Mode 4—McData native mode.

For information about configuring interop modes 2, 3, and 4, refer to the *Cisco MDS 9000 Family Switch-to-Switch Interoperability Configuration Guide* .

Table 25: Changes in Switch Behavior When Interoperability Is Enabled , on page 288 lists the changes in switch behavior when you enable interoperability mode. These changes are specific to switches in the Cisco MDS 9000 Family while in interop mode.

Table 25: Changes in Switch Behavior When Interoperability Is Enabled

Switch Feature	Changes if Interoperability Is Enabled
Domain IDs	Some vendors cannot use the full range of 239 domains within a fabric. Domain IDs are restricted to the range 97-127. This is to accommodate McData's nominal restriction to this same range. They can either be set up statically (the Cisco MDS switch accept only one domain ID, if it does not get that domain ID it isolates itself from the fabric) or preferred. (If it does not get its requested domain ID, it accepts any assigned domain ID.)
Timers	All Fibre Channel timers must be the same on all switches as these values are exchanged by E ports when establishing an ISL. The timers are F_S_TOV, D_S_TOV, E_D_TOV, and R_A_TOV.
F_S_TOV	Verify that the Fabric Stability Time Out Value timers match exactly.
D_S_TOV	Verify that the Distributed Services Time Out Value timers match exactly.
E_D_TOV	Verify that the Error Detect Time Out Value timers match exactly.
R_A_TOV	Verify that the Resource Allocation Time Out Value timers match exactly.

Switch Feature	Changes if Interoperability Is Enabled
Trunking	Trunking is not supported between two different vendor's switches. This feature may be disabled on a per port or per switch basis.
Default zone	The default zone behavior of permit (all nodes can see all other nodes) or deny (all nodes are isolated when not explicitly placed in a zone) may change.
Zoning attributes	Zones may be limited to the pWWN and other proprietary zoning methods (physical port number) may be eliminated. **Note** Brocade uses the **cfgsave** command to save fabric-wide zoning configuration. This command does not have any effect on Cisco MDS 9000 Family switches if they are part of the same fabric. You must explicitly save the configuration on each switch in the Cisco MDS 9000 Family.
Zone propagation	Some vendors do not pass the full zone configuration to other switches, only the active zone set gets passed. Verify that the active zone set or zone configuration has correctly propagated to the other switches in the fabric.
VSAN	Interop mode only affects the specified VSAN. **Note** Interop modes cannot be enabled on FICON-enabled VSANs.
TE ports and PortChannels	TE ports and PortChannels cannot be used to connect Cisco MDS to non-Cisco MDS switches. Only E ports can be used to connect to non-Cisco MDS switches. TE ports and PortChannels can still be used to connect an Cisco MDS to other Cisco MDS switches even when in interop mode.
FSPF	The routing of frames within the fabric is not changed by the introduction of interop mode. The switch continues to use src-id, dst-id, and ox-id to load balance across multiple ISL links.
Domain reconfiguration disruptive	This is a switch-wide impacting event. Brocade and McData require the entire switch to be placed in offline mode and/or rebooted when changing domain IDs.

Switch Feature	Changes if Interoperability Is Enabled
Domain reconfiguration nondisruptive	This event is limited to the affected VSAN. Only Cisco MDS 9000 Family switches have this capability—only the domain manager process for the affected VSAN is restarted and not the entire switch.
Name server	Verify that all vendors have the correct values in their respective name server database.
IVR	IVR-enabled VSANs can be configured in **no interop** (default) mode or in any of the **interop** modes.

Configuring Interop Mode 1

The interop mode1 in Cisco MDS 9000 Family switches can be enabled disruptively or nondisruptively.

Note Brocade's msplmgmtdeactivate command must explicitly be run prior to connecting from a Brocade switch to either Cisco MDS 9000 Family switches or to McData switches. This command uses Brocade proprietary frames to exchange platform information, which Cisco MDS 9000 Family switches or McData switches do not understand. Rejecting these frames causes the common E ports to become isolated.

To configure interop mode 1 in any switch in the Cisco MDS 9000 Family, follow these steps:

Step 1 Place the VSAN of the E ports that connect to the OEM switch in interoperability mode.

```
switch# config terminal
switch(config)# vsan database
switch(config-vsan-db)# vsan 1 interop 1
switch(config-vsan-db)# exit
switch(config)#
```

Note You cannot enable interop modes on FICON-enabled VSANs.

Step 2 Assign a domain ID in the range of 97 (0x61) through 127 (0x7F).

Note This is an limitation imposed by the McData switches.

```
switch(config)# fcdomain domain 100 preferred vsan 1
```

In Cisco MDS 9000 switches, the default is to request an ID from the principal switch. If the preferred option is used, Cisco MDS 9000 switches request a specific ID, but still join the fabric if the principal switch assigns a different ID. If the static option is used, the Cisco MDS 9000 switches do not join the fabric unless the principal switch agrees and assigns the requested ID.

Note When changing the domain ID, the FC IDs assigned to N ports also change.

Step 3 Change the Fibre Channel timers (if they have been changed from the system defaults).

Note The Cisco MDS 9000, Brocade, and McData FC Error Detect (ED_TOV) and Resource Allocation (RA_TOV) timers default to the same values. They can be changed if needed. The RA_TOV default is 10 seconds, and the ED_TOV default is 2 seconds. Per the FC-SW2 standard, these values must be the same on each switch within the fabric

```
switch(config)# fctimer e_d_tov ?
  <1000-4000>  E_D_TOV in milliseconds(1000-4000)
switch(config)# fctimer r_a_tov ?
  <5000-100000>  R_A_TOV in milliseconds(5000-100000)
```

Step 4 When making changes to the domain, you may or may not need to restart the Cisco MDS domain manager function for the altered VSAN.

- Force a fabric reconfiguration with the **disruptive** option.

```
switch(config)# fcdomain restart disruptive vsan 1
```

or

- Do not force a fabric reconfiguration.

```
switch(config# fcdomain restart vsan 1
```

Configuring Interop Mode 1

commandsTo verify the resulting status of issuing the interoperability command in any switch in the Cisco MDS 9000 Family, follow these steps:

SUMMARY STEPS

1. Use the **show version** command to verify the version.
2. Use the **show interface brief** command to verify if the interface states are as required by your configuration.
3. Use the **show run** command to verify if you are running the desired configuration.
4. Use the **show vsan** command to verify if the interoperability mode is active.
5. Use the **show fcdomain vsan** command to verify the domain ID.
6. Use the **show fcdomain domain-list vsan** command to verify the local principal switch status.
7. Use the **show fspf internal route vsan** command to verify the next hop and destination for the switch.
8. Use the **show fcns data vsan** command to verify the name server information.

DETAILED STEPS

Step 1 Use the **show version** command to verify the version.

```
switch# show version

Cisco Storage Area Networking Operating System (NX-OS) Software
```

```
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2003, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained herein are owned by
Cisco Systems, Inc. and/or other third parties and are used and
distributed under license. Some parts of this software are covered
under the GNU Public License. A copy of the license is available
at http://www.gnu.org/licenses/gpl.html.
Software
  BIOS:      version 1.0.8
  loader:    version 1.1(2)
  kickstart: version 2.0(1) [build 2.0(0.6)] [gdb]
  system:    version 2.0(1) [build 2.0(0.6)] [gdb]
  BIOS compile time:       08/07/03
  kickstart image file is: bootflash:///m9500-sf1ek9-kickstart-mzg.2.0.0.6.bin
  kickstart compile time:  10/25/2010 12:00:00
  system image file is:    bootflash:///m9500-sf1ek9-mzg.2.0.0.6.bin
  system compile time:     10/25/2020 12:00:00
Hardware
  RAM 1024584 kB
  bootflash: 1000944 blocks (block size 512b)
  slot0:           0 blocks (block size 512b)
  172.22.92.181 uptime is 0 days 2 hours 18 minute(s) 1 second(s)
  Last reset at 970069 usecs after Tue Sep 16 22:31:25 1980
    Reason: Reset Requested by CLI command reload
    System version: 2.0(0.6)
    Service:
```

Step 2 Use the **show interface brief** command to verify if the interface states are as required by your configuration.

```
switch# show int brief
Interface  Vsan   Admin  Admin   Status           Oper  Oper   Port-channel
                  Mode   Trunk                    Mode  Speed
                         Mode                           (Gbps)
--------------------------------------------------------------------
fc2/1      1      auto   on      up               E     2      --
fc2/2      1      auto   on      up               E     2      --
fc2/3      1      auto   on      fcotAbsent       --    --     --
fc2/4      1      auto   on      down             --    --     --
fc2/5      1      auto   on      down             --    --     --
fc2/6      1      auto   on      down             --    --     --
fc2/7      1      auto   on      up               E     1      --
fc2/8      1      auto   on      fcotAbsent       --    --     --
fc2/9      1      auto   on      down             --    --     --
fc2/10     1      auto   on      down             --    --     --
```

Step 3 Use the **show run** command to verify if you are running the desired configuration.

```
switch# show run
Building Configuration...
 interface fc2/1
no shutdown
 interface fc2/2
no shutdown
 interface fc2/3
 interface fc2/4
 interface fc2/5
 interface fc2/6
 interface fc2/7
no shutdown
 interface fc2/8
 interface fc2/9
 interface fc2/10

<snip>

interface fc2/32
 interface mgmt0
ip address 6.1.1.96 255.255.255.0
switchport encap default
no shutdown
vsan database
vsan 1 interop
boot system bootflash:/m9500-system-253e.bin sup-1
boot kickstart bootflash:/m9500-kickstart-253e.bin sup-1
boot system bootflash:/m9500-system-253e.bin sup-2
boot kickstart bootflash:/m9500-kickstart-253e.bin sup-2
callhome
fcdomain domain 100 preferred vsan 1
ip route 6.1.1.0 255.255.255.0 6.1.1.1
ip routing
line console
  databits 5
  speed 110
logging linecard
ssh key rsa 512 force
ssh server enable
switchname MDS9509
username admin password 5 $1$Li8/fBYX$SNc72.xt4nTXpSnR9OUFB/ role network-admin
```

Step 4 Use the **show vsan** command to verify if the interoperability mode is active.

```
switch# show vsan 1
vsan 1 information
         name:VSAN0001 stalactites
         interoperability mode:yes
<--------------------
verify mode
         loadbalancing:src-id/dst-id/oxid
         operational state:up
```

Step 5 Use the **show fcdomain vsan** command to verify the domain ID.

```
switch# show fcdomain vsan 1
The local switch is a Subordinated Switch.
Local switch run time information:
        State: Stable
        Local switch WWN:    20:01:00:05:30:00:51:1f
        Running fabric name: 10:00:00:60:69:22:32:91
        Running priority: 128
        Current domain ID: 0x64(100)
```

```
<---------------
verify domain id
Local switch configuration information:
        State: Enabled
        Auto-reconfiguration: Disabled
        Contiguous-allocation: Disabled
        Configured fabric name: 41:6e:64:69:61:6d:6f:21
        Configured priority: 128
        Configured domain ID: 0x64(100) (preferred)
Principal switch run time information:
        Running priority: 2
Interface               Role          RCF-reject
----------------    -------------    ------------
fc2/1               Downstream       Disabled
fc2/2               Downstream       Disabled
fc2/7               Upstream         Disabled
----------------    -------------    ------------
```

Step 6 Use the **show fcdomain domain-list vsan** command to verify the local principal switch status.

```
switch# show fcdomain domain-list vsan 1
Number of domains: 5
Domain ID              WWN
---------    -----------------------
 0x61(97)    10:00:00:60:69:50:0c:fe
 0x62(98)    20:01:00:05:30:00:47:9f
 0x63(99)    10:00:00:60:69:c0:0c:1d
0x64(100)    20:01:00:05:30:00:51:1f [Local]
0x65(101)    10:00:00:60:69:22:32:91 [Principal]
---------    -----------------------
```

Step 7 Use the **show fspf internal route vsan** command to verify the next hop and destination for the switch.

```
switch# show fspf internal route vsan 1
FSPF Unicast Routes
---------------------------
 VSAN Number  Dest Domain   Route Cost    Next hops
-----------------------------------------------
           1     0x61(97)          500      fc2/2
           1     0x62(98)         1000      fc2/1
                                            fc2/2
           1     0x63(99)          500      fc2/1
           1    0x65(101)         1000      fc2/7
```

Step 8 Use the **show fcns data vsan** command to verify the name server information.

```
switch# show fcns data vsan 1
VSAN 1:
------------------------------------------------------------------
FCID        TYPE  PWWN                    (VENDOR) FC4-TYPE:FEATURE
------------------------------------------------------------------
0x610400    N     10:00:00:00:c9:24:3d:90 (Emulex)     scsi-fcp
0x6105dc    NL    21:00:00:20:37:28:31:6d (Seagate)    scsi-fcp
0x6105e0    NL    21:00:00:20:37:28:24:7b (Seagate)    scsi-fcp
```

```
0x6105e1    NL    21:00:00:20:37:28:22:ea (Seagate)    scsi-fcp
0x6105e2    NL    21:00:00:20:37:28:2e:65 (Seagate)    scsi-fcp
0x6105e4    NL    21:00:00:20:37:28:26:0d (Seagate)    scsi-fcp
0x630400    N     10:00:00:00:c9:24:3f:75 (Emulex)     scsi-fcp
0x630500    N     50:06:01:60:88:02:90:cb              scsi-fcp
0x6514e2    NL    21:00:00:20:37:a7:ca:b7 (Seagate)    scsi-fcp
0x6514e4    NL    21:00:00:20:37:a7:c7:e0 (Seagate)    scsi-fcp
0x6514e8    NL    21:00:00:20:37:a7:c7:df (Seagate)    scsi-fcp
0x651500    N     10:00:00:e0:69:f0:43:9f (JNI)
Total number of entries = 12
```

Default Settings

Table 26: Default Settings for Advanced Features , on page 295 lists the default settings for the features included in this chapter.

Table 26: Default Settings for Advanced Features

Parameters	**Default**
CIM server	Disabled
CIM server security protocol	HTTP
D_S_TOV	5,000 milliseconds.
E_D_TOV	2,000 milliseconds.
R_A_TOV	10,000 milliseconds.
Timeout period to invoke fctrace	5 seconds.
Number of frame sent by the fcping feature	5 frames.
Remote capture connection protocol	TCP.
Remote capture connection mode	Passive.
Local capture frame limit s	10 frames.
FC ID allocation mode	Auto mode.
Loop monitoring	Disabled.
D_S_TOV	5,000 msec
E_D_TOV	2,000 msec

Parameters	Default
R_A_TOV	10,000 msec
Interop mode	Disabled

CHAPTER 13

Configuring Fibre Channel Common Transport Management Security

This chapter describes the Fibre Channel Common Transport (FC-CT) Management Security feature for Cisco MDS 9000 Series switches.

About Fibre Channel Common Transport

With the FC-CT management security feature, you can configure the network in such a manner that only a storage administrator or a network administrator can send queries to a switch and access information such as devices that are logged in devices in the fabric, switches in the fabric, how they are connected, how many ports each switch has and where each port is connected, configured zone information and privilege to add or delete zone and zone sets, and host bus adapter (HBA) details of all the hosts connected in the fabric.

Note In Cisco MDS NX-OS Release 6.2(9), the FC management feature is disabled by default. To enable FC management feature, use the fc-management enable command.

You can configure which pWWNs can send FC-CT management query and modify request to the management server. When any of the modules, such as a zone server, unzoned Fibre Channel name server (FCNS), or Fabric Configuration Server (FCS) receives an FC-CT management query, they perform a read operation on the FC-management database. If device is found in FC-management database, a reply is sent according to the permissions granted. If the device is not found in the FC-management database, each module sends a reject. If FC-management is disabled, each module processes each management query.

Configuration Guidelines

The FC-management security feature has the following configuration guidelines:

- When the FC-management security feature is enabled on a Cisco MDS switch, all management queries to the server are rejected unless the port world-wide name (pWWN) of the device that is sending management queries is added to FC-management database.
- When you enable FC Management, FC-CT management server queries from N_Port Virtualization (NPV) switches to N_Port Identifier Virtualization (NPIV) switches are rejected. We recommend that you add the switch world-wide name (sWWN) of the NPV switch to the FC management database of the NPIV switch after enabling the FC-management security feature.

Configuring the Fibre Channel Common Transport Query

To configure the FC-CT management security, follow these steps:

Step 1 switch# **config terminal**
Enters configuration mode.

Step 2 switch(config)# fc-management enable
Enables the FC-CT management security.

Step 3 switch(config)# **fc-management database vsan 1**
Configures the FC-CT management Security database.

Step 4 switch(config-fc-mgmt)# pwwn 1:1:1:1:1:1:1:1 feature all operation both
Adds the pWWN to the FC management database. You also can use these optional keywords when configuring the pwwn command:

- fcs— Enables or disables FC-CT query for fabric conf-server.
- fdmi—Enables or disables FC-CT query for FDMI.
- unzoned-ns—Enables or disables FC-CT query for unzoned name-server.
- zone—Enables or disables FC-CT query for zone-server.

Step 5 switch# **show fc-managment database**
Displays the configured FC-CT management information.

Verifying Fibre Channel Common Transport Management Security

The **show fc-management database** command displays the configured FC-CT management security feature information, see example Displays the Contents of the Fibre Channel Common Transport Query, on page 299.

Displays the Contents of the Fibre Channel Common Transport Query

```
switch# show fc-management database
-------------------------------------------------------------
VSAN PWWN FC-CT Permissions per FC services
-------------------------------------------------------------
1 01:01:01:01:01:01:01:01 Zone(RW), Unzoned-NS(RW), FCS(RW), FDMI(RW)
1 02:02:02:02:02:02:02:02 Zone(R), Unzoned-NS(R), FCS(R), FDMI(R)
1 03:03:03:03:03:03:03:03 Zone(W), Unzoned-NS(W), FCS(W), FDMI(W)
-------------------------------------------------------------
Total 3 entries
switch#
```

To verify the if the FC-management security feature is enabled or not, use the show fc-management status command:

```
switch# show fc-management status
Mgmt Security Disabled
switch#
```

Default Settings

Table 27: Default FC Management Settings , on page 299 lists the default settings for the FC management security feature in a Cisco MDS 9000 Family switch.

Table 27: Default FC Management Settings

Parameters	Default
FC-management	Disabled