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.

This chapter includes the following sections:

Note Table 2-1 on page 2-4 lists the differences between zones and VSANs.

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.

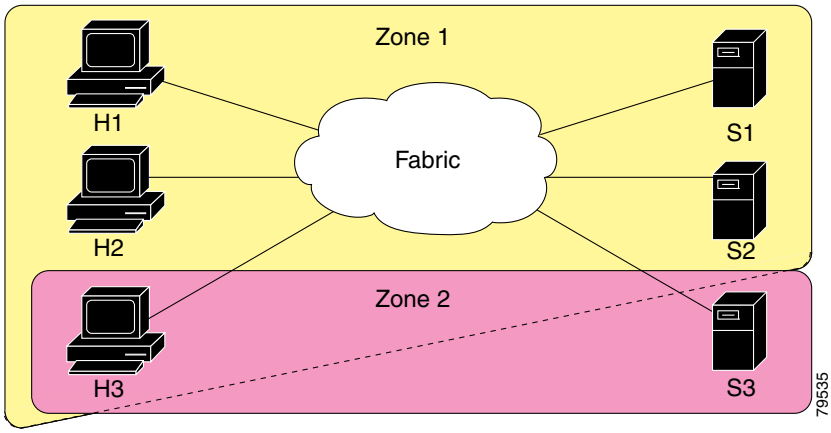
  - If zoning is activated, any device that is not in an active zone (a zone that is part of an active zoneset) is a member of the default zone.
  - Zones can vary in size.
  - Devices can belong to more than one zone.
- A zoneset consists of one or more zones.
  - A zoneset can be activated or deactivated 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

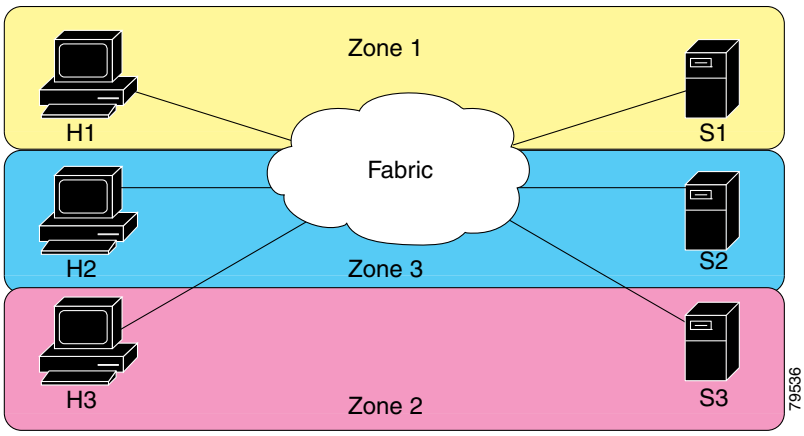
Figure 2-1 illustrates a zoneset with two zones, zone 1 and zone 2, in a fabric. Zone 1 provides access from all three hosts (H1, H2, H3) to the data residing on storage systems S1 and S2. Zone 2 restricts the data on S3 to access only by H3. Note that H3 resides in both zones.

Figure 2-1 Fabric with Two Zones



There are other ways to partition this fabric into zones. Figure 2-2 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 2-2 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 as long as the new zoneset is configured similar to the previous zoneset. Traffic of unchanged zones is not affected.

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.

Active and Full Zoneset Considerations

Before configuring a zoneset, consider the following guidelines:

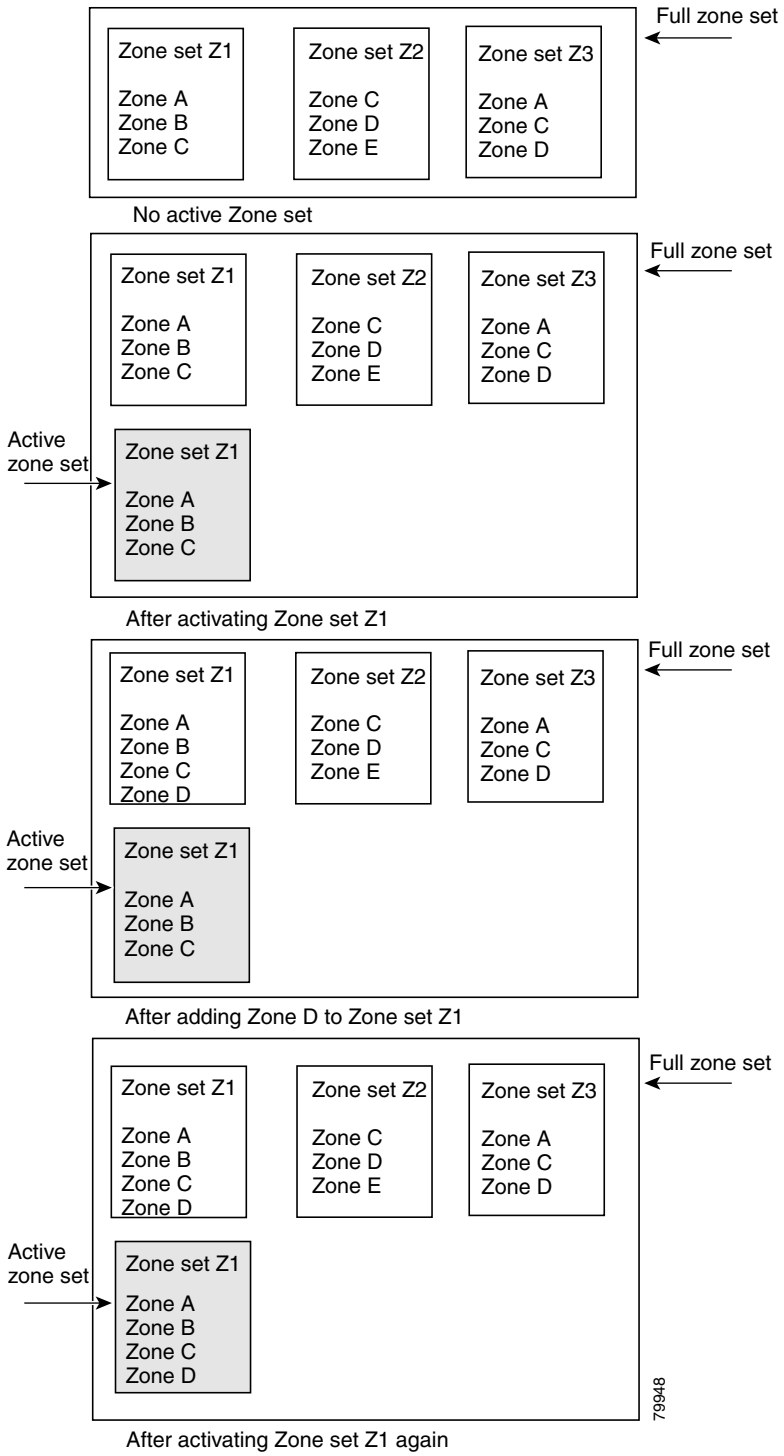
- Each VSAN can have multiple zone sets but only one zoneset can be active at any given time.
- When you create a zoneset, that zoneset becomes a part of the full zoneset.
- When you activate a zoneset, a copy of the zoneset from the full zoneset is used to enforce zoning, and is called the active zoneset. 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 2-3 shows a zone being added to an activated zoneset.

Figure 2-3 Active and Full Zone Sets



Zone Configuration

This section describes how to configure zones and includes the following topic:

- Configuring a Zone, page 2-7

Configuring a Zone

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

	Command	Purpose
Step 1	`switch# configure terminal`	Enters configuration mode.
Step 2	`switch(config)# zone name Zone1 vsan 3` `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`
	pWWN example:
	`switch(config-zone)# member pwwn 10:00:00:23:45:67:89:ab`
	Fabric pWWN example:
	`switch(config-zone)# member fwwn 10:01:10:01:10:ab:cd:ef`
	FC ID example:
	`switch(config-zone)# member fcid 0xce00d1`
	FC alias example:
	`switch(config-zone)# member fcalias Payroll`
	Domain ID example:
	`switch(config-zone)# member domain-id 2 portnumber 23`
	IPv4 address example:
	`switch(config-zone)# member ip-address 10.15.0.0 255.255.0.0`
	IPv6 address example:
	`switch(config-zone)# member ipv6-address 2001::db8:800:200c:417a/64`
	Local sWWN interface example:
	`switch(config-zone)# member interface fc 2/1`
	Remote sWWN interface example:
	`switch(config-zone)# member interface fc2/1 swwn 20:00:00:05:30:00:4a:de`
	Domain ID interface example:
	`switch(config-zone)# member interface fc2/1 domain-id 25`
	`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.

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.

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*.

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.

This section describes zone sets and includes the following topics:

- Configuring the Default Zone Access Permission, page 2-13
- About FC Alias Creation, page 2-13
- Creating FC Aliases, page 2-13
- Creating Zone Sets and Adding Member Zones, page 2-14
- Zone Enforcement, page 2-16

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:

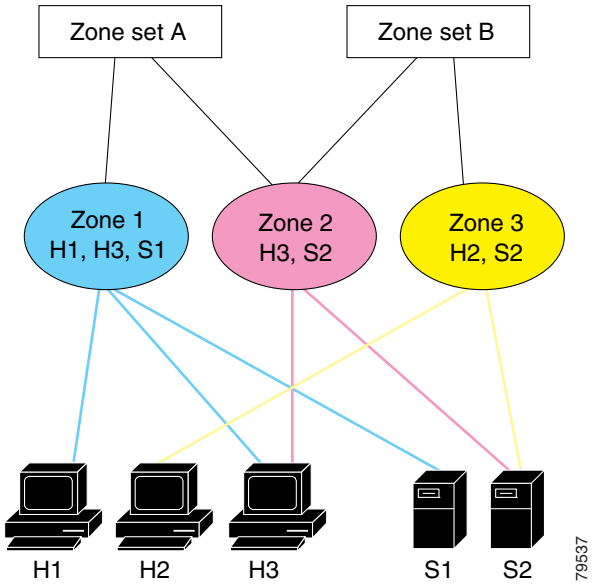
- To the full zoneset
- To a remote location (using FTP, SCP, SFTP, or TFTP)

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 Figure 2-4, two separate sets are created, each with its own membership hierarchy and zone members.

Figure 2-4 Hierarchy of ZoneSets, Zones, 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.

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

	Command	Purpose
Step 1	`switch# config terminal` `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.
		`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`

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

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

Note The overwrite control for an active zoneset feature is available only in enhanced zone mode.

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.

	Command	Purpose
Step 1	`switch# configure terminal` `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.

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.

Example 2-1 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]

Configuring the Default Zone Access Permission

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

	Command	Purpose
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.
	`switch(config)# no zone default-zone permit vsan 1`	Denies (default) traffic flow to default zone members.

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:

	Command	Purpose
Step 1	`switch# configure terminal`	Enters configuration mode.
Step 2	`switch(config)# fcalias name AliasSample vsan 3` `switch(config-fcalias)#`	Configures an alias name (AliasSample).

	Command	Purpose

Step 3	`switch(config-fcalias)# member` *`type value`*
	pWWN example:
	`switch(config-fcalias)# member pwwn 10:00:00:23:45:67:89:ab`
	fWWN example:
	`switch(config-fcalias)# member fwwn 10:01:10:01:10:ab:cd:ef`
	FC ID example:
	`switch(config-fcalias)# member fcid 0x222222`
	Domain ID example:
	`switch(config-fcalias)# member domain-id 2 portnumber 23`
	IPv4 address example:
	`switch(config-fcalias)# member ip-address 10.15.0.0 255.255.0.0`
	IPv6 address example:
	`switch(config-fcalias)# member ipv6-address 2001::db8:800:200c:417a/64`
	Local sWWN interface example:
	`switch(config-fcalias)# member interface fc 2/1`
	Remote sWWN interface example:
	`switch(config-fcalias)# member interface fc2/1 swwn 20:00:00:05:30:00:4a:de`
	Domain ID interface 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.

Step 4	**Note** Multiple members can be specified on multiple lines.	

Creating Zone Sets and Adding Member Zones

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

	Command	Purpose
Step 1	`switch# configure terminal`	Enters configuration mode.
Step 2	`switch(config)# zoneset name Zoneset1 vsan 3` `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.

	Command	Purpose
Step 4	`switch(config-zoneset)# zone name InlineZone1` `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` `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.

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" section on page 2-65). 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 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 Chapter 5, "Distributing Device Alias Services" for details and requirements about device alias modes.

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.

Table 2-1 lists the differences between these distribution methods.

Table 2-1 zoneset distribution Command Differences

zoneset distribute vsan Command (EXEC Mode)	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.

This section describes zoneset distribution and includes the following topics:

- Importing and Exporting Zone Sets, page 2-18

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:

	Command	Purpose
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 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 command only distributes the full zoneset information; it does not save the information to the startup configuration. You must explicitly 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* command 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)
```

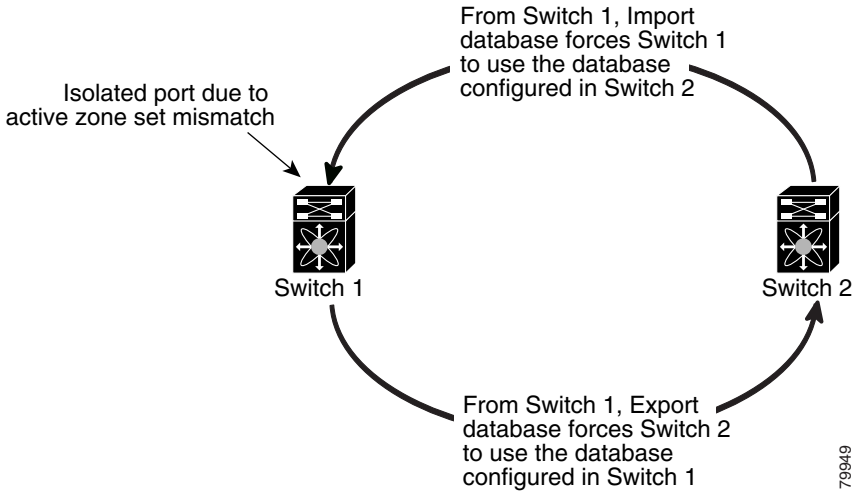
```
Status: Activation completed at 17:28:04 UTC Jun 16 2014
```

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 2-5).
- 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 2-5 Importing and Exporting the Database



Importing and Exporting Zone Sets

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

	Command	Purpose
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.
	`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 2	`switch# zoneset export vsan 5`	Exports the zoneset to the adjacent switch connected through VSAN 5.
	`switch# zoneset export vsan 5-8`	Exports the zoneset to the adjacent switch connected through the range of VSANs 5 through 8.

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.

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.

This section includes the following topics:

Copying Zone Sets

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

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

	Command	Purpose
Step 1	`switch# zone copy active-zoneset full-zoneset vsan 2` `Please enter yes to proceed.(y/n) [n]? y`	Makes a copy of the active zoneset in VSAN 2 to the full zoneset.
	`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.

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*.

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.

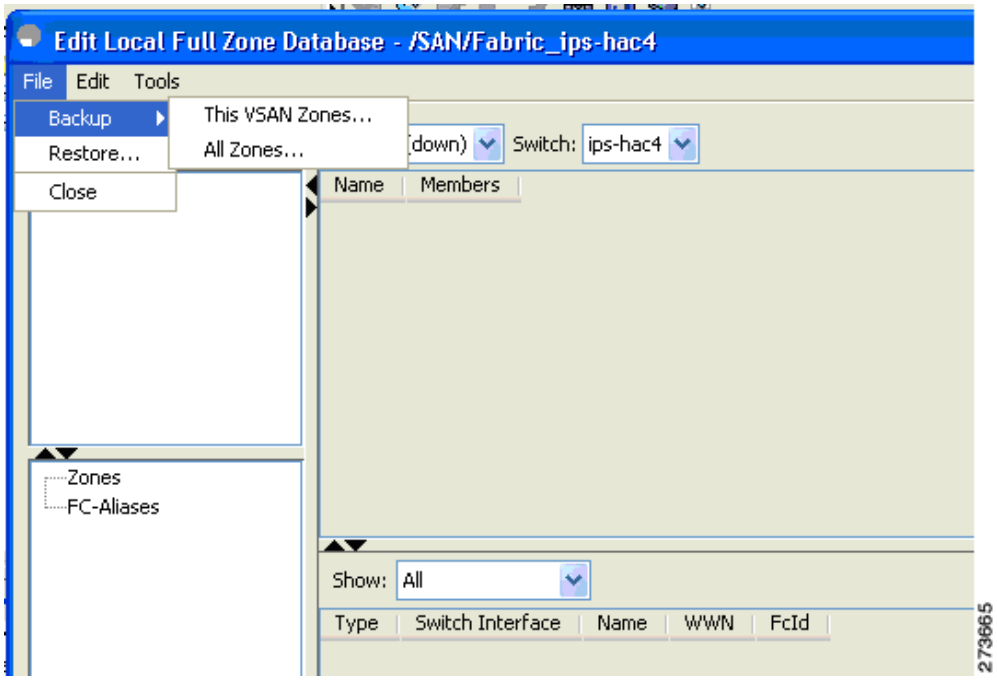
Backing Up Zones

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

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

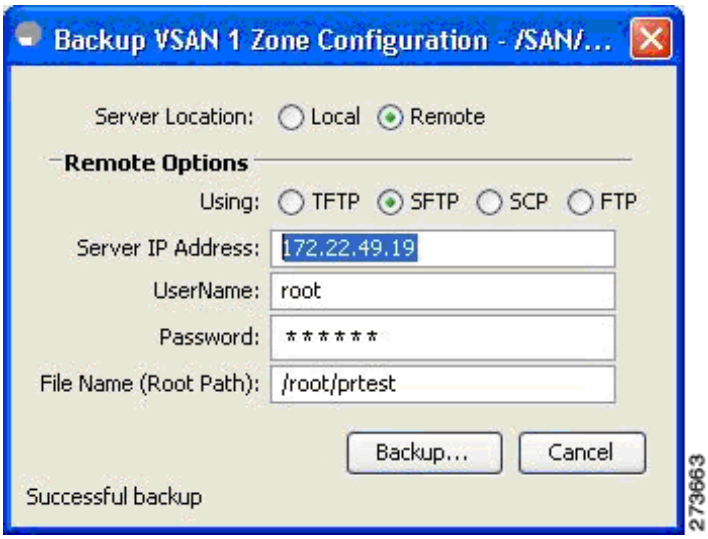
Step 2 Select a VSAN and click **OK.** You see the Edit Local Full Zone Database dialog box for the selected VSAN as shown in Figure 2-6.

Figure 2-6 Edit Local Full Zone Database



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 shown in Figure 2-7.

Figure 2-7 Backup Zone Configuration Dialog Box



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.

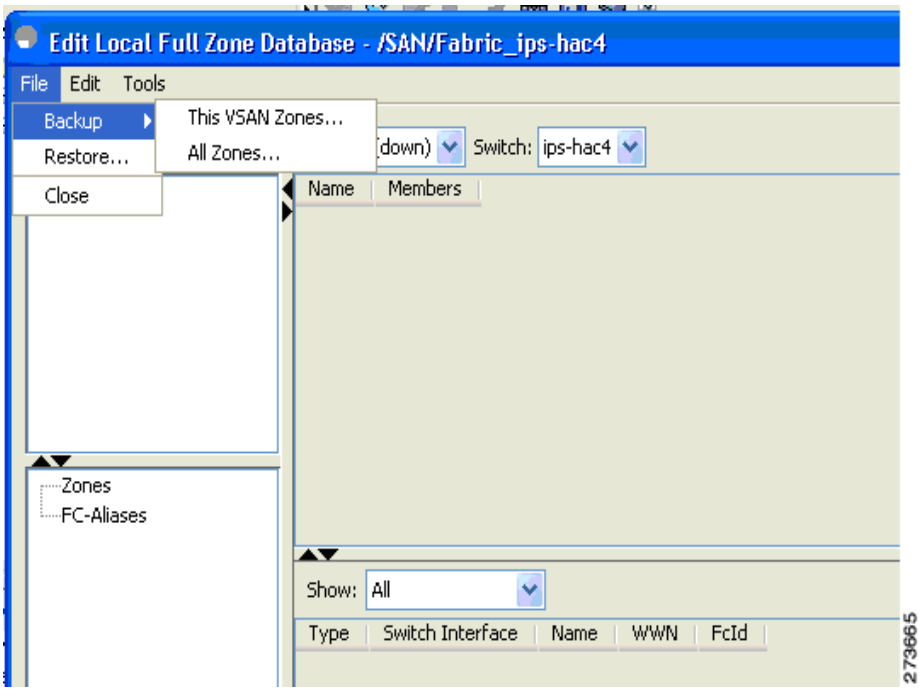
Restoring Zones

To restore the full zone configuration using DCNM, 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 as shown in Figure 2-8.

Figure 2-8 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 shown in Figure 2-9.

Figure 2-9 Restore Zone Configuration Dialog Box

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

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

	Command	Purpose
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.
	`switch(config)# zone rename oldname newname vsan 2`	Renames a zone in the specified VSAN.
	`switch(config)# fcalias rename oldname newname vsan 2`	Renames a fcalias in the specified VSAN.
	`switch(config)# zone-attribute-group rename oldname newname vsan 2`	Renames a zone attribute group in the specified VSAN.
Step 3	`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

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

	Command	Purpose
Step 1	`switch# configure terminal`	Enters configuration mode.
Step 2	`switch(config)# zoneset rename oldname newname vsan 2`	Renames a zoneset in the specified VSAN.
	`switch(config)# zone rename oldname newname vsan 2`	Renames a zone in the specified VSAN.
	`switch(config)# fcalias rename oldname newname vsan 2`	Renames a fcalias in the specified VSAN.
	`switch(config)# zone-attribute-group rename oldname newname vsan 2`	Renames a zone attribute group in the specified VSAN.
Step 3	`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

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

	Command	Purpose
Step 1	`switch# configure terminal`	Enters configuration mode.
Step 2	`switch(config)# zoneset clone oldname newname vsan 2`	Clones a zoneset in the specified VSAN.
	`switch(config)# zone clone oldname newname vsan 2`	Clones a zone in the specified VSAN.
	`switch(config)# fcalias clone oldname newname vsan 2`	Clones a fcalias in the specified VSAN.
	`switch(config)# zone-attribute-group clone oldname newname vsan 2`	Clones a zone attribute group in the specified VSAN.
Step 3	`switch(config)# zoneset activate name newname vsan 2`	Activates the zoneset and updates the new zone name in the active zoneset.

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 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.

Advanced Zone Attributes

This section describes advanced zone attributes and includes the following topics:

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 Family 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 Family 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:

	Command	Purpose
Step 1	`switch#` **`configure terminal`**	Enters configuration mode.
Step 2	`switch(config)#` **`zone name QosZone vsan 2`** `switch(config-zone)#`	Configures an alias name (QosZone) and enters zone configuration submode.
Step 3	`switch(config-zone)#` **`attribute-group qos priority high`**	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`**	Configures this zone to assign high priority QoS traffic to each frame matching this zone.
	`switch(config-zone)#` **`attribute qos priority medium`**	Configures this zone to assign medium priority QoS traffic to each frame matching this zone.
	`switch(config-zone)#` **`attribute qos priority low`**	Configures this zone to assign low priority QoS traffic to each frame matching this zone.
	`switch(config-zone)#` **`no attribute qos priority high`**	Reverts to using the default low priority for this zone.
Step 5	`switch(config-zone)#` **`exit`** `switch(config)#`	Returns to configuration mode.

	Command	Purpose
Step 6	`switch(config)# zone*set* name QosZoneset vsan 2` `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` `switch(config)#`	Returns to configuration mode.
Step 9	`switch(config)# zoneset activate name QosZoneset vsan 2`	Activates the specified zoneset.

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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone default-zone vsan 1` `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.
	`switch(config-default-zone)# no attribute qos priority high`	Removes the QoS priority attribute for the default zone and reverts to default low priority.

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 2-2 identifies the rules for the delivery of broadcast frames.

Table 2-2 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

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

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone broadcast enable vsan 2`	Broadcasts frames for the specified VSAN.
	`switch(config)# no zone broadcast enable vsan 3`	Disables (default) broadcasting for the specified VSAN.
Step 3	`switch(config)# zone name BcastZone vsan 2` `switch(config-zone)#`	Creates a broadcast zone in the specified VSAN and enters zone configuration submode.
Step 4	`switch(config-zone)# member pwwn 21:00:00:20:37:f0:2e:4d`	Adds the specified member to this zone.
Step 5	`switch(config-zone)# attribute broadcast`	Specifies this zone to be broadcast to other devices.

Step 6	`switch(config-zone)# end`
	`switch# show zone vsan 2`
	`zone name bcast-zone vsan 2`
	`attribute broadcast`
	`pwwn 21:00:00:e0:8b:0b:66:56`
	`pwwn 21:00:00:20:37:f0:2e:4d`
		Displays the broadcast configuration.

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

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

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone default-zone vsan 1` `switch(config-default-zone)#`	Enters the default zone configuration submode.
Step 3	`switch(config-default-zone)# attribute broadcast`	Sets broadcast attributes for the default zone.
	`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.
- Zones must have 50 members or less.

Smart Zoning Member Configuration

Table 2-3 displays the supported smart zoning member configurations.

Table 2-3 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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone smart-zoning enable vsan 1` `switch(config)#`	Enables smart zoning on a VSAN.
	`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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# system default zone smart-zone enable` `switch(config)#`	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` `switch(config)#`	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.

	Command	Purpose
Step 1	`switch#` **`configure terminal`** `switch(config)#`	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.

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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	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:

	Command	Purpose
Step 1	`switch(config)# clear zone smart-zoning fcalias name <alias-name> vsan <vsan no>`	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 <vsan no>`	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 <vsan no>`	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 <vsan no>`	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 for a VSAN in the Basic Zoning Mode

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

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.

Step 2	`switch(config)# zone-attribute-group name disable-sz vsan 1`
	`Enhanced zone session has been created.`
	`Please 'commit' the changes when done.`
		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.

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.

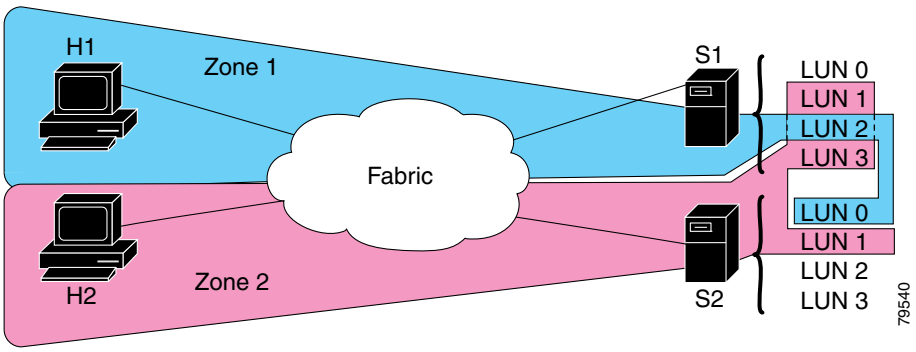
- Host H1 can access LUN 2 in S1 and LUN 0 in S2. It cannot access any other LUNs in S1 or S2.
- Host H2 can access LUNs 1 and 3 in S1 and only LUN 1 in S2. It cannot access any other LUNs in S1 or S2.

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 2-10 shows a LUN-based zone example.

Figure 2-10 LUN Zoning Access



Configuring a LUN-Based Zone

To configure a LUN-based zone, follow these steps:

	Command	Purpose
Step 1	`switch#` **`configure terminal`** `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)#` **`zone name LunSample vsan 2`** `switch(config-zone)#`	Configures a zone called LunSample for the specified VSAN (vsan 2) and enters zone configuration submode.

	Command	Purpose
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.
	`switch(config-zone)# member fcid 0x12465 lun 0x64`	Configures a zone member based on the FC ID and LUN value.

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" section on page 2-33.

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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone name Sample2 vsan 2` `switch(config-zone)#`	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.
	`switch(config-zone)# no attribute read-only`	Reverts the Sample2 zone attributes to read-write.

To configure the **read-only** option for a default zone, follow these steps:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone default-zone vsan 1` `switch(config-default-zone)#`	Enters the default zone configuration submode.
Step 3	`switch(config-default-zone)# attribute read-only`	Sets read-only attributes for the default zone.
	`switch(config-default-zone)# no attribute read-only`	Reverts the default zone attributes to read-write (default).

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. See Examples 2-2 to 2-17.

Example 2-2 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
```

Example 2-3 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.

Example 2-4 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
```

Example 2-5 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.

Example 2-6 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.

Example 2-7 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.

Example 2-8 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.

Example 2-9 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
```

Example 2-10 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
```

Example 2-11 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
```

Example 2-12 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]
```

Example 2-13 Displays Brief Descriptions of Zone Sets

```
switch# show zoneset brief
zoneset name ZoneSet1 vsan 1
  zone zone1
  zone zone2
```

Example 2-14 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
```

Example 2-15 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
```

Example 2-16 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
switch(config)#
```

Use the **show zone** command to display the zone attributes for all configured zones.

Example 2-17 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 (see Example 2-18 and Example 2-19).

Example 2-18 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
```

Example 2-19 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 Example 2-20).

Example 2-20 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
```

Example 2-21 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:
switch(config)#
```

Example 2-22 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
```

Example 2-23 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
```

Example 2-24 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
```

Example 2-25 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.

This section includes the following topics:

About Enhanced Zoning

Table 2-4 lists the advantages of the enhanced zoning feature in all switches in the Cisco MDS 9000 Series.9000 Series

Table 2-4 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.
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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone mode enhanced vsan 3000` `Set zoning mode command initiated. Check zone status`	Enables enhanced zoning in the specified VSAN.
	`switch(config)# no zone mode enhanced vsan 150` `Set zoning mode command initiated. Check zone status`	Disables enhanced zoning in the specified VSAN.

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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone commit vsan 2` `No pending info found`	Applies the changes to the enhanced zone database and closes the session.
	`switch(config)# zone commit vsan 3 force`	Forcefully applies the changes to the enhanced zone database and closes the session created by another user.
	`switch(config)# no zone commit vsan 2`	Discards the changes to the enhanced zone database and closes the session.
	`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.

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 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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	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`
	`The following zoning changes are about to be committed`
	`  +zone name zone-1 vsan 12`
	`Do you want to continue? (y/n) [n]`
		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`
	`The following zoning changes are about to be discarded`
	`  +zone name zone-1 vsan 12`
	`Do you want to continue? (y/n) [n]`
	`switch(config)#`
		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.

```
switch# conf t
switch(config)# zone-attribute-group name SampleAttributeGroup vsan 2
switch(config-attribute-group)#
```

Step 2 Add the attribute to an attribute-group object.

```
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.

```
switch(config)# zone name Zone1 vsan 2
switch(config-zone)# attribute-group SampleAttributeGroup
switch(config-zone)# exit
switch(config)#
```

Step 4 Activate the zoneset.

```
switch(config)# zoneset activate name Zoneset1 vsan 2
```

The attribute-groups are expanded and only the configured attributes are present in the active zoneset.

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 Table 2-5.

Table 2-5 Database Zone Merge Status

Local Database	Adjacent Database	Merge Status	Results of the Merge
The databases contain zone sets with the same name but different zones, aliases, and attributes groups.		Successful.	The union of the local and adjacent databases.
The databases contains a zone, zone alias, or zone attribute group object with same name but different members.		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.

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.

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# sh zoneset active vsan 100
zoneset name setA vsan 100
  zone name zone1 vsan 100
    pwwn 11:11:11:11:11:11:11:1a
    pwwn 11:11:11:11:11:11:11:1b
Switch1#
```

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# sh 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
Switch2#
```

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)# int fc1/5
Switch1(config-if)# no shut
Switch1(config-if)# exit
Switch1(config)# exit
```

Note Ensure that vsan 100 is allowed on ISL

```
Switch1# sh 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# sh 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# sh 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# sh zoneset 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
```

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.

Caution 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# sh 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# sh 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# sh 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

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# sh 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 100
         member 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:

Caution 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 shut
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 shut
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.

Switch1

```
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
```

Switch2

```
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
```

Configuring Zone Merge Control Policies

To configure merge control policies, follow these steps:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone merge-control restrict vsan 4`	Configures a restricted merge control setting for this VSAN.
	`switch(config)# no zone merge-control restrict vsan 2`	Defaults to using the allow merge control setting for this VSAN.
	`switch(config)# zone commit vsan 4`	Commits the changes made to VSAN 4.

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:

	Command	Purpose
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.
	`switch(config)# no zone default-zone permit vsan 3`	Denies traffic flow to default zone members and reverts to factory default.
Step 3	`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 The **broadcast** command is not supported from 5.x release onwards.

Table 2-6 identifies the rules for the delivery of broadcast frames.

Table 2-6 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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# zone-attribute-group name BroadcastAttr vsan 2`	Configures the zone attribute group for the required VSAN.
	`switch(config)# no zone-attribute-group name BroadAttr vsan 1`	Removes the zone attribute group for the required VSAN.

Step 3	`switch(config-attribute-group)# broadcast`
	`switch(config-attribute-group)# exit`
	`switch(config)#`
		Creates a broadcast attribute for this group and exits this submode.

	`switch(config-attribute-group)# no broadcast`	Removes broadcast attribute for this group and exits this submode.
Step 4	`switch(config)# zone name BroadcastAttr vsan 2` `switch(config-zone)#`	Configures a zone named BroadcastAttr in VSAN 2.

Step 5	`switch(config-zone)# member pwwn 21:00:00:e0:8b:0b:66:56`
	`switch(config-zone)# member pwwn 21:01:00:e0:8b:2e:80:93`
	`switch(config-zone)# attribute-group name BroadcastAttr`
	`switch(config-zone)# exit`
	`switch(config)#`
		Adds the specified members to this zone and exits this submode.

	Command	Purpose

Step 6	`switch(config)# zone commit vsan 1`
	`Commit operation initiated`
	`switch(config)# end`
		Applies the changes to the enhanced zone configuration and exits this submode.

Step 7	`switch# show zone vsan 1`
	`zone name BroadcastAttr vsan 1`
	`zone-attribute-group name BroadcastAttr vsan 1 broadcast`
	`pwwn 21:00:00:e0:8b:0b:66:56`
	`pwwn 21:01:00:e0:8b:2e:80:93`
		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:

	Command	Purpose
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.
	`switch(config)# no system default zone default-zone permit`	Configures deny (default) 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.
	`switch(config)# no system default zone distribute full`	Disables (default) full zone database distribution as the default for new VSANs on the switch. Only the active zone database is distributed.
Step 4	`switch(config)# system default zone gs read`	Configures read only as the default generic service permission for new VSANs on the switch.
	`switch(config)# system default zone gs read-write`	Configures (default) read-write as the default generic service permission for new VSANs on the switch.
	`switch(config)# no system default zone gs read-write`	Configures none(deny) 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:

	Command	Purpose
Step 1	`switch# configure terminal`	Enters configuration mode.
Step 2	`switch(config)# zone gs read vsan 3000`	Configures gs permission value as read only in the specified VSAN.
	`switch(config)# zone gs read-write vsan 3000`	Configures gs permission value as read-write in the specified VSAN.
	`switch(config)# no zone gs read-write vsan 3000`	Configures gs permission value as none(deny) in the specified VSAN.

Displaying Enhanced Zone Information

You can view any zone information by using the **show** command. See Examples 2-26 to 2-37.

Example 2-26 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]
```

Example 2-27 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
```

Example 2-28 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
```

Example 2-29 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
```

Example 2-30 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:
switch(config)#
```

Example 2-31 Displays the Pending ZoneSet Information for the VSAN to be Committed

```
switch# show zoneset pending vsan 2
No pending info found
```

Example 2-32 Displays the Pending Zone Information for the VSAN to be Committed

```
switch# show zone pending vsan 2
No pending info found
```

Example 2-33 Displays the Pending Zone Information for the VSAN to be Committed

```
switch# show zone-attribute-group pending vsan 2
No pending info found
```

Example 2-34 Displays the Pending Active ZoneSet Information for the VSAN to be Committed

```
switch# show zoneset pending active vsan 2
No pending info found
```

Example 2-35 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 (see Example 2-36).

Example 2-36 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
```

Example 2-37 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:

	Command	Purpose
Step 1	`switch# configure terminal` `switch(config)#`	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.

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 (see Example 2-38 through Example 2-42).

Example 2-38 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.

Example 2-39 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
minishan1(config-zone)#
```

Note The maximum size of the zone database per VSAN is 4096 KB.

Example 2-40 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
minishan1(config-zone)#
```

Example 2-41 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
switch(config)#
```

Example 2-42 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 2-7:

Table 2-7 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%) **Note** Cisco MDS NX-OS Release 6.2(x) does not support the LUN zoning, read-only zones, and broadcast zones features in Cisco MDS 9250i Multiservice Fabric Switch, Cisco MDS 9000 8-Port 10-Gbps Fibre Channel over Ethernet (FCoE) Module, Cisco MDS 9000 48-Port 8-Gbps Advanced Fibre Channel Switching Module, Cisco MDS 9000 32-Port 8-Gbps Advanced Fibre Channel Switching Module, and Cisco MDS 9000 48-port 16-Gbps Fibre Channel Switching Module.
Region 3 - Zoning	Zoning features, including IVR (50%-75%)
Region 4 - Bottom **Note** When a hard-zoning failure occurs, Region 4 (bottom region) is used to program wildcard entries to allow any-to-any communication.	PLOGI,ACC, and FCSP trap, ISL, ECHO-permit (10%-20%). Also, when transitioning to soft zoning mode the “SID -> Any” entries are in the Bottom region.

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

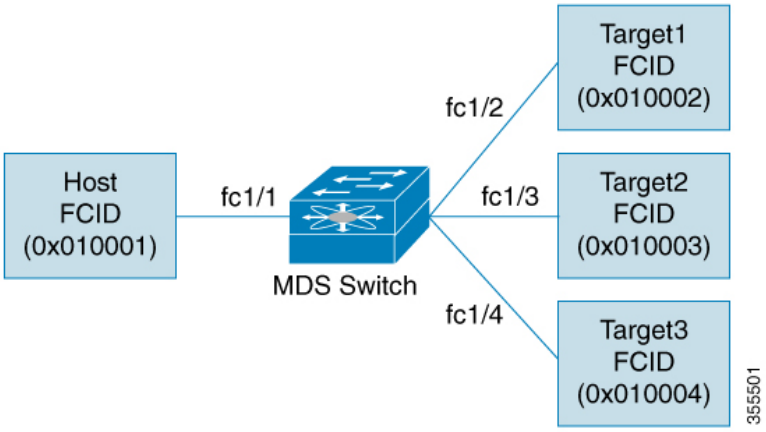
The Cisco MDS platform uses two types of zoning - 'Hard' and 'Soft' zoning.

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. When a TCAM programming failure occurs (usually due to TCAM being full) the system programs each FLOGI Source ID (SID) to be able to communicate with all destinations. These are referred to as the "SID -> Any" entries and are generated in the Bottom region. When these are generated, traffic flow continues non-disruptively as log as the Bottom region can contain all of these “SID -> Any” entries. If the Bottom region itself is exhausted then traffic disruption will occur.

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 less 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. Director-class FC linecards have more TCAM space than fabric switches. The number of forwarding engines and the amount of TCAMs allocated to each 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.
RTP-SAN-15-10-9148s-1#
```

The above example indicates the following:

- There are three forwarding engines, 1-3.
- 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 FC 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, 0-5.
- Since there are 48 ports on a Cisco MDS DS-X9448-768K9 line card, 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 fabric switches, use the **show system internal acl tcam-soc** command, and for director-class switches, use the **acltcam-soc tcam-usage** command.

Table 4-8 lists the ports allocated to the forwarding engines:

Table 2-8 Port Allocation to Forwarding Engines

Switch/Module	Fwd Engines	Port Range	Fwd-Eng Number	Zoning Region Entries	Bottom Region Entries
MDS 9148	3	fc1/25-36 & fc1/45-48	1	2852	407
		fc1/5-12 & fc1/37-44	2	2852	407
		fc1/1-4 & fc1/13-24	3	2852	407
MDS 9250i	4	fc1/5-12 & eth1/1-8	1	2852	407
		fc1/1-4 & fc1/13-20 & fc1/37-40	2	2852	407
		fc1/21-36	3	2852	407
		ips1/1-2	4	2852	407
MDS 9148S	3	fc1/1-16	1	2852	407
		fc1/17-32	2	2852	407
		fc1/33-48	3	2852	407
MDS 9396S	12	fc1/1-8	0	49136	19664
		fc1/9-16	1	49136	19664
		fc1/17-24	2	49136	19664
		fc1/25-32	3	49136	19664
		fc1/33-40	4	49136	19664
		fc1/41-48	5	49136	19664
		fc1/49-56	6	49136	19664
		fc1/57-64	7	49136	19664
		fc1/65-72	8	49136	19664
		fc1/73-80	9	49136	19664
		fc1/81-88	10	49136	19664
		fc1/89-96	11	49136	19664
DS-X9248-48K9	1	fc1/1-48	0	27168	2680
DS-X9248-96K9	2	fc1/1-24	0	27168	2680
		fc1/25-48	1	27168	2680
DS-X9224-96K9	2	fc1/1-12	0	27168	2680
		fc1/13-24	1	27168	2680
DS-X9232-256K9	4	fc1/1-8	0	49136	19664
		fc1/9-16	1	49136	19664
		fc1/17-24	2	49136	19664
		fc1/25-32	3	49136	19664

Table 2-8 Port Allocation to Forwarding Engines (continued)

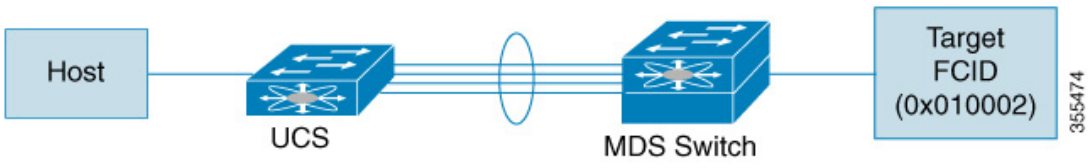
Switch/Module	Fwd Engines	Port Range	Fwd-Eng Number	Zoning Region Entries	Bottom Region Entries
DS-X9248-256K9	4	fc1/1-12	0	49136	19664
		fc1/13-24	1	49136	19664
		fc1/25-36	2	49136	19664
		fc1/37-48	3	49136	19664
DS-X9448-768K9	6	fc1/1-8	0	49136	19664
		fc1/9-16	1	49136	19664
		fc1/17-24	2	49136	19664
		fc1/25-32	3	49136	19664
		fc1/33-40	4	49136	19664
		fc1/41-48	5	49136	19664

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 Cisco 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:



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:

```
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
```

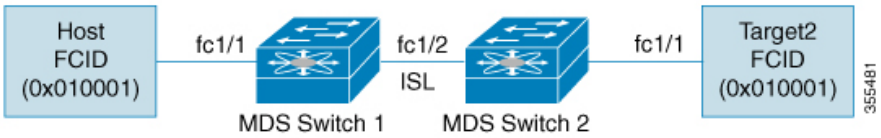
The above example shows the ACL TCAM programming that will be duplicated on each member of the F port-channel. Consequently, if a lot of programming is required because of a large number of FLOGIs on the F port channel, or a large number of devices are zoned with the devices on the F port channel, TCAM 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 modules 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
- Forward to fc1/2
1             030001(Target1)      ffffff     550002(host)     ffffff   Permit
- 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.

Default Settings

Table 2-9 lists the default settings for basic zone parameters.

Table 2-9 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.