C H A P T E R **6**

Configuring PortChannels

This chapter discusses the PortChannel feature provided in the switch and includes the following sections:

About PortChannels

PortChannels refer to the aggregation of multiple physical interfaces into one logical interface to provide higher aggregated bandwidth, load balancing, and link redundancy (See Figure 6-1). PortChannels can connect to interfaces across switching modules, so a failure of a switching module cannot bring down the PortChannel link.

Figure 6-1   PortChannel Flexibility
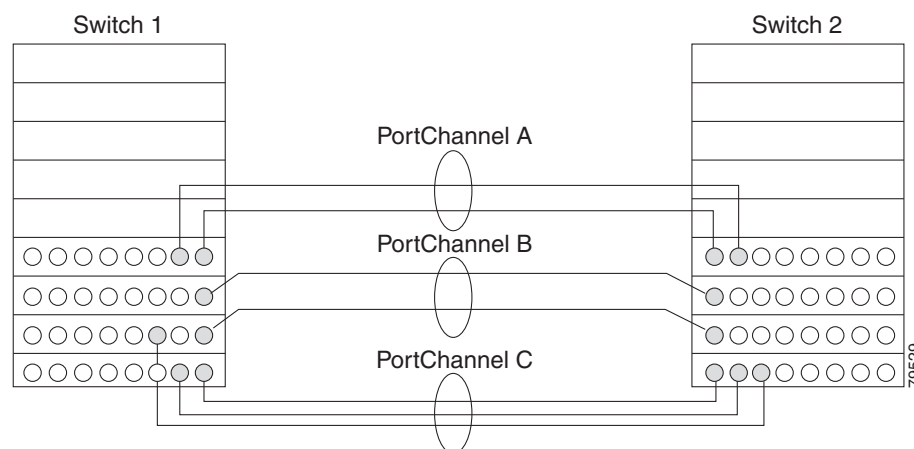
PortChannels on Cisco MDS 9000 Family switches allow flexibility in configuration. This illustrates three possible PortChannel configurations:

- PortChannel A aggregates two links on two interfaces on the same switching module at each end of a connection.

- PortChannel B also aggregates two links, but each link is connected to a different switching module. If the switching module goes down, traffic is not affected.

- PortChannel C aggregates three links. Two links are on the same switching module at each end, while one is connected to a different switching module on switch 2.

This section contains the following topics:

About E PortChannels

An E PortChannel refers to the aggregation of multiple E ports into one logical interface to provide higher aggregated bandwidth, load balancing, and link redundancy. PortChannels can connect to interfaces across switching modules, so a failure of a switching module cannot bring down the PortChannel link.

A PortChannel has the following features and restrictions:

- Provides a point-to-point connection over ISL (E ports) or EISL (TE ports). Multiple links can be combined into a PortChannel.

- Increases the aggregate bandwidth on an ISL by distributing traffic among all functional links in the channel.

- Load balances across multiple links and maintains optimum bandwidth utilization. Load balancing is based on the source ID, destination ID, and exchange ID (OX ID).

- Provides high availability on an ISL. If one link fails, traffic previously carried on this link is switched to the remaining links. If a link goes down in a PortChannel, the upper protocol is not aware of it. To the upper protocol, the link is still there, although the bandwidth is diminished. The routing tables are not affected by link failure. PortChannels may contain up to 16 physical links and may span multiple modules for added high availability.

Note   See the *Cisco MDS 9000 Family NX-OS Fabric Configuration Guide* for information about failover scenarios for PortChannels and FSPF links.

About F and TF PortChannels

An F PortChannel is also a logical interface that combines a set of F ports connected to the same Fibre Channel node and operates as one link between the F ports and the NP ports. The F port channels support bandwidth utilization and availability like the E port channels. F PortChannels are mainly used to connect MDS core and NPV switches to provide optimal bandwidth utilization and transparent failover between the uplinks of a VSAN.

An F PortChannel trunk combines the functionality and advantages of a TF port and an F PortChannel. This logical link uses the Cisco PTP and PCP protocols over Cisco EPP (ELS).

Note   If a Cisco MDS 9124 or 9134 switch is used as a core switch, only a nontrunking F PortChannel is supported. Trunking is not supported on this platform when NPIV enabled.

About PortChanneling and Trunking

Trunking is a commonly used storage industry term. However, the Cisco NX-OS software and switches in the Cisco MDS 9000 Family implement trunking and PortChanneling as follows:

- PortChanneling enables several physical links to be combined into one aggregated logical link.

- Trunking enables a link transmitting frames in the EISL format to carry (trunk) multiple VSAN traffic. For example, when trunking is operational on an E port, that E port becomes a TE port. A TE port is specific to switches in the Cisco MDS 9000 Family. An industry standard E port can link to other vendor switches and is referred to as a nontrunking interface (See Figure 6-2 and Figure 6-3). See Chapter 5, "Configuring Trunking," for information on trunked interfaces.

Figure 6-2   Trunking Only
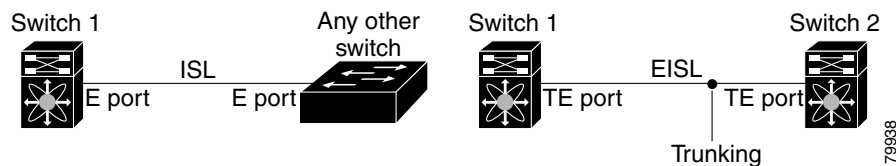
PortChanneling and trunking are used separately across an ISL:

Figure 6-3   PortChanneling and Trunking
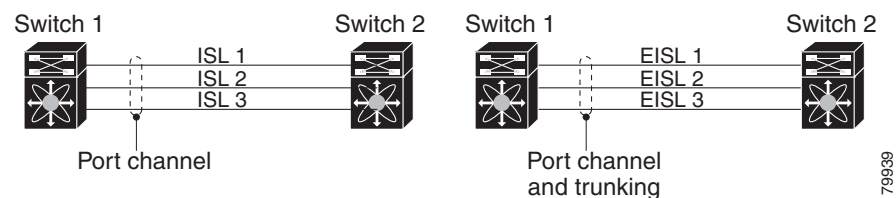
- PortChanneling—Interfaces can be channeled between the following sets of ports:
    - E ports and TE ports
    - F ports and NP ports

- – TF ports and TNP ports
- Trunking—Trunking permits carrying traffic on multiple VSANs between switches.

  See the *Cisco MDS 9000 Family NX-OS Fabric Configuration Guide*.
- Both PortChanneling and trunking can be used between TE ports over EISLs.

About Load Balancing

Two mechanisms support the load balancing functionality:

- Flow based—All frames between source and destination follow the same links for a given flow. That is, whichever link is selected for the first exchange of the flow is used for all subsequent exchanges.
- Exchange based—The first frame in an exchange picks a link and subsequent frames in the exchange follow the same link. However, subsequent exchanges can use a different link. This provides more granular load balancing while preserving the order of frames for each exchange.

Figure 6-4 illustrates how source ID 1 (SID1) and destination ID1 (DID1) based load balancing works. When the first frame in a flow is received on an interface for forwarding, link 1 is selected. Each subsequent frame in that flow is sent over the same link. No frame in SID1 and DID1 utilizes link 2.

Figure 6-4   SID1 and DID1 Based Load Balancing

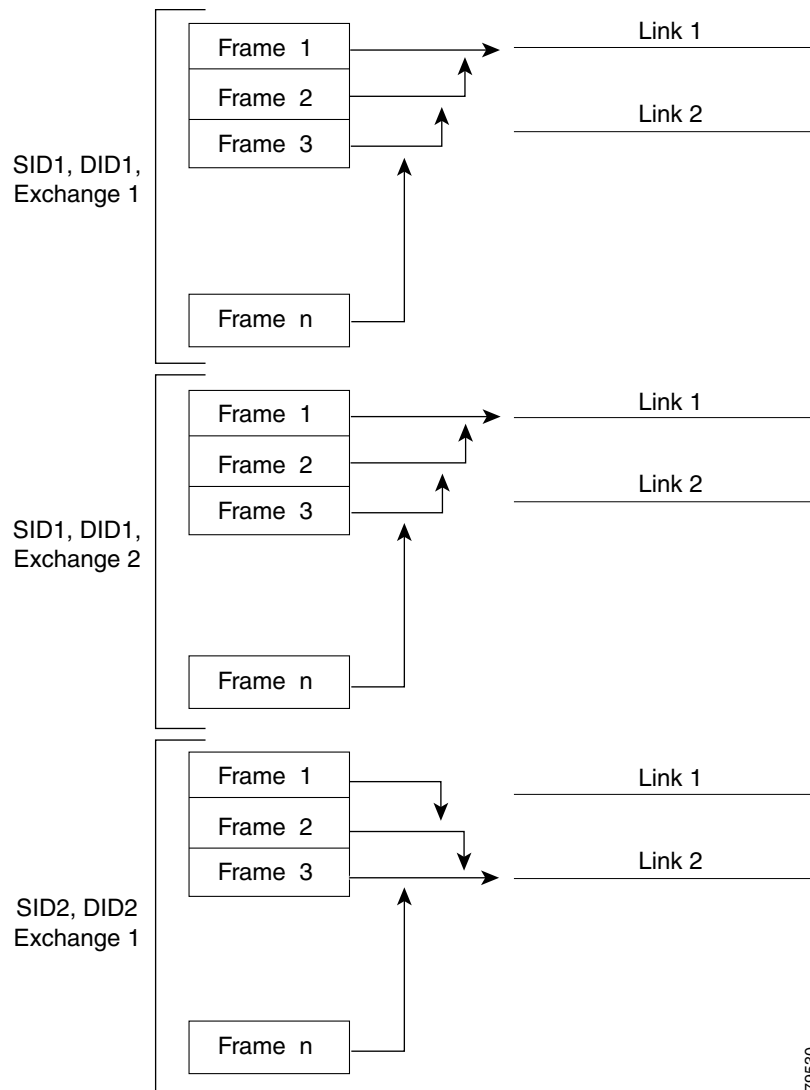Figure 6-5 illustrates how exchange-based load balancing works. When the first frame in an exchange is received for forwarding on an interface, link 1 is chosen by a hash algorithm. All remaining frames in that particular exchange are sent on the same link. For exchange 1, no frame uses link 2. For the next exchange, link 2 is chosen by the hash algorithm. Now all frames in exchange 2 use link 2.

Figure 6-5   SID1, DID1, and Exchange Based Load Balancing
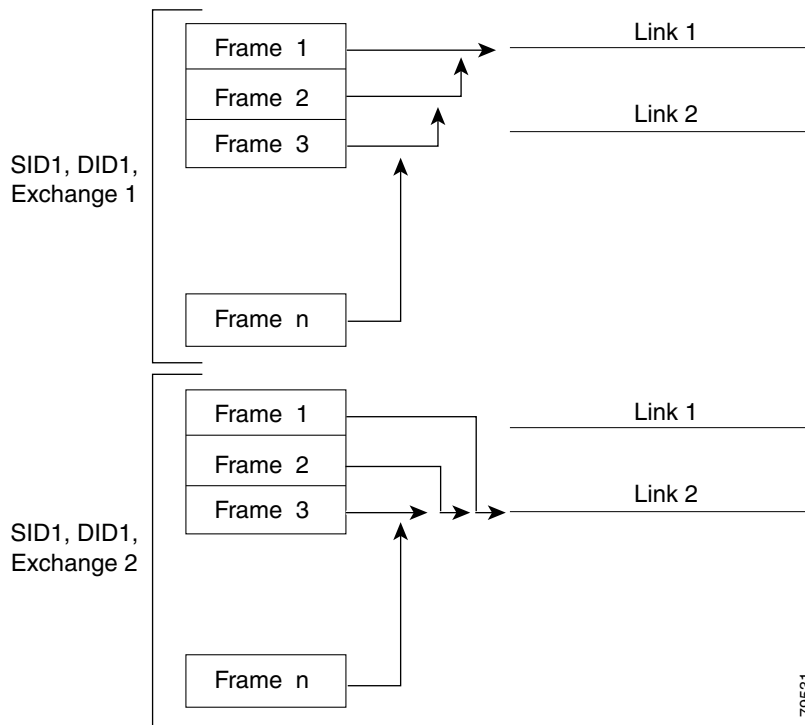
For more information on configuring load balancing and in-order delivery features, see the *Cisco MDS 9000 Family NX-OS Fabric Configuration Guide*.

About PortChannel Modes

You can configure each PortChannel with a channel group mode parameter to determine the PortChannel protocol behavior for all member ports in this channel group. The possible values for a channel group mode are as follows:

- ON (default)—The member ports only operate as part of a PortChannel or remain inactive. In this mode, the PortChannel protocol is not initiated. However, if a PortChannel protocol frame is received from a peer port, the software indicates its nonnegotiable status. This mode is backward compatible with the existing implementation of PortChannels in releases prior to Release 2.0(1b), where the channel group mode is implicitly assumed to be ON. In Cisco MDS SAN-OS Releases 1.3 and earlier, the only available PortChannel mode was the ON mode. PortChannels configured in the ON mode require you to explicitly enable and disable the PortChannel member ports at either end if you add or remove ports from the PortChannel configuration. You must physically verify that the local and remote ports are connected to each other.

- ACTIVE—The member ports initiate PortChannel protocol negotiation with the peer port(s) regardless of the channel group mode of the peer port. If the peer port, while configured in a channel group, does not support the PortChannel protocol, or responds with a nonnegotiable status, it will default to the ON mode behavior. The ACTIVE PortChannel mode allows automatic recovery without explicitly enabling and disabling the PortChannel member ports at either end.

Table 6-1 compares ON and ACTIVE modes.

Table 6-1   Channel Group Configuration Differences

ON Mode	ACTIVE Mode
No protocol is exchanged.	A PortChannel protocol negotiation is performed with the peer ports.
Moves interfaces to the suspended state if its operational values are incompatible with the PortChannel.	Moves interfaces to the isolated state if its operational values are incompatible with the PortChannel.
When you add or modify a PortChannel member port configuration, you must explicitly disable (shut) and enable (no shut) the PortChannel member ports at either end.	When you add or modify a PortChannel interface, the PortChannel automatically recovers.
Port initialization is not synchronized.	There is synchronized startup of all ports in a channel across peer switches.
All misconfigurations are not detected as no protocol is exchanged.	Consistently detect misconfigurations using a PortChannel protocol.
Transitions misconfigured ports to the suspended state. You must explicitly disable (shut) and enable (no shut) the member ports at either end.	Transitions misconfigured ports to the isolated state to correct the misconfiguration. Once you correct the misconfiguration, the protocol ensures automatic recovery.
This is the default mode.	You must explicitly configure this mode.

Configuration Guidelines and Restrictions

Cisco MDS 9000 Family switches support the following number of PortChannels per switch:

- Switches with only Generation 1 switching modules do not support F and TF PortChannels.

- Switches with Generation 1 switching modules, or a combination of Generation 1 and Generation 2 switching modules, support a maximum of 128 PortChannels. Only Generation 2 ports can be included in the PortChannels.

- Switches with only Generation 2 switching modules or Generation 2 and Generation 3 modules support a maximum of 256 PortChannels with 16 interfaces per PortChannel.

- A PortChannel number refers to the unique identifier for each channel group. This number ranges from of 1 to 256.

- Autocreation of port-channel in any mode is not supported as of MDS NX-OS Release 4.1(1b) and later.

- The PortChannel interface must be in ACTIVE mode when multiple FCIP interfaces are grouped with WA.

Generation 1 PortChannel Limitations

This section includes the restrictions on creation and addition of PortChannel members to a PortChannel on Generation 1 hardware:

- The 32-port 2-Gbps or 1-Gbps switching module

- The MDS 9140 and 9120 switches

When configuring the host-optimized ports on Generation 1 hardware, the following PortChannel guidelines apply:

- If you execute the **write erase** command on a 32-port switching module, and then copy a saved configuration to the switch from a text file that contains the **no system default switchport shutdown** command, you need to copy the text file to the switch again for the E ports to come up without manual configuration.

- The host-optimized ports in the Cisco MDS 9100 Series are subject to the same PortChannel rules as 32-port switching modules; only the first port of each group of 4 ports is included in a PortChannel.

    - You can configure only the first port in each 4-port group as an E port (for example, the first port in ports 1–4, the fifth port in ports 5–8, and so on). If the first port in the group is configured as a PortChannel, the other three ports in each group (ports 2–4, 6–8, and so on) are not usable and remain in the shutdown state.

    - If any of the other three ports are configured in a no shutdown state, you cannot configure the first port to be a PortChannel. The other three ports continue to remain in a no shutdown state.

F and TF PortChannel Restrictions

The following guidelines and restrictions are applicable for F and TF PortChannels:

- The ports must be in F mode.

- ON mode is not supported. Only ACTIVE-ACTIVE mode is supported. By default, the mode is ACTIVE on the NPV switches.

- Devices logged in through F PortChannel on an MDS switch are not supported in IVR non-NAT configuration. The devices are supported only in IVR NAT configuration.

- Port security rules are enforced only on physical PWWNs at the single link level.

- FC-SP authenticates only the first physical FLOGI of every PortChannel member.

- Since the FLOGI payload carries only the VF bits to trigger the use of a protocol after the FLOGI exchange, those bits will be overridden. In the case of the NPV switches with core Cisco switch, PCP protocol will be initiated.

- The name server registration of the N ports logging in through an F PortChannel will use the FWWN of the PortChannel interface.

- The PortChannel port VSAN cannot be configured using DPVM.

PortChannel Configuration

PortChannels are created with default values. You can change the default configuration just like any other physical interface.

Figure 6-6 provides examples of valid PortChannel configurations.

Figure 6-6   Valid PortChannel Configurations
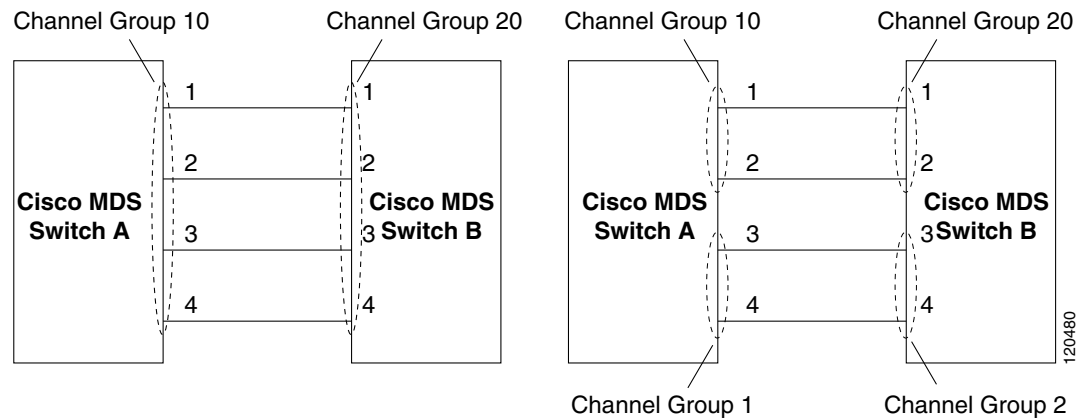
Figure 6-7 provides examples of invalid configurations. Assuming that the links are brought up in the 1, 2, 3, 4 sequence, links 3 and 4 will be operationally down as the fabric is misconfigured.

Figure 6-7   Misconfigured Configurations
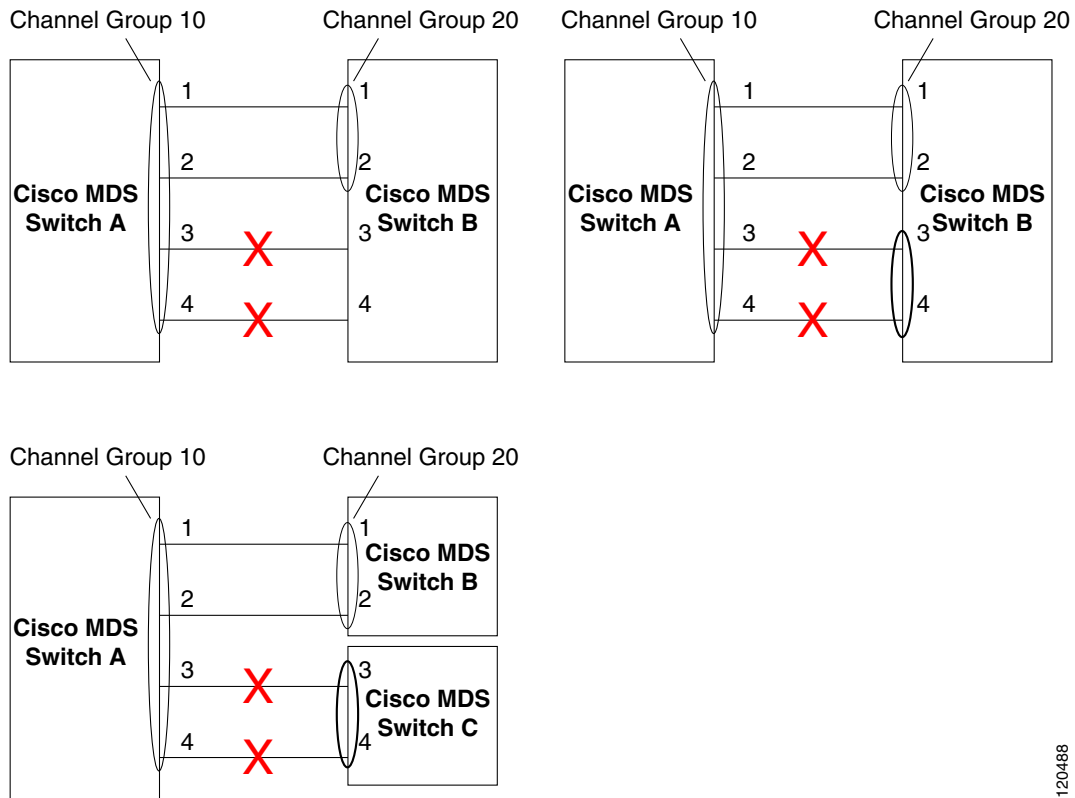
This section shows how to configure and modify PortChannels and contains the following topics:

About PortChannel Configuration

Before configuring a PortChannel, consider the following guidelines:

- Configure the PortChannel across switching modules to implement redundancy on switching module reboots or upgrades.

- Ensure that one PortChannel is not connected to different sets of switches. PortChannels require point-to-point connections between the same set of switches.

Note   On switches with Generation 1 switching modules, or a combination of Generation 1 and Generation 2 switching modules, you can configure a maximum of 128 PortChannels. On switches with only Generation 2 switching modules, or Generation 2 and Generation 3 switching modules, you can configure a maximum of 256 PortChannels.

If you misconfigure PortChannels, you may receive a misconfiguration message. If you receive this message, the PortChannel's physical links are disabled because an error has been detected.

A PortChannel error is detected if the following requirements are not met:

- Each switch on either side of a PortChannel must be connected to the same number of interfaces.
- Each interface must be connected to a corresponding interface on the other side (see Figure 6-7 for an example of an invalid configuration).
- Links in a PortChannel cannot be changed after the PortChannel is configured. If you change the links after the PortChannel is configured, be sure to reconnect the links to interfaces within the PortChannel and reenable the links.

If all three conditions are not met, the faulty link is disabled.

Enter the **show interface** command for that interface to verify that the PortChannel is functioning as required.

Creating a PortChannel

To create a PortChannel, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface port-channel 1** switch(config-if)#	Configures the specified PortChannel (1) using the default ON mode.

Configuring the PortChannel Mode

By default, the CLI and the Device Manager create the PortChannel in ON mode in the NPIV core switches and ACTIVE mode on the NPV switches. The Fabric Manager creates all PortChannels in ACTIVE mode. We recommend that you create PortChannels in ACTIVE mode. An F PortChannel is supported only on ACTIVE mode.

To configure ACTIVE mode, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface port-channel 1** switch(config-if)#	Configures the specified PortChannel (1) using the default ON mode.
Step 3	switch(config-if)# **channel mode active**	Configures the ACTIVE mode.
	switch(config-if)# **no channel mode active**	Reverts to the default ON mode.

About PortChannel Deletion

When you delete the PortChannel, the corresponding channel membership is also deleted. All interfaces in the deleted PortChannel convert to individual physical links. After the PortChannel is removed, regardless of the mode used (ACTIVE and ON), the ports at either end are gracefully brought down, indicating that no frames are lost when the interface is going down (see the "Graceful Shutdown" section on page 2-12).

If you delete the PortChannel for one port, then the individual ports within the deleted PortChannel retain the compatibility parameter settings (speed, mode, port VSAN, allowed VSAN, and port security). You can explicitly change those settings as required.

- If you use the default ON mode to avoid inconsistent states across switches and to maintain consistency across switches, then the ports shut down. You must explicitly enable those ports again.

- If you use the ACTIVE mode, then the PortChannel ports automatically recover from the deletion.

Deleting PortChannels

To delete a PortChannel, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **no interface port-channel 1** port-channel 1 deleted and all its members disabled please do the same operation on the switch at the other end of the port-channel switch(config)#	Deletes the specified PortChannel (1), its associated interface mappings, and the hardware associations for this PortChannel.

Interfaces in a PortChannel

You can add or remove a physical interface (or a range of interfaces) to an existing PortChannel. The compatible parameters on the configuration are mapped to the PortChannel. Adding an interface to a PortChannel increases the channel size and bandwidth of the PortChannel. Removing an interface from a PortChannel decreases the channel size and bandwidth of the PortChannel.

This section describes interface configuration for a PortChannel and includes the following topics:

- About Interface Addition to a PortChannel, page 6-13
- Adding an Interface to a PortChannel, page 6-14
- Forcing an Interface Addition, page 6-14
- About PortChannel Deletion, page 6-12
- Deleting an Interface from a PortChannel, page 6-15

Note For information about PortChannel support on Generation 2 switching modules, see the "PortChannels" section on page 3-12.

About Interface Addition to a PortChannel

You can add a physical interface (or a range of interfaces) to an existing PortChannel. The compatible parameters on the configuration are mapped to the PortChannel. Adding an interface to a PortChannel increases the channel size and bandwidth of the PortChannel.

A port can be configured as a member of a static PortChannel only if the following configurations are the same in the port and the PortChannel:

- Speed
- Mode
- Rate mode
- Port VSAN
- Trunking mode
- Allowed VSAN list or VF-ID list

After the members are added, regardless of the mode (ACTIVE and ON) used, the ports at either end are gracefully brought down, indicating that no frames are lost when the interface is going down (see the "Generation 1 PortChannel Limitations" section on page 6-7 and "Graceful Shutdown" section on page 2-12).

Compatibility Check

A compatibility check ensures that the same parameter settings are used in all physical ports in the channel. Otherwise, they cannot become part of a PortChannel. The compatibility check is performed before a port is added to the PortChannel.

The check ensures that the following parameters and settings match at both ends of a PortChannel:

- Capability parameters (type of interface, Gigabit Ethernet at both ends, or Fibre Channel at both ends).
- Administrative compatibility parameters (speed, mode, rate mode, port VSAN, allowed VSAN list, and port security).

> **Note**   The ports on the NPV-enabled switch in a PortChannel must be in the rate-mode dedicated mode. The ports that are on the upstream NPIV device that connect to an NPV-enabled switch (the PortChannel member ports) can be in shared mode.

- Operational parameters (remote switch WWN and trunking mode).

A port addition procedure fails if the capability and administrative parameters in the remote switch are incompatible with the capability and administrative parameters in the local switch. If the compatibility check is successful, the interfaces are operational and the corresponding compatibility parameter settings apply to these interfaces.

Suspended and Isolated States

If the operational parameters are incompatible, the compatibility check fails and the interface is placed in a suspended or isolated state based on the configured mode:

- An interface enters the suspended state if the interface is configured in the ON mode.
- An interface enters the isolated state if the interface is configured in the ACTIVE mode.

Adding an Interface to a PortChannel

To add an interface to a PortChannel, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc1/15** switch(config-if)#	Configures the specified port interface (fc1/15).
Step 3	switch(config-if)# **channel-group 15**	Adds physical Fibre Channel port 1/15 to channel group 15. If channel group 15 does not exist, it is created. The port is shut down.

To add a range of ports to a PortChannel, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc1/1 – 5** switch(config-if)#	Configures the specified range of interfaces. In this example, interfaces from 1/1 to 1/5 are configured.
Step 3	switch(config-if)# **channel-group 2**	Adds physical interfaces 1/1, 1/2, 1/3, 1/4, and 1/5 to channel group 2. If channel group 2 does not exist, it is created. If the compatibility check is successful, the interfaces are operational and the corresponding states apply to these interfaces.

Note By default, the CLI adds a interface normally to a PortChannel, while the Fabric Manager adds the interface by force, unless specified explicitly.

Forcing an Interface Addition

You can force the port configuration to be overwritten by the PortChannel. In this case, the interface is added to a PortChannel.

- If you use the default ON mode to avoid inconsistent states across switches and to maintain consistency across switches, then the ports shut down. You must explicitly enable those ports again.

- If you use the ACTIVE mode, then the PortChannel ports automatically recover from the addition.

Note When PortChannels are created from within an interface, the **force** option cannot be used.

After the members are forcefully added, regardless of the mode (ACTIVE and ON) used, the ports at either end are gracefully brought down, indicating that no frames are lost when the interface is going down (see the "Graceful Shutdown" section on page 2-12).

To force the addition of a port to a PortChannel, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc1/1** switch(config-if)#	Specifies the interface fc1/1.
Step 3	switch(config-if)# **channel-group 1 force**	Forces the addition of the physical port for interface fc1/1 to channel group 1. The port is shut down.

About Interface Deletion from a PortChannel

When a physical interface is deleted from the PortChannel, the channel membership is automatically updated. If the deleted interface is the last operational interface, then the PortChannel status is changed to a down state. Deleting an interface from a PortChannel decreases the channel size and bandwidth of the PortChannel.

- If you use the default ON mode to avoid inconsistent states across switches and to maintain consistency across switches, then the ports shut down. You must explicitly enable those ports again.

- If you use the ACTIVE mode, then the PortChannel ports automatically recover from the deletion.

After the members are deleted, regardless of the mode (ACTIVE and ON) used, the ports at either end are gracefully brought down, indicating that no frames are lost when the interface is going down (see the "Generation 1 PortChannel Limitations" section on page 6-7 and "Graceful Shutdown" section on page 2-12).

Deleting an Interface from a PortChannel

To delete a physical interface (or a range of physical interfaces) from a PortChannel, follow these steps:

	Command	Purpose
Step 1	switch(config)# **interface fc1/1** switch(config-if)#	Enters the selected physical interface level.
	switch(config)# **interface fc1/1 - 5** switch(config-if)#	Enters the selected range of physical interfaces.
Step 2	switch(config-if)# **no channel-group 2** switch(config-if)#	Deletes the physical Fibre Channel interfaces in channel group 2.

PortChannel Protocols

In earlier Cisco SAN-OS releases, PortChannels required additional administrative tasks to support synchronization. The Cisco NX-OS software provides robust error detection and synchronization capabilities. You can manually configure channel groups or they can be automatically created. In both cases, the channel groups have the same capability and configurational parameters. Any change in configuration applied to the associated PortChannel interface is propagated to all members of the channel group.

A protocol to exchange PortChannel configurations is available in all Cisco MDS switches. This addition simplifies PortChannel management with incompatible ISLs. An additional autocreation mode enables ISLs with compatible parameters to automatically form channel groups without manual intervention.

The PortChannel protocol is enabled by default.

The PortChannel protocol expands the PortChannel functional model in Cisco MDS switches. It uses the exchange peer parameters (EPP) services to communicate across peer ports in an ISL. Each switch uses the information received from the peer ports along with its local configuration and operational values to decide if it should be part of a PortChannel. The protocol ensures that a set of ports are eligible to be part of the same PortChannel. They are only eligible to be part of the same port channel if all the ports have a compatible partner.

The PortChannel protocol uses two subprotocols:

- Bringup protocol—Automatically detects misconfigurations so you can correct them. This protocol synchronizes the PortChannel at both ends so that all frames for a given flow (as identified by the source FC ID, destination FC ID and OX_ID) are carried over the same physical link in both directions. This helps make applications such as write acceleration, work for PortChannels over FCIP links.

- Autocreation protocol—Automatically aggregates compatible ports into a PortChannel.

This section describes how to configure the PortChannel protocol and includes the following sections:

- About Channel Group Creation, page 6-16
- About Autocreation, page 6-18
- Enabling and Configuring Autocreation, page 6-18
- About Manually Configured Channel Groups, page 6-19
- Converting to Manually Configured Channel Groups, page 6-19

About Channel Group Creation

Note Channel groups are not supported on internal ports in the Cisco Fabric Switch for HP c-Class BladeSystem and the Cisco Fabric Switch for IBM BladeSystem.

Assuming link A1-B1 comes up first (see Figure 6-8), that link is operational as an individual link. When the next link, say A2-B2 comes up, the PortChannel protocol identifies if this link is compatible with link A1-B1 and automatically creates channel groups 10 and 20 in the respective switches. If link A3-B3 can join the channel groups (the PortChannels), the respective ports have compatible configurations. If link A4-B4 operates as an individual link, it is because of the incompatible configuration of the two end ports with the other member ports in this channel group.

Figure 6-8   Autocreating Channel Groups
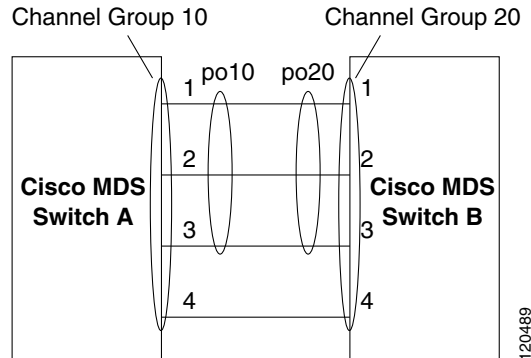
The channel group numbers are selected dynamically, and as such, the administrative configuration of the ports forming the channel group at either end are applicable to the newly created channel group. The channel group number being chosen dynamically may be different across reboots for the same set of PortChannels based on the order of ports that are initialized in the switch.

Table 6-2 identifies the differences between user-configured and auto-configured channel groups.

Table 6-2   Channel Group Configuration Differences

User-Configured Channel Group	Autocreated Channel Group
Manually configured by the user.	Created automatically when compatible links come up between two compatible switches, if channel group autocreation is enabled in all ports at both ends.
Member ports cannot participate in autocreation of channel groups. The autocreation feature cannot be configured.	None of these ports are members of a user-configured channel group.
You can form the PortChannel with a subset of the ports in the channel group. Incompatible ports remain in a suspended or isolated state depending on the ON or ACTIVE mode configuration.	All ports included in the channel group participate in the PortChannel—no member port becomes isolated or suspended; instead, the member port is removed from the channel group when the link is found to be incompatible.
Any administrative configuration made to the PortChannel is applied to all ports in the channel group, and you can save the configuration for the PortChannel interface.	Any administrative configuration made to the PortChannel is applied to all ports in the channel group, but the configurations are saved for the member ports; no configuration is saved for the PortChannel interface. You can explicitly convert this channel group, if required.
You can remove any channel group and add members to a channel group.	You cannot remove a channel group, or add/remove any of its members. The channel group is removed when no member ports exist.

Note   Autocreation is not supported as of MDS NX-OS Release 4.1(1b) and later.

About Autocreation

The autocreation protocol has the following functionality:

- A port is not allowed to be configured as part of a PortChannel when the autocreation feature is enabled. These two configurations are mutually exclusive.

- Autocreation must be enabled in both the local and peer ports to negotiate a PortChannel.

- Aggregation occurs in one of two ways:
  - A port is aggregated into a compatible autocreated PortChannel.
  - A port is aggregated with another compatible port to form a new PortChannel.

- Newly created PortChannels are allocated from the maximum possible PortChannel (128 for Generation 1 or a combination of Generation 1 and Generation 2 switches, or 256 for Generation 2 switches) in a decreasing order based on availability. If all 128 (or 256) numbers are used up, aggregation is not allowed.

- You cannot change the membership or delete an autocreated PortChannel.

- When you disable autocreation, all member ports are removed from the autocreated PortChannel.

- Once the last member is removed from an autocreated PortChannel, the channel is automatically deleted and the number is released for reuse.

- An autocreated PortChannel is not persistent through a reboot. An autocreated PortChannel can be manually configured to appear the same as a persistent PortChannel. Once the PortChannel is made persistent, the autocreation feature is disabled in all member ports.

- You can enable or disable the autocreation feature on a per-port basis or for all ports in the switch. When this configuration is enabled, the channel group mode is assumed to be active. The default for this task is disabled.

- If autocreation of channel groups is enabled for an interface, you must first disable autocreation before downgrading to earlier software versions or before configuring the interface in a manually configured channel group.

Tip When enabling autocreation in any switch in the Cisco MDS 9000 Family, we recommend that you retain at least one interconnected port between the switches without any autocreation configuration. If all ports between two switches are configured with the autocreation feature at the same time, you may face a possible traffic disruption between these two switches as the ports are automatically disabled and reenabled when ports are added to an autocreated PortChannel.

Enabling and Configuring Autocreation

To configure automatic channel groups, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc8/13** switch(config- if)#	Enters the configuration mode for the selected interface(s).

	Command	Purpose
Step 3	switch(config- if)# **channel-group auto**	Automatically creates the channel group for the selected interface(s).
	switch(config- if)# **no channel-group auto**	Disables the autocreation of channel groups for this interface, even if the system default configuration may have autocreation enabled.

About Manually Configured Channel Groups

A user-configured channel group cannot be converted to an autocreated channel group. However, you can convert an autocreated channel group to a manual channel group. Once performed, this task is irreversible. The channel group number does not change, but the member ports operate according to the properties of the manually configured channel group, and the autocreation of channel group is implicitly disabled for all member ports.

Tip   If you enable persistence, be sure to enable it at both ends of the PortChannel.

Converting to Manually Configured Channel Groups

You can convert autocreated channel group to a user-configured channel group using the **port-channel** *channel-group-number* **persistent** EXEC command. If the PortChannel does not exist, this command is not executed.

Example F and TF PortChannel Configurations

This example shows how to configure F PortChannel in shared mode and bring up the link (not supported on the MDS 91x4 switches) between F ports on the NPIV core switches and NP ports on the NPV switches:

Step 1   Enable the F port trunking and channeling protocol on the MDS core switch.

```
switch(config)# feature fport-channel-trunk
```

Step 2   Enable NPIV on the MDS core switch:

```
switch(config)# feature npiv
```

Step 3   Create the PortChannel on the MDS core switch:

```
switch(config)# interface port-channel 1
switch(config-if)# switchport mode F
switch(config-if)# channel mode active
switch(config-if)# switchport trunk mode off
switch(config-if)# switchport rate-mode shared
switch(config-if)# exit
```

Step 4   Configure the PortChannel member interfaces on the core switch:

```
switch(config)# interface fc2/1-3
switch(config-if)# shut
```

```
switch(config-if)# switchport mode F
switch(config-if)# switchport trunk mode off
switch(config-if)# switchport speed 4000
switch(config-if)# switchport rate-mode shared
switch(config-if)# channel-group 1
switch(config-if)# no shut
switch(config-if)# exit
```

Step 5   Create the PortChannel on the NPV switch:

```
switch(config)# interface port-channel 1
switch(config-if)# switchport mode NP
switch(config-if)# switchport rate-mode shared
switch(config-if)# exit
```

Step 6   Configure the PortChannel member interfaces on the NPV switch:

```
switch(config)# interface fc2/1-3
switch(config-if)# shut
switch(config-if)# switchport mode NP
switch(config-if)# switchport speed 4000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport trunk mode off
switch(config-if)# channel-group 1
switch(config-if)# no shut
switch(config-if)# exit
```

Step 7   Set the administrative state of all the PortChannel member interfaces in both NPIV core switch and the NPV switch to ON:

```
switch(config)# interface fc1/1-3
switch(config-if)# shut
switch(config-if)# no shut

switch(config)# interface fc2/1-3
switch(config-if)# shut
switch(config-if)# no shut
```

Note   The speed configuration must be the same for all member interfaces in a PortChannel. While configuring the channel in dedicated mode, ensure that required bandwidth is available to the ports.

This example shows how to configure channeling in dedicated mode and bring up the TF-TNP PortChannel link between TF ports in the NPIV core switch, and TNP ports in the NPV switch:

Step 1   Enable the F port trunking and channeling protocol on the MDS core switch:

```
switch(config)# feature fport-channel-trunk
```

Step 2   Enable NPIV on the MDS core switch:

```
switch(config)# feature npiv
```

Step 3   Create the PortChannel on the MDS core switch:

```
switch(config)# interface port-channel 2
switch(config-if)# switchport mode F
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# channel mode active
switch(config-if)# exit
```

Step 4 Configure the PortChannel member interfaces on the MDS core switch in dedicated mode:

```
switch(config)# interface fc1/4-6
switch(config-if)# shut
switch(config-if)# switchport mode F
switch(config-if)# switchport speed 4000
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport trunk mode on
switch(config-if)# channel-group 2
switch(config-if)# no shut
switch(config-if)# exit
```

Step 5 Create the PortChannel in dedicated mode on the NPV switch:

```
switch(config)# interface port-channel 2
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport mode NP
switch(config-if)# no shut
switch(config-if)# exit
```

Step 6 Configure the PortChannel member interfaces on the NPV switch in dedicated mode:

```
switch(config)# interface fc3/1-3
switch(config-if)# shut
switch(config-if)# switchport mode NP
switch(config-if)# switchport speed 4000
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport trunk mode on
switch(config-if)# channel-group 2
switch(config-if)# no shut
switch(config-if)# exit
```

Step 7 Set the administrative state of all the PortChannel member interfaces in both NPIV core switch and the NPV switch to ON:

```
switch(config)# interface fc1/4-6
switch(config-if)# shut
switch(config-if)# no shut

switch(config)# interface fc3/1-3
switch(config-if)# shut
switch(config-if)# no shut
```

Verifying the PortChannel Configuration

You can view specific information about existing PortChannels at any time from EXEC mode. The following **show** commands provide further details on existing PortChannels. You can force all screen output to go to a printer or save it to a file. See Examples 6-1 to 6-6.

The **show port-channel summary** command displays a summary of PortChannels within the switch. A one-line summary of each PortChannel provides the administrative state, the operational state, the number of attached and active interfaces (up), and the first operational port (FOP), which is the primary operational interface selected in the PortChannel to carry control-plane traffic (no load-balancing). The FOP is the first port that comes up in a PortChannel and can change if the port goes down. The FOP is also identified by an asterisk (*).

Example 6-1   Displays the PortChannel Summary

```
switch# show port-channel summary
--------------------------------------------------------------------------------
Interface               Total Ports     Oper Ports      First Oper Port
--------------------------------------------------------------------------------
port-channel 77              2               0                 --
port-channel 78              2               0                 --
port-channel 79              2               2               fcip200
```

Example 6-2   Displays the PortChannel Configured in the Default ON Mode

```
switch# show port-channel database
port-channel 77
    Administrative channel mode is on
    Operational channel mode is on
    Last membership update succeeded
    2 ports in total, 0 ports up
    Ports:   fcip1    [down]
             fcip2    [down]
port-channel 78
    Administrative channel mode is on
    Operational channel mode is on
    Last membership update succeeded
    2 ports in total, 0 ports up
    Ports:   fc2/1    [down]
             fc2/5    [down]
port-channel 79
    Administrative channel mode is on
    Operational channel mode is on
    Last membership update succeeded
    First operational port is fcip200
    2 ports in total, 2 ports up
    Ports:   fcip101  [up]
             fcip200  [up] *
```

Example 6-3   Displays the PortChannel Configured in the ACTIVE Mode

```
switch# show port-channel database
port-channel 77
    Administrative channel mode is active
    Operational channel mode is active
    Last membership update succeeded
    2 ports in total, 0 ports up
    Ports:   fcip1    [down]
             fcip2    [down]
port-channel 78
    Administrative channel mode is active
    Operational channel mode is active
    Last membership update succeeded
    2 ports in total, 0 ports up
    Ports:   fc2/1    [down]
             fc2/5    [down]
port-channel 79
    Administrative channel mode is active
    Operational channel mode is active
    Last membership update succeeded
    First operational port is fcip200
    2 ports in total, 2 ports up
    Ports:   fcip101  [up]
             fcip200  [up] *
```

The **show port-channel consistency** command has two options: without details and with details.

Example 6-4   Displays the Consistency Status without Details

```
switch# show port-channel consistency
Database is consistent
```

Example 6-5   Displays the Consistency Status with Details

```
switch# show port-channel consistency detail
Authoritative port-channel database:
================================================
totally 3 port-channels
port-channel 77:
    2 ports, first operational port is none
    fcip1    [down]
    fcip2    [down]
port-channel 78:
    2 ports, first operational port is none
    fc2/1    [down]
    fc2/5    [down]
port-channel 79:
    2 ports, first operational port is fcip200
    fcip101  [up]
    fcip200  [up]
================================================
database 1: from module 5
================================================
totally 3 port-channels
port-channel 77:
    2 ports, first operational port is none
    fcip1    [down]
    fcip2    [down]
port-channel 78:
    2 ports, first operational port is none
    fc2/1    [down]
    fc2/5    [down]
port-channel 79:
    2 ports, first operational port is fcip200
    fcip101  [up]
    fcip200  [up]
================================================
database 2: from module 4
================================================
totally 3 port-channels
port-channel 77:
    2 ports, first operational port is none
    fcip1    [down]
    fcip2    [down]
port-channel 78:
    2 ports, first operational port is none
    fc2/1    [down]
    fc2/5    [down]
port-channel 79:
    2 ports, first operational port is fcip200
    fcip101  [up]
    fcip200  [up]
...
```

The **show port-channel usage** command displays details of the used and unused PortChannel numbers.

Example 6-6   Displays the PortChannel Usage

```
switch# show port-channel usage
Totally 3 port-channel numbers used
==================================
Used  :   77 - 79
Unused:   1 - 76 , 80 - 256
```

Example 6-7   Displays the PortChannel Compatibility

```
switch# show port-channel compatibility-parameters
physical port layer               fibre channel or ethernet
    port mode                        E/AUTO only
    trunk mode
    speed
    port VSAN
    port allowed VSAN list
```

Use the existing **show** commands to obtain further details on autocreated channel group attributes. Autocreated PortChannels are indicated explicitly to help differentiate them from the manually created PortChannels. See Examples 6-8 to 6-10.

Example 6-8   Displays Autocreated PortChannels

```
switch# show interface fc1/1
fc1/1 is trunking
    Hardware is Fibre Channel, FCOT is short wave laser
    Port WWN is 20:0a:00:0b:5f:3b:fe:80
    ...
    Receive data field Size is 2112
    Beacon is turned off
    Port-channel auto creation is enabled
    Belongs to port-channel 123
...
```

Example 6-9   Displays the Specified PortChannel Interface

```
switch# show port-channel database interface port-channel 128
port-channel 128
    Administrative channel mode is active
    Operational channel mode is active
    Last membership update succeeded
    Channel is auto created
    First operational port is fc1/1
    1 ports in total, 1 ports up
    Ports:   fc1/1   [up] *
```

Example 6-10   Displays the PortChannel Summary

```
switch# show port-channel summary
-----------------------------------------------------------------------------
Interface              Total Ports      Oper Ports      First Oper Port
-----------------------------------------------------------------------------
port-channel 1              1                0                --
port-channel 2              1                1                fc8/13
port-channel 3              0                0                --
port-channel 4              0                0                --
port-channel 5              1                1                fc8/3
port-channel 6              0                0                --
```

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Default Settings

Table 6-3 lists the default settings for PortChannels.

Table 6-3   Default PortChannel Parameters

Parameters	Default
PortChannels	FSPF is enabled by default.
Create PortChannel	Administratively up.
Default PortChannel mode	ON mode on non-NPV and NPIV core switches. ACTIVE mode on NPV switches.
Autocreation	Disabled.