



Configuring PortChannels

PortChannels refer to the aggregation of multiple physical interfaces 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. Specifically, a PortChannel has the following functionality:

- Provides a point-to-point connection over an 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 “[Fail-Over Scenarios for PortChannels and FSPF Links](#)” section on page 19-3 for fail-over scenarios.

Cisco MDS 9000 Family of switches support 128 PortChannels with 16 interfaces per PortChannel.

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

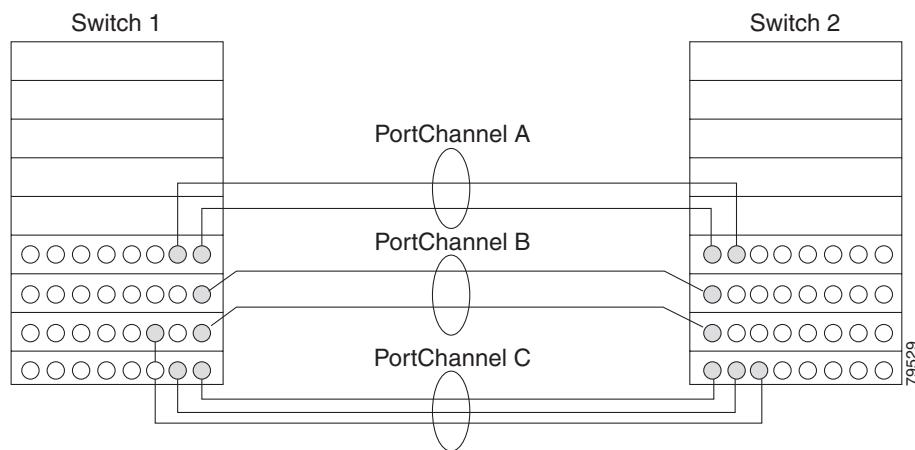
- [PortChannel Examples](#), page 12-2
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PortChannel Examples

PortChannels on Cisco MDS 9000 Family switches allow flexibility in configuration. [Figure 12-1](#) 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.

Figure 12-1 PortChannel Flexibility



32-Port Configuration Guidelines

The 32-port guidelines applies to the following hardware:

- The 32-port 2-Gbps or 1-Gbps switching module
- The Cisco MDS 9140 Switch

When configuring these host-optimized ports, the following PortChannel guidelines apply:

- Any (or all) full line rate port(s) in the Cisco MDS 9100 Series can be included in a PortChannel.
- 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 (for example, the first port in ports 1-4, the fifth port in ports 5-8 and so on) as an E port. 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 as a PortChannel. The other three ports continue to remain in a no shutdown state.

**Note**

In the Cisco MDS 9100 Series, the left most groups of ports outlined in white (4 ports in the 9120 switch and 8 ports in the 9140 switch) are full line rate like the 16-port switching module. The other ports (16 ports in the 9120 switch and 32 ports in the 9140 switch) are host-optimized like the 32-port switching module. Each group of 4 host-optimized ports have the same rules as for the 32-port switching module.

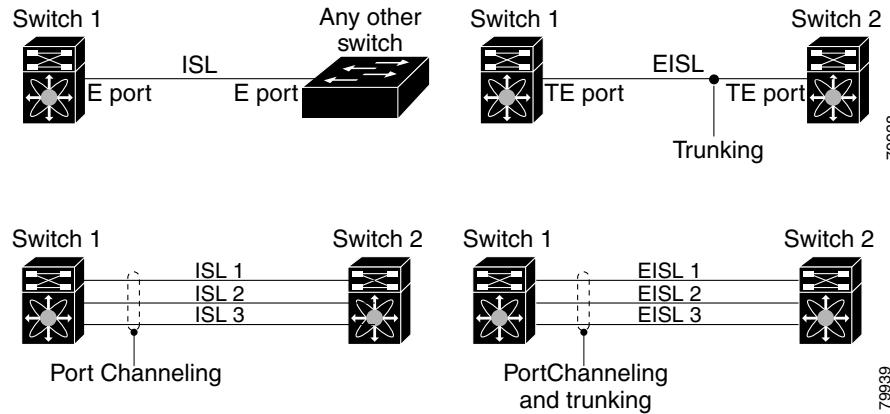
About PortChanneling and Trunking

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

Trunking enables an ISL to carry (trunk) multiple VSANs. Trunking can only be configured on 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 12-2](#)).

See [Chapter 11, “Configuring Trunking”](#) for information on trunked interfaces.

Figure 12-2 PortChanneling and Trunking



PortChanneling and trunking are used separately across an ISL:

- PortChanneling—Interfaces can be channeled between E ports over multiple ISLs or between TE ports over multiple EISLs.
- Trunking—Trunking, which permits carrying VSAN IDs between switches, can be done only between TE ports over EISLs.

See [Chapter 9, “Configuring and Managing VSANs.”](#)

Both PortChanneling and trunking can be used between TE ports over EISLs.

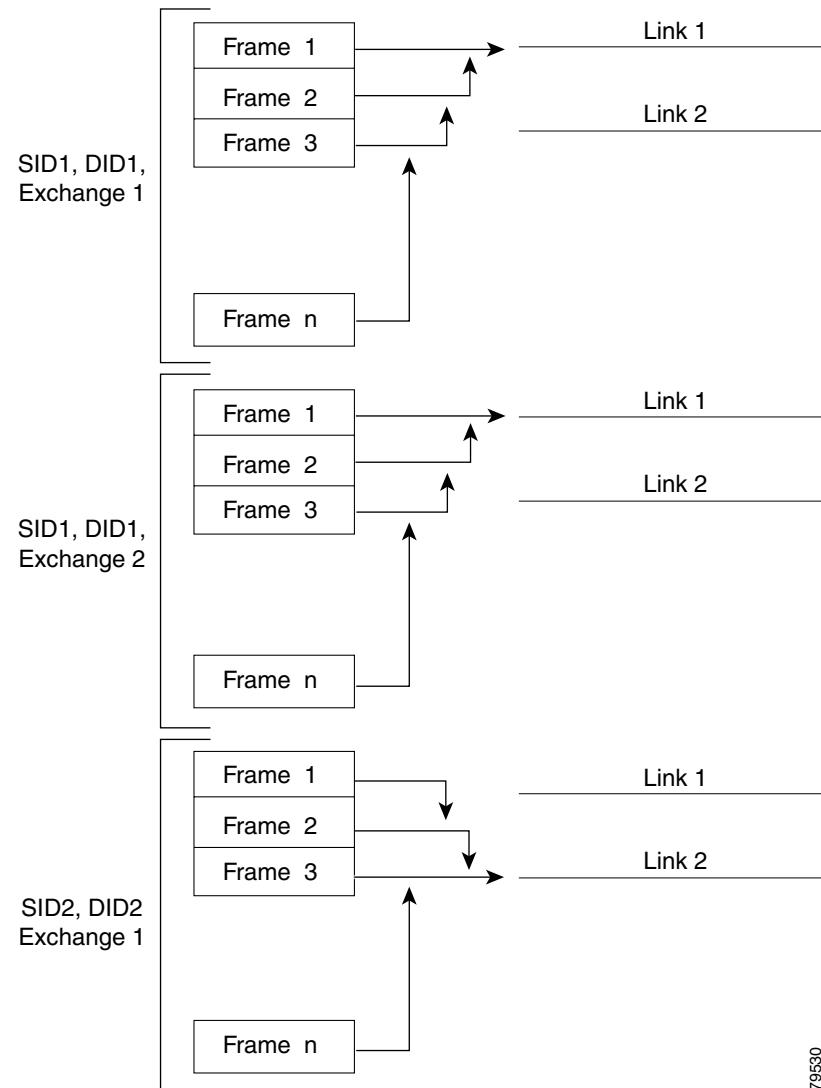
About Load Balancing

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 12-3](#) illustrates how source ID 1 (SID1) and destination ID1-based(DID1) 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.

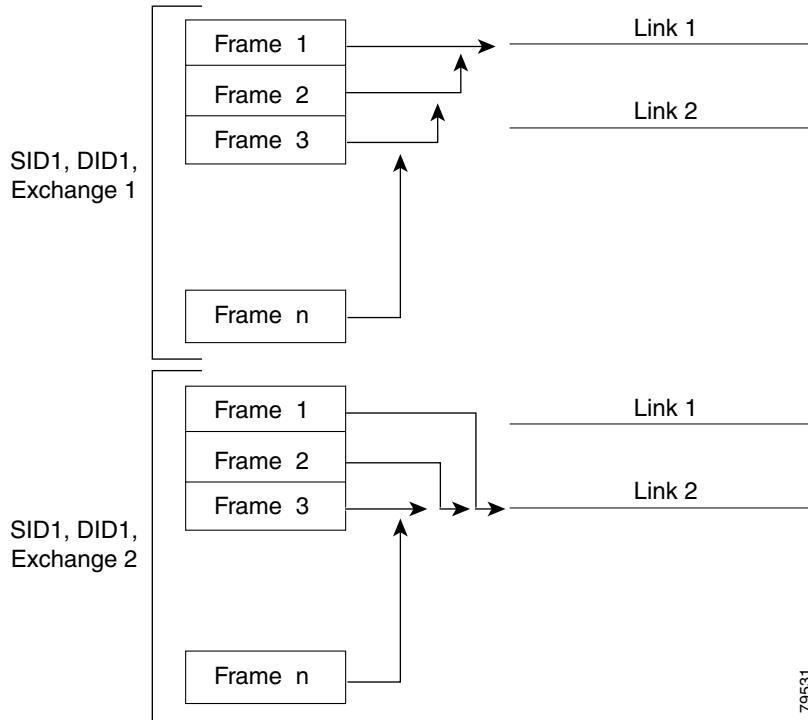
Figure 12-3 SID1 and DID1Based Load Balancing



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Figure 12-4 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 12-4 SID1, DID1, and Exchange Based Load Balancing



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For more information on configuring load balancing and in-order delivery features, see the “[VSAN Attributes](#)” section on page 9-6.

Creating a PortChannel

You can create PortChannels using the **interface port-channel** command. PortChannels are created with default values. You can change the default configuration just like any other physical interface.

To create a PortChannel, follow these steps:

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



Note

All interfaces added to PortChannels are administratively shut down, and the PortChannel remains administratively up.

■ Deleting a PortChannel

Deleting a PortChannel

To delete the PortChannel, you must explicitly issue the **no interface port-channel** command. When you delete the PortChannel, the corresponding channel membership is also deleted. All interfaces in the deleted PortChannel convert to individual physical links. To avoid inconsistent states across switches, and to maintain consistency across switches, the ports shut down. They continue to use the configured values of the physical port.

To delete a PortChannel, follow these steps:

Command	Purpose
Step 1 switch# config t	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)#[/td> <td>Deletes the specified PortChannel (1), its associated interface mappings, and the hardware associations for this PortChannel.</td>	Deletes the specified PortChannel (1), its associated interface mappings, and the hardware associations for this PortChannel.

Adding Interfaces to a PortChannel

You can add a physical interface (or a range of interfaces) to a nonexistent or an existing PortChannel and the PortChannel is automatically created. If the PortChannel does not exist, it is created. The compatible parameters on the configuration are mapped to the PortChannel.

To add a port (or a range of ports) to a PortChannel, follow these steps:

Command	Purpose
Step 1 switch# config t	Enters configuration mode.
Step 2 switch(config)# interface fc1/15 switch(config-if)#[/td> <td>Configures the specified port interface (fc1/15).</td>	Configures the specified port interface (fc1/15).
switch(config)# interface fc1/1 - 5 switch(config-if)#[/td> <td>Configures the specified range of interfaces. In this example, interfaces from 1/1 to 1/5 are configured.</td>	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 15 fc1/15 added to port-channel 15 and disabled please do the same operation on the switch at the other end of the port-channel, then do "no shutdown" at both ends to bring them up switch(config-if)#[/td> <td>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.</td>	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.
switch(config-if)# channel-group 2 fc1/1 fc1/2 fc1/3 fc1/4 fc1/5 added to port-channel 2 and disabled please do the same operation on the switch at the other end of the port-channel, then do "no shutdown" at both ends to bring them up switch(config-if)#[/td> <td>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.</td>	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.

Forcing an Interface Addition

You can specify a **force** option to force the port configuration to be overwritten by the PortChannel. In this case, the interface is added to a PortChannel and the port is shut down.


Note

When PortChannels are created automatically, the **force** option cannot be used.

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

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# interface fc1/1 switch(config-if)#	Configures the specified port interface (fc1/1).
Step 3	switch(config-if)# channel-group 1 force fc1/1 added to port-channel 1 and disabled please do the same operation on the switch at the other end of the port-channel, then do "no shutdown" at both ends to bring them up switch(config-if)#	Forces a physical Fibre Channel port 1/1 addition to channel group 1. The E port is shut down.

Compatibility Check

A compatibility check ensures that the same configuration values are used in all physical ports in the channel. For example, to enable trunk mode, all operational ports in the configuration must be configured in the trunk mode or in the nontrunking mode. Otherwise, they cannot become part of a PortChannel. A port cannot be operational if it is incompatible with the PortChannel. If the compatibility check is successful, the interfaces are operational and the corresponding states apply to these interfaces.

Suspended State

An interface enters the suspended state if its operational values are incompatible with the PortChannel. A compatibility check on operational parameters is done when one of the following events occurs:

- A port becomes operational in a PortChannel.
- An operational parameter changes for a port in a PortChannel.

The software performs a compatibility check on the operational parameters and places the interface in an operational or suspended state based on the result (see the “Reason Codes” section on page 10-6).

Deleting Interfaces from a PortChannel

To delete a physical interface (or a range of physical interfaces), you must explicitly issue the **no channel-group** command at the physical interface level. 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.

**Note**

When an interface is deleted, it is shut down but the physical configuration is retained. The inherited PortChannel configuration information is not deleted.

To delete a physical interface (or a range of physical interfaces), 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 fc1/1 fc1/2 fc1/3 fc1/4 fc1/5 removed from port-channel 2 and disabled. Please do the same operation on the switch at the other end of the port-channel switch(config-if) #	Deletes the physical Fibre Channel interfaces in channel group 2.

Quiescing a PortChannel ISL

Generally a **shutdown** command issued on an interface through which traffic is flowing disables the interface with a possible frame drop. You can avoid this frame drop by using the **quiesce** command to gracefully shutdown an interface without dropping any frames. This command can only be issued on an ISL within a PortChannel—at both ends of the link. This addition prevents frame loss for a planned link shutdown or removal.

**Note**

If the in-order delivery feature is enabled, some frames may still be dropped. By default, the in-order delivery feature is disabled in all switches in the Cisco MDS 9000 Family.

The following conditions return an error:

- The interface is not part of PortChannel.
- The interface is not up.
- The interface is the last operational interface in the PortChannel.

You can negate a previously issued **quiesce** command by issuing the **quiesce no interface** before the interface is shut down.

To gracefully shut down an ISL in a PortChannel, follow these steps:

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- Step 1** Log in to switch A and issue the **quiesce** command on the ISL.

```
switchA# quiesce interface fc 2/1
```

WARNING: this command will stop forwarding frames to the specified interfaces. It is intended to be used to gracefully shutdown interfaces in a port-channel. The procedure is:

1. quiesce the interfaces on both switches.
2. shutdown the interfaces administratively.

Do you want to continue? (y/n) [n] **y**

Step 2 Log in to switch N and issue the **quiesce** command on the ISL.

```
switchN# quiesce interface fc 2/9
```

WARNING: this command will stop forwarding frames to the specified interfaces. It is intended to be used to gracefully shutdown interfaces in a port-channel. The procedure is:

1. quiesce the interfaces on both switches.
2. shutdown the interfaces administratively.

Do you want to continue? (y/n) [n] **y**

Step 3 Ensure that the command has completed its sequence and issue the **shutdown** command on one or both switches.

```
switchN(config-if)# shutdown
```

PortChannel Configuration Guidelines

Before configuring a PortChannel, consider the following guidelines

- Configure the PortChannel across switching modules to prevent redundancy on switching module reboots or upgrades.
- Ensure that one PortChannel is not connected to two switches. PortChannels require point-to-point connections.

Error Detection

If you misconfigure PortChannels, you may receive the `Error disabled - Possible port channel misconfiguration` message. If you receive this message, the PortChannel's physical links are disabled since 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.
- Links in a PortChannel must not 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 re-enable the links. Issue the **show interface** command for that interface to verify that the PortChannel is functioning as required.

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

Displaying PortChannel Information

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 12-1 to 12-5.

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 (*). See Example 12-1 and 12-2.

Example 12-1 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 12-2 PortChannel Database

```
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] *
```

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

Example 12-3 Command without Details

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

Example 12-4 Command 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.

■ Default Settings

Example 12-5 PortChannel Usage

```
switch# show port-channel usage
Totally 3 port-channel numbers used
=====
Used : 77 - 79
Unused: 1 - 76 , 80 - 128
```

Example 12-6 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
```

Default Settings

Table 12-1 lists the default settings for PortChannels.

Table 12-1 Default PortChannel Parameters

Parameters	Default
PortChannels	FSPF is enabled by default.
Create PortChannel	Administratively up.
Default mode	Auto.
Quiesce	Disabled.