Configuring Fibre Channel Interfaces

This chapter provides information about Fibre Channel interfaces, its features, and how to configure the Fibre Channel interfaces.

Finding Feature Information

Your software release might not support all the features documented in this module. For the latest caveats and feature information, see the Bug Search Tool at https://tools.cisco.com/bugsearch/ and the release notes for your software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the New and Changed chapter or the Feature History table below.

Information About Fibre Channel Interfaces

Generations of Modules and Switches

Cisco MDS 9000 Series hardware modules and switches are categorized into generations based on the time of introduction, capabilities, features, and compatibilities:

- Generation 1—Modules and switches with a maximum port speed of 2 Gbps.

- Generation 2—Modules and switches with a maximum port speed of 4 Gbps.

- Generation 3—Modules and switches with a maximum port speed of 8 Gbps.

- Generation 4—Modules with a maximum port speed of 8-Gbps or 10-Gbps.

The Cisco MDS 9500 Series switches, Cisco MDS 9222i, Cisco MDS 9216A, and Cisco MDS 9216i switches support the Generation 2 modules. Each module or switch can have one or more ports in port groups that share common resources such as bandwidth and buffer credits.

In addition to supporting Generation 2 modules, the Cisco MDS 9500 Series switches and the Cisco MDS 9222i switch support the Generation 3 modules. Similar to Generation 2, each Generation 3 or Generation 4 module can have one or more ports in port groups that share common resources such as bandwidth and buffer credits.

Generation 3 modules are supported on the Cisco MDS 9222i switch. Similar to Generation 2, each Generation 3 or Generation 4 module can have one or more ports in port groups that share common resources such as bandwidth and buffer credits.

Generation 3 modules are supported on the Cisco MDS 9506 and 9509 switches with Supervisor-2 modules. The MDS 9513 Director supports 4/44-port Host-Optimized Fibre Channel switching module with either Fabric 1 or Fabric 2 modules, but requires Fabric 2 module for support of the 48-port and the 24-port 8-Gbps Fibre Channel switching modules.

The MDS 9222i switch supports the 4/44-port Host-Optimized Fibre Channel switching module.

The Cisco 9500 Series switches support the following Generation 4 modules: the 48-port 8-Gbps Advanced Fibre Channel switching module (DS-X9248-256K9) and the 32-port 8-Gbps Advanced Fibre Channel module (DS-X9232-256K9).

Cisco MDS NX-OS Release 5.2(1) or higher is required to support the Generation 4 modules.

Table 1: Fibre Channel Modules and Fabric Switches , on page 3 identifies the Generation 2, Generation 3, and Generation 4 modules, as well as the Fabric switches.

Table 1: Fibre Channel Modules and Fabric Switches

Part Number	Product Name and Description
Generation 4 Modules	
DS-X9248-256K9	48-port 8-Gbps Advanced Fibre Channel switching module.
DS-X9232-256K9	32-port 8-Gbps Advanced Fibre Channel switching module.

Part Number	Product Name and Description
DS-X9530-SF2A-K9	Supervisor-2A module for Cisco MDS 9500 Series switches.
DS-13SLT-FAB3	Fabric 3 module that enables the 32-port and the 48-port 8-Gbps Advanced Fibre Channel switching module to use the full 96-Gbps or 256-Gbps backplane crossbar bandwidth.
Generation 3 Modules	
DS-X9248-96K9	48-port 8-Gbps Fibre Channel switching module.
DS-X9224-96K9	24-port 8-Gbps Fibre Channel switching module.
DS-X9248-48K9	4/44-port 8-Gbps Host-Optimized Fibre Channel switching module
DS-13SLT-FAB2	Fabric 2 module that enables the 24-port and the 48-port 8-Gbps Fibre Channel switching module to use the full 96-Gbps backplane bandwidth with any-to-any connectivity.
Generation 3 Fabric Switch	
DS-C9148-K9	Cisco MDS 9148 Fabric switch. 48-port 8-Gbps Fabric switch.

Generation 2 Modules	
DS-X9124	24-port 4-Gbps Fibre Channel switching module.
DS-X9304-18K9	18-port 4-Gbps Fibre Channel switching module with 4-Gigabit Ethernet ports.
DS-X9112	12-port 4-Gbps Fibre Channel switching module.
DS-X9704	4-port 10-Gbps Fibre Channel switching module.
DS-X9530-SF2-K9	Supervisor-2 module for Cisco MDS 9500 Series switches.
DS-X9148	48-port 4-Gbps Fibre Channel switching module.
Generation 2 Fabric Switches	
DS-C9134-K9	Cisco MDS 9134 Fabric switch. 32-port 4-Gbps Fabric switch with 2 additional 10-Gbps ports.
DS-C9124-K9	Cisco MDS 9124 Fabric switch. 24-port 4-Gbps Fabric switch.

DS-C9222i-K9	Cisco MDS 9222i Multiservice Modular switch.
	18-port 4-Gbps switch with 4-Gigabit Ethernet IP storage services ports, and a modular expansion slot to host Cisco MDS 9000 Series switching and services modules.

Note Generation 2 Fibre Channel switching modules are not supported on the Cisco MDS 9216 switch; however, they are supported by both the Supervisor-1 module and the Supervisor-2 module.

For detailed information about the installation and specifications for these modules and switches, refer to the hardware installation guide for your switch.

Port Groups

Each module or switch can have one or more ports in port groups that share common resources such as bandwidth and buffer credits. Port groups are defined by the hardware consisting of sequential ports. For example, ports 1 through 6, ports 7 through 12, ports 13 through 18, ports 19 through 24, ports 25 through 30, 31 through 36, and ports 37 through 42, 43 through 48 are the port groups on the 48-port 8-Gbps Advanced Fibre Channel switching modules.

Table 2: Bandwidth and Port Groups for the Fibre Channel Modules and Fabric Switches , on page 5 shows the bandwidth and number of ports per port group for the Generation 2, Generation 3, and Generation 4 Fibre Channel modules and Generation 2 and Generation 3 Fabric switches.

Table 2: Bandwidth and Port Groups for the Fibre Channel Modules and Fabric Switches

Part Number	Product Name/ Description	Number of Ports Per Port Group	Bandwidth Per Port Group (Gbps)	Maximum Bandwidth Per Port (Gbps)
Generation 4 Modules				
DS-X9248-256K9	48-port 8-Gbps Advanced Fibre Channel switching module.	6	32.4[1] or 12.8[2]	8 or 10 Gbps—depending on the configuration
DS-X9232-256K9	32-port 8-Gbps Advanced Fibre Channel switching module.	4	32.4 or 12.8	8 or 10 Gbps—depending on the configuration
Generation 3 Modules				
DS-X9248-96K9	48-port 8-Gbps Fibre Channel switching module	6	12.8	8 Gbps
DS-X9224-96K9	24-port 8-Gbps Fibre Channel switching module	3	12.8	8 Gbps

Part Number	Product Name/ Description	Number of Ports Per Port Group	Bandwidth Per Port Group (Gbps)	Maximum Bandwidth Per Port (Gbps)
DS-X9248-48K9	4/44-port 8-Gbps Host-Optimized Fibre Channel switching module	12	12.8	8/4 Gbps[3]
Generation 3 Fabric Switches				
DS-C9148-K9 (Cisco MDS 9148 Fabric switch)	48-port 8-Gbps Fabric switch	4	32	8 Gbps

[1] This bandwidth is available with the Fabric 3 module (DS-13SLT-FAB3) in the MDS 9513 switch.

[2] This bandwidth is available with the Fabric 2 module (DS-13SLT-FAB2) in the MDS 9513 switch, and with the Supervisor-2 (DS-X9530-SF2-K9) or Supervisor-2A module (DS-X9530-SF2AK9) in the MDS 9509 switch or MDS 9506 switch.

[3] A maximum of four ports (one per port group) in a 4/44-port 8-Gbps switching module can operate at 8-Gbps bandwidth in dedicated or shared mode. All the other ports can operate at a maximum of 4-Gbps in shared mode or dedicated mode.

Generation 2 Modules				
DS-X9148	48-port 4-Gbps Fibre Channel switching module	12	12.8	4 Gbps
DS-X9124	24-port 4-Gbps Fibre Channel switching module	6	12.8	4 Gbps
DS-X9304-18K9 (MSM-18/4 Multiservice module)	18-port 4-Gbps Fibre Channel switching module with 4-Gigabit Ethernet ports	6	12.8	4 Gbps
DS-X9112	12-port 4-Gbps Fibre Channel switching module	3	12.8	4 Gbps
DS-X9704	4-port 10-Gbps Fibre Channel switching module	1	10	10 Gbps
Generation 2 Fabric Switches				
DS-C9134-K9 (Cisco MDS 9134 Fabric switch)	32-port 4-Gbps Fabric switch	4	16	4 Gbps
	2-port 10-Gbps Fabric switch	1	10	10 Gbps
DS-C9124K9 (Cisco MDS 9124 Fabric switch)	24-port 4-Gbps Fabric switch	4	16	4 Gbps
DS-C9222i-K9 (Cisco MDS 9222i Multiservice Modular switch)	18-port 4-Gbps, 4 Gigabit Ethernet ports and a modular expansion slot.	6	12.8	4 Gbps

Port Rate Modes

In Generation 2, Generation 3, and Generation 4 modules, you can configure the port rate modes. The *port rate mode* configuration is used to determine the bandwidth allocation for ports in a port group. Two port rate modes are supported:

- Dedicated Rate Mode-A port is allocated required fabric bandwidth to sustain line traffic at the maximum operating speed configured on the port. For more information, see the Dedicated Rate Mode, on page 8 section.

- Shared Rate Mode-Multiple ports in a port group share data paths to the switch fabric and share bandwidth. For more information, see the Shared Rate Mode, on page 9 section.

Note In Generation 1 modules, you cannot configure the port rate modes. The mode is determined implicitly based on the port mode and line card type.

Note Port rate modes are not supported on the Cisco Fabric Switch for HP c-Class Blade System, and the Cisco Fabric Switch for IBM Blade Center.

Table 3: Port Rate Mode Support on Generation 2, Generation 3, and Generation 4 Modules and Switches , on page 7 shows the modules that support dedicated, shared, and the default rate modes.

Table 3: Port Rate Mode Support on Generation 2, Generation 3, and Generation 4 Modules and Switches

Generation 2 Modules				
DS-X9148	48-port 4-Gbps Fibre Channel switching module [4]	Yes	Yes	Auto, Shared
DS-X9124	24-port 4-Gbps Fibre Channel switching module	Yes	Yes	Auto, Shared
DS-X9304-18K9 (MSM-18/4 Multiservice module)	18-port 4-Gbps Fibre Channel switching module with 4-Gigabit Ethernet ports	Yes	Yes	Auto, Shared
DS-X9112	12-port 4-Gbps Fibre Channel switching module	Yes	No	Auto, Dedicated
DS-X9704	4-port 10-Gbps Fibre Channel switching module	Yes	No	Auto, Dedicated
Generation 2 Fabric Switches				
DS-C9134-K9 (Cisco MDS 9134 Fabric switch)	32-port 4-Gbps Fabric switch	Yes	Yes	Auto, Shared
	2-port 10-Gbps Fabric switch	Yes	No	Auto, Dedicated

DS-C9124-K9 (Cisco MDS 9124 Fabric switch)	24-port 4-Gbps Fabric switch [5]	Yes	No	Auto, Dedicated
DS-C9222i-K9 (Cisco MDS 9222i Multiservice Modular switch)	18-port 4-Gbps Fibre Channel switch with 4-Gigabit Ethernet IP storage services ports, and a modular expansion slot to host Cisco MDS 9000 Series switching and services modules	Yes	Yes	Auto, Shared

[4] All ports in a 48-port 4-Gbps switching module can operate in dedicated rate mode with a 1-Gbps operating speed. However, if you configure one or more ports to operate in 2-Gbps or 4-Gbps dedicated rate mode, some of the other ports in the port group would have to operate in shared mode.

[5] All ports in a 24-port 4-Gbps switching module can operate in dedicated rate mode with a 2-Gbps operating speed. However, if you configure one or more ports to operate in 4-Gbps dedicated rate mode, some of the other ports in the port group would have to operate in shared mode.

Dedicated Rate Mode

When port rate mode is configured as dedicated, a port is allocated required fabric bandwidth and related resources to sustain line rate traffic at the maximum operating speed configured for the port. In this mode, ports do not use local buffering and all receive buffers are allocated from a global buffer pool.

Table 4: Bandwidth Reserved for the Port Speeds on Generation 4 Switching Modules , on page 8 shows the bandwidth provided by the various port speed configurations on the 8-Gbps Advanced Fibre Channel switching modules.

Table 4: Bandwidth Reserved for the Port Speeds on Generation 4 Switching Modules

Configured Speed	Reserved Bandwidth
Auto 8-Gbps	8 Gbps
Auto with 4-Gbps maximum 4-Gbps	4 Gbps
Auto with 2-Gbps maximum 2-Gbps	2 Gbps
1-Gbps	1 Gbps

Table 5: Bandwidth Reserved for the Port Speeds on Generation 3 Switching Modules , on page 9 shows the bandwidth provided by the various port speed configurations on the 8-Gbps Fibre Channel switching modules.

Table 5: Bandwidth Reserved for the Port Speeds on Generation 3 Switching Modules

Configured Speed	Reserved Bandwidth
Auto	8 Gbps
8-Gbps	
Auto with 4-Gbps maximum	4 Gbps
4-Gbps	
Auto with 2-Gbps maximum	2 Gbps
2-Gbps	
1-Gbps	1 Gbps

Table 6: Bandwidth Reserved for the Port Speeds on Generation 2 Switching Modules , on page 9 shows the amount of bandwidth reserved for a configured port speed on 4-Gbps switching modules.

Table 6: Bandwidth Reserved for the Port Speeds on Generation 2 Switching Modules

Configured Speed	Reserved Bandwidth
Auto	4 Gbps
4-Gbps	
Auto with 2-Gbps maximum	2 Gbps
2-Gbps	
1-Gbps	1 Gbps

Note The 4-Port 10-Gbps Fibre Channel module ports in auto mode only support auto speed mode at 10 Gbps.

Shared Rate Mode

When port rate mode is configured as shared, multiple ports within a port group share data paths to the switch fabric so that fabric bandwidth and related resources are shared. Often, the available bandwidth to the switch fabric may be less than the negotiated operating speed of a port. Ports in this mode use local buffering for the BB_credit buffers.

All ports in 8-Gbps Advanced Fibre Channel switching modules where bandwidth is shared support 1-Gbps, 2-Gbps, 4-Gbps, or 8 Gbps traffic. However, it is possible to configure one or more ports in a port group to operate in dedicated rate mode with 1-Gbps, 2-Gbps, 4-Gbps, or 8 Gbps operating speed.

All ports in 4-Gbps Fibre Channel switching modules where bandwidth is shared support 1-Gbps, 2-Gbps, or 4-Gbps traffic. However, it is possible to configure one or more ports in a port group to operate in dedicated rate mode with 1-Gbps, 2-Gbps, or 4-Gbps operating speed.

All ports in the 32-Port or 48-Port 8-Gbps Advanced Fibre Channel modules where bandwidth is shared support 1-Gbps, 2-Gbps, 4-Gbps, or 8-Gbps traffic in a maximum or 32 or 48 ports.

All ports in the 48-Port and 24-Port 8-Gbps Fibre Channel switching modules where bandwidth is shared support 1-Gbps, 2-Gbps, 4-Gbps, or 8-Gbps traffic.

In the 4/44-Port 8-Gbps Host-Optimized Fibre Channel switching module, all the ports where bandwidth is shared support 1-Gbps, 2-Gbps, 4-Gbps in a maximum of 44 ports, or 8 Gbps in a maximum of 4 ports.

Dedicated Rate Mode Configurations for the 8-Gbps Modules

Table 7: Dedicated Rate Mode Bandwidth Reservation for Generation 4 Fibre Channel Modules , on page 10 shows the maximum possible dedicated rate mode configuration scenarios for the Generation 4 Fibre Channel modules.

Table 7: Dedicated Rate Mode Bandwidth Reservation for Generation 4 Fibre Channel Modules

Part Number	Product Name/ Description	Dedicated Bandwidth per Port	Maximum Allowed Ports That Can Come Up	Ports in Shared Mode
DS-X9248-256K9	48-port 8-Gbps Advanced Fibre Channel switching module	10 Gbps	24 Ports	All the remaining ports are 8 Gbps shared.
		8 Gbps	32 Ports	
		4 Gbps	48 Ports	
		2 Gbps	48 Ports	
		1 Gbps	48 Ports	
DS-X9232-256K9	32-port 8-Gbps Advanced Fibre Channel switching module	10 Gbps	24 Ports	All the remaining ports are 8 Gbps shared.
		8 Gbps	32 Ports	
		4 Gbps	32 Ports	
		2 Gbps	32 Ports	
		1 Gbps	32 Ports	

Table 8: Dedicated Rate Mode Bandwidth Reservation for Generation 3 Fibre Channel Modules , on page 10 shows the maximum possible dedicated rate mode configuration scenarios for the Generation 3 Fibre Channel modules.

Table 8: Dedicated Rate Mode Bandwidth Reservation for Generation 3 Fibre Channel Modules

Part Number	Product Name/ Description	Dedicated Bandwidth per Port	Maximum Allowed Ports That Can Come Up	Ports in Shared Mode
DS-X9224-96K9	24-port 8-Gbps Fibre Channel switching module	8 Gbps	8 Ports	All the remaining ports are 8 Gbps shared.
		4 Gbps	24 Ports	

Part Number	Product Name/ Description	Dedicated Bandwidth per Port	Maximum Allowed Ports That Can Come Up	Ports in Shared Mode
DS-X9248-96K9	48-port 8-Gbps Fibre Channel switching module	8 Gbps	8 Ports	All the remaining ports are 8 Gbps shared.
		4 Gbps	24 Ports	
		2 Gbps	48 Ports	
DS-X9248-48K9	4/44-port 8-Gbps Host-Optimized Fibre Channel switching module	8 Gbps	4 Ports	All the remaining ports are 4 Gbps shared (8 Gbps of bandwidth can be provided only to one port per port group in dedicated or shared rate mode).
		4 Gbps	12 Ports	
		2 Gbps	24 Ports	
		1 Gbps	48 Ports	

Port Speed

The port speed on an interface, combined with the rate mode, determines the amount of shared resources available to the ports in the port group on a 48-port, 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching module. With the dedicated rate mode, the port group resources are reserved even though the bandwidth is not used. For example, on Generation 3 modules, if an interface is configured for autosensing (auto) and dedicated rate mode, then 8 Gbps of bandwidth is reserved even though the maximum operating speed is 2 Gbps. For the same interface, if autosensing with a maximum speed of 2 Gbps (auto max 2000) is configured, then only 2 Gbps of bandwidth is reserved and the unused 2 Gbps is shared with the other interface in the port group.

Note
- The Generation 2, 4-port 10-Gbps switching module supports 10-Gbps traffic only.

- On Generation 2, 4-Gbps modules, setting the port speed to auto enables autosensing, which negotiates to a maximum speed of 4 Gbps.

- On Generation 3, 8-Gbps modules, setting the port speed to auto enables autosensing, which negotiates to a maximum speed of 8 Gbps.

- On Generation 4, 8-Gbps modules, setting the port speed to auto enables autosensing, which negotiates to a maximum speed of 8 Gbps.

Forward Error Correction

The Transmitter Training Signal (TTS) is defined in FC-FS-4(Clause 5.5). It provides the capability for FC ports to negotiate the following two capabilities:

1. Transmitter training, which enables a receiver to send feedback to a transmitter to assist the transmitter in adapting to the characteristics of the link that connects them.

2. FEC usage.

The TTS is not used by 4 and 8-gigabit FC ports. From 32-gigabit speed and higher, its use is mandatory. For 16-gigabit FC ports, EA variants must transmit the TTS during the link speed negotiation, but the use of it by the receiver is optional, and EL variants must not use TTS.

Forward Error Correction (FEC) is defined in IEEE 802.3TM clause 74 and is implemented in FC without modification. FEC is not supported on 4, 8 and 16-gigabit EL ports. Its use is optional on 16-gigabit EA ports. The TTS is the mechanism that allows FEC negotiation on such ports.

For more information on configuring FEC and TTS, see the Configuring FEC, on page 34 section.

Dynamic Bandwidth Management

On port switching modules where bandwidth is shared, the bandwidth available to each port within a port group can be configured based on the port rate mode and speed configurations. Within a port group, some ports can be configured in dedicated rate mode while others operate in shared mode.

Ports configured in dedicated rate mode are allocated the required bandwidth to sustain a line rate of traffic at the maximum configured operating speed, and ports configured in shared mode share the available remaining bandwidth within the port group. Bandwidth allocation among the shared mode ports is based on the operational speed of the ports.

For example, if four ports operating at speeds 1 Gbps, 1 Gbps, 2 Gbps, and 4 Gbps share bandwidth of 8 Gbps, the ratio of allocation would be 1:1:2:4.

Unutilized bandwidth from the dedicated ports is shared among only the shared ports in a port group as per the ratio of the configured operating speed. A port cannot be brought up unless the reserved bandwidth is quarantined for the shared ports. For dedicated ports, configured bandwidth is taken into consideration while calculating available bandwidth for the port group. This behavior can be changed using bandwidth fairness by using the **rate-mode bandwidth-fairness module** *number* command.

For example, consider a 48-port 8-Gbps module. This module has 6 ports per port group with 12.8 Gbps bandwidth. Ports 3 to 6 are configured at 4 Gbps. If the first port is configured at 8 Gbps dedicated rate mode, and the second port is configured at 4-Gbps dedicated rate mode, then no other ports can be configured at 4 Gbps or 8 Gbps because the left over bandwidth of 0.8 Gbps (12.8-(8+4)) cannot meet the required 0.96 Gbps for the remaining four ports. A minimum of 0.24 Gbps reserved bandwidth is required for the for the rest of the four ports. However, if the two ports (for example, 5 and 6) are taken out of service (which is not same as shutdown), required reserved bandwidth for the two ports (3 and 4) is 0.48 and port 2 can be configured at 4 Gbps in dedicated rate mode. This behavior can be overridden by the bandwidth fairness command in which case reserved bandwidth is not enforced. Once the port is up, ports 3 and 4 can share the unutilized bandwidth from ports 1 and 2.

Out-of-Service Interfaces

On supported modules and fabric switches, you might need to allocate all the shared resources for one or more interfaces to another interface in the port group or module. You can take interfaces out of service to release shared resources that are needed for dedicated bandwidth. When an interface is taken out of service, all shared resources are released and made available to the other interface in the port group or module. These shared resources include bandwidth for the shared mode port, rate mode, BB_credits, and extended BB_credits. All shared resource configurations are returned to their default values when the interface is brought back into service. Corresponding resources must be made available in order for the port to be successfully returned to service.

⚠️

Caution   If you need to bring an interface back into service, you might disrupt traffic if you need to release shared resources from other interfaces in the same port group.

Oversubscription Ratio Restrictions

The 48-port and 24-port 4-Gbps, and all 8-Gbps Fibre Channel switching modules support oversubscription on switches with shared rate mode configurations. By default, all 48-port and 24-port 4-Gbps, and 8-Gbps Fibre Channel switching modules have restrictions on oversubscription ratios enabled. As of Cisco SAN-OS Release 3.1(1) and NX-OS Release 4.1(1), you can disable restrictions on oversubscription ratios.

Table 9: Bandwidth Allocation for Oversubscribed Interfaces , on page 13 describes the bandwidth allocation for oversubscribed interfaces configured in shared mode on the 4-Gbps and 8-Gbps modules.

Table 9: Bandwidth Allocation for Oversubscribed Interfaces

Switching Module	Configured Speed	Reserved Bandwidth (Gbps)	Maximum Bandwidth (Gbps)	Ratios disabled
		Ratios enabled		
24-Port 8-Gbps Fibre Channel Module	Auto 8 Gbps	0.8	0.8	8
	Auto Max 4 Gbps	0.4	0.4	4
	Auto Max 2 Gbps	0.2	0.2	2
4/44-Port 8-Gbps Host-Optimized Fibre Channel Module	8 Gbps	0.87	0.16	8
	Auto Max 4 Gbps	0.436	0.08	4
	Auto Max 2 Gbps	0.218	0.04	2
	1 Gbps	0.109	0.02	1
48-port 4-Gbps Fibre Channel switching module	Auto 4 Gbps	0.8	0.09	4
	Auto Max 2 Gbps	0.4	0.045	2
	1 Gbps	0.2	0.0225	1
24-port 4-Gbps Fibre Channel switching module	Auto 4 Gbps	1	0.27	4
	Auto Max 2 Gbps	0.5	0.135	2
	1 Gbps	0.25	0.067	1

All ports in the 48-port and 24-port 4-Gbps modules can be configured to operate at 4 Gbps in shared mode even if other ports in the port group are configured in dedicated mode, regardless of available bandwidth. However, when oversubscription ratio restrictions are enabled, you may not have all shared 4-Gbps module ports operating at 4 Gbps.

All ports in the 48-port, 32-Port, and 24-port 8-Gbps modules can be configured to operate at 8 Gbps in shared mode even if other ports in the port group are configured in dedicated mode, regardless of available bandwidth. However, when oversubscription ratio restrictions are enabled you may not have all shared 8-Gbps module ports operating at 8 Gbps.

On the 48-port, 32-Port, and 24-port 8-Gbps modules, if you have configured one 8-Gbps dedicated port in one port group, no other ports in the same port group can be configured to operate at 8-Gbps dedicated mode. You can have any number of 8-Gbps shared and 4-Gbps dedicated or shared ports. On the 4/44-port 8-Gbps module, only one port per port group can be configured in 8-Gbps dedicated or shared mode.

In the following example, each of the 4 ports already have 500 credits and you have 2150 remaining for the port group. So, in all 4150 credits:

```
switch(config-if)# show port-resources module 1
Module 1
  Available dedicated buffers for global buffer #0 [port-group 1] are 2150
  Available dedicated buffers for global buffer #1 [port-group 2] are 2150
  Available dedicated buffers for global buffer #2 [port-group 3] are 2150
  Available dedicated buffers for global buffer #3 [port-group 4] are 2148
  Available dedicated buffers for global buffer #4 [port-group 5] are 2150
  Available dedicated buffers for global buffer #5 [port-group 6] are 2150
  Available dedicated buffers for global buffer #6 [port-group 7] are 2150
  Available dedicated buffers for global buffer #7 [port-group 8] are 650
  Available dedicated buffers for global buffer #8 [port-group 9] are 2150
  Available dedicated buffers for global buffer #9 [port-group 10] are 2150
  Available dedicated buffers for global buffer #10 [port-group 11] are 2150
  Available dedicated buffers for global buffer #11 [port-group 12] are 2150

 Port-Group 1
  Total bandwidth is 64.0 Gbps
  Allocated dedicated bandwidth is 64.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group        B2B Credit  Bandwidth  Rate Mode
                                         Buffers     (Gbps)
  --------------------------------------------------------------------
  fc1/1                                      500       16.0   dedicated
  fc1/2                                      500       16.0   dedicated
  fc1/3                                      500       16.0   dedicated
  fc1/4                                      500       16.0   dedicated

Port-Group 6
  Total bandwidth is 64.0 Gbps
  Allocated dedicated bandwidth is 64.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group        B2B Credit  Bandwidth  Rate Mode
                                         Buffers     (Gbps)
  --------------------------------------------------------------------
  fc4/21                                    4090       16.0   dedicated
  fc4/22                                      10       16.0   dedicated
  fc4/23                                      10       16.0   dedicated
  fc4/24                                      10       16.0   dedicated
```

In the following example, a 24-port 4-Gbps module has oversubscription ratios enabled and three dedicated ports in one port group operating at 4-Gbps. No other ports in the same port group can be configured to operate at 4 Gbps.

```
switch# show port-resources module 8
Module 8
  Available dedicated buffers are 5478
```

```
 Port-Group 1
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 0.8 Gbps
  Allocated dedicated bandwidth is 12.0 Gbps
  -------------------------------------------------------------------
  Interfaces in the Port-Group        B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  -------------------------------------------------------------------
  fc8/1                                    16         4.0   dedicated
  fc8/2                                    16         4.0   dedicated
  fc8/3                                    16         4.0   dedicated
  fc8/4 (out-of-service)
  fc8/5 (out-of-service)
  fc8/6 (out-of-service)
```

For dedicated ports, oversubscription ratio restrictions do not apply to the shared pool in port groups. So if oversubscription ratio restrictions are disabled, and you have configured three 4-Gbps dedicated ports in one port group, then you can configure all other ports in the same port group to operate at a shared rate of 4 Gbps.

In the following example, a 48-port module has a group of six ports, four dedicated ports are operating at 8 Gbps, and the two shared ports are also operating at 8 Gbps:

```
switch# show port-resources module 5
Module 5
Available dedicated buffers for global buffer #0 [port-group 1] are 3970
  Available dedicated buffers for global buffer #1 [port-group 2] are 3970
  Available dedicated buffers for global buffer #2 [port-group 3] are 3970
  Available dedicated buffers for global buffer #3 [port-group 4] are 3970
  Available dedicated buffers for global buffer #4 [port-group 5] are 3058
  Available dedicated buffers for global buffer #5 [port-group 6] are 3058
  Available dedicated buffers for global buffer #6 [port-group 7] are 3970
  Available dedicated buffers for global buffer #7 [port-group 8] are 3970

Port-Group 1
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  -------------------------------------------------------------------
  Interfaces in the Port-Group        B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  -------------------------------------------------------------------
  fc5/1                                    32         8.0   shared
  fc5/2                                    32         8.0   shared
  fc5/3                                    32         8.0   shared
  fc5/4                                    32         8.0   shared

Port-Group 2
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  -------------------------------------------------------------------
  Interfaces in the Port-Group        B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  -------------------------------------------------------------------
  fc5/5                                    32         8.0   shared
  fc5/6                                    32         8.0   shared
  fc5/7                                    32         8.0   shared
  fc5/8                                    32         8.0   shared

Port-Group 3
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
```

```
    Allocated dedicated bandwidth is 0.0 Gbps
    ----------------------------------------------------------------
    Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
    ----------------------------------------------------------------
    fc5/9                                    32        8.0   shared
    fc5/10                                   32        8.0   shared
    fc5/11                                   32        8.0   shared
    fc5/12                                   32        8.0   shared

Port-Group 4
    Total bandwidth is 32.4 Gbps
    Total shared bandwidth is 32.4 Gbps
    Allocated dedicated bandwidth is 0.0 Gbps
    ----------------------------------------------------------------
    Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
    ----------------------------------------------------------------
    fc5/13                                   32        8.0   shared
    fc5/14                                   32        8.0   shared
    fc5/15                                   32        8.0   shared
    fc5/16                                   32        8.0   shared

Port-Group 5
    Total bandwidth is 32.4 Gbps
    Total shared bandwidth is 16.4 Gbps
    Allocated dedicated bandwidth is 16.0 Gbps
    ----------------------------------------------------------------
    Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
    ----------------------------------------------------------------
    fc5/17                                   32        8.0   shared
    fc5/18                                   32        8.0   shared
    fc5/19                                  500        8.0   dedicated
    fc5/20                                  500        8.0   dedicated

Port-Group 6
    Total bandwidth is 32.4 Gbps
    Total shared bandwidth is 16.4 Gbps
    Allocated dedicated bandwidth is 16.0 Gbps
    ----------------------------------------------------------------
    Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
    ----------------------------------------------------------------
    fc5/21                                  500        8.0   dedicated
    fc5/22                                  500        8.0   dedicated
    fc5/23                                   32        8.0   shared
    fc5/24                                   32        8.0   shared

Port-Group 7
    Total bandwidth is 32.4 Gbps
    Total shared bandwidth is 32.4 Gbps
    Allocated dedicated bandwidth is 0.0 Gbps
    ----------------------------------------------------------------
    Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
    ----------------------------------------------------------------
    fc5/25                                   32        8.0   shared
    fc5/26                                   32        8.0   shared
    fc5/27                                   32        8.0   shared
    fc5/28                                   32        8.0   shared

Port-Group 8
    Total bandwidth is 32.4 Gbps
```

```
    Total shared bandwidth is 32.4 Gbps
    Allocated dedicated bandwidth is 0.0 Gbps
    -------------------------------------------------------------------
    Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                         Buffers     (Gbps)
    -------------------------------------------------------------------
    fc5/29                                  32         8.0    shared
    fc5/30                                  32         8.0    shared
    fc5/31                                  32         8.0    shared
    fc5/32                                  32         8.0    shared

switch# show port-resources module 13
Module 13
  Available dedicated buffers for global buffer #0 [port-group 1] are 3880
  Available dedicated buffers for global buffer #1 [port-group 2] are 3880
  Available dedicated buffers for global buffer #2 [port-group 3] are 3880
  Available dedicated buffers for global buffer #3 [port-group 4] are 3056
  Available dedicated buffers for global buffer #4 [port-group 5] are 3880
  Available dedicated buffers for global buffer #5 [port-group 6] are 3880
  Available dedicated buffers for global buffer #6 [port-group 7] are 3880
  Available dedicated buffers for global buffer #7 [port-group 8] are 3880

Port-Group 1
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  -------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                       Buffers     (Gbps)
  -------------------------------------------------------------------
  fc13/1                                  32         8.0    shared
  fc13/2                                  32         8.0    shared
  fc13/3                                  32         8.0    shared
  fc13/4                                  32         8.0    shared
  fc13/5                                  32         8.0    shared
  fc13/6                                  32         8.0    shared

Port-Group 2
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  -------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                       Buffers     (Gbps)
  -------------------------------------------------------------------
  fc13/7                                  32         8.0    shared
  fc13/8                                  32         8.0    shared
  fc13/9                                  32         8.0    shared
  fc13/10                                 32         8.0    shared
  fc13/11                                 32         8.0    shared
  fc13/12                                 32         8.0    shared

Port-Group 3
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  -------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                       Buffers     (Gbps)
  -------------------------------------------------------------------
  fc13/13                                 32         8.0    shared
  fc13/14                                 32         8.0    shared
  fc13/15                                 32         8.0    shared
  fc13/16                                 32         8.0    shared
```

```
fc13/17                                  32      8.0  shared
fc13/18                                  32      8.0  shared

Port-Group 4
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 0.4 Gbps
  Allocated dedicated bandwidth is 32.0 Gbps
  ----------------------------------------------------------------
  Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
  ----------------------------------------------------------------
  fc13/19                               250       8.0  dedicated
  fc13/20                               250       8.0  dedicated
  fc13/21                               250       8.0  dedicated
  fc13/22                               250       8.0  dedicated
  fc13/23                                32       8.0  shared
  fc13/24                                32       8.0  shared

Port-Group 5
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  ----------------------------------------------------------------
  Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
  ----------------------------------------------------------------
  fc13/25                                32       8.0  shared
  fc13/26                                32       8.0  shared
  fc13/27                                32       8.0  shared
  fc13/28                                32       8.0  shared
  fc13/29                                32       8.0  shared
  fc13/30                                32       8.0  shared

Port-Group 6
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  ----------------------------------------------------------------
  Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
  ----------------------------------------------------------------
  fc13/31                                32       8.0  shared
  fc13/32                                32       8.0  shared
  fc13/33                                32       8.0  shared
  fc13/34                                32       8.0  shared
  fc13/35                                32       8.0  shared
  fc13/36                                32       8.0  shared

Port-Group 7
  Total bandwidth is 32.4 Gbps
  Total shared bandwidth is 32.4 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  ----------------------------------------------------------------
  Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
  ----------------------------------------------------------------
  fc13/37                                32       8.0  shared
  fc13/38                                32       8.0  shared
  fc13/39                                32       8.0  shared
  fc13/40                                32       8.0  shared
  fc13/41                                32       8.0  shared
  fc13/42                                32       8.0  shared

Port-Group 8
```

```
Total bandwidth is 32.4 Gbps
Total shared bandwidth is 32.4 Gbps
Allocated dedicated bandwidth is 0.0 Gbps
-------------------------------------------------------------------
Interfaces in the Port-Group          B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
-------------------------------------------------------------------
fc13/43                                   32          8.0    shared
fc13/44                                   32          8.0    shared
fc13/45                                   32          8.0    shared
fc13/46                                   32          8.0    shared
fc13/47                                   32          8.0    shared
fc13/48                                   32          8.0    shared
...
```

When disabling restrictions on oversubscription ratios, all ports in shared mode on 48-port and 24-port 4-Gbps or any 8-Gbps Fibre Channel switching modules must be shut down. When applying restrictions on oversubscription ratios, you must take shared ports out of service.

Note When restrictions on oversubscription ratios are disabled, the bandwidth allocation among the shared ports is proportionate to the configured speed. If the configured speed is auto on Generation 2 modules, then bandwidth is allocated assuming a speed of 4 Gbps. For example, if you have three shared ports configured at 1, 2, and 4 Gbps, then the allocated bandwidth ratio is 1:2:4.

As of Cisco SAN-OS Release 3.0 and NX-OS Release 4.1(1) or when restrictions on oversubscription ratios are enabled, the port bandwidths are allocated in equal proportions, regardless of port speed, so, the bandwidth allocation for the same three ports mentioned in the example would be 1:1:1.

Bandwidth Fairness

This feature improves fairness of bandwidth allocation among all ports and provides better throughput average to individual data streams. Bandwidth fairness can be configured per module.

As of Cisco SAN-OS Release 3.1(2), all 48-port and 24-port 4-Gbps Fibre Channel switching modules, as well as 18-port Fibre Channel/4-port Gigabit Ethernet Multiservice modules, have bandwidth fairness enabled by default. As of Cisco NX-OS Release 4.1(1), all the 8-Gbps Fibre Channel switching modules have bandwidth fairness enabled by default.

Caution When you disable or enable bandwidth fairness, the change does not take effect until you reload the module.

Use the show module bandwidth-fairness command to check whether ports in a module are operating with bandwidth fairness enabled or disabled.

```
switch# show module 2 bandwidth-fairness
Module 2 bandwidth-fairness is enabled
```

Note This feature is supported only on the 48-port and 24-port 4-Gbps modules, the 8-Gbps modules, and the 18/4-port Multiservice Module (MSM).

Upgrade or Downgrade Scenario

When you are upgrading from a release earlier than Cisco SAN-OS Release 3.1(2), all modules operate with bandwidth fairness disabled until the next module reload. After the upgrade, any new module that is inserted has bandwidth fairness enabled.

When you are downgrading to a release earlier than Cisco SAN-OS Release 3.1(2), all modules keep operating in the same bandwidth fairness configuration prior to the downgrade. After the downgrade, any new module that is inserted has bandwidth fairness disabled.

Note After the downgrade, any insertion of a module or module reload will have bandwidth fairness disabled.

Guidelines and Limitations

Combining Generation 1, Generation 2, Generation 3, and Generation 4 Modules

Cisco MDS NX-OS Release 5.2(x) and later supports combining Generation 1, Generation 2, Generation 3, and Generation 4 modules and switches with the following considerations:

- MDS NX-OS Release 4.1(1) and later features are not supported on the following Generation 1 switches and modules:

  - Supervisor 1 module

  - 4-Port IP Storage Services module

  - 8-Port IP Storage Services module

  - MDS 9216 switch

  - MDS 9216A switch

  - MDS 9020 switch

  - MDS 9120 switch

  - MDS 9140 switch

- Supervisor-1 modules must be upgraded to Supervisor-2 modules on the MDS 9506 and MDS 9509 Directors.

- IPS-4 and IPS-8 modules must be upgraded to the MSM-18/4 Multiservice modules.

- Fabric 1 modules must be upgraded to Fabric 2 modules on the MDS 9513 Director to use the 48-port or the 24-port 8-Gbps module.

- Fabric 2 modules must be upgraded to Fabric 3 modules on the MDS 9513 Director to get the maximum backplane bandwidth of 256 Gbps.

- Cisco Fabric Manager Release 4.x supports MDS SAN-OS Release 3.x and NX-OS 4.x in mixed mode through Interswitch Link (ISL) connectivity.

Local Switching Limitations

- All ports in the module must be in shared mode. Use the **switchport ratemode shared** command to ensure that all the ports in the module are in shared mode.

- No E ports are allowed in the module because E ports must be in dedicated mode.

Port Index Limitations

Cisco MDS 9000 switches allocate index identifiers for the ports on the modules. These port indexes cannot be configured. You can combine Generation 1, Generation 2, Generation 3, and Generation 4 switching

modules, with either Supervisor-1 modules or Supervisor-2 modules. However, combining switching modules and supervisor modules has the following port index limitations:

- Supervisor-1 modules only support a maximum of 252 port indexes, regardless of the type of switching modules.

- Supervisor-2 modules support a maximum of 1020 port indexes when all switching modules in the chassis are Generation 2 or Generation 3.

- Supervisor-2 modules only support a maximum of 252 port indexes when only Generation 1 switching modules, or a combination of Generation 1, Generation 2, Generation 3, or Generation 4 switching modules are installed in the chassis.

Note   On a switch with the maximum limit of 252 as port index, any new module that exceeds the limit does not power up when installed.

You can use the **show port index-allocation** command to display the allocation of port indexes on the switch.

```
switch# show port index-allocation
Module index distribution:
-------------------------------------------------------+
Slot | Allowed |       Allotted indices info    |
     |   range | Total |          Index values |
-----------|---------|-------|----------------------|
1    | ----- |  -   | (None)                    |
2    | ----- |  -   | (None)                    |
3    | ----- |  -   | (None)                    |
4    | ----- |  -   | (None)                    |
5    |    0-1023| 32  | 0-31                     |
6    | ----- |  -   | (None)                    |
9    | ----- |  -   | (None)                    |
10   | ----- |  -   | (None)                    |
11   | ----- |  -   | (None)                    |
12   | ----- |  -   | (None)                    |
13   |    0-1023| 48  | 32-79                    |
SUP  | 253-255 |  3   | 253-255                  |
```

Generation 1 switching modules have specific numbering requirements. If these requirements are not met, the module does not power up. The port index numbering requirements include the following:

- If port indexes in the range of 256 to 1020 are assigned to operational ports, Generation 1 switching modules do not power up.

- A block of contiguous port indexes is available. If this block of port indexes is not available, Generation 1 modules do not power up. Table 10: Port Index Requirements for Generation 1 Modules , on page 23 shows the port index requirements for the Generation 1 modules.

Note   If the switch has Supervisor-1 modules, the block of 32 contiguous port indexes must begin on the slot boundary. The slot boundary for slot 1 is 0, for slot 2 is 32, and so on. For Supervisor-2 modules, the contiguous block can start anywhere.

Table 10: Port Index Requirements for Generation 1 Modules

Generation 1 Module	Number of Port Indexes Required	
	Supervisor-1 Module	**Supervisor-2 Module**
16-port 2-Gbps Fibre Channel module	16	16
32-port 2-Gbps Fibre Channel module	32	32
8-port Gigabit Ethernet IP Storage Services module	32	32
4-port Gigabit Ethernet IP Storage Services module	32	16
32-port 2-Gbps Fibre Channel Storage Services Module (SSM).	32	32
14-port Fibre Channel/2-port Gigabit Ethernet Multiprotocol Services (MPS-14/2) module	32	22

The allowed mix of Generation 1 and Generation 2 switching modules in a chassis is determined at run-time, either when booting up the switch or when installing the modules. In some cases, the sequence in which switching modules are inserted into the chassis determines if one or more modules is powered up.

When a module does not power up because of a resource limitation, you can display the reason by using the **show module** command.

```
switch# show module
Mod  Ports  Module-Type                          Model              Status
---  -----  ------------------------------------ -----------------  ----------
5    32     1/2/4/8/10 Gbps Advanced FC Module   DS-X9232-256K9     ok
7    0      Supervisor/Fabric-2                  DS-X9530-SF2-K9    active *
13   48     1/2/4/8/10 Gbps Advanced FC Module   DS-X9248-256K9     ok
Mod  Sw             Hw      World-Wide-Name(s) (WWN)
---  -------------- ------  --------------------------------------------------
5    5.2(2)         0.207   21:01:00:0d:ec:b7:28:c0 to 21:20:00:0d:ec:b7:28:c0
7    5.2(2)         1.9     --
13   5.2(2)         0.212   23:01:00:0d:ec:b7:28:c0 to 23:30:00:0d:ec:b7:28:c0
Mod  MAC-Address(es)                        Serial-Num
---  ------------------------------------   ----------
5    68-ef-bd-a8-45-cc to 68-ef-bd-a8-45-d0  JAF1450CHQT
7    00-24-c4-60-00-f8 to 00-24-c4-60-00-fc  JAE141502L2
13   68-ef-bd-a8-40-00 to 68-ef-bd-a8-40-04  JAF1450BMBP
Xbar Ports  Module-Type                          Model              Status
---  -----  ------------------------------------ -----------------  ----------
1    0      Fabric Module 3                      DS-13SLT-FAB3      ok
2    0      Fabric Module 3                      DS-13SLT-FAB3      ok
Xbar Sw             Hw      World-Wide-Name(s) (WWN)
---  -------------- ------  --------------------------------------------------
1    NA             0.4     --
2    NA             0.4     --
Xbar MAC-Address(es)                        Serial-Num
---  ------------------------------------   ----------
```

```
1   NA                                         JAF1451AMHG
2   NA                                         JAF1451AMHN
* this terminal session
```

The running configuration is updated when modules are installed. If you save the running configuration to the startup configuration (using the copy running-config startup-config command), during reboot the switch powers up the same set of modules as before the reboot regardless of the sequence in which the modules initialize. You can use the **show port index-allocation startup** command to display the index allocation the switch uses at startup.

```
switch# show port index-allocation startup
Startup module index distribution:
-------------------------------------------------------+
Slot | Allowed |       Alloted indices info       |
     |  range  | Total |        Index values       |
-----|---------|-------|---------------------------|
  1  |  -----  |  34   | 0-31,80-81                |
  2  |  -----  |  32   | 32-63                     |
  3  |  -----  |  16   | 64-79                     |(Slot 1 shares 80-81)
  4  |  -----  |  48   | 96-127,224-239            |
 SUP | 253-255 |   3   | 253-255                   |
```

Note   The output of the **show port index-allocation startup** command does not display anything in the Allowed range column because the command extracts the indices from the persistent storage service (PSS) and displaying an allowed range for startup indices is meaningless.

If a module fails to power up, you can use the **show module** *slot* **recovery-steps** command to display the reason.

Tip   Whenever using mixed Generation 1 and Generation 2 modules, power up the Generation 1 modules first. During a reboot of the entire switch, the Generation 1 modules power up first (default behavior).

PortChannel Limitations

PortChannels have the following restrictions:

- The maximum number of PortChannels allowed is 256 if all switching modules are Generation 2 or Generation 3, or both.

- The maximum number of PortChannels allowed is 128 whenever there is a Generation 1 switching module in use with a Generation 2 or Generation 3 switching module.

- Ports need to be configured in dedicated rate mode on the Generation 2 and Generation 3 switching module interfaces to be used in the PortChannel.

- Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (DS-X9648-1536K9) supports 32 Gbps, 16 Gbps, 8 Gbps, and 4 Gbps speed. However, a single 32-Gbps SFP supports only 32 Gbps, 16 Gbps, and 8 Gbps speed and a single 16-Gbps SFP supports only 16 Gbps, 8 Gbps, and 4 Gbps speed. You must not configure speed values other than the values recommended for these SFPs.

Note The number of PortChannels allowed does not depend on the type of supervisor module. However, Generation 3 modules require the Supervisor 2 module on the MDS 9506 and 9509 switches.

The Generation1, Generation 2, and Generation 3 modules have the following restrictions for PortChannel configuration:

- Generation 1 switching module interfaces do not support auto speed with a maximum of 2 Gbps.

- Generation 1 and Generation 2 module interfaces do not support auto speed with maximum of 4 Gbps.

- Generation 2 and Generation 3 switching module interfaces cannot be forcefully added to a PortChannel if sufficient resources are not available.

Note Before adding a Generation 2 or Generation 3 interface to a PortChannel, use the **show port-resources module** command to check for resource availability.

When configuring PortChannels on switches with Generation 1, Generation 2, and Generation 3 switching modules, follow one of these procedures:

- Configure the PortChannel, and then configure the Generation 2 and Generation 3 interfaces to auto with a maximum of 2 Gbps.

- Configure the Generation 1 switching modules followed by the Generation 2 switching modules, and then the Generation 3 switching modules, and then configure the PortChannel.

When configuring PortChannels on switches with only Generation 2 and Generation 3 switching modules, follow one of these procedures:

- Configure the PortChannel, and then configure the Generation 3 interfaces to auto with a maximum of 4 Gbps.

- Configure the Generation 2 switching modules, followed by the Generation 3 switching modules, and then configure the PortChannel.

Table 11: PortChannel Configuration and Addition Results , on page 26 describes the results of adding a member to a PortChannel for various configurations.

Table 11: PortChannel Configuration and Addition Results

PortChannel Members	Configured Speed		New Member Type	Addition Type	Result
	PortChannel	**New Member**			
No members	Any	Any	Generation 1 or Generation 2 or Generation 3 or Generation 4	Force	Pass
	Auto	Auto	Generation 1 or Generation 2 or Generation 3 or Generation 4	Normal or force	Pass
	Auto	Auto max 2000	Generation 2 or Generation 3 or Generation 4	Normal	Fail
				Force	Pass or fail[6]
	Auto	Auto max 4000	Generation 3 or Generation 4		
	Auto max 2000	Auto	Generation 2 or Generation 3 or Generation 4	Normal	Fail
				Force	Pass
	Auto max 2000	Auto max 4000	Generation 3 or or Generation 4		
	Auto max 4000	Auto	Generation 2 or Generation 3 or or Generation 4		
	Auto max 4000	Auto max 2000	Generation 2 or Generation 3 or or Generation 4		
Generation 1 interfaces	Auto	Auto	Generation 2 or Generation 3	Normal	Fail
				Force	Pass
	Auto max 2000	Auto	Generation 1	Normal or force	Pass
	Auto max 2000	Auto	Generation 2 or Generation 3	Normal	Fail
				Force	Pass or fail[7]
	Auto max 4000	Auto	Generation 1 or Generation 2		
	Auto max 4000	Auto	Generation 3		

PortChannel Members	Configured Speed		New Member Type	Addition Type	Result
	PortChannel	New Member			
Generation 2 interfaces	Auto	Auto	Generation 1	Normal or force	Fail
	Auto max 2000	Auto	Generation 1	Normal or force	Pass
	Auto max 2000	Auto	Generation 2 or Generation 3	Normal	Fail
				Force	Pass
	Auto	Auto max 2000	Generation 2 or Generation 3	Normal	Fail
				Force	Pass
Generation 3 interfaces	Auto	Auto	Generation 1	Normal or force	Fail
	Auto max 2000	Auto	Generation 1	Normal or force	Pass
	Auto max 2000	Auto	Generation 2	Normal	Fail
				Force	Pass
	Auto	Auto max 2000	Generation 2	Normal	Fail
				Force	Pass
	Auto max 2000	Auto	Generation 3	Normal	Fail
				Force	Pass
	Auto	Auto max 2000	Generation 3	Normal	Fail
				Force	Pass
Generation 4 interfaces	Auto	Auto	Generation 1	Normal or force	Fail
	Auto max 2000	Auto	Generation 1	Normal or force	Pass
	Auto max 2000	Auto	Generation 2	Normal	Fail
				Force	Pass
	Auto	Auto max 2000	Generation 2	Normal	Fail
				Force	Pass
	Auto max 2000	Auto	Generation 3 or Generation 4	Normal	Fail
				Force	Pass
	Auto	Auto max 2000	Generation 3 or Generation 4	Normal	Fail
				Force	Pass

[6] If resources are not available.

[7] If resources are not available.

Use the **show port-channel compatibility parameters** command to obtain information about PortChannel addition errors.

Default Settings

Table 12: Default Generation 2 Interface Parameters , on page 29 lists the default settings for Generation 2 interface parameters.

Table 12: Default Generation 2 Interface Parameters

Parameter	Default			
	48-Port 4-Gbps Switching Module	**24-Port 4-Gbps Switching Module**	**12-Port 4-Gbps Switching Module**	**4-Port 10-Gbps Switching Module**
Speed mode	**auto**	**auto**	**auto**	**auto**[8]
Rate mode	**shared**	**shared**	**dedicated**	**dedicated**
Port mode	Fx	Fx	auto[9]	auto [10]
BB_credit buffers	16	16	250	250
Performance buffers	–	–	145 [11]	145 5

[8] The 4-port 10-Gbps switching module only supports 10-Gbps traffic.
[9] Auto port mode on the 12-port 4-Gbps switching module interfaces can operate in E port mode, TE port mode, and Fx port mode.
[10] Auto port mode on the 4-port 10-Gbps switching module interfaces can operate in E port mode, TE port mode, and F port mode.
[11] Performance buffers are shared among all ports on the module.

Table 13: Default Generation 3 Interface Parameters , on page 29 lists the default settings for Generation 3 interface parameters.

Table 13: Default Generation 3 Interface Parameters

Parameter	Default		
	48-Port 8-Gbps Switching Module	**24-Port 8-Gbps Switching Module**	**4/44-Port 8-Gbps Host-Optimized Switching Module**
Speed mode	**auto**	**auto**[12]	**auto_max_4G** [13]
Rate mode	**shared**	**shared**	**shared**
Port mode	Fx	Fx	Fx
BB_credit buffers	32	32	32

[12] Auto_max_4G speed mode on the 4/44-port 8-Gbps switching module negotiates to a maximum speed of 4 Gbps.
[13] Auto_max_4G speed mode on the 4/44-port 8-Gbps switching module negotiates to a maximum speed of 4 Gbps.

Table 14: Default Generation 4 Interface Parameters , on page 30 lists the default settings for Generation 4 interface parameters.

Table 14: Default Generation 4 Interface Parameters

Parameter	Default	
	48-Port 8-Gbps Advanced Fibre Channel Switching Module	**32-Port 8-Gbps Advanced Fibre Channel Switching Module**
Speed mode	**auto**	**auto**
Rate mode	**shared**	**shared**
Port mode	Fx	Fx
BB_credit buffers	32	32

Configuring Fibre Channel Interfaces

Task Flow for Migrating Interfaces from Shared Mode to Dedicated Mode

The 48-Port, 24-Port, and 4/44-Port 8-Gbps Fibre Channel switching modules support the following features:

- 1-Gbps, 2-Gbps, 4-Gbps, and 8-Gbps speed traffic
- Shared and dedicated rate mode
- ISL and Fx port modes
- Extended BB_credits

The 48-port and 24-port 4-Gbps Fibre Channel switching modules support the following features:

- 1-Gbps, 2-Gbps, and 4-Gbps speed traffic
- Shared and dedicated rate mode
- ISL (E or TE) and Fx (F or FL) port modes
- Extended BB_credits

Note If you change the port bandwidth reservation parameters on a 48-port or 24-port 4-Gbps module, the change affects only the changed port. No other ports in the port group are affected.

To configure the Fibre Channel switching modules when starting with the default configuration or when migrating from shared rate mode to dedicated rate mode, perform these steps:

Step 1 Take unused interfaces out of service to release resources for other interfaces, if necessary.

See the Taking Interfaces out of Service, on page 47.

Step 2 Configure the traffic speed to use (1 Gbps, 2 Gbps, 4 Gbps, 8 Gbps, or autosensing with a maximum of 2 Gbps or 4 Gbps).

See the Dynamic Bandwidth Management, on page 12.

Step 3 Configure the rate mode (dedicated or shared).

See the Configuring FEC, on page 34.

Step 4 Configure the port mode.

See the Configuring an Interface Mode.

Note ISL ports cannot operate in shared rate mode.

Step 5 Configure the BB_credits and extended BB_credits, as necessary.

See the Configuring Buffer-to-Buffer Credits and Extended Buffer-to-Buffer Credits .

Task Flow for Migrating Interfaces from Dedicated Mode to Shared Mode

To configure the Fibre Channel switching modules migrating from dedicated rate mode to shared rate mode, perform these steps:

Step 1   Take unused interfaces out of service to release resources for other interfaces, if necessary.

See the Taking Interfaces out of Service, on page 47.

Step 2   Configure the BB_credits and extended BB_credits, as necessary.

See the Configuring Buffer-to-Buffer Credits and Extended Buffer-to-Buffer Credits

Step 3   Configure the port mode.

See the Configuring an Interface Mode.

Note   ISL ports cannot operate in shared rate mode.

Step 4   Configure the rate mode (dedicated or shared) to use.

See the Configuring FEC, on page 34.

Step 5   Configure the traffic speed (1 Gbps, 2 Gbps, 4 Gbps, or autosensing with a maximum of 2 Gbps or 4 Gbps) to use.

See the Dynamic Bandwidth Management, on page 12.

Task Flow for Configuring 4-Port 10-Gbps Module Interfaces

The 4-port 10-Gbps switching modules support the following features:

- Only 10-Gbps speed traffic

- Only dedicated rate mode

- ISL (E or TE) and F port modes

- Extended BB_credits

- Performance buffers

To configure 4-port 10-Gbps switching modules when starting with the default configuration, perform these steps:

Step 1   Configure the port mode.

See the Configuring an Interface Mode.

Step 2   Configure the BB_credits, performance buffers, and extended BB_credits, as necessary.

Configuring Port Speed

| Note | Changing port speed and rate mode disrupts traffic on the port. Traffic on other ports in the port group is not affected. |

To configure the port speed on an interface, perform these steps:

Step 1   switch# **configure terminal**

Enters configuration mode.

Step 2   switch(config)# **interface fc 1/1**

Selects the interface and enters interface configuration submode.

Step 3   switch(config-if)# **switchport speed** {**1000** | **2000** | **4000** | **8000** | **10000** | **16000** | **32000**}

Configures the port speed in megabits per second. The auto parameter enables autosensing on the interface.

Step 4   switch(config-if)# **switchport speed auto**

Configures autosensing for an interface.

| Note | The auto speed configurations are available only for the specific modules. |

Step 5   switch(config-if)# **no switchport speed**

Reverts to the default speed for the interface (auto).

| Note | The default speed on 48-port and 24-port 4-Gbps modules is 4000. The default speed on 48-port and 24-port 8-Gbps modules is 8000. The default speed on the 4/44-port 8-Gbps module is auto max 4000. |

Use the **show interface** command to verify the port speed configuration for an interface.

```
switch# show interface fc 9/1
fc9/1 is up
    Hardware is Fibre Channel, SFP is short wave laser w/o OFC (SN)
    Port WWN is 22:01:00:05:30:01:9f:02
    Admin port mode is F
    snmp traps are enabled
    Port mode is F, FCID is 0xeb0002
    Port vsan is 1
    Speed is 2 Gbps
    Rate mode is shared
    Transmit B2B Credit is 64
    Receive B2B Credit is 16
    Receive data field Size is 2112
    Beacon is turned off
    5 minutes input rate 0 bits/sec, 0 bytes/sec, 0 frames/sec
    5 minutes output rate 0 bits/sec, 0 bytes/sec, 0 frames/sec
      226 frames input, 18276 bytes
```

```
   0 discards, 0 errors
   0 CRC, 0 unknown class
   0 too long, 0 too short
 326 frames output, 21364 bytes
   0 discards, 0 errors
 0 input OLS, 0 LRR, 1 NOS, 0 loop inits
 3 output OLS, 2 LRR, 0 NOS, 0 loop inits
 16 receive B2B credit remaining
 64 transmit B2B credit remaining
```

Configuring FEC

FEC has the following restrictions:

- In Cisco NX-OS 6.2(7), Release 7.3(0)D1(1), and later releases, FEC is supported on the DS-X9334-K9, DS-X9648-1536K9, and DS-X9448-768K9 modules in the Cisco MDS 9700 Series switch. From Cisco MDS NX-OS Release 6.2(13), FEC is also supported on the Cisco MDS 9396S Multilayer Fabric Switch. FEC is not supported on the MDS 9500 series, MDS 9148, MDS 9148S, and MDS 9200 series switches.

- Modifying FEC configuration briefly disrupts traffic on the port.

- FEC can be configured only on fixed speed 16-Gbps Fibre Channel ports. FEC is not supported for ports configured with 2000/4000/8000/auto/auto-max maximum speed.

- 32-Gbps Fibre Channel ports come up automatically in FEC. You do not have to configure the ports using the **switchport fec** and **switchport fec tts** commands, as they are meant only for 16-Gbps Fibre Channel ports and have no effect on 32-Gbps Fibre Channel ports.

- From Cisco MDS NX-OS Release 6.2(11c), FEC with Transmitter Training Signal (TTS) is supported on the Cisco MDS 9396S 16-Gbps Multilayer Fabric Switch and Cisco MDS 9700 48-Port 16-Gbps Fibre Channel Switching Module (DS-X9448-768K9), except in Cisco MDS NX-OS Release 6.2(13).

- From Cisco MDS NX-OS Release 8.2(1), FEC with TTS feature is supported in Simple Network Management Protocol (SNMP) and Device Manager (DM). This feature is not supported in Cisco MDS NX-OS Release 8.1(1) or earlier.

  Note FEC is supported in DM.

- DM uses SNMP to get switch updates.

To configure FEC on an interface on the 48-port 16-Gbps Fibre Channel switching module, perform these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **interface fc 1/1**

Selects the interface and enters interface configuration submode.

Step 3   switch(config-if)# **switchport speed 16000**

Sets the port speed to 16 Gbps.

Step 4   switch(config-if)# **switchport fec**

Note   The **switchport fec** command works only in fixed 16-Gbps speed and a message stating the same appears when you execute this command.

Enables FEC for the 16-Gbps interface.

- FEC is active if it is configured on both local and peer switches.

- FEC is not active if it is configured only on the local switch, but not on the peer switch.

Step 5   switch(config-if)# **switchport fec tts**

(Optional) Enables TTS, that allows negotiation of FEC. This command is only accepted on ports with fixed 16-Gbps speed and FEC enabled.

Note   The **switchport fec tts** command can be used only after configuring FEC using the **switchport fec** command.

Use the **show interface** command to verify the port speed configuration for an interface on the 48-port, 16-Gbps Fibre Channel switching module.

```
switch# show interface fc3/15
fc3/15 is up
    Hardware is Fibre Channel, SFP is short wave laser w/o OFC (SN)
    Port WWN is 20:8f:54:7f:ee:ea:3a:00
    Admin port mode is auto, trunk mode is off
    snmp link state traps are enabled
    Port mode is F, FCID is 0xdf0000
    Port vsan is 100
    Speed is 2 Gbps
    Rate mode is dedicated
    Transmit B2B Credit is 128
    Receive B2B Credit is 32
    Receive data field Size is 2112
    Beacon is turned off
    admin fec state is down
    oper fec state is down
    5 minutes input rate 0 bits/sec,0 bytes/sec, 0 frames/sec
    5 minutes output rate 0 bits/sec,0 bytes/sec, 0 frames/sec
      16072969258 frames input,34396153854332 bytes
        23 discards,45 errors
        22 invalid CRC/FCS,0 unknown class
        0 too long,0 too short
      8040504998 frames output,17206679580576 bytes
        1344 discards,0 errors
      0 input OLS,0  LRR,0 NOS,0 loop inits
      306 output OLS,304 LRR, 1 NOS, 4 loop inits
      32 receive B2B credit remaining
      128 transmit B2B credit remaining
      128 low priority transmit B2B credit remaining
    Interface last changed at Wed Mar 12 21:23:36 2014
    Last clearing of "show interface" counters  :never
```

Configuring Rate Mode

Note Changing port speed and rate mode disrupts traffic on the port.

To configure the rate mode (dedicated or shared) on an interface on a Fibre Channel switching module, perform these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **interface fc 1/1**

Selects the interface and enters interface configuration submode.

Step 3 switch(config-if)# **switchport rate-mode dedicated**

Reserves dedicated bandwidth for the interface.

Note If you cannot reserve dedicated bandwidth on an interface, you might have exceeded the port group maximum bandwidth. Use the **show port-resources** command to determine what resources are already allocated.

Step 4 switch(config-if)# **switchport rate-mode shared**

Reserves shared (default) bandwidth for the interface.

Step 5 switch(config-if)# **no switchport rate-mode**

Reverts to the default state (shared).

Displaying the Rate Mode Configuration for Interfaces

Use **show port-resources module** command to verify the rate mode configuration for interfaces on a Fibre Channel switching module.

This example shows the port rate mode configuration for interfaces on a 4-Gbps module:

```
switch# show port-resources module 9
Module 9
Available dedicated buffers are 5400
 Port-Group 1
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 12.8 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  ----------------------------------------------------------------
  Interfaces in the Port-Group        B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  ----------------------------------------------------------------
  fc9/1                                       16       4.0   shared
  fc9/2                                       16       4.0   shared
  fc9/3                                       16       4.0   shared
  fc9/4                                       16       4.0   shared
```

```
 fc9/5                                      16      4.0  shared
 fc9/6                                      16      4.0  shared
Port-Group 2
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 ----------------------------------------------------------------------
 Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                      Buffers    (Gbps)
 ----------------------------------------------------------------------
 fc9/7                                      16      4.0  shared
 fc9/8                                      16      4.0  shared
 fc9/9                                      16      4.0  shared
 fc9/10                                     16      4.0  shared
 fc9/11                                     16      4.0  shared
 fc9/12                                     16      4.0  shared
Port-Group 3
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 ----------------------------------------------------------------------
 Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                      Buffers    (Gbps)
 ----------------------------------------------------------------------
 fc9/13                                     16      4.0  shared
 fc9/14                                     16      4.0  shared
 fc9/15                                     16      4.0  shared
 fc9/16                                     16      4.0  shared
 fc9/17                                     16      4.0  shared
 fc9/18                                     16      4.0  shared
Port-Group 4
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 ----------------------------------------------------------------------
 Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                      Buffers    (Gbps)
 ----------------------------------------------------------------------
 fc9/19                                     16      4.0  shared
 fc9/20                                     16      4.0  shared
 fc9/21                                     16      4.0  shared
 fc9/22                                     16      4.0  shared
 fc9/23                                     16      4.0  shared
 fc9/24                                     16      4.0  shared
```

This example shows the port rate mode configuration for interfaces on a 48-port 8-Gbps module:

```
switch# show port-resource module 4
Module 4
  Available dedicated buffers for global buffer #0 [port-groups 1-4] are 5016
  Available dedicated buffers for global buffer #1 [port-groups 5-8] are 5016
 Port-Group 1
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 12.8 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  ----------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                       Buffers    (Gbps)
  ----------------------------------------------------------------------
  fc4/1                                      32      8.0  shared
  fc4/2                                      32      8.0  shared
  fc4/3                                      32      8.0  shared
  fc4/4                                      32      8.0  shared
```

```
fc4/5                                    32      8.0  shared
fc4/6                                    32      8.0  shared
Port-Group 2
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 -----------------------------------------------------------------------
 Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                     Buffers     (Gbps)
 -----------------------------------------------------------------------
 fc4/7                                    32      8.0  shared
 fc4/8                                    32      8.0  shared
 fc4/9                                    32      8.0  shared
 fc4/10                                   32      8.0  shared
 fc4/11                                   32      8.0  shared
 fc4/12                                   32      8.0  shared
Port-Group 3
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 -----------------------------------------------------------------------
 Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                     Buffers     (Gbps)
 -----------------------------------------------------------------------
 fc4/13                                   32      8.0  shared
 fc4/14                                   32      8.0  shared
 fc4/15                                   32      8.0  shared
 fc4/16                                   32      8.0  shared
 fc4/17                                   32      8.0  shared
 fc4/18                                   32      8.0  shared
Port-Group 4
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 -----------------------------------------------------------------------
 Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                     Buffers     (Gbps)
 -----------------------------------------------------------------------
 fc4/19                                   32      8.0  shared
 fc4/20                                   32      8.0  shared
 fc4/21                                   32      8.0  shared
 fc4/22                                   32      8.0  shared
 fc4/23                                   32      8.0  shared
 fc4/24                                   32      8.0  shared
Port-Group 5
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 -----------------------------------------------------------------------
 Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                     Buffers     (Gbps)
 -----------------------------------------------------------------------
 fc4/25                                   32      8.0  shared
 fc4/26                                   32      8.0  shared
 fc4/27                                   32      8.0  shared
 fc4/28                                   32      8.0  shared
 fc4/29                                   32      8.0  shared
 fc4/30                                   32      8.0  shared
Port-Group 6
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 -----------------------------------------------------------------------
 Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
```

```
                                           Buffers     (Gbps)
        ----------------------------------------------------------------------
        fc4/31                                32        8.0   shared
        fc4/32                                32        8.0   shared
        fc4/33                                32        8.0   shared
        fc4/34                                32        8.0   shared
        fc4/35                                32        8.0   shared
        fc4/36                                32        8.0   shared
       Port-Group 7
        Total bandwidth is 12.8 Gbps
        Total shared bandwidth is 12.8 Gbps
        Allocated dedicated bandwidth is 0.0 Gbps
        ----------------------------------------------------------------------
        Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                           Buffers     (Gbps)
        ----------------------------------------------------------------------
        fc4/37                                32        8.0   shared
        fc4/38                                32        8.0   shared
        fc4/39                                32        8.0   shared
        fc4/40                                32        8.0   shared
        fc4/41                                32        8.0   shared
        fc4/42                                32        8.0   shared
       Port-Group 8
        Total bandwidth is 12.8 Gbps
        Total shared bandwidth is 12.8 Gbps
        Allocated dedicated bandwidth is 0.0 Gbps
        ----------------------------------------------------------------------
        Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                           Buffers     (Gbps)
        ----------------------------------------------------------------------
        fc4/43                                32        8.0   shared
        fc4/44                                32        8.0   shared
        fc4/45                                32        8.0   shared
        fc4/46                                32        8.0   shared
        fc4/47                                32        8.0   shared
        fc4/48                                32        8.0   shared
```

This example shows the port rate mode configuration for interfaces on a 4/44-port 8-Gbps module:

```
switch# show port-resources module 7
Module 7
  Available dedicated buffers are 3888
 Port-Group 1
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 12.8 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  ----------------------------------------------------------------------
  Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                     Buffers     (Gbps)
  ----------------------------------------------------------------------
  fc7/1                                 32        4.0   shared
  fc7/2                                 32        4.0   shared
  fc7/3                                 32        4.0   shared
  fc7/4                                 32        4.0   shared
  fc7/5                                 32        4.0   shared
  fc7/6                                 32        4.0   shared
  fc7/7                                 32        4.0   shared
  fc7/8                                 32        4.0   shared
  fc7/9                                 32        4.0   shared
  fc7/10                                32        4.0   shared
  fc7/11                                32        4.0   shared
  fc7/12                                32        4.0   shared
 Port-Group 2
```

```
Total bandwidth is 12.8 Gbps
Total shared bandwidth is 12.8 Gbps
Allocated dedicated bandwidth is 0.0 Gbps
-----------------------------------------------------------------------
Interfaces in the Port-Group         B2B Credit  Bandwidth  Rate Mode
                                       Buffers     (Gbps)
-----------------------------------------------------------------------
fc7/13                                     32         4.0    shared
fc7/14                                     32         4.0    shared
fc7/15                                     32         4.0    shared
fc7/16                                     32         4.0    shared
fc7/17                                     32         4.0    shared
fc7/18                                     32         4.0    shared
fc7/19                                     32         4.0    shared
fc7/20                                     32         4.0    shared
fc7/21                                     32         4.0    shared
fc7/22                                     32         4.0    shared
fc7/23                                     32         4.0    shared
fc7/24                                     32         4.0    shared
Port-Group 3
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
-----------------------------------------------------------------------
Interfaces in the Port-Group         B2B Credit  Bandwidth  Rate Mode
                                       Buffers     (Gbps)
-----------------------------------------------------------------------
fc7/25                                     32         4.0    shared
fc7/26                                     32         4.0    shared
fc7/27                                     32         4.0    shared
fc7/28                                     32         4.0    shared
fc7/29                                     32         4.0    shared
fc7/30                                     32         4.0    shared
fc7/31                                     32         4.0    shared
fc7/32                                     32         4.0    shared
fc7/33                                     32         4.0    shared
fc7/34                                     32         4.0    shared
fc7/35                                     32         4.0    shared
fc7/36                                     32         4.0    shared
Port-Group 4
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
-----------------------------------------------------------------------
Interfaces in the Port-Group         B2B Credit  Bandwidth  Rate Mode
                                       Buffers     (Gbps)
-----------------------------------------------------------------------
fc7/37                                     32         4.0    shared
fc7/38                                     32         4.0    shared
fc7/39                                     32         4.0    shared
fc7/40                                     32         4.0    shared
fc7/41                                     32         4.0    shared
fc7/42                                     32         4.0    shared
fc7/43                                     32         4.0    shared
fc7/44                                     32         4.0    shared
fc7/45                                     32         4.0    shared
fc7/46                                     32         4.0    shared
fc7/47                                     32         4.0    shared
fc7/48                                     32         4.0    shared
```

Configuring Local Switching

Note   We recommend that you shut down all of the ports on the module before you execute the local switching command. If local switching is enabled, then ports cannot be configured in dedicated mode. If there are dedicated ports and you enter the local switching command, a warning is displayed and the operation is prevented.

To enable or disable local switching module, perform these steps:

Step 1   switch# **configure terminal**

Enters configuration mode.

Step 2   switch(config)# **local-switching module 5**

Enables local switching for a module.

If you want to proceed with enabling local switching, when prompted press **Y** to continue or **N** to exit.

Step 3   switch(config)# **no local-switching module 5**

Disables local switching for a module.

If you want to proceed with disabling local switching, when prompted press **Y** to continue or **N** to exit.

Step 4   switch(config)# **exit**

Exits configuration mode.

Use the **show system internal xbar local-switching** command to verify the local switching configuration status on a module.

```
switch# show system internal xbar local-switching
------------------------------------
| Slot | Local-switching enabled       |
------------------------------------
|  1  |          no                   |
|  2  |          no                   |
|  3  |          no                   |
|  4  |          no                   |
|  5  |          yes          |
|  6  |          no                   |
|  9  |          no                   |
| 10  |          no                   |
| 11  |          no                   |
| 12  |          no                   |
| 13  |          no                   |
------------------------------------
```

Disabling Restrictions on Oversubscription Ratios

Note   Before disabling restrictions on oversubscription ratios, ensure that you have explicitly shut down shared ports.

To disable restrictions on oversubscription ratios on a Fibre Channel switching module, perform these steps:

Step 1   switch# **configure terminal**

Enters configuration mode.

Step 2   switch(config)# **no rate-mode oversubscription-limit module 1**

Disables restrictions on oversubscription ratios for a module.

Note   You must enter this command separately for each module for which you want to remove the restrictions.

Step 3   switch(config)# **exit**

Exits configuration mode.

Step 4   switch# **copy running-config startup-config**

Saves the new oversubscription ratio configuration to the startup configuration, and then the new configuration is enforced upon subsequent reboots of the module.

Use the **show running-config** command to view oversubscription ratios for a module. If oversubscription ratios are enabled, then no restriction appears in the output.

```
switch# show running-config
version 3.1(1)
...
no rate-mode oversubscription-limit module 2
interface fc2/1
  switchport speed 2000
interface fc2/1
...
```

Examples

To disable restrictions on oversubscription ratios for ports on a 48-port Generation 2 switch that is configured with both shared and dedicated ports, perform these steps:

Step 1   To disable restrictions on oversubscription ratios, you must shut down any shared ports. Use the show port-resources command to view the configuration on a module and to identify shared ports.

Example:

```
switch# show port-resources module 2
Module 2
Available dedicated buffers are 4656
```

```
Port-Group 1
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 ----------------------------------------------------------------
 Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
 ----------------------------------------------------------------
 fc2/1                                    16        4.0    shared
 fc2/2                                    16        4.0    shared
 fc2/3                                    16        4.0    dedicated
 fc2/4                                    16        4.0    shared
 fc2/5                                    16        4.0    shared
 fc2/6                                    16        4.0    dedicated
 fc2/7                                    16        4.0    dedicated
 fc2/8                                    16        4.0    shared
 fc2/9                                    16        4.0    shared
 fc2/10                                   16        4.0    shared
 fc2/11                                   16        4.0    shared
 fc2/12                                   16        4.0    shared
 ...
 Port-Group 4
 Total bandwidth is 12.8 Gbps
 Total shared bandwidth is 12.8 Gbps
 Allocated dedicated bandwidth is 0.0 Gbps
 ----------------------------------------------------------------
 Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
 ----------------------------------------------------------------
 fc2/37                                   16        4.0    shared
 fc2/38                                   16        4.0    shared
 fc2/39                                   16        4.0    dedicated
 fc2/40                                   16        4.0    dedicated
 fc2/41                                   16        4.0    dedicated
 fc2/42                                   16        4.0    shared
 fc2/43                                   16        4.0    shared
 fc2/44                                   16        4.0    shared
 fc2/45                                   16        4.0    shared
 fc2/46                                   16        4.0    shared
 fc2/47                                   16        4.0    shared
 fc2/48                                   16        4.0    shared
```

Step 2   Shut down all shared ports for which you want to remove restrictions on oversubscription ratios.

Example:

```
switch (config)# interface fc2/1-2, fc2/4-5, fc2/8-38, fc2/43-48
switch (config-if)# shutdown
```

Step 3   Display the interface status to confirm the shutdown of all shared ports.

Example:

```
switch(config-if)# end
switch# show interface brief
--------------------------------------------------------------------------------
Interface  Vsan   Admin  Admin  Status         SFP    Oper  Oper    Port
                  Mode   Trunk                        Mode  Speed   Channel
                         Mode                                (Gbps)
--------------------------------------------------------------------------------
fc2/1      1      FX     --     down           swl    --            --
```

```
fc2/2      1     FX    --     down          swl    --          --
fc2/3      1     T     --     up            swl    --          --
fc2/4      1     FX    --     down          swl    --          --
fc2/5      1     FX    --     down          swl    --          --
fc2/6      1     TE    --     up            swl    --          --
fc2/7      1     TE    --     up            swl    --          --
fc2/8      1     FX    --     down          swl    --          --
...
fc2/48     1     FX    --     down          swl    --          --
```

Step 4 Disable restrictions on oversubscription ratios for the ports.

Example:

```
switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# no rate-mode oversubscription-limit module 2
```

Step 5 Bring up the ports that you shut down in step 2, and display their status to confirm that they are no longer shut down.

Example:

```
switch(config)# interface fc2/1-2, fc2/4-5, fc2/8-38, fc2/43-48
switch(config-if)# no shutdown
switch(config-if)# end
switch# show interface brief
-------------------------------------------------------------------------------
Interface  Vsan  Admin  Admin  Status        SFP    Oper  Oper   Port
                 Mode   Trunk                       Mode  Speed  Channel
                        Mode                              (Gbps)
-------------------------------------------------------------------------------
fc2/1      1     FX    --     up            swl    --          --
fc2/2      1     FX    --     up            swl    --          --
fc2/3      1     T     --     up            swl    --          --
fc2/4      1     FX    --     up            swl    --          --
fc2/5      1     FX    --     up            swl    --          --
fc2/6      1     TE    --     up            swl    --          --
fc2/7      1     TE    --     up            swl    --          --
fc2/8      1     FX    --     up            swl    --          --
...
fc2/48     1     FX    --     up            swl    --          --
```

Step 6 Confirm that the ports are now operating with no restrictions on oversubscription ratios.

Example:

```
switch# show running-config | include oversubscription-limit
no rate-mode oversubscription-limit module 2 <---indicates no restrictions on oversubscription ratios
```

Step 7 Save the new oversubscription ratio configuration to the startup configuration.

Example:

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

Enabling Restrictions on Oversubscription Ratios

Note
- You must enable restrictions on oversubscription ratios before you can downgrade modules to a previous release.
- Before enabling restrictions on oversubscription ratios, ensure that you have explicitly configured shared ports to out-of-service mode.

To enable restrictions on oversubscription ratios on a Fibre Channel switching module, perform these steps:

Step 1   switch# **configure terminal**

Enters configuration mode.

Step 2   switch(config)# **interface fc2/1-2, fc2/4-5, fc2/8-38, fc2/43-48**

Specifies the port interfaces for which you want to enable restrictions on oversubscription ratios.

Step 3   switch(config-if)# **shutdown**

Shuts down shared ports.

Step 4   switch(config-if)# **out-of-service**

Takes shared ports out of service.

Step 5   switch# **rate-mode oversubscription-limit module 1**

Enables restrictions on oversubscription ratios for the module.

Note   You must enter this command separately for each module for which you want to add the restriction.

Step 6   switch# **configure terminal**

Enters configuration mode.

Step 7   switch(config)# **interface fc2/1-2, fc2/4-5, fc2/8-38, fc2/43-48**

Specifies the port interfaces for which you want to enable restrictions on oversubscription ratios.

Step 8   switch(config)# **no out-of-service**

Returns all shared ports to service.

Step 9   switch(config-if)# **no shutdown**

Bring up shared ports.

Step 10   switch(config)# **exit**

Exits configuration mode.

Step 11   switch# **copy running-config startup-config**

Saves the new oversubscription ratio configuration to the startup configuration, and then the new configuration is enforced upon subsequent reboots of the module.

Enabling Bandwidth Fairness

To enable bandwidth fairness on a switching module, perform these steps:

Step 1   switch# **configure terminal**

Enters configuration mode.

Step 2   switch(config)# **rate-mode bandwidth-fairness module 1**

Enables bandwidth fairness for a module.

Note   You must enter this command separately for each module for which you want to enable bandwidth fairness. You must reload the module for the command to take effect.

Step 3   switch(config)# **exit**

Exits configuration mode.

Disabling Bandwidth Fairness

Note   If you disable bandwidth fairness, up to a 20 percent increase in internal bandwidth allocation is possible for each port group; however, bandwidth fairness is not guaranteed when there is a mix of shared and full-rate ports in the same port group.

To disable bandwidth fairness on a switching module, perform these steps:

Step 1   switch# **configure terminal**

Enters configuration mode.

Step 2   switch(config)# **no rate-mode bandwidth-fairness module 1**

Disables bandwidth fairness for a module.

Note   You must enter this command separately for each module for which you want to disable bandwidth fairness. You must reload the module for the command to take effect.

Step 3   switch(config)# **exit**

Exits configuration mode.

Taking Interfaces out of Service

You can take interfaces out of service on Generation 2 and Generation 3 switching modules. When an interface is out of service, all the shared resources for the interface are released as well as the configuration associated with those resources.

Note
- The interface must be disabled using a **shutdown** command before it can be taken out of service.

- The interface cannot be a member of a PortChannel.

- Taking interfaces out of service releases all the shared resources to ensure that they are available to other interfaces. This causes the configuration in the shared resources to revert to default when the interface is brought back into service. Also, an interface cannot come back into service unless the default shared resources for the port are available. The operation to free up shared resources from another port is disruptive.

To take an interface out of service, perform these steps:

Step 1 switch# **configure terminal**

Enters configuration mode.

Step 2 switch(config)# **interface fc 1/1**

Selects the interface and enters interface configuration submode.

Step 3 switch(config-if)# **no channel-group**

Removes the interface from a PortChannel.

Step 4 switch(config-if)# **shutdown**

Disables the interface.

Step 5 switch(config-if)# **out-of-service**

Takes the interface out of service.

Use the **show port-resources module** command to verify the out-of-service configuration for interfaces on a Generation 2 and Generation 3 switching module.

This example shows a 24-port 4-Gbps module:

```
switch# show port-resources module 9
Module 9
Available dedicated buffers are 5429
 Port-Group 1
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 12.8 Gbps
  Allocated dedicated bandwidth is 0.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group      B2B Credit  Bandwidth  Rate Mode
                                      Buffers     (Gbps)
  --------------------------------------------------------------------
  fc9/1                                 16         4.0   shared
```

```
fc9/2 (out-of-service)
fc9/3                                        16      4.0  shared
fc9/4                                        16      4.0  shared
fc9/5                                        16      4.0  shared
fc9/6                                        16      4.0  shared
...
```

Releasing Shared Resources in a Port Group

When you want to reconfigure the interfaces in a port group on a Generation 2 or Generation 3 module, you can return the port group to the default configuration to avoid problems with allocating shared resources.

Note
- The interface cannot be a member of a PortChannel.
- Releasing shared resources disrupts traffic on the port. Traffic on other ports in the port group is not affected.

To release the shared resources for a port group, perform these steps:

Step 1   switch# **configure t**

Enters configuration mode.

Step 2   switch(config)# **interface fc 1/1**

Selects the interface and enters interface configuration submode.

Tip   You can use an interface range to release the resources for all interfaces in a port group.

Step 3   switch(config-if)# **no channel-group**

Removes the interface from a PortChannel.

Step 4   switch(config-if)# **shutdown**

Disables the interface.

Step 5   switch(config-if)# **out-of-service**

Takes the interface out of service.

Step 6   switch(config-if)# **no out-of-service**

Makes the interface available for service. Repeat Step 2 through Step 6 for all the interfaces in the port group.

Disabling ACL Adjacency Sharing for System Image Downgrade

Fibre Channel ACL adjacency sharing is enabled by default on the switches with an active Generation 2 switching module as of Cisco MDS SAN-OS Release 3.0(3), and with an active Generation 3 module as of MDS NX-OS Release 4.1(1). Fibre Channel ACL adjacency sharing improves the performance for zoning and inter-VSAN routing (IVR) network address translation (NAT). To prevent disruptions when downgrading the system image on your switch to a release prior to Cisco SAN-OS Release 3.0(3), enter the following command in EXEC mode:

switch# **system no acl-adjacency-sharing**

To reenable Fibre Channel ACL adjacency sharing on your switch, enter the following command in EXEC mode:

switch# **system acl-adjacency-sharing**

Verifying Fibre Channel Interfaces Configuration

To display Fibre Channel interface configuration information, perform one of the following tasks:

Command	Purpose
show module	Displays the module.
show module *slot* **recovery-steps**	Displays the slot for the module.
show port-resources module *slot*	Displays the port resources for the slot.
show interface fc *slot/port*	Displays the slot or port information. FEC admin and operational states are displayed.
show interface brief	Displays the interface.
show port index-allocation	Displays the port in the index allocation.
show port index-allocation startup	Displays the startup port in the index allocation.
show port-channel compatibility parameters	Displays the PortChannel compatibility parameters.
show module *slot* **bandwidth-fairness**	Displays the module slot bandwidth fairness information.

For detailed information about the fields in the output from these commands, refer to the Cisco MDS 9000 Series Command Reference.

Displaying Interface Capabilities

Before configuring a Generation 2 or Generation 3 interface, you can use the **show interface capabilities** command to display detailed information about the capabilities of the interface.

This example shows the capabilities of a Generation 2 Fibre Channel interface:

```
switch# show interface fc 9/1 capabilities
 Min Speed is 1 Gbps
 Max Speed is 4 Gbps
 FC-PH Version (high, low)                    (0,6)
 Receive data field size (max/min)            (2112/256) bytes
 Transmit data field size (max/min)           (2112/128)  bytes
 Classes of Service supported are             Class 2, Class 3, Class F
 Class 2 sequential delivery                  supported
 Class 3 sequential delivery                  supported
 Hold time (max/min)                          (100/1) micro sec
 BB state change notification                 supported
 Maximum BB state change notifications        14
 Rate Mode change                             supported
 Rate Mode Capabilities                       Shared        Dedicated
  Receive BB Credit modification supported       yes              yes
  FX mode Receive BB Credit (min/max/default)  (1/16/16)     (1/250/16)
  ISL mode Receive BB Credit (min/max/default)    --         (2/250/250)
  Performance buffer modification supported       no               no
 Out of Service capable                       yes
```

```
   Beacon mode configurable                         yes
```

This example shows the capabilities of an interface on the 48-port 8-Gbps Fibre Channel switching module:

```
switch# show interface fc 4/1 capabilities
 Min Speed is 1 Gbps
 Max Speed is 8 Gbps
 FC-PH Version (high, low)                          (0,6)
 Receive data field size (max/min)                  (2112/256) bytes
 Transmit data field size (max/min)                 (2112/128) bytes
 Classes of Service supported are                   Class 2, Class 3, Class F
 Class 2 sequential delivery                        supported
 Class 3 sequential delivery                        supported
 Hold time (max/min)                                (100000/1) micro sec
 BB state change notification                       supported
 Maximum BB state change notifications              14
 Rate Mode change                                   supported
 Rate Mode Capabilities                             Shared        Dedicated
  Receive BB Credit modification supported            yes              yes
  FX mode Receive BB Credit (min/max/default)       (1/32/32)      (1/500/32)
  ISL mode Receive BB Credit (min/max/default)        --           (2/500/250)
  Performance buffer modification supported           no               no
 Out of Service capable                             yes
 Beacon mode configurable                           yes
 Extended B2B credit capable                        yes
```

Displaying SFP Diagnostic Information

You can use the **show interface transceiver** command to display small form-factor pluggable (SFP) diagnostic information.

```
switch# show interface transceiver
...
fc2/9 sfp is present
    Name is CISCO-Switch
    Manufacturer's part number is XXXX-XXXX-XXX
    Revision is V01
    Serial number is XXXXXX
    Cisco part number is XXXXX
    Cisco pid is XXXXXX
    FC Transmitter type is short wave laser w/o OFC (SN)
    FC Transmitter supports short distance link length
    Transmission medium is multimode laser with 50 um aperture (M5)
    Supported speeds are - Min speed: 8000 Mb/s, Max speed: 32000 Mb/s
    Nominal bit rate is 28000 Mb/s
    Link length supported for 50/125um OM3 fiber is 70 m
    Cisco extended id is unknown (0x0)

    No tx fault, rx loss, no sync exists, diagnostic monitoring type is 0x68
    SFP Diagnostics Information:
      Temperature        :  30.61 C
       Voltage           :   3.35 V
       Current           :   4.10 mA
       Optical Tx Power   :  -2.44 dBm
       Optical Rx Power   :  N/A   dBm        --
       Tx Fault count  : 0
    Note: ++  high-alarm; +  high-warning; --  low-alarm; -low-warning
...
```

Configuration Examples for Fibre Channel Interfaces

Configuration Example for FEC Module Interfaces

These steps describe how to configure FEC module interfaces:

Step 1   Select the interfaces fc 4/1 through fc 4/2.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/1 - 2
```

Step 2   Configure the FEC on the interfaces.

Example:

```
switch(config-if)# switchport speed 16000
switch(config-if)# switchport fec
```

Step 3   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Step 4   Select the interfaces fc 4/3 through fc 4/4.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/3 - 4
```

Step 5   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 16000
switch(config-if)# switchport fec
```

Configuration Example for 48-Port 8-Gbps Module Interfaces

These steps describe how to configure the 48-port 8-Gbps module interfaces:

Step 1 Select the interfaces fc 4/1 through fc 4/2.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/1 - 2
```

Step 2 Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 8000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 3 Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Step 4 Select the interfaces fc 4/3 through fc 4/4.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/3 - 4
```

Step 5 Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed auto max 4000
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport mode f
```

Step 6 Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Step 7 Select the interfaces fc 4/5 through fc 4/6.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/5 - 6
```

Step 8   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed auto max 4000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 9   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Configuration Example for 24-Port 8-Gbps Module Interfaces

These steps describe how to configure the 24-port 8-Gbps module interfaces:

Step 1   Select interfaces fc 3/1.

Example:

```
switch# configure terminal
switch(config)# interface fc 3/1
```

Step 2   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 8000
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport mode f
```

Step 3   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Step 4   Select the interfaces fc 3/2 through fc 3/3.

Example:

```
switch# configure terminal
switch(config)# interface fc 3/2 - 3
```

Step 5   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 8000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 6   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Configuration Example for 4/44-Port 8-Gbps Module Interfaces

These steps describe how to configure the 4/44-port 8-Gbps module interfaces:

Step 1   Select interfaces fc 4/11 through fc 4/12.

Example:

```
switch# config terminal
switch(config)# interface fc 4/11 - 12
```

Step 2   Disable the interfaces and take them out of service.

Example:

```
switch(config-if)# shutdown
switch(config-if)# out-of-service
```

Step 3   Return to configuration mode.

Example:

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

Step 4   Select the interfaces fc 4/1.

Example:

```
switch# config t
switch(config)# interface fc 4/1
```

Step 5   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 8000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 6   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Step 7   Select the interfaces fc 4/2 through fc 4/10.

Example:

```
switch# config t
switch(config)# interface fc 4/2 - 10
```

Step 8   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed auto max 4000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 9   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Configuration Example for 48-Port 4-Gbps Module Interfaces

These steps describe how to configure the example shown in :

Step 1   Select interfaces fc 4/11 through fc 4/12.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/11 - 12
```

Step 2   Disable the interfaces and take them out of service.

Example:

```
switch(config-if)# shutdown
switch(config-if)# out-of-service
```

Step 3   Return to configuration mode.

Example:

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

Step 4   Select the interfaces fc 4/1 through fc 4/6.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/1 - 6
```

Step 5   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed auto max 2000
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport mode e
```

Step 6   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
```

Step 7   Select the interfaces fc 4/7 through fc 4/10.

Example:

```
switch# configure terminal
switch(config)# interface fc 4/7 - 10
```

Step 8   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 1000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 9   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
```

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

Configuration Example for 24-Port 4-Gbps Module Interfaces

These steps describe how to configure the example shown in :

Step 1   Select interfaces fc 3/1 through fc 3/3.

Example:

```
switch# config t
switch(config)# interface fc 3/1 - 3
```

Step 2   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 4000
switch(config-if)# switchport rate-mode dedicated
switch(config-if)# switchport mode e
```

Step 3   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
switch#
```

Step 4   Select the interfaces fc 3/4 through fc 3/6.

Example:

```
switch# config terminal
switch(config)# interface fc 3/4 - 6
```

Step 5   Configure the port speed, rate mode, and port mode on the interfaces.

Example:

```
switch(config-if)# switchport speed 1000
switch(config-if)# switchport rate-mode shared
switch(config-if)# switchport mode f
```

Step 6   Enable the interfaces and return to configuration mode.

Example:

```
switch(config-if)# no shutdown
switch(config-if)# exit
switch#
```