Configuring Generation 2 and Generation 3 Switching Modules

Cisco MDS 9000 Family 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.

This chapter describes how to configure these modules and switches, including the following sections:

About Generations of Modules and Switches

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

Generation 3 Fibre Channel modules are supported on the Cisco MDS 9506 and 9509 switches with Supervisor-2 modules, and on the MDS 9513 Director with Fabric 2 modules. The MDS 9222i switch supports the 4/44-port Host-Optimized Fibre Channel Switching module. MDS NX-OS Release 4.1(1) is required to support the Generation 3 modules.

Table 22-1 identifies the modules supported by the Cisco MDS 9500 Series switches and Cisco MDS 9216A and Cisco MDS 9216i switches, as well as the Fabric switches.

Table 22-1   Fibre Channel Modules and Fabric Switches

Part Number	Product Name/Description
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 48-port 8-Gbps Fibre Channel switching module to use the full 96-Gbps backplane bandwidth with any-to-any connectivity without reducing bandwidth utilization when one fabric card goes down on the MDS 9513 Director.
Generation 2 Modules	
DS-X9148	48-port 4-Gbps Fibre Channel switching module
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.
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	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 Family 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.

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Port Groups and Port Rate Modes

This section includes the following topics:

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 12, ports 13 through 24, ports 25 through 36, and ports 37 through 48 are the port groups on the 48-port 4-Gbps Fibre Channel switching modules.

Table 22-2 shows the port groups for the Generation 2 and Generation 3 Fibre Channel modules, and Generation 2 Fabric switches.

Table 22-2   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 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
DS-X9248-48K9	4/44-port 8-Gbps Host-Optimized Fibre Channel switching module	12	12.8	8/4 Gbps[1]
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

Table 22-2   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)
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	6	12.8	4 Gbps

1. A maximum of 4 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.

Port Rate Modes

In Generation 2 and Generation 3 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" section on page 22-6

- 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" section on page 22-7.

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 BladeSystem, and the Cisco Fabric Switch for IBM BladeCenter.

Table 22-3 shows the modules that support dedicated, shared, and the default rate modes.

Table 22-3   Port Rate Mode Support on Generation 2 and Generation 3 Modules and Switches

Part Number	Product Name/ Description	Supports Dedicated Rate Mode	Supports Shared Rate Mode	Default Speed Mode and Rate Mode on All Ports
Generation 3 Modules				
DS-X9248-96K9	48-Port 8-Gbps Fibre Channel switching module	Yes	Yes[1]	Auto, Shared
DS-X9224-96K9	24-Port 8-Gbps Fibre Channel switching module	Yes	Yes**[1]**	Auto, Shared
DS-X9248-48K9	4/44-Port 8-Gbps Host-Optimized Fibre Channel switching module	Yes	Yes[1]	Auto Max 4 Gbps, Shared
Generation 2 Modules				
DS-X9148	48-port 4-Gbps Fibre Channel switching module[2]	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 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

Table 22-3   Port Rate Mode Support on Generation 2 and Generation 3 Modules and Switches

Part Number	Product Name/ Description	Supports Dedicated Rate Mode	Supports Shared Rate Mode	Default Speed Mode and Rate Mode on All Ports
DS-C9124 (Cisco MDS 9124 Fabric switch)	24-port 4-Gbps Fabric switch[3]	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 Family Switching and Services Modules	Yes	Yes	Auto, Shared

1. Shared rate mode is supported on Fx ports only and no ISLs.

2. 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.

3. 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 (see the "Buffer Pools" section on page 22-10).

Table 22-4 shows the bandwidth provided by the various port speed configurations on the 8-Gbps Fibre Channel switching modules.

Table 22-4   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 22-5 show the amount of bandwidth reserved for a configured port speed on 4-Gbps switching modules.

Table 22-5   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 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 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 22-2 shows the maximum possible dedicated rate mode configuration scenarios for the Generation 3 Fibre Channel modules.

Table 22-6   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-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-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	

Table 22-6 *Dedicated Rate Mode Bandwidth Reservation for Generation 3 Fibre Channel Modules (continued)*

Part Number	Product Name/ Description	Dedicated Bandwidth per Port	Maximum Allowed Ports that can come up	Ports in Shared Mode
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	

Reserving Bandwidth Quickly for the 8-Gbps Modules

To quickly reserve bandwidth for all the ports in the port groups on the Generation 3 Fibre Channel modules using the Device Manager, follow these steps:

Step 1   On the Device Manager window, right-click the 8-Gbps Fibre Channel module.

Figure 22-1 *Device Manager - 8 Gbps Module - Pop-Up Menu*
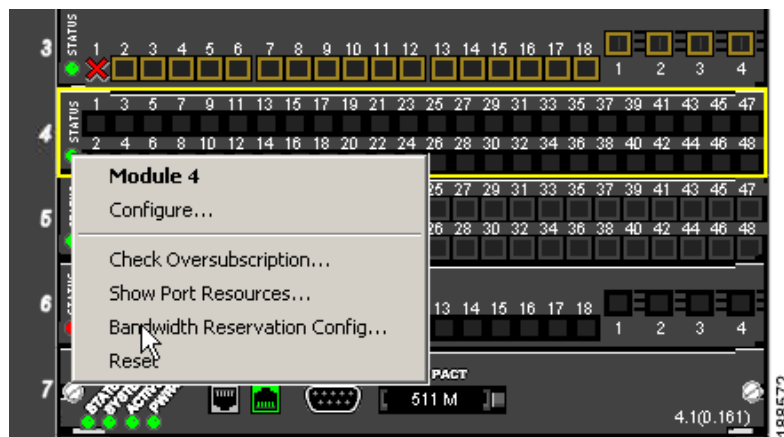
Step 2   From the pop up menu, select **Bandwidth Reservation Config...**

Step 3   In the Bandwidth Reservation Configuration dialog box that is displayed, choose a bandwidth reservation scheme. (Figure 22-2).

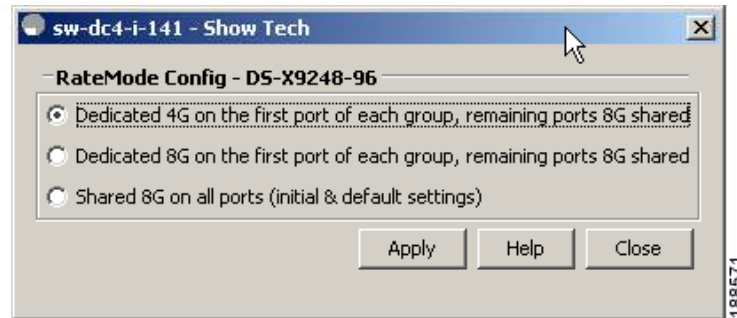*Figure 22-2   RateMode Configuration Dialog Box*

Table 22-7 describes the default RateMode configuration schemes available in the Bandwidth Reservation Configuration dialog box for the 8-Gbps modules.

Table 22-7   RateMode Configuration Schemes

Module	Available RateMode Config Macros
DS-X9248-96K9 48-Port 8-Gbps Fibre Channel module	• Dedicated 4 Gbps on the first port of each group and the remaining ports 8 Gbps shared • Dedicated 8 Gbps on the first port of each group and the remaining ports 8 Gbps shared • Shared 8 Gbps on all ports (initial & default settings)
DS-X9224-96K9 24-Port 8-Gbps Fibre Channel module	• Dedicated 8 Gbps on the first port of each group and the remaining ports 8G shared • Shared Auto[1] on all ports (initial & default settings)
DS-X9248-48K9 4/44-Port 8-Gbps Host-Optimized Fibre Channel module	• Dedicated 2 Gbps on the first port of each group and the remaining ports 4 Gbps shared • Dedicated 8 Gbps on the first port of each group and the remaining ports 4 Gbps shared • Shared Auto with Maximumu of 4 Gbps on all ports (initial & default settings)

1. Auto is 8 Gbps.

Step 4   Click **Apply**.

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.

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, 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.

Buffer Credit Allocation

This section describes how buffer credits are allocated to switches and modules, and includes the following topics:

- Buffer Pools, page 22-10
- BB_Credit Buffers for Switching Modules, page 22-13
- BB_Credit Buffers for Fabric Switches, page 22-22
- Extended BB_Credits, page 22-23

Buffer Pools

In the architecture of Generation 2 and Generation 3 modules, receive buffers shared by a set of ports are called *buffer groups*. The receive buffer groups are organized into *global* and *local* buffer pools.

The receive buffers allocated from the global buffer pool to be shared by a port group are called a *global recieve buffer pool*. Global receive buffer pools include the following buffer groups:

- Reserved internal buffers
- Allocated BB_credit buffers for each Fibre Channel interface (user configured or assigned by default)
- Common unallocated buffer pool for BB_credits, if any, to be used for additional BB_credits as needed
- Performance buffers (only used on 12-port 4-Gbps and 4-port 10-Gbps switching modules)

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> **Note** The 48-Port and 24-Port 8-Gbps modules have *dual global buffer pools*. Each buffer pool in the 48-port modules support 24 ports and in the 24-port modules each buffer pool supports 12 ports.

Figure 22-3 shows the allocation of BB_credit buffers on linecards (24-port and 48-port 4-Gbps line cards).

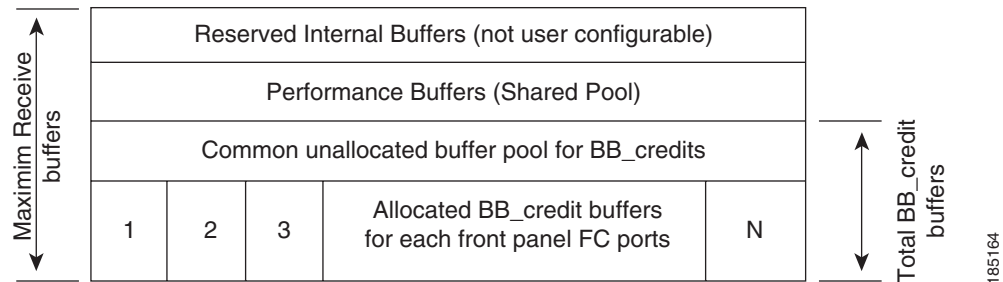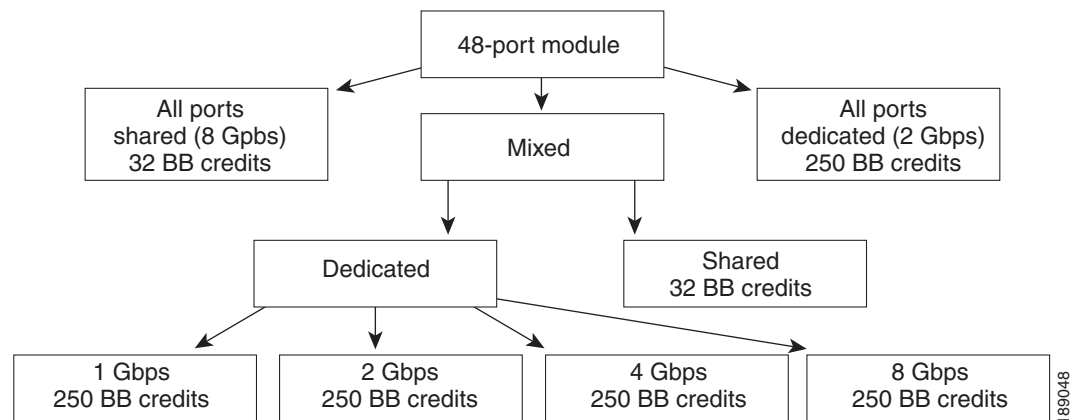**Figure 22-3   Receive Buffers for Fibre Channel Ports in a Global Buffer Pool**

Figure 22-4 shows the default BB_credit buffer allocation model for 48-port 8-Gbps switching modules. The minimum BB_credits required to bring up a port is two buffers.

Figure 22-4   BB_Credit Buffer Allocation in 48-port 8-Gbps Switching Modules

Figure 22-5 shows the default BB_credit buffer allocation model for 24-port 8-Gbps switching modules. The minimum BB_credits required to bring up a port is two buffers.

Figure 22-5   BB_Credit Buffer Allocation in 24-port 8-Gbps Switching Modules
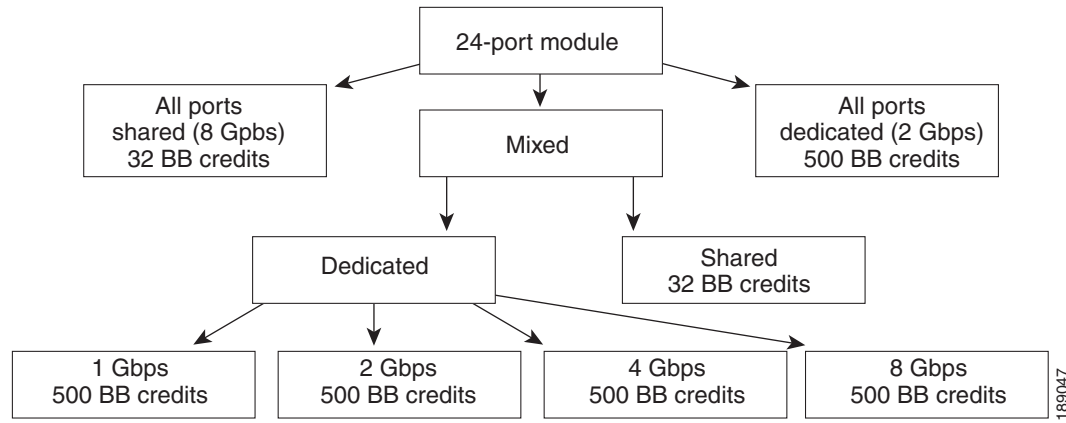
Figure 22-6 shows the default BB_credit buffer allocation model for 4/44-port 8-Gbps Host-Optimized switching modules. The minimum BB_credits required to bring up a port is two buffers.

Figure 22-6   BB_Credit Buffer Allocation in 4/44-port 8-Gbps Switching Modules
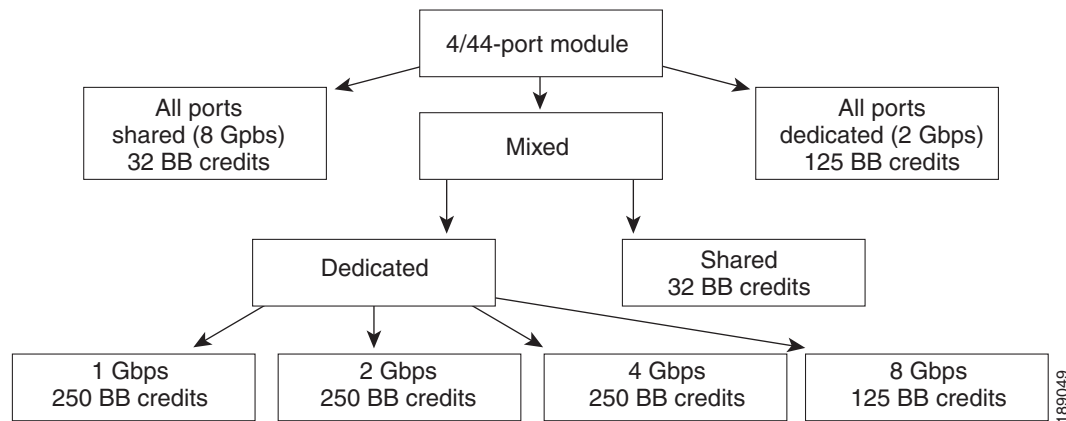
Figure 22-7 shows the default BB_credit buffer allocation model for 24-port 4-Gbps switching modules. The minimum BB_credits required to bring up a port is two buffers.

Figure 22-7   BB_Credit Buffer Allocation in 24-port 4-Gbps Switching Modules
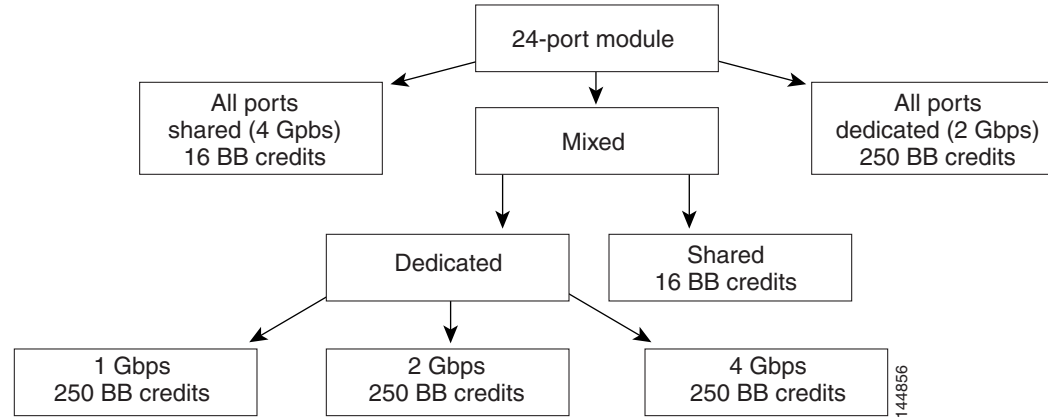
Note   The default BB_credit buffer allocation is the same for all port speeds.

BB_Credit Buffers for Switching Modules

This section describes how buffer credits are allocated to Cisco MDS 9000 switching modules, and includes the following topics:

48-Port 8-Gbps Fibre Channel Module BB_Credit Buffers

Table 22-8 lists the BB_credit buffer allocation for the 48-port 8-Gbps Fibre Channel switching module.

Table 22-8   48-Port 8-Gbps Switching Module BB_Credit Buffer Allocation

	BB_Credit Buffers Per Port		
	Dedicated Rate Mode 8-Gbps Speed		Shared Rate Mode 8-Gbps Speed
BB_Credit Buffer Allocation	ISL	Fx Port	Fx Port
Default BB_credit buffers	250	32	32
Maximum BB_credit buffers	500	500	32
Total Number of BB_Credit Buffers per Module			
Ports 1 through 24	6000		
Ports 25 through 48	6000		

The following guidelines apply to BB_credit buffers on 48-port 8-Gbps Fibre Channel switching modules:

- BB_credit buffers allocated for ports 1 through 24 and 25 through 48 can be a maximum of 6000 each so that the load is distributed.

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 500 buffers for dedicated rate mode.

- BB_credit buffers for Fx port mode connections can be configured. The minimum is 2 buffers and the maximum of 500 buffers for dedicated rate mode or 32 buffers for shared rate mode.

- Performance buffers are not supported on this module.

Each port group on the 48-port 8-Gbps Fibre Channel switching module consists of six ports. The ports in shared rate mode in a port group can have a maximum bandwidth oversubscription of 10:1 considering that each port group has 12.8-Gbps bandwidth.

The following example configurations are supported by the 48-port 8-Gbps Fibre Channel switching modules:

- Six ports with shared rate mode and 8-Gbps speed (4:1 oversubscription) (default)

- One port with dedicated rate mode and 8-Gbps speed plus
  five ports with shared rate mode and 8-Gbps speed (10:1 oversubscription)

- Two ports with dedicated rate mode and 4-Gbps speed plus
  four ports with shared rate mode and 4-Gbps speed (4:1 oversubscription)

- One port with dedicated rate mode and 4-Gbps speed plus
  three ports with dedicated rate mode and 2-Gbps speed plus
  two ports with shared rate mode and 4-Gbps speed (4:1 oversubscription)

- Six ports with dedicated rate mode and 2-Gbps speed

24-Port 8-Gbps Fibre Channel Module BB_Credit Buffers

Table 22-9 lists the BB_credit buffer allocation for the 24-port 8-Gbps Fibre Channel switching module.

Table 22-9   24-Port 8-Gbps Switching Module BB_Credit Buffer Allocation

BB_Credit Buffer Allocation	BB_Credit Buffers Per Port		
	Dedicated Rate Mode 8-Gbps Speed		Shared Rate Mode 8-Gbps Speed
	ISL	Fx Port	Fx Port
Default BB_credit buffers	500	32	32
Maximum BB_credit buffers	500[1]	500[1]	32
Total Number of BB_Credit Buffers per Module			
Ports 1 through 12	6000		
Ports 13 through 24	6000		

1. When connected to Generation 1 modules, reduce the maximum BB_credit allocation to 250.

The following guidelines apply to BB_credit buffers on 24-port 8-Gbps Fibre Channel switching modules:

- BB_credit buffers allocated for ports 1 through 12 and 13 through 24 can be a maximum of 6000 each so that the load is distributed.
- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 500 buffers for dedicated rate mode.
- BB_credit buffers for Fx port mode connections can be configured. The minimum is 2 buffers and the maximum of 500 buffers for dedicated rate mode or 32 buffers for shared rate mode.
- Performance buffers are not supported on this module.

Each port group on the 24-port 8-Gbps Fibre Channel switching module consists of three ports. The ports in shared rate mode in a port group can have a maximum bandwidth oversubscription of 10:1 considering that each port group has 12.8-Gbps bandwidth.

The following example configurations are supported by the 24-port 8-Gbps Fibre Channel switching modules:

- Three ports with shared rate mode and 8-Gbps speed (2:1 oversubscription) (default)
- One port with dedicated rate mode and 8-Gbps speed plus
  two ports with shared rate mode and 8-Gbps speed (4:1 oversubscription)
- One port with dedicated rate mode and 8-Gbps speed plus
  one port with dedicated rate mode and 4-Gbps speed plus
  one port with shared rate mode and 8-Gbps speed (10:1 oversubscription)
- Two ports with dedicated rate mode and 4-Gbps speed plus
  one port with shared rate mode and 8-Gbps speed (2:1 oversubscription)
- Three ports with dedicated rate mode and 4-Gbps speed

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4/44-Port 8-Gbps Host-Optimized Fibre Channel Module BB_Credit Buffers

Table 22-10 lists the BB_credit buffer allocation for the 4/44-port 8-Gbps Fibre Channel switching module.

Table 22-10   4/44-Port 8-Gbps Switching Module BB_Credit Buffer Allocation

BB_Credit Buffer Allocation	BB_Credit Buffers Per Port		
	Dedicated Rate Mode 8-Gbps Speed		Shared Rate Mode 8-Gbps Speed
	ISL	Fx Port	Fx Port
Default BB_credit buffers	125	32	32
Maximum BB_credit buffers	250	250	32
Total number of BB_credit buffers per module	6000		

The following guidelines apply to BB_credit buffers on 4/44-port 8-Gbps Fibre Channel switching modules:

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 500 buffers for dedicated rate mode.
- BB_credit buffers for Fx port mode connections can be configured. The minimum is 2 buffers and the maximum of 250 buffers for dedicated rate mode or 32 buffers for shared rate mode.
- Performance buffers are not supported on this module.

Each port group on the 24-port 8-Gbps Fibre Channel switching module consists of 12 ports. The ports in shared rate mode in a port group can have a maximum bandwidth oversubscription of 10:1 considering that each port group has 12.8-Gbps bandwidth.

The following example configurations are supported by the 4/44-port 8-Gbps Fibre Channel switching modules:

- Twelve ports with shared rate mode and 4-Gbps speed (5:1 oversubscription) (default)
- One port with dedicated rate mode and 8-Gbps speed plus
  eleven ports with shared rate mode and 4-Gbps speed (10:1 oversubscription)
- One port with dedicated rate mode and 4-Gbps speed plus
  three ports with dedicated rate mode and 3-Gbps speed plus
  eight ports with shared rate mode and 4-Gbps speed (2:1 oversubscription)
- Twelve ports with dedicated rate mode and 1-Gbps speed

48-Port 4-Gbps Fibre Channel Module BB_Credit Buffers

Table 22-11 lists the BB_credit buffer allocation for 48-port 4-Gbps Fibre Channel switching modules.

Table 22-11   48-Port 4-Gbps Switching Module BB_Credit Buffer Allocation

| | BB_Credit Buffers Per Port | | |
| | Dedicated Rate Mode 4-Gbps Speed | | Shared Rate Mode 4-Gbps Speed |
BB_Credit Buffer Allocation	ISL[1]	Fx Port	Fx Port
Default BB_credit buffers	125	16	16
Maximum BB_credit buffers	250	250	16
Total number of BB_credit buffers per module	6000		

1. ISL = E port or TE port.

The following considerations apply to BB_credit buffers on 48-port 4-Gbps Fibre Channel switching modules:

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 250 buffers for dedicated rate mode or 16 buffers for shared rate mode.

- BB_credit buffers for Fx port mode connections can be configured. The minimum is 2 buffers and the maximum of 250 buffers for dedicated rate mode or 16 buffers for shared rate mode.

- Performance buffers are not supported on this module.

Each port group on the 48-port 4-Gbps Fibre Channel switching module consists of 12 ports. The ports in shared rate mode have bandwidth oversubscription of 2:1 by default. However, some configurations of the shared ports in a port group can have maximum bandwidth oversubscription of 4:1 (considering that each port group has 12.8-Gbps bandwidth).

The following example configurations are supported by the 48-port 4-Gbps Fibre Channel switching modules:

- Twelve ports with shared rate mode and 4-Gbps speed (4:1 oversubscription) (default)

- One port with dedicated rate mode and 4-Gbps speed plus
  11 ports with shared rate mode and 4-Gbps speed (5:1 oversubscription)

- One port with dedicated rate mode and 4-Gbps speed plus
  11 ports with shared rate mode and 2-Gbps speed (2.5:1 oversubscription)

- Two ports with dedicated rate mode and 2-Gbps speed plus
  10 ports with shared rate mode and 4-Gbps speed (5:1 oversubscription)

- Two ports with dedicated rate mode and 2-Gbps speed plus
  10 ports with shared rate mode and 2-Gbps speed (2.5:1 oversubscription)

- Twelve ports with dedicated rate mode and 1-Gbps speed

- Three ports with dedicated rate mode and 4-Gbps speed plus
  four ports with shared rate mode and 1-Gbps speed plus
 five ports put out-of-service (see Figure 22-8)

Figure 22-8   Example Speed and Rate Configuration on a 48-Port 4-Gbps Switching Module
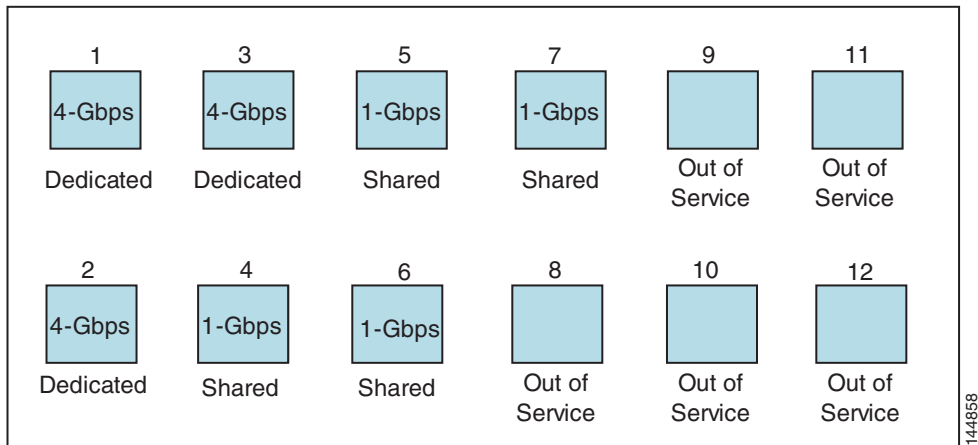
- Six ports with dedicated rate mode and 2-Gbps speed plus
  four ports with shared rate mode and 1-Gbps speed plus
  two ports put out-of-service (see Figure 22-9)

Figure 22-9   Example Speed and Rate Configuration on a 48-Port 4-Gbps Switching Module
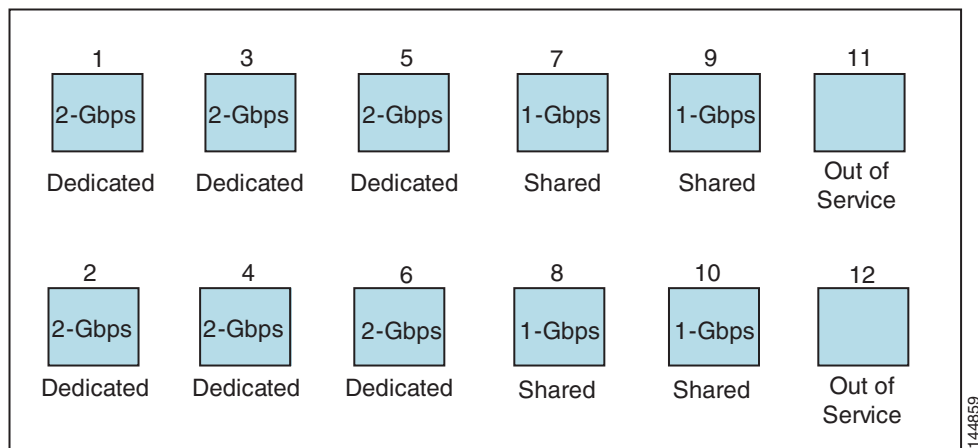
24-Port 4-Gbps Fibre Channel Module BB_Credit Buffers

Table 22-12 lists the BB_credit buffer allocation for 24-port 4-Gbps Fibre Channel switching modules.

Table 22-12   24 Port 4-Gbps Switching Module BB_Credit Buffer Allocation

	BB_Credit Buffers Per Port		
	Dedicated Rate Mode 4-Gbps Speed		Shared Rate Mode 4-Gbps Speed
BB_Credit Buffer Allocation	ISL[1]	Fx Port	Fx Port
Default BB_credit buffers	250	16	16

Table 22-12   24 Port 4-Gbps Switching Module BB_Credit Buffer Allocation

BB_Credit Buffer Allocation	BB_Credit Buffers Per Port		
	Dedicated Rate Mode 4-Gbps Speed		Shared Rate Mode 4-Gbps Speed
	ISL[1]	Fx Port	Fx Port
Maximum BB_credit buffers	250	250	16
Total number of BB_credits buffers per module	6000		

1. ISL = E port or TE port.

The following considerations apply to BB_credit buffers on 24-port 4-Gbps Fibre Channel switching modules:

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 250 buffers for dedicated rate mode or 16 buffers for shared rate mode.

- BB_credit buffers for Fx port mode connections can be configured. The minimum is 2 buffers and the maximum of 250 buffers for dedicated rate mode or 16 buffers for shared rate mode.

- Performance buffers are not supported on this module.

Each port group on the 24-port 4-Gbps Fibre Channel switching module consists of six ports. The ports in shared rate mode have a bandwidth oversubscription of 2:1 by default. However, some configurations of the shared ports in a port group can have a maximum bandwidth oversubscription of 4:1 (considering that each port group has 12.8-Gbps bandwidth).

The following example configurations are supported by the 24-port 4-Gbps Fibre Channel switching modules:

- Six ports with shared rate mode and 4-Gbps speed (2:1 oversubscription) (default)

- Two ports with dedicated rate mode and 4-Gbps speed plus
  four ports with shared rate mode and 4-Gbps speed (with 4:1 oversubscription)

- One port with dedicated rate mode and 4-Gbps speed plus
  three ports with dedicated rate mode and 2-Gbps speed plus
  two ports with shared rate mode and 4-Gbps speed (4:1 oversubscription)

- Six ports with dedicated rate mode and 2-Gbps speed

- Three ports with dedicated rate mode and 4-Gbps speed plus
  three ports with shared rate mode and 1-Gbps speed (see Figure 22-10)

Figure 22-10   Example Speed and Rate Configuration on a 24-Port 4-Gbps Switching Module
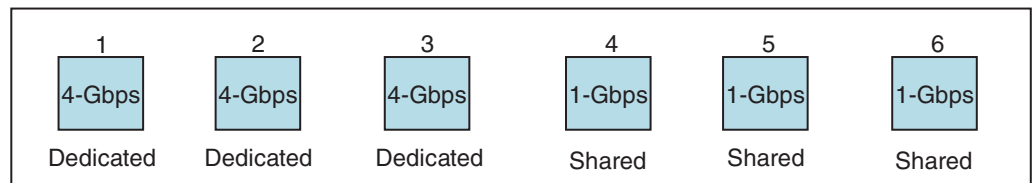
18-Port Fibre Channel/4-Port Gigabit Ethernet Multiservice Module BB_Credit Buffers

Table 22-12 lists the BB_credit buffer allocation for 18-port 4-Gbps multiservice modules.

Table 22-13   18-Port 4-Gbps Multiservice Module BB_Credit Buffer Allocation

| | BB_Credit Buffers Per Port | | | |
| | Dedicated Rate Mode 4-Gbps Speed | | Shared Rate Mode 4-Gbps Speed | |
BB_Credit Buffer Allocation	ISL[1]	Fx Port	ISL[1]	Fx Port
Defualt BB_credit buffers	250	16	16	16
Maximum BB_credit buffers	250	250	16	16
Total number of BB_credit buffers per module	4509			

1. ISL = E port or TE port.

The following considerations apply to BB_credit buffers on18-port 4-Gbps Fibre Channel switching modules:

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 250 buffers for dedicated rate mode or 16 buffers for shared rate mode.

- BB_credit buffers for Fx port mode connections can be configured. The minimum is 2 buffers and the maximum of 250 buffers for dedicated rate mode or 16 buffers for shared rate mode.

- Performance buffers are not supported on this module.

12-Port 4-Gbps Switching Module BB_Credit Buffers

Table 22-14 lists the BB_credit buffer allocation for 12-port 4-Gbps switching modules.

Table 22-14   12-Port 4-Gbps Switching Module BB_Credit Buffer Allocation

| | BB_Credit Buffers Per Port | |
| | Dedicated Rate Mode 4-Gbps Speed | |
BB_Credit Buffer Allocation Type	ISL [1]	Fx Port
Default BB_credit buffers	250	16
Maximum BB_credit buffers	250	16
Default Performance buffers	145	12
Total number of BB_credit buffers per module	5488	
Total number of performance buffers per module	512 (shared)	

1. ISL = E port or TE port.

The following considerations apply to BB_credit buffers on 12-port 4-Gbps switching modules:

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 250 buffers.

- BB_credit buffers for Fx port mode connections can be configured from a minimum of 2 buffers to a maximum of 250 buffers.

- By default, 512 performance buffers are preallocated and are shared by all the ports. These buffers are configurable and the buffers are assigned to the port based on the availability of the buffers in the shared pool.

- There are 2488 extra buffers available as extended BB_credit buffers after allocating all the default BB_credit buffers for all the ports in ISL mode (5488 - (250 * 12)).

> **Note** Extended BB_credits are allocated across all ports on the switch. That is, they are not allocated by port group.

> **Note** By default, the ports in the 12-port 4-Gbps switching modules come up in 4-Gbps dedicated rate mode but can be configured as 1-Gbps and 2-Gbps dedicated rate mode. Shared mode is not supported.

4-Port 10-Gbps Switching Module BB_Credit Buffers

Table 22-15 lists the BB_credit buffer allocation for 4-port 10-Gbps switching modules.

Table 22-15   4-Port 10-Gbps Switching Module BB_Credit Buffer Allocation

BB_Credit Buffer Allocation Type	BB_Credit Buffers Per Port	
	Dedicated Rate Mode 10-Gbps Speed	
	ISL[1]	F port[2]
Default BB_credit buffers	250	16
Maximum BB_credit buffers	750	16
Maximum BB_credit buffers on one of the ports with Enterprise license	4095	
Total number of BB_credit buffers per module	5488	
Default Performance buffers	145	12
Total number of performance buffers per module	512 (shared)	

1. ISL = E port or TE port.

2. Ports on the 4-port 10-Gbps cannot operate in FL port mode.

> **Note** The ports in the 4-port 10-Gbps switching module only support 10-Gbps dedicated rate mode. FL port mode and shared rate mode are not supported.

The following considerations apply to BB_credit buffers on 4-port 10-Gbps switching modules:

- BB_credit buffers for ISL connections can be configured from a minimum of 2 buffers to a maximum of 750 buffers.

- BB_credit buffers for Fx port mode connections can be configured from a minimum of 2 buffers to a maximum of 750 buffers.

- By default, 512 performance buffers are preallocated and are shared by all the ports. These buffers are configurable and the buffers are assigned to the port based on the availability of the buffers in the shared pool.

- There are 2488 extra buffers available as extended BB_credits after allocating all the default BB_credit buffers for all the ports in ISL mode (5488 - (750 * 4)).

Note   Extended BB_credits are allocated across all ports on the switch. That is, they are not allocated by port group.

BB_Credit Buffers for Fabric Switches

This section describes how buffer credits are allocated to Cisco MDS 9000 Fabric switches, and includes the following topics:

- Cisco MDS 9134 Fabric Switch BB_Credit Buffers, page 22-22
- Cisco MDS 9124 Fabric Switch BB_Credit Buffers, page 22-23
- Cisco MDS 9222i Multiservice Modular Switch BB_Credit Buffers, page 22-23

Cisco MDS 9134 Fabric Switch BB_Credit Buffers

Table 22-16 lists the BB_credit buffer allocation for 32-port 4-Gbps Fibre Channel switches.

Table 22-16   32-Port 4-Gbps Switching Module BB_Credit Buffer Allocation Defaults

BB_Credit Buffer Allocation Type	BB_Credit Buffers Per Port Group	BB_Credit Buffers Per Port	
		ISL[1]	Fx Port
User-configurable BB_credit buffers on 4-Gbps mode	64	64	64
Default BB_credit buffers	64	16	16

1. ISL = E port or TE port.

The following considerations apply to BB_credit buffers on 32-port 4-Gbps switches:

- BB_credit buffers can be configured from a minimum of 1 buffer to a maximum of 61 buffers per port when the ports are in F mode and in 4-Gbps speed mode.

- BB_credit buffers can be configured from a minimum of 2 buffers to a maximum of 64 buffers per port when the ports are in auto or E mode and in 4-Gbps speed mode.

- BB_credit buffers can be configured from a minimum of 64 buffers to a maximum of 64 buffers per port when a port is in 10-Gbps speed mode. There can be only one port per port group configured in 10-Gbps mode. The rest of the three ports must be in down state.

- BB_credit buffers for Fx port mode connections can be configured from a minimum of 2 buffers to a maximum of 64 buffers.

Cisco MDS 9124 Fabric Switch BB_Credit Buffers

Table 22-17 lists the BB_credit buffer allocation for 24-port 4-Gbps Fibre Channel switches.

Table 22-17   24-Port 4-Gbps Switching Module BB_Credit Buffer Allocation Defaults

BB_Credit Buffer Allocation Type	BB_Credit Buffers Per Port Group	BB_Credit Buffers Per Port Defaults	
		ISL[1]	Fx Port
User-configurable BB_credit buffers	64	16	16

1. ISL = E port or TE port.

Cisco MDS 9222i Multiservice Modular Switch BB_Credit Buffers

Table 22-18 lists the BB_credit buffer allocation for 18-port 4-Gbps Multiservice Modular switches.

Table 22-18   18-Port 4-Gbps Switching Module BB_Credit Buffer Allocation Defaults

BB_Credit Buffer Allocation Type	BB_Credit Buffers Per Port Group	BB_Credit Buffers Per Port Defaults	
		ISL[1]	Fx Port
User-configurable BB_credit buffers	4509	250	16

1. ISL = E port or TE port.

Extended BB_Credits

Note   Extended BB_credits are not supported on the Cisco MDS 9124 Fabric Switch, Cisco MDS 9134 Fabric Switch, Cisco MDS 9222i Fabric Switch, the Cisco Fabric Switch for HP c-Class BladeSystem, and the Cisco Fabric Switch for IBM BladeCenter.

To facilitate BB_credits for long haul links, the extended BB_credits feature allows the user to configure the receive buffers above the maximum value on all Generation 2 switching modules (see the "Buffer Credit Allocation" section on page 22-10). When necessary, you can reduce the buffers on one port and assign them to another port, exceeding the default maximum. The minimum extended BB_credits per port is 256 and the maximum is 4095.

In general, the user can configure any port in a port group to dedicated rate mode. To do this, you must first release the buffers from the other ports before configuring larger extended BB_credits for a port.

Note   The ENTERPRISE_PKG license is required to use extended BB_credits on Generation 2 switching modules. Also, extended BB_credits are not supported by ports in shared rate mode.

All ports on the Generation 2 switching modules support extended BB_credits. There are no limitations

for how many extended BB_credits you can assign to a port (except for the maximum and minimum limits). If necessary, you can take interfaces out of service to make more extended BB_credits available to other ports.

Combining Generation 1, Generation 2, and Generation 3 Modules

Cisco MDS NX-OS Release 4.1(1) and later supports combining Generation 1, Generation 2, and Generation 3 modules and switches with the following considerations:

- MDS NX-OS Release 4.1(1) and later features are not supported on Generation 1 switches and modules.
- Generation 3 modules do not support the following Generation 1 hardware:
    - 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 swtich
- 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, and the Fabric 2 modules must be configured in active-active mode.
- MDS 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.

Note   When a Cisco or a other vendor switch port is connected to a Generation 1 module port (ISL connection), the receive buffer-to-buffer credits of the port connected to the Generation 1 module port should not exceed 255.

Port Indexes

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, and Generation 3 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, or Generation 3 switching modules, are installed in the chassis.

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

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 22-19 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 22-19   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 see the reason by viewing the module information in the Information pane.

 For information on recovering a module powered-down because port indexes are not available, refer to the *Cisco MDS 9000 Family Troubleshooting Guide, Release 3.x*.

PortChannels

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.

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.

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 22-20 describes the results of adding a member to a PortChannel for various configurations.

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Table 22-20   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	Force	Pass
	Auto	Auto	Generation 1 or Generation 2 or Generation 3	Normal or force	Pass
	Auto	Auto max 2000	Generation 2 or Generation 3	Normal	Fail
				Force	Pass or fail[1]
	Auto	Auto max 4000	Generation 3		
	Auto max 2000	Auto	Generation 2 or Generation 3	Normal	Fail
				Force	Pass
	Auto max 2000	Auto max 4000	Generation 3		
	Auto max 4000	Auto	Generation 2 or Generation 3		
	Auto max 4000	Auto max 2000	Generation 2 or Generation 3		
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[1]
	Auto max 4000	Auto	Generation 1 or Generation 2		
	Auto max 4000	Auto	Generation 3		
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

Table 22-20   PortChannel Configuration and Addition Results (continued)

PortChannel Members	Configured Speed		New Member Type	Addition Type	Result
	PortChannel	New Member			
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

1.   If resources are not available.

Configuring Module Interface Shared Resources

This section describes how to configure Generation 2 and Generation 3 module interface shared resources and contains the following sections:

Configuration Guidelines for 48-Port, 24-Port, and 4/44-Port 8-Gbps Fibre Channel Switching Modules

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

Migrating from Shared Mode to Dedicated Mode

To configure 48-port, 24-port, 4/44-port 8-Gbps Fibre Channel switching modules when starting with the default configuration or when migrating from shared rate mode to dedicated rate mode, follow these guidelines:

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

   See the "Taking Interfaces Out of Service" section on page 22-40.

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 "Configuring Port Speed" section on page 22-32.

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

   See the "Configuring Rate Mode" section on page 22-33.

4. Configure the port mode.

   See the "About Interface Modes" section on page 20-3.

   ✎
   Note   ISL ports cannot operate in shared rate mode.

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

   See the "Extended BB_Credits" section on page 22-23.

Migrating from Dedicated Mode to Shared Mode

To configure 48-port, 24-port, 4/44-port 8-Gbps Fibre Channel switching modules migrating from dedicated rate mode to shared rate mode, follow these guidelines:

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

   See the "Taking Interfaces Out of Service" section on page 22-40.

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

   See the "BB_Credit Buffers for Switching Modules" section on page 22-13, "BB_Credit Buffers for Fabric Switches" section on page 22-22, and the "Extended BB_Credits" section on page 22-23.

3. Configure the port mode.

   See the "About Interface Modes" section on page 20-3.

   ✎
   Note   ISL ports cannot operate in shared rate mode.

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

   See the "Configuring Rate Mode" section on page 22-33.

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

See the "Configuring Port Speed" section on page 22-32.

Configuration Guidelines for 48-Port and 24-Port 4-Gbps Fibre Channel Switching Modules

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

Migrating from Shared Mode to Dedicated Mode

To configure 48-port and 24-port 4-Gbps Fibre Channel switching modules when starting with the default configuration or when migrating from shared rate mode to dedicated rate mode, follow these guidelines:

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

   See the "Taking Interfaces Out of Service" section on page 22-40.

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

   See the "Configuring Port Speed" section on page 22-32.

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

   See the "Configuring Rate Mode" section on page 22-33.

4. Configure the port mode.

   See the "About Interface Modes" section on page 20-3.

   ✎
   Note   ISL ports cannot operate in shared rate mode.

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

   See the "Extended BB_Credits" section on page 22-23.

Migrating from Dedicated Mode to Shared Mode

To configure 48-port and 24-port 4-Gbps Fibre Channel switching modules migrating from dedicated rate mode to shared rate mode, follow these guidelines:

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

   See the "Taking Interfaces Out of Service" section on page 22-40.

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

   See the "BB_Credit Buffers for Switching Modules" section on page 22-13, "BB_Credit Buffers for Fabric Switches" section on page 22-22, and the "Extended BB_Credits" section on page 22-23.

3. Configure the port mode.

See the "About Interface Modes" section on page 20-3.

> **Note**   ISL ports cannot operate in shared rate mode.

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

See the "Configuring Rate Mode" section on page 22-33.

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 "Configuring Port Speed" section on page 22-32.

Configuration Guidelines for 12-Port 4-Gbps Switching Module Interfaces

The 12-port 4-Gbps switching modules support the following features:

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

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

1. 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 "Configuring Port Speed" section on page 22-32.

2. Configure the port mode.

See the "About Interface Modes" section on page 20-3.

3. Configure the BB_credits, performance buffers, and extended BB_credits, as necessary.

See the "BB_Credit Buffers for Switching Modules" section on page 22-13, "BB_Credit Buffers for Fabric Switches" section on page 22-22, and the "Extended BB_Credits" section on page 22-23.

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

Configuration Guidelines for 4-Port 10-Gbps Switching 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

Use the following guidelines to configure 4-port 10-Gbps switching modules when starting with the default configuration:

1. Configure the port mode.

   See the "About Interface Modes" section on page 20-3.

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

   See the "BB_Credit Buffers for Switching Modules" section on page 22-13, "BB_Credit Buffers for Fabric Switches" section on page 22-22, and the "Extended BB_Credits" section on page 22-23.

Configuring 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. Especially in the case of dedicated rate mode, the port group resources are reserved even though the bandwidth is not used. For example, on Generation 2 modules, if an interface is configured for autosensing (auto) and dedicated rate mode, then 4 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 3, 8-Gbps modules, setting the port speed to auto enables autosensing, which negotiates to a maximum speed of 8 Gbps.
- On Generation 2, 4-Gbps modules, setting the port speed to auto enables autosensing, which negotiates to a maximum speed of 4 Gbps.

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

To configure dedicated bandwidth on an interface using Fabric Manager, follow these steps:

Step 1   Select a switch from the Fabric pane, or select a group of switches (SAN, fabric, VSAN) from the Logical Domains pane.

Step 2   Expand **Switches,** expand **Interfaces** and select **FC Physical** from the Physical Attributes pane.

You see the **FC Physical > General** tab in the Interfaces pane.

Step 3   Scroll until you see the row containing the switch and port you want to configure.

Step 4   Select **auto**, **1Gb**, **4Gb**, or **autoMax2G** from the Speed Admin column (see Figure 22-11).

Note   The Generation 3, 8-Gbps Fibre Channel swtiching modules support the following **speed** configurations: **1G, 2G, 4G, 8G**, **autoMax2G**, **autoMax4G** and the **auto** speed configuration configures autosensing for the interface with 8 Gbps of bandwidth reserved.

Figure 22-11   Speed Admin Column in Port Configuration

The auto parameter enables autosensing on the interface. The autoMax2G parameter enables autosensing on the interface with a maximum speed of 2 Gbps.

✎

Note   If you change the port bandwidth reservation parameters on a 48-port or 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching module, the change affects only the changed port. No other ports in the port group are affected.

Step 5   Click the **Apply Changes** icon.

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Configuring Rate Mode

To configure the rate mode (dedicated or shared) on an interface on a 4-Gbps or 8-Gbps Fibre Channel switching module using Fabric Manager, follow these steps:

Step 1   Select a switch from the Fabric pane, or select a group of switches (SAN, fabric, VSAN) from the Logical Domains pane.

Step 2   Expand **Switches > Interfaces** and then select **FC Physical** from the Physical Attributes pane.

You see the **FC Physical > General** tab in the Interfaces pane.

Step 3   Scroll until you see the row containing the switch and port you want to configure.

Step 4   Select **dedicated** or **shared** from the Rate Mode column (see Figure 22-12).

Figure 22-12   Rate Mode Port Configuration

Step 5 Click the **Apply Changes** icon.

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> **Caution** Changing port speed and rate mode disrupts traffic on the port.

Configuring 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 22-21 describes the bandwidth allocation for oversubscribed interfaces configured in shared mode on the 4-Gbps modules.

Table 22-21   Bandwidth Allocation for Oversubscribed Interfaces

Switching Module	Configured Speed	Reserved Bandwidth (Gbps)		Maximum Bandwidth (Gbps)
		Ratios enabled	Ratios disabled	
48-Port 8-Gbps Fibre Channel Module	Auto 8 Gbps	0.36	0.2	8
	Auto Max 4 Gbps	0.24	0.1	4
	Auto Max 2 Gbps	0.12	0.05	2
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 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 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, 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.

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.

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.

Disabling Restrictions on Oversubscription Ratios

Before disabling restrictions on oversubscription ratios, ensure that you have explicitly shut down shared ports. To disable restrictions on oversubscription ratios on multiple 48-port or 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching modules using Device Manager, follow these steps:

Step 1   Choose **Physical > Modules**.

You see the Module dialog box as shown in Figure 22-13.

Figure 22-13   Module Dialog Box

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Caution   This feature is only supported on 48-port and 24-port 4-Gbps, and 8-Gbps Fibre Channel switching modules.

Step 2   Select **disabled** from the RateModeOversubscriptionLimit drop-down list for each module for which you want to disable restrictions on oversubscription ratios.

Step 3   Click **Apply** to save the changes.

To disable restrictions on oversubscription ratios on a single 48-port or 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching module using Device Manager, follow these steps:

Step 1   Right-click a module and select **Configure**.

You see the Module dialog box as shown in Figure 22-14.

Figure 22-14   Module Dialog Box
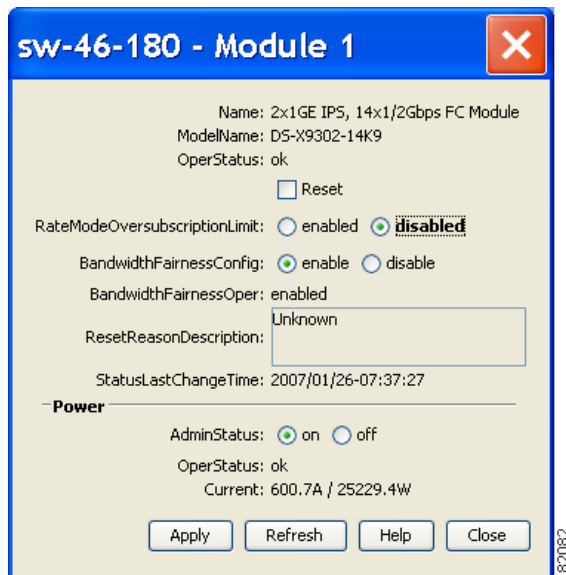
Step 2   Click the **disabled** radio button to disable restrictions on oversubscription ratios.

Step 3   Click **Apply** to save the changes.

Enabling Restrictions on Oversubscription Ratios

Caution   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 multiple 48-port or 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching modules using Device Manager, follow these steps:

Step 1   Choose **Physical > Modules**.

You see the Module dialog box as shown in Figure 22-13.

Step 2   Select **enabled** from the RateModeOversubscriptionLimit drop-down list for each module for which you want to enable restrictions on oversubscription ratios.

Step 3   Click **Apply** to save the changes.

To enable restrictions on oversubscription ratios on a single 48-port or 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching module using Device Manager, follow these steps:

Step 1   Right-click a module and select **Configure**.

You see the Module dialog box as shown in Figure 22-14.

Step 2   Click the **enabled** radio button to enable restrictions on oversubscription ratios.

Step 3   Click **Apply** to save the changes.

Configuring 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.

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).
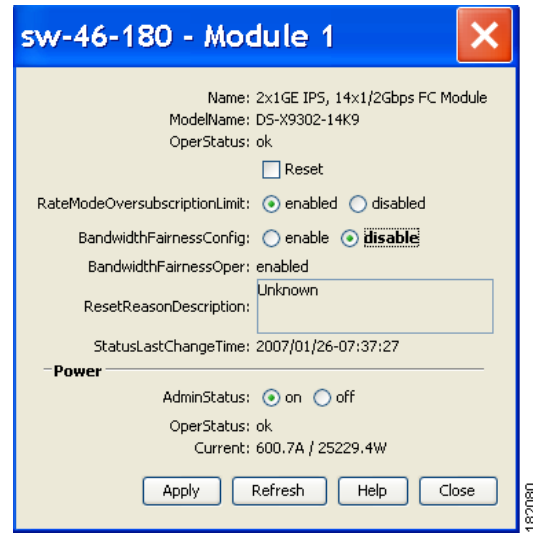
Enabling Bandwidth Fairness

To enable bandwidth fairness on multiple 48-port or 24-port 4-Gbps, or any 8-Gbps Fibre Channel switching modules using Device Manager, follow these steps:

Step 1   Choose **Physical** > **Modules**.

You see the Module dialog box as shown in Figure 22-15.

Figure 22-15   Module Dialog Box

Step 2   Select **enable** from the BandwidthFairnessConfig drop-down list for each module for which you want to enable bandwidth fairness.

Step 3   Click **Apply** to save the changes.

To enable bandwidth fairness on a single 48-port or 24-port 4-Gbps Fibre Channel switching module using Device Manager, follow these steps:

Step 1   Right-click a module and select **Configure**.

You see the Module dialog box as shown in Figure 22-16.

Figure 22-16   Module Dialog Box

Step 2   Click the **enable** radio button to enable bandwidth fairness.

Step 3   Click **Apply** to save the changes.

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 multiple 48-port or 24-port 4-Gbps, or 8-Gbps Fibre Channnel switching modules using Device Manager, follow these steps:

Step 1   Choose **Physical > Modules**.

You see the Module dialog box as shown in Figure 22-15.

Step 2   Select **disable** from the BandwidthFairnessConfig drop-down list for each module for which you want to disable bandwidth fairness.

Step 3   Click **Apply** to save the changes.

To disable bandwidth fairness on a single 48-port or 24-port 4-Gbps, or 8-Gbps Fibre Channel switching module using Device Manager, follow these steps:

Step 1   Right-click a module and select **Configure**.

You see the Module dialog box as shown in Figure 22-16.

Step 2   Click the **disable** radio button to disable bandwidth fairness.

Step 3   Click **Apply** to save the changes.

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.

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 before it can be taken out of service.

Caution   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.

Note   The interface cannot be a member of a PortChannel.

To take an interface out of service using Fabric Manager, follow these steps:

Step 1   Select a switch from the Fabric pane, or select a group of switches (SAN, fabric, VSAN) from the Logical Domains pane.

Step 2   Expand **Switches**, expand **Interfaces** and select **FC Physical** in the Physical Attributes pane.

You see the **FC Physical > General** tab in the Information pane.

Step 3   Scroll down until you see the row containing the switch and port you want to configure.

Step 4   Scroll right (if necessary) until you see the **Status Service** column.

Step 5   Select **in** or **out** from the Status Service column.

Step 6   Click the **Apply Changes** icon.

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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.

Caution   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 using Fabric Manager, follow these steps:

Step 1   Select a switch from the Fabric pane, or select a group of switches (SAN, fabric, VSAN) from the Logical Domains pane.

Step 2   Expand **Switches > Interfaces** and then select **FC Physical** from the Physical Attributes pane.

You see the **FC Physical > General** tab in the Information pane.

Step 3   Scroll down until you see the row containing the switch and port you want to configure.

Step 4   Scroll right (if necessary) until you see the **Status Service** column (see Figure 22-17).

Figure 22-17   Status Service Column for FC Physical

Step 5   Select the **out** status from the **Status Service** column.

Step 6   Click the **Apply Changes** icon.

Step 7   Select the **in** status from the **Status Service** column.

Step 8   Click the **Apply Changes** icon.

Displaying SFP Diagnostic Information

To view diagnostic information for multiple ports using Device Manager, follow these steps:

Step 1   Choose **Interface** > **FC All** and click the **Diagnostics** tab or hold down the **Control** key, and then click each port for which you want to view diagnostic information.

Step 2   Right-click the selected ports, select **Configure**, and click the **Diagnostics** tab.

You see the FC Interfaces dialog box shown in .

Figure 22-18   FC Interfaces Dialog Box

Step 3   Click **Refresh** to view the latest diagnostic information.

To view diagnostic information for a single port using Device Manager, follow these steps:

Step 1   Right-click a port, select **Configure**, and click the **Diagnostics** tab.

You see the port licensing options for the selected port shown in .

Figure 22-19   Diagnostics Tab for Selected Port

Step 2   Click **Refresh** to view the latest diagnostic information.

Default Settings

Table 22-22 lists the default settings for Generation 2 interface parameters.

Table 22-22   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**[1]	**auto**[1]	**auto**[1]	**auto**[2]
Rate mode	**shared**	**shared**	**dedicated**	**dedicated**
Port mode	Fx	Fx	auto[3]	auto[4]
BB_credit buffers	16	16	250	250
Performance buffers	–	–	145[5]	145[5]

1. Auto speed mode on the 4-Gbps switching modules enables autosensing and negotiates to a maximum speed of 4 Gbps.

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

3. 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.

4. 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.

5. Performance buffers are shared among all ports on the module.

Table 22-23 lists the default settings for Generation 3 interface parameters.

Table 22-23   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**[1]	**auto**[1]	**auto_max_4G**[2]
Rate mode	**shared**	**shared**	**shared**
Port mode	Fx	Fx	Fx
BB_credit buffers	32	32	32

1. Auto speed mode on the 8-Gbps switching modules enables autosensing and negotiates to a maximum speed of 8 Gbps.

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