Configuring Interface Buffers

This chapter describes how to configure buffer credits for the Fibre Channel interfaces.

This chapter includes the following topics:

Information About Interface Buffers

Fibre Channel interfaces use buffer credits to ensure all packets are delivered to their destination.

This section includes the following topics:

Buffer-to-Buffer Credits

Buffer-to-buffer credits (BB_credits) are a flow-control mechanism to ensure that Fibre Channel switches do not run out of buffers, so that switches do not drop frames. BB_credits are negotiated on a per-hop basis.

The receive BB_credit (fcrxbbcredit) value may be configured for each Fibre Channel interface. In most cases, you do not need to modify the default configuration.

The receive BB_credit values depend on the module type and the port mode, as follows:

- For 16-port switching modules and full rate ports, the default value is 16 for Fx mode and 255 for E or TE modes. The maximum value is 255 in all modes. This value can be changed as required.

- For 32-port switching modules and host-optimized ports, the default value is 12 for Fx, E, and TE modes. These values cannot be changed.

- For Generation 2, Generation 3, and Generation 4 switching modules, see the "Buffer Pools" section on page 60-2.

Note   In the Cisco MDS 9100 Series switches, the groups of ports on the left outlined in white are in dedicated rate mode. The other ports are host-optimized. Each group of 4 host-optimized ports have the same features as for the 32-port switching module.

Note   Because Generation 1 modules do not support as many buffer-to-buffer credits as Generation 4 modules supports, you cannot configure an ISL on E or TE ports between a Generation 1 module such as the 16-port 1-, 2-Gbps Fibre Channel Switching Module (DS-X9016) and a Generation 4 module such as the 48 port 8-Gbps Advanced Fibre Channel module (DS-X9248-256K9) or the 32-port 8-Gbps Advanced Fibre Channel module (DS-X9232-256K9).

Performance Buffers

Regardless of the configured receive BB_credit value, additional buffers, called performance buffers, improve switch port performance. Instead of relying on the built-in switch algorithm, you can manually configure the performance buffer value for specific applications (for example, forwarding frames over FCIP interfaces).

Note   Performance buffers are not supported on the Cisco MDS 9148 Fabric Switch, Cisco MDS 9124 Fabric Switch, the Cisco Fabric Switch for HP c-Class BladeSystem, and the Cisco Fabric Switch for IBM BladeCenter.

For each physical Fibre Channel interface in any switch in the Cisco MDS 9000 Family, you can specify the amount of performance buffers allocated in addition to the configured receive BB_credit value.

The default performance buffer value is 0. If you set the performance buffer value to 0, the built-in algorithm is used. If you do not specify the performance buffer value, 0 is automatically used.

The default performance buffer value is 0. If you use the **default** option, the built-in algorithm is used. If you do not specify this command, the **default** option is automatically used.

Buffer Pools

In the architecture of Generation 2, Generation 3, and Generation 4 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 receive 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)

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 60-1 shows the allocation of BB_credit buffers on line cards (24-port and 48-port 4-Gbps line cards).

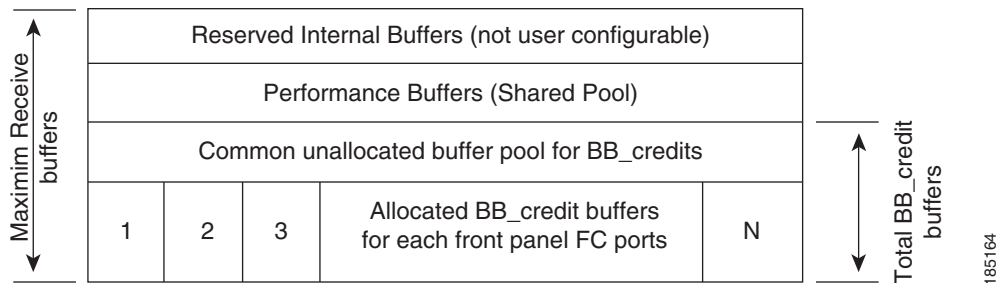*Figure 60-1   Receive Buffers for Fibre Channel Ports in a Global Buffer Pool*

Figure 60-2 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 60-2   BB_Credit Buffer Allocation in 48-Port 8-Gbps Switching Modules
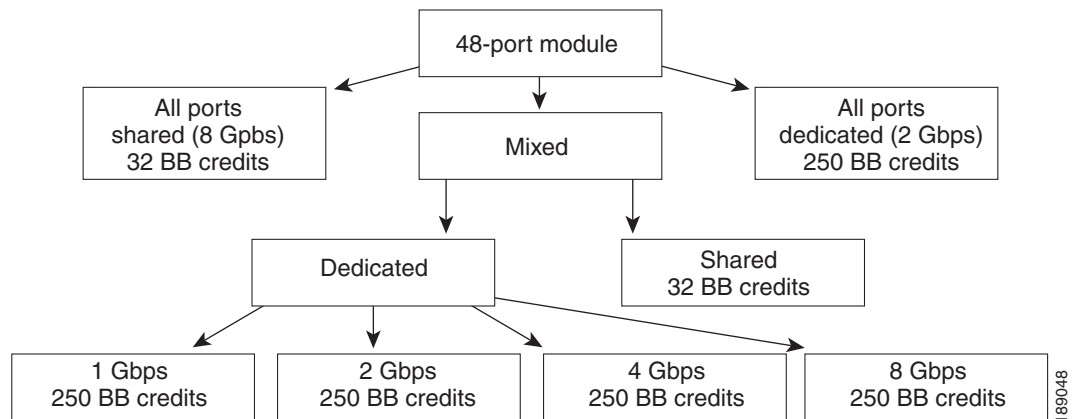
Figure 60-3 shows the default BB_credit buffer allocation model for 24-port 8-Gbps switching modules. The minimum BB_credits required to bring up a port is two buffers.

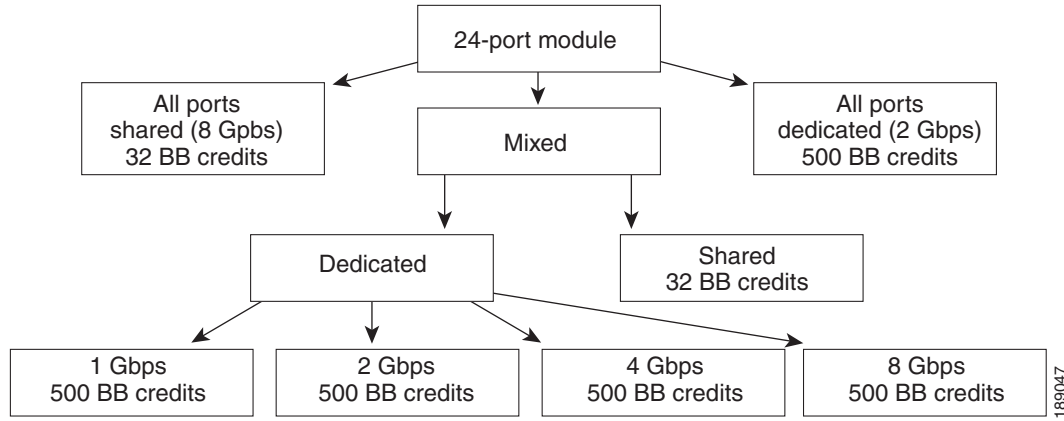*Figure 60-3   BB_Credit Buffer Allocation in 24-Port 8-Gbps Switching Modules*

Figure 60-4 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.

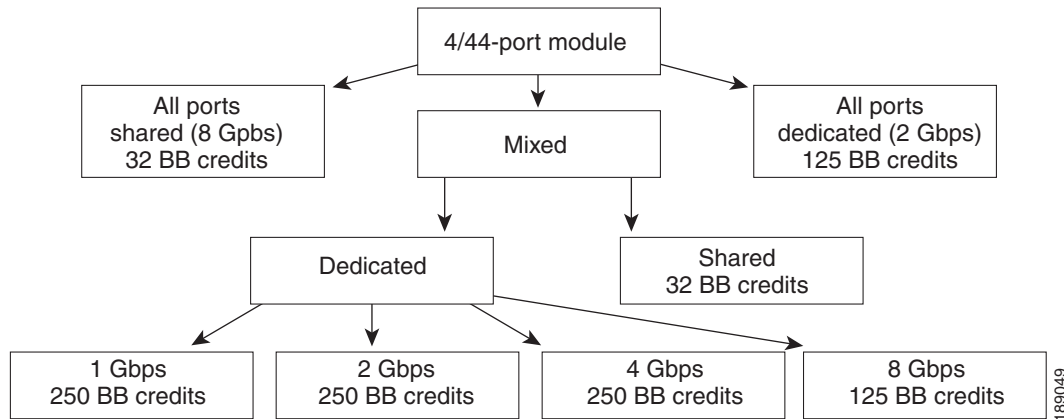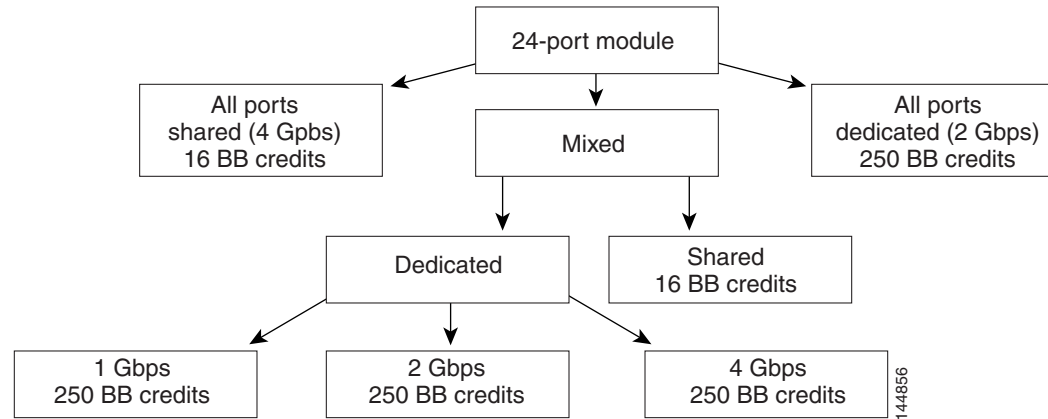*Figure 60-4   BB_Credit Buffer Allocation in 4/44-Port 8-Gbps Switching Modules*

Figure 60-5 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 60-5   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:

Configuring Buffer Credits on a Generation 2, Generation 3 or Generation 4 Module

When you configure port mode to auto or E on a Generation 2 module, one of the ports will not come up for the following configuration:

- Port Mode: auto or E for all of the ports

- Rate Mode: dedicated

- Buffer Credits: default value

When you configure port mode to auto or E on a Generation 3 module, one or two of the ports will not come up for the following configuration:

- Port Mode: auto or E for the first half of the ports, the second half of the ports or for all of the ports
- Rate Mode: dedicated
- Buffer Credits: default value

When you configure port mode to auto or E for all ports in the global buffer pool, you need to reconfigure buffer credits on one or more of the ports. The total number of buffer credits configured for all the ports in the global buffer pool should be reduced by 64.

48-Port 8-Gbps Advanced Fibre Channel Module BB_Credit Buffers

Table 60-1 lists the BB_credit buffer allocation for the 48-port 8-Gbps Advanced Fibre Channel switching module.

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Table 60-1   48-Port 8-Gbps Advanced 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 for 48 port 500 for 32 port	32	32
Maximum BB_credit buffers	500	500	32

The following guidelines apply to BB_credit buffers on 32/48-port Advanced 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 500 buffers for dedicated rate mode or 32 buffers for shared rate mode.
- Performance buffers are not supported on this module.
- The buffers should not be allocated automatically.

Each port group on the 32/48-port Advanced 8-Gbps Fibre Channel switching module consists of four/six ports. The ports in shared rate mode in a port group can have a maximum bandwidth oversubscription of 1.5:1 considering that each port group has 32-Gbps bandwidth. In case of 32 Port version, each port group of 4 ports has sufficient bandwidth (32 Gbps) to handle the line rate traffic without any oversubscription.

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

- Six ports with shared rate mode and 8-Gbps speed (1.5:1 oversubscription) (default).
- Two port with dedicated rate mode and 8-Gbps speed plus four ports with shared rate mode and 8-Gbps speed (2:1 oversubscription).
- Two ports with dedicated rate mode and 8-Gbps speed plus four ports with shared rate mode and 8-Gbps speed (2:1 oversubscription) .

- One port with dedicated rate mode and 8-Gbps speed plus three ports with dedicated rate mode and 4-Gbps speed plus two ports with shared rate mode and 8-Gbps speed (1.33:1 oversubscription).

- Six ports with dedicated rate mode and 8-Gbps speed.

48-Port 8-Gbps Fibre Channel Module BB_Credit Buffers

Table 60-2 lists the BB_credit buffer allocation for the 48-port 8-Gbps Fibre Channel switching module.

Table 60-2   48-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	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.

- The buffers should not be allocated automatically.

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 60-3 lists the BB_credit buffer allocation for the 24-port 8-Gbps Fibre Channel switching module.

Table 60-3   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

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

Table 60-4 lists the BB_credit buffer allocation for the 4/44-port 8-Gbps Fibre Channel switching module.

Table 60-4   4/44-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	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 60-5 lists the BB_credit buffer allocation for 48-port 4-Gbps Fibre Channel switching modules.

Table 60-5   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 60-6)

Figure 60-6   Example Speed and Rate Configuration on a 48-Port 4-Gbps Switching Module
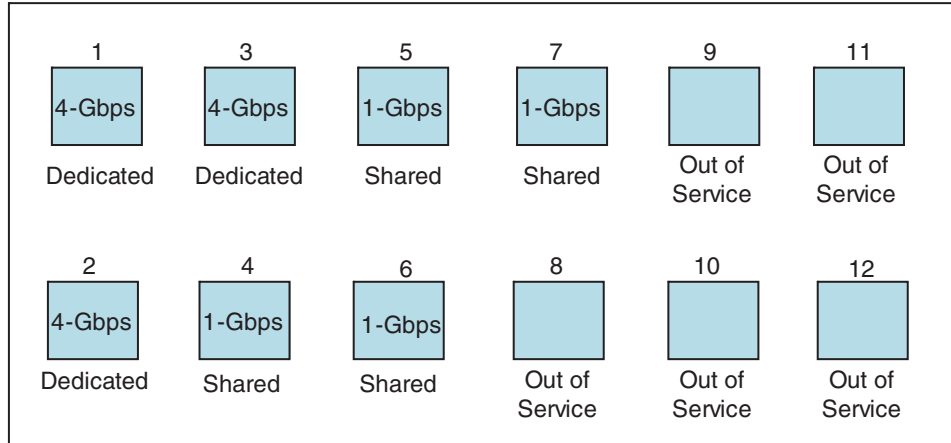
- Six ports with dedicated rate mode and 2-Gbps speed plus
  four ports with shared rate mode and 1-Gbps speed plus
  two ports put out-of-service (see Figure 60-7)

Figure 60-7   Example Speed and Rate Configuration on a 48-Port 4-Gbps Switching Module
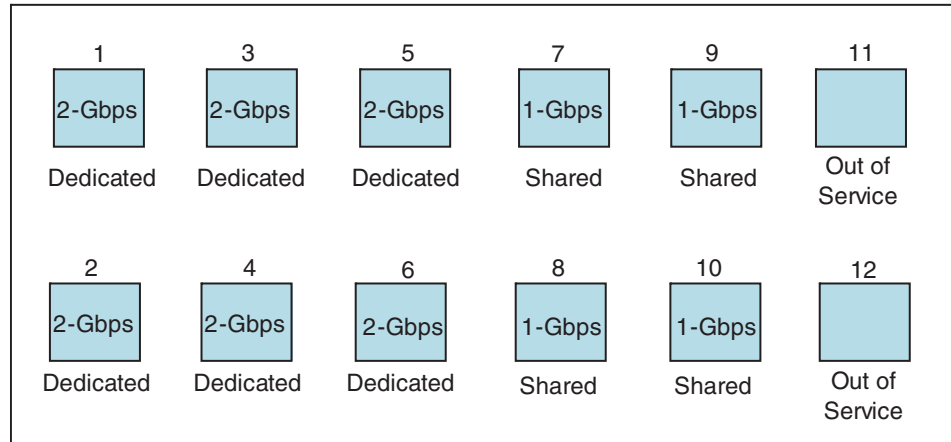
24-Port 4-Gbps Fibre Channel Module BB_Credit Buffers

Table 60-6 lists the BB_credit buffer allocation for 24-port 4-Gbps Fibre Channel switching modules.

Table 60-6   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 60-6   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
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
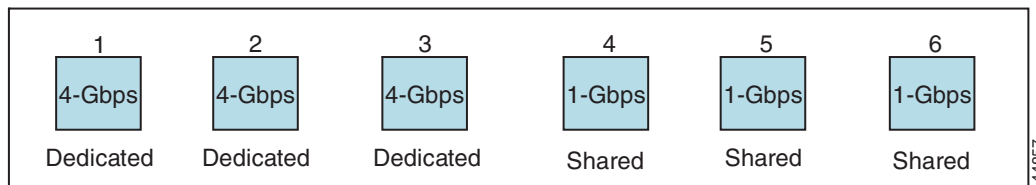 three ports with shared rate mode and 1-Gbps speed (see Figure 60-8)

Figure 60-8   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 60-7 lists the BB_credit buffer allocation for 18-port 4-Gbps multiservice modules.

Table 60-7   18-Port 4-Gbps Multiservice 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	ISL[1]	Fx Port
Default 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 60-8 lists the BB_credit buffer allocation for 12-port 4-Gbps switching modules.

Table 60-8   12-Port 4-Gbps Switching Module BB_Credit Buffer Allocation

| BB_Credit Buffer Allocation Type | BB_Credit Buffers Per Port | |
| | Dedicated Rate Mode 4-Gbps Speed | |
	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 60-9 lists the BB_credit buffer allocation for 4-port 10-Gbps switching modules.

Table 60-9   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 9148 Fabric Switch BB_Credit Buffers

Table 60-10 lists the BB_credit buffer allocation for 48-port 8-Gbps Fibre Channel switches.

Table 60-10   48-Port 8-Gbps Fabric Switch BB_Credit Buffer Allocation

BB_Credit Buffer Allocation Type	BB_Credit Buffers Per Port Group	BB_Credit Buffers Per Port	
		ISL[1]	Fx Port
Default BB_credit buffers	128	32	32
Maximum configurable BB_credit buffers on 8-Gbps mode	128	125	125

1. ISL = E port or TE port.

The following considerations apply to BB_credit buffers on 48-port 8-Gbps Fabric Switches:

- BB_credit buffers can be configured from a minimum of 1 buffer to a maximum of 32 buffers per port when the ports are in F or FL mode.

- BB_credit buffers can be configured from a minimum of 2 buffers to a maximum of 32 buffers per port when the ports are in E or TE mode.

Cisco MDS 9134 Fabric Switch BB_Credit Buffers

Table 60-11 lists the BB_credit buffer allocation for MDS 9134 Fabric Switches.

Table 60-11   MDS 9134 Fabric Switch BB_Credit Buffer Allocation

BB_Credit Buffer Allocation Type	BB_Credit Buffers Per Port Group	BB_Credit Buffers Per Port	
		ISL[1]	Fx Port
Maximum user-configurable BB_credit buffers	64	61	61
Minimum user-configurable BB_credit buffers		2	1
Default BB_credit buffers on 10-Gbps mode	64	64	64
Default BB_credit buffers on 4-Gbps mode	64	16	16

1.   ISL = E port or TE port.

Cisco MDS 9124 Fabric Switch BB_Credit Buffers

Table 60-12 lists the BB_credit buffer allocation for MDS 9124 Fabric Switches.

Table 60-12   MDS 9124 Fabric Switch 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
Maximum user-configurable BB_credit buffers	64	61	61
Minimum user-configurable BB_credit buffers		2	1
Default BB_credit buffers	64	16	16

1.   ISL = E port or TE port.

Cisco MDS 9222i Multiservice Modular Switch BB_Credit Buffers

Table 60-13 lists the BB_credit buffer allocation for 18-port 4-Gbps Multiservice Modular switches.

Table 60-13   18-Port 4-Gbps Fabric Switch 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

To facilitate BB_credits for long-haul links, the extended BB_credits feature allows you to configure the receive buffers above the maximum value on all Generation 2, Generation 3 and Generation 4 switching modules. 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.

> **Note** Extended BB_credits are not supported on the Cisco MDS 9148 Fabric Switch, Cisco MDS 9134 Fabric Switch, Cisco MDS 9124 Fabric Switch, the Cisco Fabric Switch for HP c-Class BladeSystem, and the Cisco Fabric Switch for IBM BladeCenter.

In general, you 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, Generation 3 and Generation 4 switching modules. Also, extended BB_credits are not supported by ports in shared rate mode.

All ports on the Generation 2 and Generation 3 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.

You can use the extended BB_credits flow control mechanism in addition to BB_credits for long-haul links.

This section includes the following topics:

- Extended BB_credits on Generation 1 Switching Modules section, page 60-17
- Extended BB_credits on Generation 2 and Generation 3 Switching Modules section, page 60-18

Extended BB_credits on Generation 1 Switching Modules

The BB_credits feature allows you to configure up to 255 receive buffers on Generation 1 switching modules. To facilitate BB_credits for long haul links, you can configure up to 3,500 receive BB_credits on a Fibre Channel port on a Generation 1 switching module.

To use this feature on Generation 1 switching modules, you must meet the following requirements:

- Obtain the ENTERPRISE_PKG license. See the *Cisco MDS 9000 Family NX-OS Licensing Guide*.
- Configure this feature in any port of the full-rate 4-port group in either the Cisco MDS 9216i Switch or in the MPS-14/2 module (see Figure 60-9).

Figure 60-9   Port Group Support for the Extended BB_Credits Feature
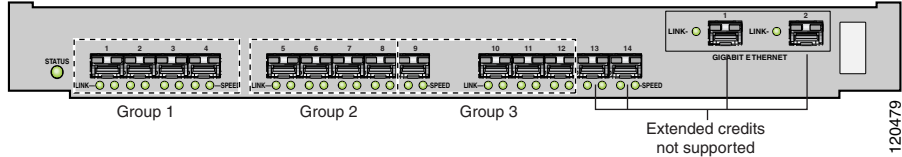
The port groups that support extended credit configurations are as follows:

–   Any one port in ports 1 to 4 (identified as Group 1).

–   Any one port in ports 5 to 8 (identified as Group 2).

–   Any one port in ports 9 to 12 (identified as Group 3).

Note   The last two Fibre Channel ports (port 13 and port 14) and the two Gigabit Ethernet ports do not support the extended BB_credits feature.

•   Explicitly enable this feature in the required Cisco MDS switch.

•   Disable the remaining three ports in the 4-port group if you need to assign more than 2,400 BB_credits to the first port in the port group.

–   If you assign less than 2,400 extended BB_credits to any one port in a port group, the remaining three ports in that port group can retain up to 255 BB_credits based on the port mode.

Note   The receive BB_credit value for the remaining three ports depends on the port mode. The default value is 16 for the Fx mode and 255 for E or TE modes. The maximum value is 255 in all modes. This value can be changed as required without exceeding the maximum value of 255 BB_credits.

–   If you assign more than 2,400 (up to a maximum of 3,500) extended BB_credits to the port in a port group, you must disable the other three ports.

•   If you change the BB_credit value the port is disabled, and then reenabled.

–   Disable (explicitly) this feature if you need to nondisruptively downgrade to Cisco SAN-OS Release 1.3 or earlier. When you disable this feature, the existing extended BB_credit configuration is completely erased.

Note   The extended BB_credit configuration takes precedence over the receive BB_credit and performance buffer configurations.

Extended BB_credits on Generation 2 and Generation 3 Switching Modules

To use this feature on Generation 2 or Generation 3 switching modules, you must meet the following requirements:

•   Display the interface configuration in the Information pane.

•   Obtain the Enterprise package (ENTERPRISE_PKG) license (see the *NX-OS Family Licensing Guide*).

- Configure this feature in any port on a Generation 2 switch module. See the "Extended BB_Credits" section on page 60-17 for more information on extended BB_credits on Generation 2 switching modules.

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

Buffer-to-Buffer Credit Recovery

Although the Fibre Channel standards require low bit error rates, bit errors do occur. Over time, the corruption of receiver-ready messages, known as R_RDY primitives, can lead to a loss of credits, which can eventually cause a link to stop transmitting in one direction. The Fibre Channel standards provide a feature for two attached ports to detect and correct this situation. This feature is called buffer-to-buffer credit recovery.

Buffer-to-buffer credit recovery functions as follows: the sender and the receiver agree to send checkpoint primitives to each other, starting from the time that the link comes up. The sender sends a checkpoint every time it has sent the specified number of frames, and the receiver sends a checkpoint every time it has sent the specified number of R_RDY primitives. If the receiver detects lost credits, it can retransmit them and restore the credit count on the sender.

The buffer-to-buffer credit recovery feature can be used on any non arbitrated loop link. This feature is most useful on unreliable links, such as MANs or WANs, but can also help on shorter, high-loss links, such as a link with a faulty fiber connection.

> **Note**   The buffer-to-buffer credit recovery feature is not compatible with the distance extension (DE) feature, also known as buffer-to-buffer credit spoofing. If you use intermediate optical equipment, such as DWDM transceivers or Fibre Channel bridges, on ISLs between switches that use DE, then buffer-to-buffer credit recovery on both sides of the ISL needs to be disabled.

Buffer-to-Buffer State Change Number

The BB_SC_N field (word 1, bits 15-12) specifies the buffer-to-buffer state change (BB_SC) number. The BB_SC_N field indicates that the sender of the port login (PLOGI), fabric login (FLOGI), or ISLs (E or TE ports) frame is requesting $2^{SC\_BB\_N}$ number of frames to be sent between two consecutive BB_SC send primitives, and twice the number of R_RDY primitives to be sent between two consecutive BB_SC receive primitives.

For Generation 2 and Generation 3 modules, the BB_SCN on ISLs (E or TE ports) is enabled by default. This can fail the ISLs if used with optical equipment using distance extension (DE), also known as buffer-to-buffer credit spoofing.

On a Generation-2 module, one port will not come up for the following configuration for all ports:

- Port Mode: auto or E for all the ports
- Rate Mode: dedicated
- Buffer Credits: default value

On a Generation-3 module, one or two ports will not come up for the following configuration for the first half of the ports, the second half of the ports, or all ports:

- Port Mode: auto or E for the first half of the ports, the second half of the ports, or for all of the ports
- Rate Mode: dedicated
- Buffer Credits: default value

When you configure port mode to auto or E and rate-mode to dedicated for all ports in the global buffer pool, you need to reconfigure buffer credits on one or more ports (other than default).

> **Note**   If you use distance extension (buffer-to-buffer credit spoofing) on ISLs between switches, the BB_SCN parameter on both sides of the ISL needs to be disabled.

Receive Data Field Size

You can also configure the receive data field size for Fibre Channel interfaces. If the default data field size is 2112 bytes, the frame length will be 2148 bytes.

Configuring Interface Buffers

This section includes the following topics:

Configuring Buffer-to-Buffer Credits

To configure BB_credits for a Fibre Channel interface, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc1/1** switch(config-if)#	Selects a Fibre Channel interface and enters interface configuration submode.

	Command	Purpose
Step 3	switch(config-if)# **switchport fcrxbbcredit default**	Applies the default operational value to the selected interface. The operational value depends on the port mode. The default values are assigned based on the port capabilities.
	switch(config-if)# **switchport fcrxbbcredit 5**	Assigns a BB_credit of 5 to the selected interface. The range to assign BB_credits is between 1 and 255.
	switch(config-if)# **switchport fcrxbbcredit 5 mode E**	Assigns this value if the port is operating in E or TE mode. The range to assign BB_credits is between 1 and 255.
	switch(config-if)# **switchport fcrxbbcredit 5 mode Fx**	Assigns this value if the port is operating in F or FL mode. The range to assign BB_credits is between 1 and 255.
Step 4	switch(config-if# **do show int fc1/1**	Displays the receive and transmit BB_credit along with other pertinent interface information for this interface. **Note** The BB_credit values are correct at the time the registers are read. They are useful to verify situations when the data traffic is slow.

This example shows the output of the **show int fc1/1** command:

```
intfc1/1 is up
    ...
    16 receive B2B credit remaining
    3 transmit B2B credit remaining
```

To configure BB_credits for a Fibre Channel interface using DCNM-SAN, follow these steps:

Step 1 Expand **Switches > Interfaces**, and then select **FC Physical**. You see the interface configuration in the Information pane.

Step 2 Click the **Bb Credit** tab.

You see the buffer credits.

Step 3 Set any of the buffer-to-buffer credits for an interface.

Step 4 Click **Apply Changes**.

Configuring Performance Buffers

To configure performance buffers for a Fibre Channel interface, follow these steps:

	Command	Purpose
Step 1	switch# **config t**	Enters configuration mode.
Step 2	switch(config)# **interface fc1/1** switch(config-if)#	Selects a Fibre Channel interface and enters interface configuration submode.
Step 3	switch(config-if)# **switchport fcrxbbcredit performance-buffers 45**	Assigns a performance buffer of 45 to the selected interface. The value ranges from 1 to 145.
	switch(config-if)# **switchport fcrxbbcredit performance-buffers default**	Reverts to the factory default of using the built-in algorithm.

Note Use the **show interface bbcredit** command to display performance buffer values and other BB_credit information.

To configure performance buffers for a Fibre Channel interface using DCNM-SAN, follow these steps:

Step 1   Expand **Switches > Interfaces**, and then select **FC Physical**.

You see the interface configuration in the Information pane.

Step 2   Click the **BB Credit** tab.

You see performance buffer information in the Perf Bufs Admin and Perf Bufs Oper columns.

Step 3   Set the performance buffers for an interface.

Step 4   Click **Apply Changes**.

Configuring Extended BB_credits

To configure extended BB_credits for a MDS-14/2 interface, for a Generation 2 switching module interface (not including the Cisco MDS 9124 Fabric Switch), or for an interface in a Cisco MDS 9216i switch, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **fcrxbbcredit extended enable**	Enables the extended BB_credits feature.
	switch(config)# **no fcrxbbcredit extended enable**	Disables (default) the extended BB_credits feature.
Step 3	switch(config)# **interface fc1/1** switch(config-if)#	Selects a Fibre Channel interface and enters interface configuration submode.

	Command	Purpose
Step 4	switch(config-if)# **switchport fcrxbbcredit extended 1500**	Applies the extended BB_credit value of 1,500 credits to the selected interface. The valid range is from 256 to 3,500 credits.
	switch(config-if)# **no switchport fcrxbbcredit extended 1500**	Clears the configured extended BB_credit configuration for this port.

Step 5	switch# **do show interface fc3/2**
	fc3/2 is trunking
	Hardware is Fibre Channel, SFP is short wave laser w/o OFC (SN)
	    Port WWN is 20:82:00:05:30:00:2a:1e
	    Peer port WWN is 20:42:00:0b:46:79:f1:80
	    Admin port mode is auto, trunk mode is on
	    Port mode is TE
	    Port vsan is 1
	    Speed is 2 Gbps
	    Transmit B2B Credit is 255
	    Receive B2B Credit is 1500
	    Receive data field Size is 2112
	    ...
		Displays the receive and transmit BB_credit values along with other pertinent interface information for this interface if the interface is in the up state.
		
		Note The receive BB_credit value reflects the extended BB_credit configuration, if applicable.

To configure extended BB_credits for an MDS-14/2 interface, for a Generation 2 switching module interface, or for an interface in a Cisco MDS 9216i switch using DCNM-SAN, follow these steps:

Step 1   Expand **Switches > Interfaces**, and then select **FC Physical**. You see the interface configuration in the Information pane.

Step 2   Click the **BB Credit** tab.

Step 3   In the **Extended** column, set the extended BB_credits for the selected interface.

Step 4   Click **Apply Changes**.

Enabling Buffer-to-Buffer Credit Recovery

Buffer-to-buffer credit recovery on ISLs (E or TE ports) is enabled by default.

To use buffer-to-buffer credit recovery on a port, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc 1/1** switch(config-if)#	Selects the interface and enters interface configuration submode.
Step 3	switch(config-if)# **switchport fcbbscn**	Enables buffer-to-buffer credit recovery on the interface.
	switch(config-if)# **no switchport fcbbscn**	Disables (default) buffer-to-buffer credit recovery on the interface.

Enabling the Buffer-to-Buffer State Change Number

To use the BB_SC_N field during PLOGI or FLOGI, follow these steps:

	Command	Purpose
Step 1	switch# **config t** switch(config)#	Enters configuration mode.
Step 2	switch(config)# **interface fc 1/1** switch(config-if)#	Selects the interface and enters interface configuration submode.
Step 3	switch(config-if)# **switchport fcbbscn**	Enables the use of buffer-to-buffer state change number for PLOGIs and FLOGIs on the interface.
	switch(config-if)# **no switchport fcbbscn**	Disables (default) the use of buffer-to-buffer state change number for PLOGIs and FLOGIs on the interface.

Configuring Receive Data Field Size

To configure the receive data field size, follow these steps:

	Command	Purpose
Step 1	switch# **config t**	Enters configuration mode.
Step 2	switch(config)# **interface fc1/1** switch(config-if)#	Selects a Fibre Channel interface and enters interface configuration submode.
Step 3	switch(config-if)# **switchport fcrxbufsize 2000**	Reduces the data field size for the selected interface to 2000 bytes. The default is 2112 bytes and the range is from 256 to 2112 bytes.

To configure the receive data field size using DCNM-SAN, follow these steps:

Step 1   Expand **Switches > FC Interfaces**, and then select **FC Physical**.

You see the interface configuration in the Information pane.

Step 2   Click the **Other** tab and set the RxDataFieldSize field.

Step 3   (Optional) Set other configuration parameters using the other tabs.

Step 4   Click **Apply Changes**.

Verifying BB_Credit Configuration

To display BB_credit configuration information, perform one of the following tasks:

Command	Purpose
show interface	Displays the interface configuration.
show interface bbcredit	Displays the BB_credit configuration for all the interfaces.
show interface fc *numbers* **bbcredit**	Displays the BB_credit configuration for the specified interfaces.

For detailed information about the fields in the output from these commands, refer to the *Cisco NX-OS Command Reference*.

To display the BB_credit information, use the **show interface bbcredit** command (see Example 60-1 and Example 60-2).

Example 60-1   Displays BB_credit Information

```
switch# show interface bbcredit
fc2/1 is down (SFP not present)
...
fc2/17 is trunking
    Transmit B2B Credit is 255
    Receive B2B Credit is 12
    Receive B2B Credit performance buffers is 375
     12 receive B2B credit remaining
     255 transmit B2B credit remaining
fc2/18 is down (SFP not present)
fc2/19 is down (SFP not present)
fc2/20 is down (SFP not present)
fc2/21 is down (Link failure or not-connected)
...
fc2/31 is up
    Transmit B2B Credit is 0
    Receive B2B Credit is 12
    Receive B2B Credit performance buffers is 48
     12 receive B2B credit remaining
     0 transmit B2B credit remaining
fc2/32 is down (Link failure or not-connected)
```

Example 60-2   Displays BB_credit Information for a Specified Fibre Channel Interface

```
switch# show interface fc2/31 bbcredit
fc2/31 is up
    Transmit B2B Credit is 0
    Receive B2B Credit is 12
    Receive B2B Credit performance buffers is 48
     12 receive B2B credit remaining
     0 transmit B2B credit remaining
```