



# Configuring Fibre Channel over IP

Cisco MDS 9000 Family IP Storage (IPS) services extend the reach of Fibre Channel SANs by using open-standard, IP-based technology. The switch can connect separated SAN islands using Fibre Channel over IP (FCIP).



**Note**

FCIP is supported on Fibre Channel module with IPS ports on Cisco 24/10 port SAN Extension Module on Cisco MDS 9700 Series switches, MDS 9250i Multiservice Fabric Switch, and MDS 9220i Fabric Switch.

This chapter includes the following sections:

- [Feature Information, page 2-xv](#)
- [Configuring FCIP, page 2-xxi](#)
- [Default Settings for FCIP Parameters, page 2-lxiii](#)

## Feature Information

This section briefly describes the new and updated features for releases.

**Table 2-1**      **Feature Information Table**

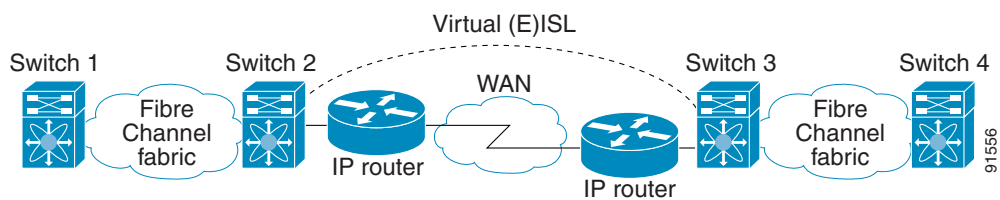
Feature	Release	Description
FCIP	8.5(1)	Added support for Cisco MDS 9220i Fabric Switch.
<code>show interface fcip fcip-id</code>	8.4(2)	The <code>show interface fcip fcip-id</code> command output was modified to support the RTT statistics for each TCP connection.

**Table 2-1 Feature Information Table**

Feature	Release	Description
<a href="#">Maximum Retransmission Threshold for OBFL Logging, page 2-xxviii</a>	8.4(1)	The following command was introduced to configure the threshold for logging the TCP retransmission rate to OBFL:  <pre>tcp logging onboard tcp-retransmission-threshold</pre> <p>The following command is deprecated:  <pre>tcp obfl max-retransmissions_pkt_thresh value</pre></p>
<a href="#">Maximum Retransmission Threshold for OBFL Logging, page 2-xxviii</a>	8.2(1)	This feature enables users to configure the threshold for logging the TCP retransmission rate to OBFL.  <p>The following new command was introduced: <b>tcp obfl max-retransmissions_pkt_thresh value</b></p>

## Overview of FCIP

The Fibre Channel over IP Protocol (FCIP) is a tunneling protocol that connects geographically distributed Fibre Channel storage area networks (SAN islands) transparently over IP local area networks (LANs), metropolitan area networks (MANs), and wide area networks (WANs). The switch can connect separated SAN islands using Fibre Channel over IP (FCIP). (See [Figure 2-1](#)).

**Figure 2-1 Fibre Channel SANs Connected by FCIP**

FCIP uses TCP as a network layer transport. The DF bit is set in the TCP header.

**Note**

For more information about FCIP protocols, refer to the IETF standards for IPStorage at <http://www.ietf.org>. Also refer to the Fibre Channel standards for switch backbone connection at <http://www.t11.org> (see FC-BB-2).

This section includes the following topics:

- [FCIP Concepts, page 2-xvii](#)
- [FCIP High-Availability Solutions, page 2-xix](#)

- [Configuring FCIP, page 2-xxi](#)

## FCIP Concepts

To configure Fibre Channel module with IPS ports for FCIP, you should have a basic understanding of the following concepts:

- [FCIP and VE Ports, page 2-xvii](#)
- [FCIP Links, page 2-xviii](#)
- [FCIP Profiles, page 2-xviii](#)
- [FCIP Interfaces, page 2-xix](#)

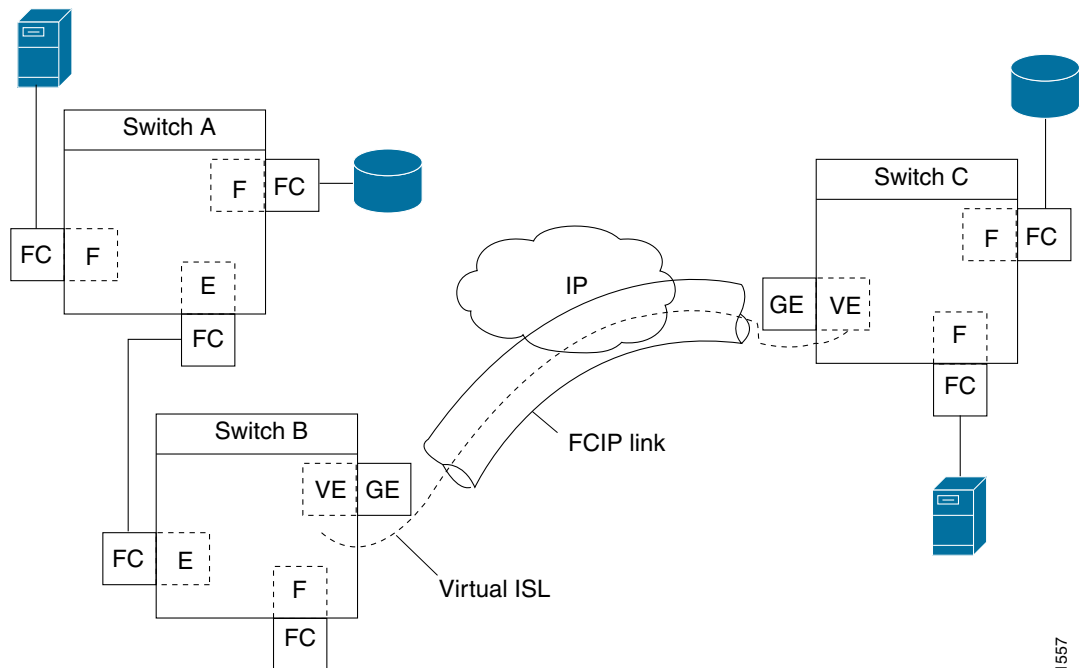
## FCIP and VE Ports

[Figure 2-2](#) shows the internal model of FCIP in relation to Fibre Channel Inter-Switch Links (ISLs) and Cisco's extended ISLs (EISLs).

FCIP virtual E (VE) ports operate exactly like standard Fibre Channel E ports, except that the transport in this case is FCIP instead of Fibre Channel. The only requirement is for the other end of the VE port to be another VE port.

A virtual ISL is established over an FCIP link and transports Fibre Channel traffic. Each associated virtual ISL looks like a Fibre Channel ISL with either an E port or a TE port at each end (see [Figure 2-2](#)).

**Figure 2-2** FCIP Links and Virtual ISLs



See the “[Configuring E Ports](#)” section on page 2-xxxv for more information.

## FCIP Links



**Note**

In-order delivery (IOD) is not supported on FCIP ISLs where WA and TA are enabled.

FCIP links consist of one or more TCP connections between two FCIP link endpoints. Each link carries encapsulated Fibre Channel frames.

When the FCIP link comes up, the VE ports at both ends of the FCIP link create a virtual Fibre Channel (E)ISL and initiate the E port protocol to bring up the (E)ISL.

By default, the FCIP feature on any Cisco MDS 9000 Family switch creates two TCP connections for each FCIP link:

- One connection is used for data frames.
- The other connection is used only for Fibre Channel control frames, that is, switch-to-switch protocol frames (all Class F). This arrangement provides low latency for all control frames.

To enable FCIP on the Fibre Channel module with IPS ports, an FCIP profile and FCIP interface (interface FCIP) must be configured.

The FCIP link is established between two peers, the VE port initialization operation is identical to a normal E port. This operation is independent of the link being FCIP or pure Fibre Channel, and is based on the E port discovery process (ELP, ESC).

Once the FCIP link is established, the VE port operation is identical to E port operation for all inter-switch communication (including domain management, zones, and VSANs). At the Fibre Channel layer, all VE and E port operations are identical.

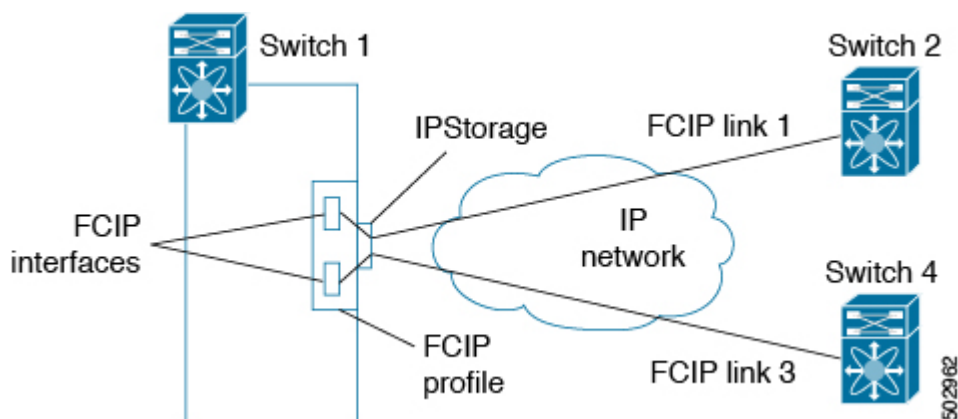
## FCIP Profiles

The FCIP profile contains information about the local IP address and TCP parameters. The profile defines the following information:

- The local connection points (IP address and TCP port number)
- The operation of the underlying TCP connections for all FCIP links that use this profile

The FCIP profile's local IP address determines the IPStorage port where the FCIP links terminate (see [Figure 2-3](#)).

**Figure 2-3** FCIP Profile and FCIP Link



## FCIP Interfaces

The FCIP interface is the local endpoint of the FCIP link and a VE port interface. All the FCIP and E port parameters are configured in context to the FCIP interface.

The FCIP parameters consist of the following:

- The FCIP profile determines which IPStorage port initiates the FCIP links and defines the TCP connection operation.
- Peer information.
- Number of TCP connections for the FCIP link.
- E port parameters—trunking mode and trunk-allowed VSAN list.

## FCIP High-Availability Solutions

The following high-availability solutions are available for FCIP configurations:

- [Fibre Channel Port Channels, page 2-xix](#)
- [FSPF, page 2-xx](#)
- [VRRP, page 2-xxi](#)

## Fibre Channel Port Channels

Port channels comprised of FCIP interfaces behave the same way as Fibre Channel port channels. They offer the same benefits of link redundancy between Fibre Channel switches as native FC port channels. Beneath the FCIP level, an FCIP link can run on top of a IPStorage port. This link is totally transparent to the Fibre Channel layer.

The Fibre Channel Port Channel (to which FCIP link can be a part of) does not have a restriction on which (E)ISL links can be combined in a Fibre Channel Port Channel as long as it passes the compatibility check.



### Note

When port channel is configured with members on Cisco MDS 48-Port 64-Gbps Fibre Channel Switching Module (DS-X9748-3072K9), packet drops may be expected when IOD is configured and a member of the port channel is added, removed, or flaps.

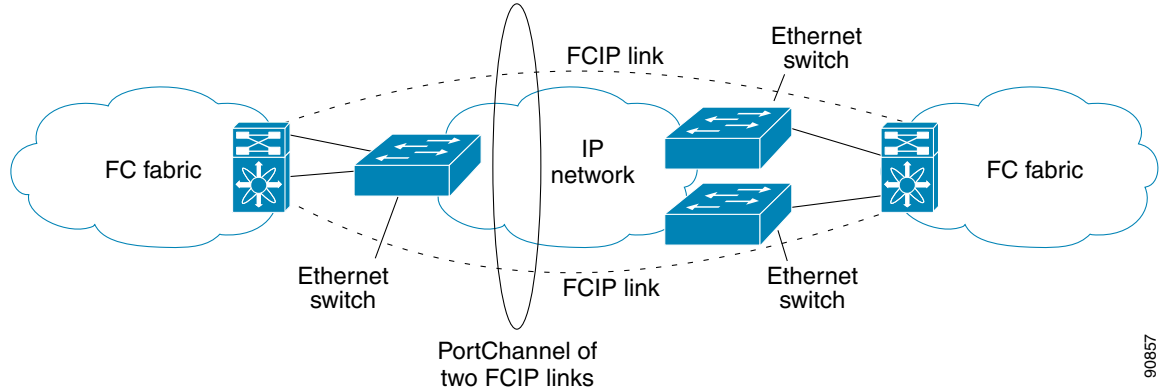
For information, see the *Cisco Fabric Manager Interfaces Configuration Guide* and *Cisco MDS 9000 Series NX-OS Interfaces Configuration Guide*.

The maximum number of Fibre Channel ports that can be put into a Fibre Channel Port Channel is 16.

To configure Fibre Channel Port Channels, see the *Cisco MDS 9000 Series NX-OS Interfaces Configuration Guide* and *Cisco Fabric Manager Interfaces Configuration Guide*.

[Figure 2-4](#) provides an example of a port channel-based load-balancing configuration. To perform this configuration, you need two IP addresses on each SAN island. This solution addresses link failures.

**Figure 2-4** Port Channel-Based Load Balancing



900857

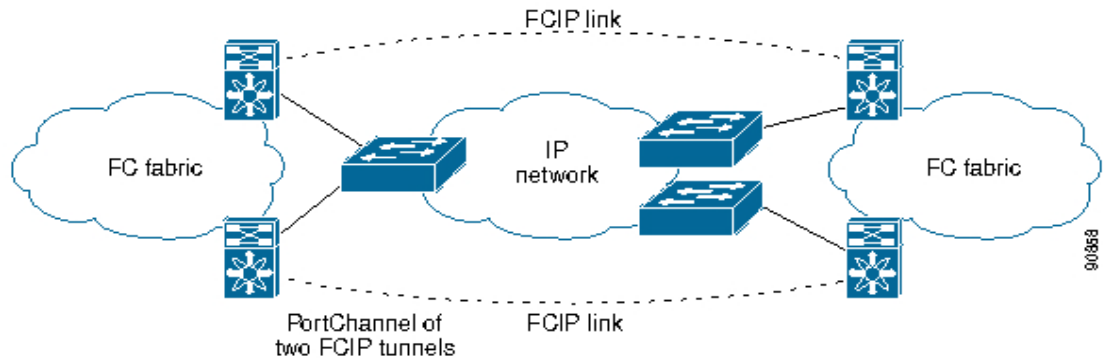
The following characteristics set Fibre Channel port channel solutions apart from other solutions:

- The entire bundle is one logical (E)ISL link.
- All FCIP links in the port channel should terminate on the same two switches.
- The Fibre Channel traffic is load balanced across the FCIP links in the port channel.

## FSPF

Figure 2-5 displays a FSPF-based load balancing configuration example. This configuration requires two IP addresses on each SAN island, and addresses IP and FCIP link failures.

**Figure 2-5** FSPF-Based Load Balancing



900858

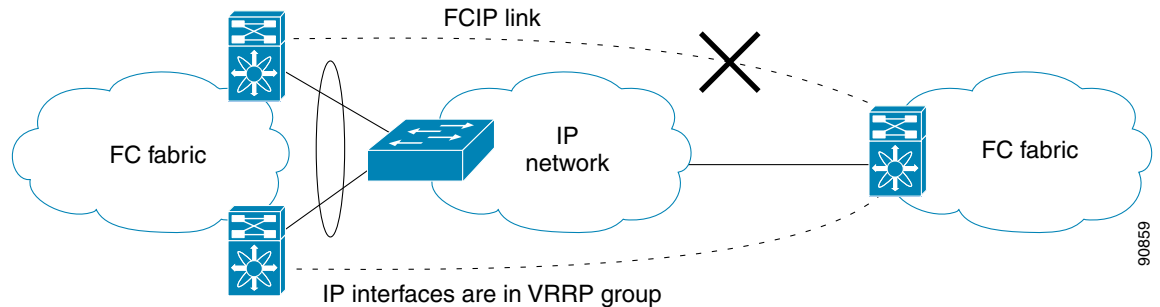
The following characteristics set FSPF solutions apart from other solutions:

- Each FCIP link is a separate (E)ISL.
- The FCIP links can connect to different switches across two SAN islands.
- The Fibre Channel traffic is load balanced across the FCIP links.

## VRRP

Figure 2-6 displays a Virtual Router Redundancy Protocol (VRRP)-based high availability FCIP configuration example. This configuration requires at least two physical IPStorage ports connected to the Ethernet switch on the island where you need to implement high availability using VRRP.

**Figure 2-6 VRRP-Based High Availability**



The following characteristics set VRRP solutions apart from other solutions:

- If the active VRRP port fails, the standby VRRP port takes over the VRRP IP address.
- When the VRRP switchover happens, the FCIP link automatically disconnects and reconnects.
- This configuration has only one FCIP (E)ISL link.



**Note**

Port-fast needs to be enabled in the Cisco catalyst 6500 series and Cisco Nexus 7000 series switches where the IPStorage ports or Management port is connected.



**Note**

VRRP IPv6 is not supported for MDS 9250i switch.



**Note**

From Cisco MDS NX-OS Release 8.3(1) and later, the VRRP feature is not supported on Cisco MDS 9000 Series Switches.

## Configuring FCIP

This section describes how to configure FCIP and includes the following topics:

- [Enabling FCIP, page 2-xxii](#)
- [Basic FCIP Configuration, page 2-xxii](#)
- [Creating FCIP Profiles, page 2-xxiii](#)
- [Displaying FCIP Profile Information, page 2-xxx](#)
- [Advanced FCIP Profile Configuration, page 2-xxvi](#)
- [Advanced FCIP Interface Configuration, page 2-xxx](#)
- [Configuring Peers, page 2-xxxii](#)

- [Configuring E Ports, page 2-xxxv](#)
- [Displaying FCIP Interface Information, page 2-xxxvi](#)
- [Advanced FCIP Features, page 2-xlii](#)

## Enabling FCIP

The Fibre Channel over IP Protocol (FCIP) is a tunneling protocol that connects geographically distributed Fibre Channel storage area networks (SAN islands) transparently over IP local area networks (LANs), metropolitan area networks (MANs), and wide area networks (WANs).

To begin configuring the FCIP feature, you must explicitly enable FCIP on the required switches in the fabric. By default, this feature is disabled in all switches in the Cisco MDS 9000 Family.

The configuration and verification operations commands for the FCIP feature are only available when FCIP is enabled on a switch. When you disable this feature, all related configurations are automatically discarded.

By default, the Cisco MDS 9700 series switches, MDS 9250i switches, and MDS 9220i switches are shipped with the SAN extension over IP package license.

To enable FCIP on any participating switch, follow these steps:

	Command	Purpose
Step 1	switch# <b>configure terminal</b>	Enters configuration mode.
Step 2	switch(config)# <b>feature fcip</b>	Enables FCIP on that switch.
Step 3	switch(config)# <b>no feature fcip</b>	(Optional) Disables (default) FCIP on that switch.

To create and manage FCIP links with DCNM-SAN, use the FCIP Wizard. For more information on the FCIP Wizard, see the *Configuring FCIP* chapter, in the *Cisco DCNM SAN Client Online Help* document.

## Basic FCIP Configuration

Once you have created FCIP links using the FCIP wizard, you may need to modify parameters for these links. This includes modifying the FCIP profiles as well as the FCIP link parameters.

- For Cisco MDS 9220i Switch, each 1 Gbps or 10 Gbps IPStorage interface can have three FCIP links configured at a time and the 40 Gbps IPStorage interface can have four FCIP links configured at a time.
- For Cisco MDS 9250i Switch, each IPStorage interface can have six FCIP links configured at a time.
- For Cisco MDS 24/10-Port SAN Extension Module, each 1 Gbps or 10 Gbps IPStorage interface can have three FCIP links configured at a time and the 40 Gbps IPStorage interface can have four FCIP links configured at a time.



### Note

When using IPsec and IKE, each IPStorage interface on the Fibre Channel module with IPS ports must be configured in its own IP subnet. If there are multiple IPStorage interfaces configured with IP address or network-mask in the same IP subnet, IKE packets might not be sent out to the correct IPS port and the IPsec link will not come up.





**Note** You can configure FCIP with IPsec and NAT on Cisco MDS 9220i switches.

To configure an FCIP link, follow these steps on both switches:

- Step 1** Configure the IPStorage interface.  
See the *Cisco MDS 9000 Family NX-OS IP Services Configuration Guide*.
- Step 2** Create an FCIP profile and then assign the IPStorage interface's IP address to the profile.
- Step 3** Create an FCIP interface and then assign the profile to the interface.
- Step 4** Configure the peer IP address for the FCIP interface.
- Step 5** Enable the interface.

## Creating FCIP Profiles

You must assign a local IP address of an IPStorage interface or subinterface to the FCIP profile to create an FCIP profile. You can assign IPv4 or IPv6 addresses to the interfaces. [Figure 2-7](#) shows an example configuration.

**Figure 2-7 Assigning Profiles to Each IPStorage Interface**



To create an FCIP profile in switch 1 in [Figure 2-7](#), follow these steps:

	Command	Purpose
<b>Step 1</b>	switch1# <b>configure terminal</b>	Enters configuration mode.
<b>Step 2</b>	switch1(config)# <b>fcip profile 10</b>	Creates a profile for the FCIP connection. The valid range is from 1 to 255.
<b>Step 3</b>	switch1(config-profile)# <b>ip address 10.100.1.25</b>	Associates the profile (10) with the local IPv4 address of the IPStorage interface (3/1).
<b>Step 4</b>	switch1# <b>show fcip profile</b>	(Optional) Displays FCIP profile information.

To assign an FCIP profile in switch 2 in [Figure 2-7](#), follow these steps:

	Command	Purpose
<b>Step 1</b>	switch2# <b>configure terminal</b>	Enters configuration mode.
<b>Step 2</b>	switch2(config)# <b>fcip profile 20</b>	Creates a profile for the FCIP connection.

	Command	Purpose
Step 3	switch2(config-profile)# <b>ip address 10.1.1.1</b>	Associates the profile (20) with the local IPv4 address of the IPStorage interface.
Step 4	switch2# <b>show fcip profile</b>	(Optional) Displays FCIP profile information.

## Displaying FCIP Profile Information

### Example 2-1 Displaying Summary of FCIP Profiles

```
switch# show fcip profile
```

```
-----
ProfileId      Ipaddr                TcpPort
-----
1              20.1.1.1              3225
2              20.1.1.1              2000
3              20.1.1.1              3000
4              20.1.1.1              4000
5              20.1.1.1              5000
6              20.1.1.1              6000
7              30.1.1.1              3225
8              31.1.1.1              3225
9              32.1.1.1              3225
10             33.1.1.1              3225
11             34.1.1.1              3225
12             35.1.1.1              3225
```

### Example 2-2 Displaying Detailed FCIP Profile Information

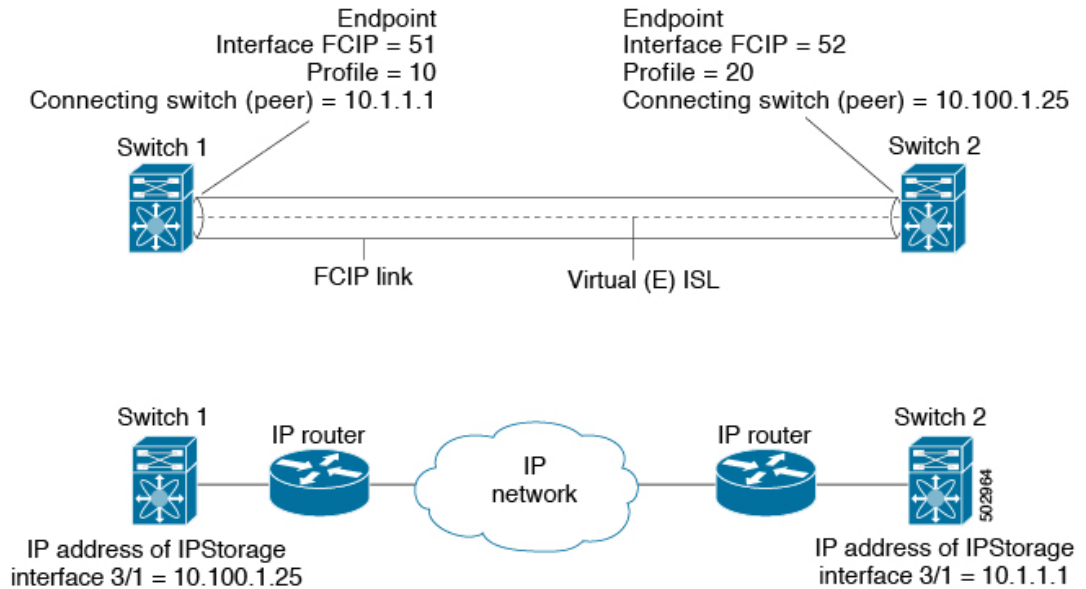
```
switch# show fcip profile 1
FCIP Profile 1
  Internet Address is 20.1.1.1 (interface IPStorage1/1)
  Tunnels Using this Profile: fcip1
  Listen Port is 3225
  TCP parameters
    SACK is enabled
    PMTU discovery is enabled, reset timeout is 3600 sec
    Keep alive is 60 sec
    Minimum retransmission timeout is 200 ms
    Maximum number of re-transmissions is 4
    Send buffer size is 16384 KB
    Maximum allowed bandwidth is 5000000 kbps
    Minimum available bandwidth is 4000000 kbps
    Configured round trip time is 1000 usec
    Congestion window monitoring is enabled, burst size is 50 KB
    Auto jitter detection is enabled
```

## Creating FCIP Links

When two FCIP link endpoints are created, an FCIP link is established between the two IPS ports. The peer IP address specifies the address of the remote FCIP endpoint. This allows the creation of an FCIP link to that peer switch once the FCIP interface is enabled.

Figure 2-8 shows an example configuration of an FCIP link.

**Figure 2-8 Assigning Profiles to Each IPStorage Interface**



To create an FCIP link endpoint in switch 1, follow these steps:

	Command	Purpose
Step 1	switch1# <b>configure terminal</b>	Enters configuration mode.
Step 2	switch1(config)# <b>interface fcip 51</b>	Creates an FCIP interface (51).
Step 3	switch1(config-if)# <b>use-profile 10</b>	Assigns the profile (10) to the FCIP interface.
Step 4	switch1(config-if)# <b>peer-info ipaddr 10.1.1.1</b>	Assigns the peer IPv4 address information (10.1.1.1 for switch 2) to the FCIP interface.
Step 5	switch1(config-if)# <b>no shutdown</b>	Enables the interface.

To create an FCIP link endpoint in switch 2, follow these steps:

	Command	Purpose
Step 1	switch2# <b>configure terminal</b>	Enters configuration mode.
Step 2	switch2(config)# <b>interface fcip 52</b>	Creates an FCIP interface (52).
Step 3	switch2(config-if)# <b>use-profile 20</b>	Binds the profile (20) to the FCIP interface.
Step 4	switch2(config-if)# <b>peer-info ip address 10.100.1.25</b>	Assigns the peer IPv4 address information (10.100.1.25 for switch 1) to the FCIP interface.
Step 5	switch1(config-if)# <b>no shutdown</b>	Enables the interface.

## Advanced FCIP Profile Configuration

A basic FCIP configuration uses the local IP address to configure the FCIP profile. In addition to the local IP address and the local port, you can specify other TCP parameters as part of the FCIP profile configuration.

This sections includes the following topics:

- [Configuring TCP Listener Ports, page 2-xxvi](#)
- [Configuring TCP Parameters, page 2-xxvi](#)

FCIP configuration options can be accessed from the switch (config-profile)# submode prompt.

### Configuring TCP Listener Ports

To configure TCP listener ports, follow these steps:

	Command	Purpose
Step 1	switch# <b>configure terminal</b>	Enters configuration mode.
Step 2	switch(config)# <b>fcip profile 20</b>	Creates the profile (if it does not already exist) and enters profile configuration submode. The valid range is from 1 to 255.

The default TCP port for FCIP is 3225. You can change this port by using the **port** command.

To change the default FCIP port number (3225), follow these steps:

	Command	Purpose
Step 1	switch(config-profile)# <b>port 5000</b>	Associates the profile with the local port number (5000).
Step 2	switch(config-profile)# <b>no port</b>	Reverts to the default 3225 port.

### Configuring TCP Parameters

You can control TCP behavior in a switch by configuring the TCP parameters that are described in this section.



#### Note

When FCIP is sent over a WAN link, the default TCP settings may not be appropriate. In such cases, we recommend that you tune the FCIP WAN link by modifying the TCP parameters (specifically bandwidth, round-trip times, and CWM burst size).

This section includes the following topics:

- [Minimum Retransmit Timeout, page 2-xxvii](#)
- [Keepalive Timeout, page 2-xxvii](#)
- [Maximum Retransmissions, page 2-xxvii](#)
- [Path MTUs, page 2-xxviii](#)
- [Selective Acknowledgments, page 2-xxix](#)
- [Window Management, page 2-xxix](#)
- [Monitoring Congestion, page 2-xxx](#)
- [Displaying FCIP Profile Information, page 2-xxxi](#)

- [Displaying FCIP Profile Information, page 2-xxxi](#)

### Minimum Retransmit Timeout

You can control the minimum amount of time TCP waits before retransmitting. By default, this value is 200 milliseconds.

To configure the minimum retransmit time, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-profile)# tcp min-retransmit-time 500</code>	Specifies the minimum TCP retransmit time for the TCP connection to be 500 milliseconds. The default is 200 milliseconds and the range is from 200 to 5000 milliseconds.
Step 2	<code>switch(config-profile)# no tcp min-retransmit-time 500</code>	(Optional) Reverts the minimum TCP retransmit time to the factory default of 200 milliseconds.

### Keepalive Timeout

You can configure the interval that the TCP connection uses to verify that the FCIP link is functioning. This ensures that an FCIP link failure is detected quickly even when there is no traffic.

If the TCP connection is idle for more than the specified time, then keepalive timeout packets are sent to ensure that the connection is active. The keepalive timeout feature can be used to tune the time taken to detect FCIP link failures.

You can configure the first interval during which the connection is idle (the default is 60 seconds). When the connection is idle for the configured interval, eight keepalive probes are sent at 1-second interval. If no response is received for these eight probes and the connection remains idle throughout, then the FCIP link is automatically closed.



**Note** Only the first interval (during which the connection is idle) can be changed.

To configure the first keepalive timeout interval, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-profile)# tcp keepalive-timeout 120</code>	Specifies the keepalive timeout interval for the TCP connection in seconds (120). The range is from 1 to 7200 seconds.
Step 2	<code>switch(config-profile)# no tcp keepalive-timeout 120</code>	(Optional) Reverts the keepalive timeout interval to the default 60 seconds.

### Maximum Retransmissions

You can specify the maximum number of times a packet is retransmitted before TCP decides to close the connection.

To configure maximum retransmissions, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-profile)# tcp max-retransmissions 6</code>	Specifies the maximum number of retransmissions (6). The range is from 1 to 8 retransmissions.
Step 2	<code>switch(config-profile)# no tcp max-retransmissions 6</code>	(Optional) Reverts to the default of 4 retransmissions.

## Maximum Retransmission Threshold for OBFL Logging

FCIP links utilize peer to peer TCP sessions. The intermediate network is often Ethernet which is not lossless and may drop frames. These are automatically retransmitted by the TCP sender. End applications should be able to tolerate some degree of delay caused by retransmissions. However, some applications may have a lower tolerance for retransmissions than others. Excessive TCP retransmission events are logged to OBFL to assist in troubleshooting. The threshold retransmission rate that will trigger logging can be configured. This retransmission rate is measured per FCIP profile.

To configure the OBFL retransmission rate per FCIP profile, follow these steps:

	Command	Purpose
Step 1	switch# <b>configure terminal</b>	Enters the global configuration mode.
Step 2	switch(config)# <b>fcip profile profile_id</b>	Creates a profile (if it does not already exist) and enters profile configuration submode. The range is from 1 to 255.
Step 3	switch(config-profile)# <b>tcp obfl max-retransmissions_pkt_thresh value</b>  or  switch(config-profile)# <b>tcp logging onboard tcp-retransmission-threshold value</b>	Specifies the threshold for logging the TCP retransmission rate to OBFL, that is, the number of packets retransmitted per 10000 packets measured every minute. The range is from 5 to 10. The default value is 5.  Starting from Cisco MDS Release 8.4(1), the <b>tcp obfl max-retransmissions_pkt_thresh value</b> command is deprecated. Use the <b>tcp logging onboard tcp-retransmission-threshold value</b> command to configure the TCP retransmission rate to OBFL. The range is from 0.01 to 0.10. The default value is 0.05%.
Step 4	switch# <b>show logging onboard error-stats</b>	Displays the excessive FCIP retransmission logs.

## Path MTUs

Path MTU (PMTU) is the minimum MTU on the IP network between the two endpoints of the FCIP link. PMTU discovery is a mechanism by which TCP learns of the PMTU dynamically and adjusts the maximum TCP segment accordingly (RFC 1191).

By default, PMTU discovery is enabled on all switches with a timeout of 3600 seconds. If TCP reduces the size of the maximum segment because of PMTU change, the reset-timeout specifies the time after which TCP tries the original MTU.

To configure PMTU, follow these steps:

	Command	Purpose
Step 1	switch(config-profile)# <b>no tcp pmtu-enable</b>	Disables PMTU discovery.
Step 2	switch(config-profile)# <b>tcp pmtu-enable</b>	Enables (default) PMTU discovery with the default value of 3600 seconds.
Step 3	switch(config-profile)# <b>tcp pmtu-enable reset-timeout 90</b>	Specifies the PMTU reset timeout to 90 seconds. The range is 60 to 3600 seconds.
Step 4	switch(config-profile)# <b>no tcp pmtu-enable reset-timeout 600</b>	Leaves PMTU discovery enabled but reverts the timeout to the default of 3600 seconds.

## Selective Acknowledgments

TCP may experience poor performance when multiple packets are lost within one window. With the limited information available from cumulative acknowledgments, a TCP sender can only learn about a single lost packet per round trip. A selective acknowledgment (SACK) mechanism helps overcome the limitations of multiple lost packets during a TCP transmission.

The receiving TCP sends back SACK advertisements to the sender. The sender can then retransmit only the missing data segments. By default, SACK is enabled on Cisco MDS 9000 Family switches.

To configure SACK, follow these steps:

	Command	Purpose
Step 1	switch(config-profile)# <b>no tcp sack-enable</b>	Disables SACK.
Step 2	switch(config-profile)# <b>tcp sack-enable</b>	Enables SACK (default).

## Window Management

The optimal TCP window size is automatically calculated using the maximum bandwidth parameter, the minimum available bandwidth parameter, and the dynamically measured round-trip time (RTT).



### Note

The configured **round-trip-time** parameter determines the window scaling factor of the TCP connection. This parameter is only an approximation. The measured RTT value overrides the **round trip** time parameter for window management. If the configured **round-trip-time** is too small compared to the measured RTT, then the link may not be fully utilized due to the window scaling factor being too small.

The **min-available-bandwidth** parameter and the measured RTT together determine the threshold below which TCP aggressively maintains a window size sufficient to transmit at minimum available bandwidth.

The **max-bandwidth-mbps** parameter and the measured RTT together determine the maximum window size.



### Note

Set the maximum bandwidth to match the worst-case bandwidth available on the physical link, considering other traffic that might be going across this link (for example, other FCIP links, WAN limitations). Maximum bandwidth should be the total bandwidth minus all other traffic going across that link.



### Note

In Cisco MDS 9250i Multiservice Fabric Switch, you can configure the TCP maximum bandwidth up to 5 Gbps. We recommend that the minimum available bandwidth is 80% of the maximum bandwidth.

To configure window management, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-profile)# tcp max-bandwidth-mbps 900 min-available-bandwidth-mbps 300 round-trip-time-ms 10</code>	Configures the maximum available bandwidth at 900 Mbps, the minimum slow start threshold at 300 Mbps, and the RTT at 10 milliseconds.
Step 2	<code>switch(config-profile)# no tcp max-bandwidth-mbps 900 min-available-bandwidth-mbps 300 round-trip-time-ms 10</code>	(Optional) Reverts to the factory defaults. The FCIP defaults are maximum bandwidth at 1 Gbps, minimum available bandwidth at 500 Mbps, and RTT at 1 milliseconds.
Step 3	<code>switch(config-profile)# tcp max-bandwidth-kbps 2000 min-available-bandwidth-kbps 2000 round-trip-time-us 200</code>	Configures the maximum available bandwidth at 2000 Kbps, the minimum available bandwidth at 2000 Kbps, and the RTT at 200 milliseconds.

## Monitoring Congestion

By enabling the congestion window monitoring (CWM) parameter, you allow TCP to monitor congestion after each idle period. The CWM parameter also determines the maximum burst size allowed after an idle period. By default, this parameter is enabled and the default burst size is 50 KB.

The interaction of bandwidth parameters and CWM and the resulting TCP behavior is outlined as follows:

- If the average rate of the Fibre Channel traffic over the preceding RTT is less than the min-available-bandwidth multiplied by the RTT, the entire burst is sent immediately at the min-available-bandwidth rate, provided no TCP drops occur.
- If the average rate of the Fibre Channel traffic is greater than min-available-bandwidth multiplied by the RTT, but less than max-bandwidth multiplied by the RTT, then if the Fibre Channel traffic is transmitted in burst sizes smaller than the configured CWM value the entire burst is sent immediately by FCIP at the max-bandwidth rate.
- If the average rate of the Fibre Channel traffic is larger than the min-available-bandwidth multiplied by the RTT and the burst size is greater than the CWM value, then only a part of the burst is sent immediately. The remainder is sent with the next RTT.

The software uses standard TCP rules to increase the window beyond the one required to maintain the min-available-bandwidth to reach the max-bandwidth.



### Tip

We recommend that this feature remains enabled to realize optimal performance. Increasing the CWM burst size can result in more packet drops in the IP network, impacting TCP performance. Only if the IP network has sufficient buffering, try increasing the CWM burst size beyond the default to achieve lower transmit latency.

To change the CWM defaults, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-profile)# no tcp cwm</code>	Disables congestion monitoring.
Step 2	<code>switch(config-profile)# tcp cwm</code>	Enables congestion monitoring and sets the burst size to its default size. The default burst size is 50 KB.



	Command	Purpose
Step 3	switch(config-profile)# <b>tcp cwm burstsize 30</b>	Changes the burst size to 30 KB. The valid range is from 10 to 100 KB.
Step 4	switch(config-profile)# <b>no tcp cwm burstsize 25</b>	(Optional) Leaves the CWM feature in an enabled state but changes the burst size to its factory default.

## Displaying FCIP Profile Information

Use the **show fcip profile** command to display FCIP profile information for the Cisco MDS 9250i Multiservice Fabric Switch:

```
switch# show fcip profile 1
Internet address is 209.165.200.226 (interface IPStorage5/4.101)
Listen Port is 3225
TCP parameters
  SACK is enabled
  PMTU discovery is enabled, reset timeout is 3600 sec
  Keep alive is 60 sec
  Minimum retransmission timeout is 200 ms
  Maximum number of re-transmissions is 4
  Maximum number of obfl re-transmission Thresh is 5
  Maximum allowed bandwidth is 5000000 kbps
  Minimum available bandwidth is 4000000 kbps
  Configured round trip time is 1000 usec
  Congestion window monitoring is enabled, burst size is 50 KB
  Auto jitter detection is enabled
```

Use the **show fcip profile** command to display FCIP profile information for the 24/10 port SAN Extension module:

```
switch# show fcip profile 41
FCIP Profile 41
Internet Address is 209.165.200.225 (interface IPStorage5/4.101)
Listen Port is 3225
TCP parameters
  SACK is enabled
  PMTU discovery is enabled, reset timeout is 3600 sec
  Keep alive is 60 sec
  Minimum retransmission timeout is 200 ms
  Maximum number of re-transmissions is 4
  Maximum number of obfl re-transmission Thresh is 6
  Maximum allowed bandwidth is 10000000 kbps
  Minimum available bandwidth is 8000000 kbps
  Configured round trip time is 1000 usec
  Congestion window monitoring is enabled, burst size is 50 KB
  Auto jitter detection is enabled
```

## Advanced FCIP Interface Configuration

This section describes the options you can configure on an FCIP interface to establish connection to a peer and includes the following topics:

- [Assigning a Peer IP Address, page 2-xxxii](#)
- [Configuring Number of TCP Connections, page 2-xxxiii](#)

- [Configuring Active Connections, page 2-xxxiv](#)
- [Enabling Time Stamp Control, page 2-xxxiv](#)
- [Configuring Active Connections, page 2-xxxiv](#)

To establish a peer connection, you must first create the FCIP interface and enter the config-if submode.

To enter the config-if submode, follow these steps:

	Command	Purpose
Step 1	switch# <b>configure terminal</b>	Enters configuration mode.
Step 2	switch(config)# <b>interface fcip 100</b>	Creates an FCIP interface (100).

Each IPStorage interface can have three FCIP links configured at a time. For Cisco MDS 9250i, each IPStorage port can have six FCIP links configured at a time. For Cisco MDS 24/10-Port SAN Extension Module, each IPStorage port can have three FCIP links configured at a time.

## Configuring Peers

All the FCIP and E port parameters are configured in context to the FCIP interface. To create an FCIP link, assign a profile to the FCIP interface and configure the peer information on the two switches at the ends of the FCIP link. The peer IP switch information causes the switch to initiate an FCIP link to that peer switch. The basic FCIP configuration uses the peer's IP address to configure the peer information. You can establish an FCIP link with the peer using the Peer IP address option. This option configures both ends of the FCIP link. Optionally, you can also use the peer TCP port along with the IP address.

## Configuring Peer Information

### Assigning a Peer IP Address

The basic FCIP configuration uses the peer's IP address to configure the peer information. You can also specify the peer's port number to configure the peer information. If you do not specify a port, the default 3225 port number is used to establish a connection. You can specify an IPv4 address or an IPv6 address.

To assign the peer information based on the IPv4 address and port number, follow these steps:

	Command	Purpose
Step 1	switch(config-if)# <b>peer-info ipaddr 10.1.1.1</b>	Assigns an IPv4 address to configure the peer information. Because no port is specified, the default port number (3225) is used.
Step 2	switch(config-if)# <b>peer-info ipaddr 10.1.1.1 port 3000</b>	Assigns the IPv4 address and sets the peer TCP port to 3000. The valid port number range is 0 to 65535.
Step 3	switch(config-if)# <b>no shutdown</b>	Enables the interface.

To assign the peer information based on the IPv6 address and port number, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-if)# peer-info ipaddr</code>	Assigns an IPv6 address to configure the peer information. Because no port is specified, the default port number (3225) is used.
	<code>switch(config-if)# no peer-info ipaddr 2001:0db8:800:200c::417a</code>	Deletes the assigned peer port information.
Step 2	<code>switch(config-if)# peer-info ipaddr 2001:0db8:800:200c::417a port 3000</code>	Assigns the IPv6 address and sets the peer TCP port to 3000. The valid port number range is 0 to 65535.
	<code>switch(config-if)# no peer-info ipaddr 2001:0db8:800:200c::417a port 3000</code>	Deletes the assigned peer port information.
Step 3	<code>switch(config-if)# no shutdown</code>	Enables the interface.
Step 4	<code>switch(config-if)# interface IPStorage slot-number/plot-number</code>	Enters IPStorage interface configuration mode.
Step 5	<code>switch(config-if)# shutdown</code>	Disable the interface.
Step 6	<code>switch(config-if)# ipv6 enable</code>	Enables IPv6 processing on the interface.
Step 7	<code>switch(config-if)# no shutdown</code>	Enables the interface.

## Configuring Number of TCP Connections

You can specify the number of TCP connections used for an FCIP link to be either two or five connections. By default, FCIP uses two connections for each link. Connection 0 is the FCIP control connection. The remaining one or four TCP connections are used for data.



### Note

Make sure that the peer switch FCIP link is also configured with the same number of TCP connections, otherwise FCIP link will not come up.



### Note

On the Cisco MDS platform, 10 Gb IPStorage ports have different performance characteristics than 1 Gb Ethernet ports. To achieve maximum throughput on FCIP links utilizing MDS 10 Gb IPStorage ports, set the number of TCP connections to 5 on these links.

To specify the TCP connection attempts, follow these steps:

	Command	Purpose
Step 1	<code>switch# configure terminal</code>	Enters global configuration mode.
Step 2	<code>switch(config)# interface fcip 4</code>	Enters FCIP interface configuration mode.
Step 3	<code>switch(config-if)# shutdown</code>	Disables the interface.
Step 4	<code>switch(config-if)# tcp-connection 5</code>	Specifies the number of TCP connections. Valid values are 2 or 5.

	Command	Purpose
Step 5	<code>switch(config-if)# no tcp-connection</code>	(Optional) Reverts to the factory set default of two TCP sessions per FCIP interface.
Step 6	<code>switch(config-if)# no shutdown</code>	Enables the interface.



**Note** To change the number of TCP connections ensure that the FCIP interface is shut down first.

## Configuring Active Connections

You can configure the mode for initiating a TCP connection. By default, the active mode is enabled to actively attempt an IP connection. If you enable the passive mode, the switch does not initiate a TCP connection but waits for the peer to connect to it. By default, the switch tries two TCP connections for each FCIP link.



**Note** Ensure that both ends of the FCIP link are not configured as passive mode. If both ends are configured as passive, the connection is not initiated.

To configure the passive mode, follow these steps:

	Command	Purpose
Step 1	<code>switch(config-if)# passive-mode</code>	Enables passive mode while attempting a TCP connection.
Step 2	<code>switch(config-if)# no passive-mode</code>	Reverts to the factory set default of using the active mode while attempting the TCP connection.
Step 3	<code>switch(config-if)# no shutdown</code>	Enables the interface.

## Enabling Time Stamp Control

You can configure the switch to discard packets that are outside a specified time range. When enabled, this feature specifies the time range within which packets can be accepted. If the packet arrived within the range specified by this option, the packet is accepted. Otherwise, it is dropped.

By default, time stamp control is disabled in all switches in the Cisco MDS 9000 Family. When enabled, if a packet arrives within a 2000 millisecond interval (+ or -2000 milliseconds) from the network time that packet is accepted.



**Note** If the **time-stamp** option is enabled, ensure to configure NTP on both switches (see the *Cisco NX-OS Fundamentals Configuration Guide* for more information).



**Tip** Do not enable time stamp control on an FCIP interface that has tape acceleration or Write Acceleration configured.

To enable or disable the time stamp control, follow these steps:

	Command	Purpose
Step 1	switch(config-if)# <b>time-stamp</b> Please enable NTP with a common time source on both MDS Switches that are on either side of the FCIP link	Enables time stamp checking for received packets with a default acceptable time difference of 2000 milliseconds.
Step 2	switch(config-if)# <b>no time-stamp</b>	(Optional) Disables (default) time stamps.
Step 3	switch(config-if)# <b>time-stamp acceptable-diff 4000</b>	Configures the packet acceptance time. The valid range is from 500 to 10,000 millisecond.
Step 4	switch(config-if)# <b>no time-stamp acceptable-diff 500</b>	(Optional) Deletes the configured time difference and reverts the difference to factory defaults. The default difference is a 2000-millisecond interval from the network time.
Step 5	switch(config-if)# <b>no shutdown</b>	Enables the interface.

## Quality of Service

The quality of service (QoS) parameter specifies the differentiated services code point (DSCP) value to mark all IP packets (type of service—TOS field in the IP header).

- The control DSCP value applies to all FCIP frames in the control TCP connection.
- The data DSCP value applies to all FCIP frames in the data connection.

If the FCIP link has only one TCP connection, that data DSCP value is applied to all packets in that connection.

To set the QoS values on FCIP interfaces, follow these steps:

	Command	Purpose
Step 1	switch(config-if)# <b>qos control 24 data 26</b>	Configures the control TCP connection and data connection to mark all packets on that DSCP value. The control and data value ranges from 0 to 63.
	switch(config-if)# <b>no qos control 24 data 26</b>	Reverts the switch to its factory default (marks all control and data packets with DCSP value 0).

## Configuring E Ports

You configure FCIP interfaces in the same way as you configure FC (T)E interfaces. Specifically, the following features are available for FCIP interfaces:

- An FCIP interface can be a member of any VSAN  
See the *Cisco Fabric Configuration Guide* and *Cisco MDS 9000 Family NX-OS Fabric Configuration Guide*.
- Trunk mode and trunk allowed VSANs  
See the *Cisco Fabric Manager Interfaces Configuration Guide* and *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide*.
- Port Channels
  - Multiple FCIP links can be bundled into a Fibre Channel Port Channel.

- FCIP links and Fibre Channel links cannot be combined in one Port Channel.

See the *Cisco Fabric Manager Security Configuration Guide* and *Cisco MDS 9000 Family NX-OS Security Configuration Guide*.

- FSPF

See the *Cisco Fabric Manager Fabric Configuration Guide* and *Cisco MDS 9000 Family NX-OS Fabric Configuration Guide*.

- Importing and exporting the zone database from the adjacent switch

See the *Cisco Fabric Manager System Management Configuration Guide* and *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*.

## Displaying FCIP Interface Information

Use the **show interface** commands to view the summary, counter, description, and status of the FCIP link. Use the output of these commands to verify the administration mode, the interface status, the operational mode, the related VSAN ID, and the profile used. See [Example 2-3](#) through [Example 2-7](#).

### Example 2-3 Displaying the FCIP Summary

```
switch# show fcip summary
```

Tun	prof	IPS-if	peer-ip	Status	T	W	T	Enc	Comp	Bandwidth	rtt
					E	A	A			max/min	(us)
1	1	IPS1/1	20.1.1.2	TRNK	Y	N	N	N	A	5000M/4000M	1000
2	2	IPS1/1	20.1.1.2	TRNK	Y	N	N	N	A	1000M/800M	1000
3	3	IPS1/1	20.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
4	4	IPS1/1	20.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
5	5	IPS1/1	20.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
6	6	IPS1/1	20.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
7	7	IPS1/2.1	30.1.1.2	TRNK	Y	N	N	N	M2	1000M/800M	1000
8	8	IPS1/2.2	31.1.1.2	TRNK	Y	N	N	N	M2	1000M/800M	1000
9	9	IPS1/2.3	32.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
10	10	IPS1/2.4	33.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
11	11	IPS1/2.5	34.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000
12	12	IPS1/2.6	35.1.1.2	DOWN	N	N	N	N	N	1000M/800M	1000

### Example 2-4 Displaying the FCIP Interface Summary of Counters for a Specified Interface

```
switch# show interface fcip 1
```

```
fcip1 is trunking
  Hardware is IPStorage
  Port WWN is 20:2b:00:2a:6a:1b:60:70
  Peer port WWN is 20:62:8c:60:4f:73:d7:80
  Admin port mode is auto, trunk mode is on
  snmp link state traps are enabled
  Port mode is TE
  Port vsan is 1
  Operating Speed is 5 Gbps
  Trunk vsans (admin allowed and active) (1)
  Trunk vsans (up) (1)
  Trunk vsans (isolated) ()
  Trunk vsans (initializing) ()
```

Interface last changed at Wed Nov 27 15:12:25 2019

Using Profile id 1 (interface IPStorage1/1)

Peer Information

Peer Internet address is 10.1.1.6 and port is 3225  
 Write acceleration mode is configured off  
 Tape acceleration mode is configured off  
 Tape Accelerator flow control buffer size is automatic  
 FICON XRC Accelerator is configured off  
 Ficon Load Balancer configured off for all vsans  
 Ficon Tape acceleration configured off for all vsans  
 IP Compression is enabled and set for mode2  
 Maximum number of TCP connections is 5  
 QOS control code point is 0  
 QOS data code point is 0  
 TCP Connection Information  
 5 Active TCP connections  
 27 Attempts for active connections, 2 close of connections  
 Path MTU 1500 bytes  
 Current retransmission timeout is 6400 ms  
 Current Send Buffer Size: 87080 KB, Requested Send Buffer Size: 62500 KB  
 CWM Burst Size: 50 KB

CONN<0>

Data connection: Local 10.1.1.12:65489, Remote 10.1.1.6:3225

TCP Parameters

Advertized window: Current: 24580 KB, Maximum: 24580 KB, Scale: 6  
 Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7  
 Congestion window: Current: 7372 KB, Slow start threshold: 8094 KB  
 Measured RTT : 500000 us Min RTT: 500000 us Max RTT: 0 us  
 Round trip time: Smoothed 0 ms, Variance: 100 Jitter: 150 us

TCP Connection Rate

Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec  
 Input Frames: 0/sec, Output Frames: 0/sec

CONN<1>

Data connection: Local 10.1.1.12:65487, Remote 10.1.1.6:3225

TCP Parameters

Advertized window: Current: 487 KB, Maximum: 24580 KB, Scale: 6  
 Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7  
 Congestion window: Current: 870 KB, Slow start threshold: 8094 KB  
 Measured RTT : 500000 us Min RTT: 7573 us Max RTT: 0 us  
 Round trip time: Smoothed 8 ms, Variance: 4 Jitter: 150 us

TCP Connection Rate

Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec  
 Input Frames: 0/sec, Output Frames: 0/sec

CONN<2>

Data connection: Local 10.1.1.12:65485, Remote 10.1.1.6:3225

TCP Parameters

Advertized window: Current: 477 KB, Maximum: 24580 KB, Scale: 6  
 Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7  
 Congestion window: Current: 853 KB, Slow start threshold: 8094 KB  
 Measured RTT : 500000 us Min RTT: 7419 us Max RTT: 0 us  
 Round trip time: Smoothed 8 ms, Variance: 4 Jitter: 150 us

TCP Connection Rate

Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec  
 Input Frames: 0/sec, Output Frames: 0/sec

CONN<3>

Data connection: Local 10.1.1.12:65483, Remote 10.1.1.6:3225

TCP Parameters

Advertized window: Current: 488 KB, Maximum: 24580 KB, Scale: 6  
 Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7  
 Congestion window: Current: 872 KB, Slow start threshold: 8094 KB  
 Measured RTT : 500000 us Min RTT: 7590 us Max RTT: 0 us  
 Round trip time: Smoothed 8 ms, Variance: 4 Jitter: 150 us

TCP Connection Rate

```

Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
Input Frames: 0/sec, Output Frames: 0/sec
CONN<4>
Control connection: Local 10.1.1.12:65481, Remote 10.1.1.6:3225
TCP Parameters
  Advertized window: Current: 335 KB, Maximum: 24580 KB, Scale: 6
  Peer receive window: Current: 8125 KB, Maximum: 8125 KB, Scale: 7
  Congestion window: Current: 50 KB, Slow start threshold: 8069 KB
  Measured RTT : 18 us Min RTT: 18 us Max RTT: 23 us
  Round trip time: Smoothed 1 ms, Variance: 1 Jitter: 150 us
TCP Connection Rate
  Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
  Input Frames: 0/sec, Output Frames: 0/sec
  5 minutes input rate 208 bits/sec, 26 bytes/sec, 0 frames/sec
  5 minutes output rate 272 bits/sec, 34 bytes/sec, 0 frames/sec
  1658 frames input, 174756 bytes
    1658 Class F frames input, 174756 bytes
    0 Class 2/3 frames input, 0 bytes
    0 Reass frames
    0 Error frames timestamp error 0
  1663 frames output, 202836 bytes
    1663 Class F frames output, 202836 bytes
    0 Class 2/3 frames output, 0 bytes
    0 Error frames

```

### Example 2-5 Displaying the FCIP Interface Summary of Counters for a Specified Interface

```

switch# show interface fcip 1

fcip1 is trunking
  Hardware is IPStorage
  Port WWN is 20:62:8c:60:4f:73:d7:80
  Peer port WWN is 20:2b:00:2a:6a:1b:60:70
  Admin port mode is auto, trunk mode is on
  snmp link state traps are enabled
  Port mode is TE
  Port vsan is 1
  Operating Speed is 10000 Mbps
  Trunk vsans (admin allowed and active) (1)
  Trunk vsans (up) (1)
  Trunk vsans (isolated) ()
  Trunk vsans (initializing) ()
  Interface last changed at Tue Nov 26 15:16:55 2019

Using Profile id 1 (interface IPStorage2/3)
Peer Information
  Peer Internet address is 10.1.1.12 and port is 3225
  Write acceleration mode is configured off
  Tape acceleration mode is configured off
  Tape Accelerator flow control buffer size is automatic
  FICON XRC Accelerator is configured off
  Ficon Load Balancer configured off for all vsans
  Ficon Tape acceleration configured off for all vsans
  IP Compression is enabled and set for mode2
  Maximum number of TCP connections is 5
  QOS control code point is 0
  QOS data code point is 0
TCP Connection Information
  5 Active TCP connections
  23 Attempts for active connections, 5 close of connections
  Path MTU 1500 bytes
  Current retransmission timeout is 200 ms
  Current Send Buffer Size: 149580 KB, Requested Send Buffer Size: 125000 KB

```



```

CWM Burst Size: 50 KB
CONN<0>
Data connection: Local 10.1.1.6:3225, Remote 10.1.1.12:65489
TCP Parameters
  Advertized window: Current: 24580 KB, Maximum: 24580 KB, Scale: 7
  Peer receive window: Current: 4095 KB, Maximum: 4095 KB, Scale: 6
  Congestion window: Current: 3686 KB, Slow start threshold: 3998 KB
  Measured RTT : 500000 us Min RTT: 500000 us Max RTT: 0 us
  Round trip time: Smoothed 24 ms, Variance: 12 Jitter: 150 us
TCP Connection Rate
  Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
  Input Frames: 0/sec, Output Frames: 0/sec
CONN<1>
Data connection: Local 10.1.1.6:3225, Remote 10.1.1.12:65487
TCP Parameters
  Advertized window: Current: 24580 KB, Maximum: 24580 KB, Scale: 7
  Peer receive window: Current: 487 KB, Maximum: 487 KB, Scale: 6
  Congestion window: Current: 438 KB, Slow start threshold: 462 KB
  Measured RTT : 500000 us Min RTT: 500000 us Max RTT: 0 us
  Round trip time: Smoothed 24 ms, Variance: 12 Jitter: 150 us
TCP Connection Rate
  Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
  Input Frames: 0/sec, Output Frames: 0/sec
CONN<2>
Data connection: Local 10.1.1.6:3225, Remote 10.1.1.12:65485
TCP Parameters
  Advertized window: Current: 24580 KB, Maximum: 24580 KB, Scale: 7
  Peer receive window: Current: 477 KB, Maximum: 477 KB, Scale: 6
  Congestion window: Current: 429 KB, Slow start threshold: 453 KB
  Measured RTT : 500000 us Min RTT: 500000 us Max RTT: 0 us
  Round trip time: Smoothed 24 ms, Variance: 12 Jitter: 150 us
TCP Connection Rate
  Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
  Input Frames: 0/sec, Output Frames: 0/sec
CONN<3>
Data connection: Local 10.1.1.6:3225, Remote 10.1.1.12:65483
TCP Parameters
  Advertized window: Current: 24580 KB, Maximum: 24580 KB, Scale: 7
  Peer receive window: Current: 488 KB, Maximum: 488 KB, Scale: 6
  Congestion window: Current: 439 KB, Slow start threshold: 463 KB
  Measured RTT : 500000 us Min RTT: 500000 us Max RTT: 0 us
  Round trip time: Smoothed 24 ms, Variance: 12 Jitter: 150 us
TCP Connection Rate
  Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
  Input Frames: 0/sec, Output Frames: 0/sec
CONN<4>
Control connection: Local 10.1.1.6:3225, Remote 10.1.1.12:65481
TCP Parameters
  Advertized window: Current: 8123 KB, Maximum: 24580 KB, Scale: 7
  Peer receive window: Current: 334 KB, Maximum: 334 KB, Scale: 6
  Congestion window: Current: 50 KB, Slow start threshold: 373 KB
  Measured RTT : 19 us Min RTT: 20 us Max RTT: 25 us
  Round trip time: Smoothed 1 ms, Variance: 1 Jitter: 150 us
TCP Connection Rate
  Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
  Input Frames: 0/sec, Output Frames: 0/sec
5 minutes input rate 288 bits/sec, 36 bytes/sec, 0 frames/sec
5 minutes output rate 224 bits/sec, 28 bytes/sec, 0 frames/sec
1130 frames input, 137324 bytes
  1130 Class F frames input, 137324 bytes
  0 Class 2/3 frames input, 0 bytes
  0 Reass frames
  0 Error frames timestamp error 0
1132 frames output, 119060 bytes

```

```

1132 Class F frames output, 119060 bytes
0 Class 2/3 frames output, 0 bytes
0 Error frames

```

### Example 2-6 Displaying Detailed FCIP Interface Standard Counter Information

```

switch# show interface fcip 1 counters
fcip1
  TCP Connection Information
    5 Active TCP connections
    27 Attempts for active connections, 2 close of connections
    Path MTU 1500 bytes
    Current retransmission timeout is 6400 ms
    Current Send Buffer Size: 87080 KB, Requested Send Buffer Size: 62500 KB
    CWM Burst Size: 50 KB
CONN<0>
  Data connection: Local 10.1.1.12:65489, Remote 10.1.1.6:3225
  TCP Parameters
    Advertized window: Current: 24580 KB, Maximum: 24580 KB, Scale: 6
    Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7
    Congestion window: Current: 7372 KB, Slow start threshold: 8094 KB
    Measured RTT : 500000 us Min RTT: 500000 us Max RTT: 0 us
    Round trip time: Smoothed 0 ms, Variance: 100 Jitter: 150 us
  TCP Connection Rate
    Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
    Input Frames: 0/sec, Output Frames: 0/sec
CONN<1>
  Data connection: Local 10.1.1.12:65487, Remote 10.1.1.6:3225
  TCP Parameters
    Advertized window: Current: 487 KB, Maximum: 24580 KB, Scale: 6
    Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7
    Congestion window: Current: 870 KB, Slow start threshold: 8094 KB
    Measured RTT : 500000 us Min RTT: 7573 us Max RTT: 0 us
    Round trip time: Smoothed 8 ms, Variance: 4 Jitter: 150 us
  TCP Connection Rate
    Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
    Input Frames: 0/sec, Output Frames: 0/sec
CONN<2>
  Data connection: Local 10.1.1.12:65485, Remote 10.1.1.6:3225
  TCP Parameters
    Advertized window: Current: 477 KB, Maximum: 24580 KB, Scale: 6
    Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7
    Congestion window: Current: 853 KB, Slow start threshold: 8094 KB
    Measured RTT : 500000 us Min RTT: 7419 us Max RTT: 0 us
    Round trip time: Smoothed 8 ms, Variance: 4 Jitter: 150 us
  TCP Connection Rate
    Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
    Input Frames: 0/sec, Output Frames: 0/sec
CONN<3>
  Data connection: Local 10.1.1.12:65483, Remote 10.1.1.6:3225
  TCP Parameters
    Advertized window: Current: 488 KB, Maximum: 24580 KB, Scale: 6
    Peer receive window: Current: 8191 KB, Maximum: 8191 KB, Scale: 7
    Congestion window: Current: 872 KB, Slow start threshold: 8094 KB
    Measured RTT : 500000 us Min RTT: 7590 us Max RTT: 0 us
    Round trip time: Smoothed 8 ms, Variance: 4 Jitter: 150 us
  TCP Connection Rate
    Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
    Input Frames: 0/sec, Output Frames: 0/sec
CONN<4>
  Control connection: Local 10.1.1.12:65481, Remote 10.1.1.6:3225
  TCP Parameters
    Advertized window: Current: 333 KB, Maximum: 24580 KB, Scale: 6

```

```

Peer receive window: Current: 8122 KB, Maximum: 8122 KB, Scale: 7
Congestion window: Current: 50 KB, Slow start threshold: 8069 KB
Measured RTT : 500000 us Min RTT: 18 us Max RTT: 0 us
Round trip time: Smoothed 1 ms, Variance: 1 Jitter: 150 us
TCP Connection Rate
Input Bytes: 0.00 MB/sec, Output Bytes: 0.00 MB/sec
Input Frames: 0/sec, Output Frames: 0/sec
5 minutes input rate 224 bits/sec, 28 bytes/sec, 0 frames/sec
5 minutes output rate 288 bits/sec, 36 bytes/sec, 0 frames/sec
1686 frames input, 177260 bytes
  1686 Class F frames input, 177260 bytes
  0 Class 2/3 frames input, 0 bytes
  0 Reass frames
  0 Error frames timestamp error 0
1691 frames output, 206072 bytes
  1691 Class F frames output, 206072 bytes
  0 Class 2/3 frames output, 0 bytes
  0 Error frames
IP compression statistics
83360 rxbytes
  55942 rxbytes compressed, 0 rxbytes non-compressed
  1.49 rx compression ratio
99132 txbytes
  64015 txbytes compressed, 1152 txbytes non-compressed
  1.52 tx compression ratio
IP compression flow control statistics
0 bytes queued for hw compression
0 queued for hardware compression
0 queued for hardware decompression
0 slowed tcp flow control
0 accelerated tcp flow control
0 side band flow control ON
2346 side band flow control OFF
IP compression hung statistics
0 times compression engine hung detected
0 jobs replayed for hardware compression
0 jobs replayed for hardware decompression
0 compression jobs not processed during compression engine reset
0 compression response job not processed during compression engine reset
0 decompression jobs not processed during decompression engine reset
0 decompression response job not processed during decompression engine reset

```

### Example 2-7 Displaying the FCIP Interface Description

```

switch# show interface fcip 51 description
FCIP51
Sample FCIP interface

```

The transmitted bytes shown in the total *txbytes* counter is the amount of data before compression. After compression, the compressed *txbytes* bytes are transmitted with compression and the uncompressed *txbytes* bytes are transmitted without compression. A packet may be transmitted without compression, if it becomes bigger after compression (see [Example 2-4](#) and [Example 2-5](#)).

### Example 2-8 Displaying Brief FCIP Interface Counter Information (Cisco MDS 9250i Multiservice Fabric Switch)

```

switch# show interface fcip 1-12 counters brief
-----
Interface          Input (rate is 5 min avg)      Output (rate is 5 min avg)
-----
Rate      Total          Rate      Total
-----

```

	MB/s	Frames	MB/s	Frames
fcip1	191	1155974124	225	1363537690
fcip2	173	1046686124	227	1372311228
fcip3	0	0	0	0
fcip4	0	0	0	0
fcip5	0	0	0	0
fcip6	0	0	0	0
fcip7	189	1143612956	221	1339130294
fcip8	194	1167499884	218	1317700800
fcip9	0	0	0	0
fcip10	0	0	0	0
fcip11	0	0	0	0
fcip12	0	0	0	0

**Example 2-9 Displaying Brief FCIP Interface Counter Information (24/10 port SAN Extension Module)**

```
switch# show interface fcip 41 counters brief
```

Interface	Input (rate is 5 min avg)		Output (rate is 5 min avg)	
	Rate	Total	Rate	Total
	MB/s	Frames	MB/s	Frames
fcip41	191	1155974124	225	1363537690

## Advanced FCIP Features

You can significantly improve application performance by configuring one or more of the following options for the FCIP interface:

- [FCIP Write Acceleration, page 2-xlii](#)
- [Configuring FCIP Write Acceleration, page 2-xlv](#)
- [Displaying Write Acceleration Activity Information, page 2-xlv](#)
- [FCIP Tape Acceleration, page 2-xlvi](#)
- [Configuring FCIP Tape Acceleration, page 2-li](#)
- [Displaying Tape Acceleration Activity Information, page 2-li](#)
- [FCIP Compression, page 2-liii](#)
- [Configuring FCIP Compression, page 2-liv](#)
- [Displaying FCIP Compression Information, page 2-liv](#)
- [Configuring FCIP Links for Maximum Performance, page 2-lv](#)

### FCIP Write Acceleration

The FCIP Write Acceleration feature enables you to significantly improve the application write performance when storage traffic is routed over wide area networks using FCIP. When FCIP Write Acceleration is enabled, WAN throughput is maximized by acknowledging the write frames from the sender at the closer FCIP switch, thereby eliminating the impact of WAN latency for write operations. The Write Acceleration feature is disabled by default and must be enabled on both sides of the FCIP link.

**Note**

FCIP links using Write Acceleration (WA) must be ensured that all accelerated flows go through a single FCIP link (or port channel). This applies to both commands and responses in both directions. If that does not occur, then FCIP WA will fail. Consequently, FCIP WA cannot be used across FSPF equal cost paths because commands and responses could take different paths.

**Note**

Ensure that all FCIP links in a port channel have the same attributes such as 2 or 5 connections, WA, TA, and so on. Otherwise, you will encounter undesirable results during an upgrade.

**Note**

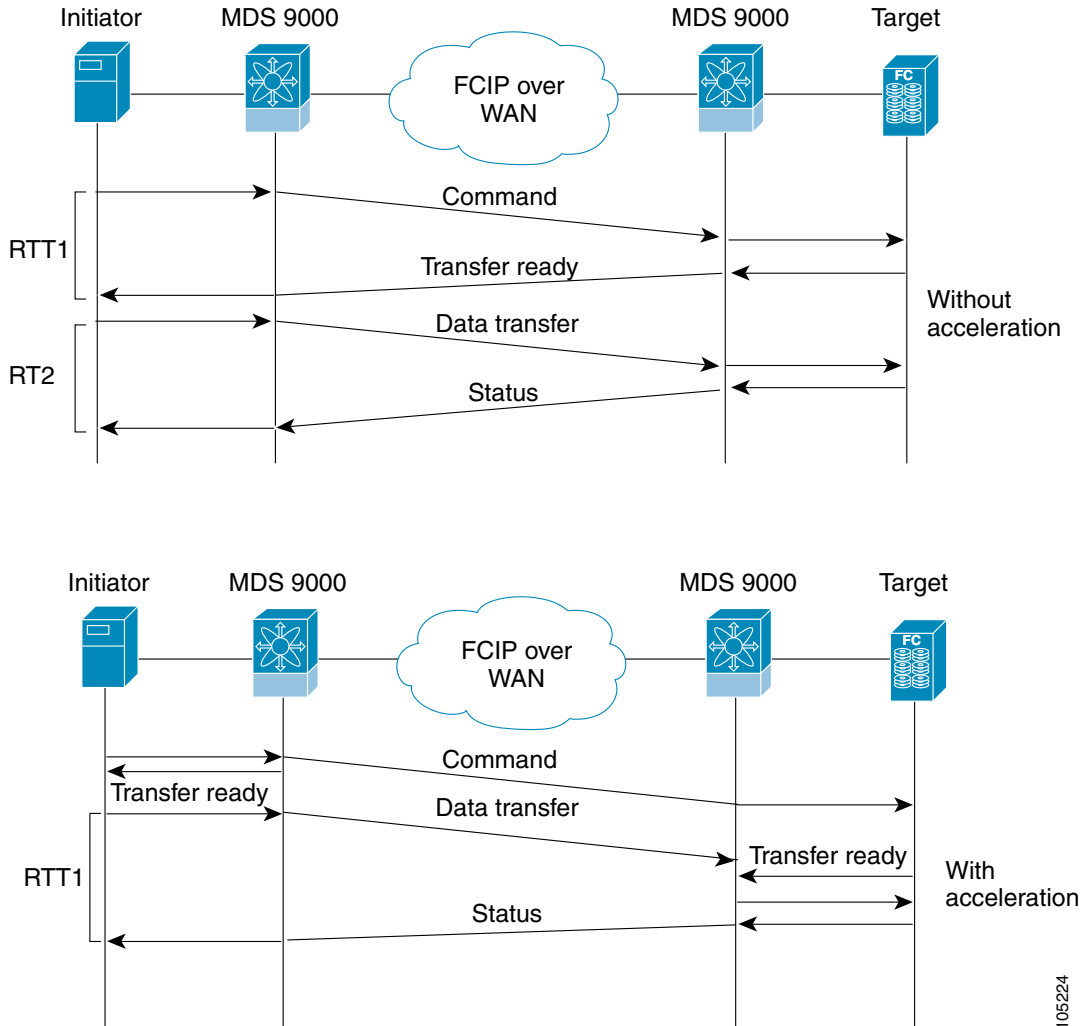
The FCIP Write Acceleration feature accelerates FC standard compliant SCSI WRITE commands only.

**Note**

IBM Peer-to-Peer Remote Copy (PPRC) is not supported by FCIP Write Acceleration.

In [Figure 2-9](#), the SCSI WRITE command without Write Acceleration requires two round-trip transfers (RTT), while the SCSI WRITE command with Write Acceleration only requires one RTT. The maximum sized Transfer Ready is sent from the host side of the FCIP link back to the host before the SCSI WRITE command reaches the target. This enables the host to start sending the write data without waiting for the long latency over the FCIP link of the SCSI WRITE command and Transfer Ready. It also eliminates the delay caused by multiple Transfer Readys needed for the exchange going over the FCIP link.

Figure 2-9 FCIP Link Write Acceleration

**Tip**

FCIP Write Acceleration (WA) can be enabled for multiple FCIP links if the links are part of a port channel configured with "channel mode active". These are port channels constructed with Port Channel Protocol (PCP). Write Acceleration cannot be used across FSPF equal cost paths in FCIP deployments. Native Fibre Channel Write Acceleration can be used with port channels. Also, FCIP Write Acceleration can be used in port channels configured with channel mode active or constructed with Port Channel Protocol (PCP). FCIP WA does not work if multiple non-port channel FCIP links exist with equal cost between the initiator and the target ports. This configuration might cause either SCSI discovery failure or failed WRITE or READ operations. When FCIP WA is used the FSPF routing should ensure that a single FCIP Port-Channel or ISL is always in the path between the initiator and the target ports.

Only one FCIP port channel is supported per VSAN on FCIPs configured on Cisco MDS 9700 Series switches with Write Acceleration configured.

**Tip**

Do not enable time stamp control on an FCIP interface with Write Acceleration configured.

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**Note**

From Cisco MDS NX-OS Release 7.3(1)DY(1) and later, FCIP Write Acceleration can be enabled when FCIP port channels are configured between a Cisco MDS 9250i switch and a Cisco MDS 24/10 port SAN Extension Module in a Cisco MDS 9700 Director.

Ensure that the following prerequisites are met before enabling Write Acceleration:

- Use the **fcip-enhanced** command on the Cisco MDS 9220i and MDS 9250i switches while creating new port channels for FCIP ports. For more information on creating port channels, see the [Configuring Port Channels](#) chapter in the Cisco MDS 9000 Series Interfaces Configuration Guide. For more information on the **fcip-enhanced** command, see the [Cisco MDS 9000 Series Command Reference](#).
- When you configure FCIP port channels between Cisco MDS 9250i and MDS 9700 switches and if write acceleration is enabled on the FCIP ports, then ensure that you enable write acceleration on the FCIP port-channels using the **fcip-enhanced** command on the Cisco MDS 9250i switch. For more information on creating port channels, see the [Configuring Port Channels](#) chapter in the Cisco MDS 9000 Series Interfaces Configuration Guide. For more information on the **fcip-enhanced** command, see the [Cisco MDS 9000 Series Command Reference](#).
- Use the **show port-channel database** command to ensure that only FCIP interfaces are members of port channels.
- Enable **passive-mode** on FCIP interfaces created on a Cisco MDS 24/10 port SAN Extension Module in a Cisco MDS 9700 Director. For more information on enabling passive mode, see the [Configuring Active Connections](#) section.

**Note**

In Cisco MDS NX-OS Release 8.1(1) and later, Write Acceleration on FCIP port channels should not be configured between two MDS 9700 Series switches with Cisco MDS 24/10 port SAN Extension Module under the following conditions:

- If traffic flows between an FCoE port and an FC port through an FCIP port channel.
- If traffic flows through two successive FCIP port channels, one after another.

## Configuring FCIP Write Acceleration

To enable Write Acceleration, follow these steps:

	Command	Purpose
Step 1	switch1# <b>configure terminal</b>	Enters configuration mode.
Step 2	switch1(config)# <b>interface fcip 51</b>	Creates an FCIP interface (51).
Step 3	switch1(config-if)# <b>write-accelerator</b>	Enables Write Acceleration.

## Displaying Write Acceleration Activity Information

[Example 2-10](#) through [Example 2-12](#) show how to display information about Write Acceleration activity.

**Example 2-10 Displaying the Exchanges Processed by Write Acceleration at the Specified Host-End FCIP Link**

```
switch# show fcip host-map 100

MAP TABLE (5 entries TOTAL entries 5)

  OXID | RXID | HOST FCID| TARG FCID| VSAN |  Index
-----+-----+-----+-----+-----+-----
0xd490|0xffff|0x00690400|0x00620426|0x0005|0x0000321f
0xd4a8|0xffff|0x00690400|0x00620426|0x0005|0x00003220
0xd4c0|0xffff|0x00690400|0x00620426|0x0005|0x00003221
0xd4d8|0xffff|0x00690400|0x00620426|0x0005|0x00003222
0xd4f0|0xffff|0x00690400|0x00620426|0x0005|0x00003223
```

**Example 2-11 Displaying Exchanges Processed by Write Acceleration at the Specified Target End FCIP Link**

```
switch# show fcip target-map 100

MAP TABLE (3 entries TOTAL entries 3)

  OXID | RXID | HOST FCID| TARG FCID| VSAN |  Index
-----+-----+-----+-----+-----+-----
0xc308|0xffff|0x00690400|0x00620426|0x0005|0x00003364
0xc320|0xffff|0x00690400|0x00620426|0x0005|0x00003365
0xc338|0xffff|0x00690400|0x00620426|0x0005|0x00003366
```

**Example 2-12 Displaying Detailed FCIP Interface Write Acceleration Counter Information**

```
switch# show interface fcip 4 counters
fcip4
  TCP Connection Information
  ...
  Write Accelerator statistics
    6091 packets in      5994 packets out
    0 frames dropped  0 CRC errors
    0 rejected due to table full
    0 ABTS sent      0 ABTS received
    0 tunnel synchronization errors
    37 writes recd      37 XFER_RDY sent (host)
    0 XFER_RDY rcvd (target)
    37 XFER_RDY rcvd (host)
    0 XFER_RDY not proxied due to flow control (host)
    0 bytes queued for sending
    0 estimated bytes queued on the other side for sending
    0 times TCP flow ctrl(target)
    0 bytes current TCP flow ctrl(target)
```

## FCIP Tape Acceleration

The FCIP Tape Acceleration feature enables you to significantly improve application write performance when storage traffic is routed over wide area networks using FCIP. When FCIP Tape Acceleration is enabled, WAN throughput is maximized by acknowledging the frames from the sender at the closer FCIP switch, thereby eliminating the impact of WAN latency for write operations. The FCIP TAPE Acceleration feature is disabled by default and must be enabled on both sides of the FCIP link.

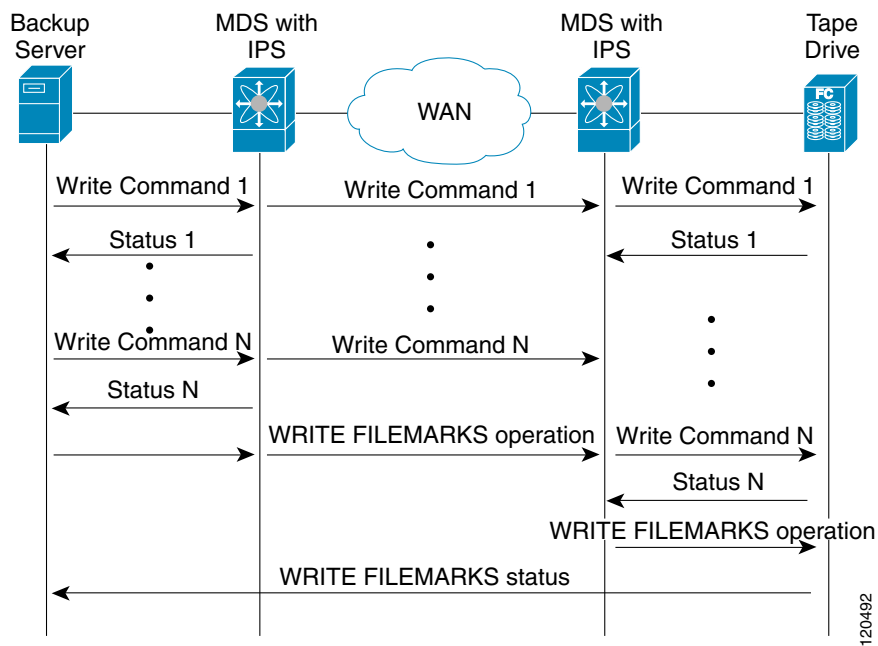


Tapes are storage devices that store and retrieve user data sequentially. Cisco MDS NX-OS provides both tape write and read acceleration.

Applications that access tape drives normally have only one SCSI WRITE or READ operation outstanding to it. This single command process limits the benefit of the tape acceleration feature when using an FCIP link over a long-distance WAN link. It impacts backup and performance because each SCSI WRITE or READ operation does not complete until the host receives a good status response from the tape drive. The FCIP tape acceleration feature helps solve this problem. It improves tape backup, archive, and restore operations by allowing faster data streaming between the host and tape drive over the WAN link.

In an example of tape acceleration for write operations, the backup server in [Figure 2-10](#) issues write operations to a drive in the tape library. Acting as a proxy for the remote tape drives, the local Cisco MDS switch proxies a transfer ready to signal the host to start sending data. After receiving all the data, the local Cisco MDS switch proxies the successful completion of the SCSI WRITE operation. This response allows the host to start the next SCSI WRITE operation. This proxy method results in more data being sent over the FCIP link in the same time period compared to the time taken to send data without proxying. The proxy method improves the performance on WAN links.

**Figure 2-10 FCIP Link Tape Acceleration for Write Operations**



At the tape end of the FCIP link, another Cisco MDS switch buffers the command and data it has received. It then acts as a backup server to the tape drive by listening to a transfer ready from the tape drive before forwarding the data.

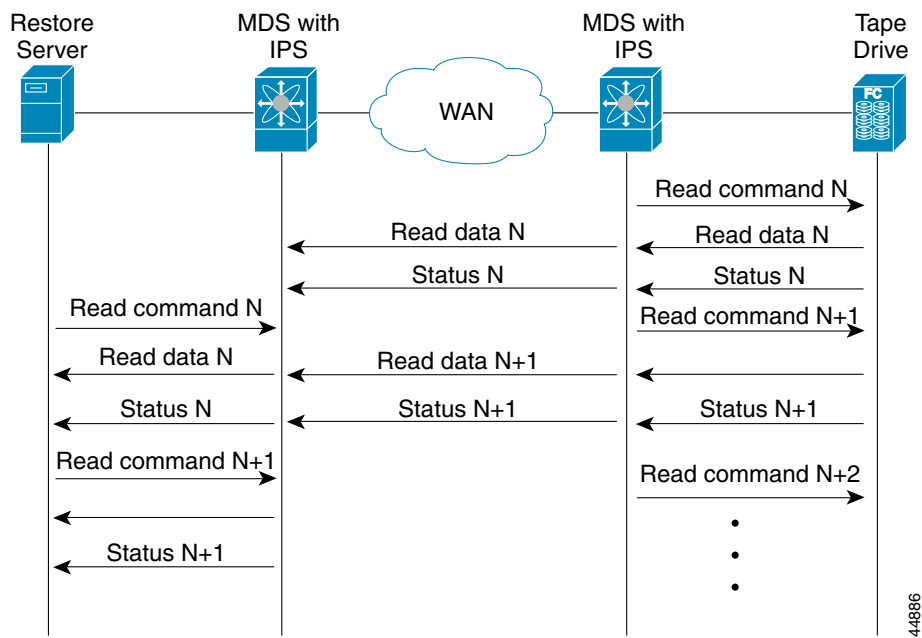
**Note**

In some cases such as a quick link up/down event (FCIP link, Server/Tape Port link) in a tape library environment that exports Control LUN or a Medium Changer as LUN 0 and tape drives as other LUNs, tape acceleration may not detect the tape sessions and may not accelerate these sessions. You need to keep the FCIP link disabled for a couple of minutes before enabling the link. This does not apply to tape environments where the tape drives are either direct FC attached or exported as LUN 0.

The Cisco NX-OS provides reliable data delivery to the remote tape drives using TCP/IP over the WAN. It maintains write data integrity by allowing the WRITE FILEMARKS operation to complete end-to-end without proxying. The WRITE FILEMARKS operation signals the synchronization of the buffer data with the tape library data. While tape media errors are returned to backup servers for error handling, tape busy errors are retried automatically by the Cisco NX-OS software.

In an example of tape acceleration for read operations, the restore server in Figure 2-11 issues read operations to a drive in the tape library. During the restore process, the remote Cisco MDS switch at the tape end, in anticipation of more SCSI read operations from the host, sends out SCSI read operations on its own to the tape drive. The prefetched read data is cached at the local Cisco MDS switch. The local Cisco MDS switch on receiving SCSI read operations from the host, sends out the cached data. This method results in more data being sent over the FCIP link in the same time period compared to the time taken to send data without read acceleration for tapes. This improves the performance for tape reads on WAN links.

**Figure 2-11 FCIP Link Tape Acceleration for Read Operations**



The Cisco NX-OS provides reliable data delivery to the restore application using TCP/IP over the WAN. While tape media errors during the read operation are returned to the restore server for error handling, the Cisco NX-OS software recovers from any other errors.



**Note**

The FCIP tape acceleration feature is disabled by default and must be enabled on both sides of the FCIP link. If it is only enabled on one side of the FCIP link, the tape acceleration feature is operationally off.



**Tip**

FCIP tape acceleration does not work if the FCIP port is part of a port channel or if there are multiple paths between the initiator and the target port. Such a configuration might cause either SCSI discovery failure or broken write or read operations.

When tape acceleration is enabled in an FCIP interface, a FICON VSAN cannot be enabled in that interface. Likewise, if an FCIP interface is up in a FICON VSAN, tape acceleration cannot be enabled on that interface.

**Note**

When you enable the tape acceleration feature for an FCIP link, the link is reinitialized and the write and read acceleration feature is also automatically enabled.

In tape acceleration for writes, after a certain amount of data has been buffered at the remote Cisco MDS switch, the write operations from the host are flow controlled by the local Cisco MDS switch by not proxying the Transfer Ready. On completion of a write operation when some data buffers are freed, the local Cisco MDS switch resumes the proxying. Likewise, in tape acceleration for reads, after a certain amount of data has been buffered at the local Cisco MDS switch, the read operations to the tape drive are flow controlled by the remote Cisco MDS switch by not issuing any further reads. On completion of a read operation, when some data buffers are freed, the remote Cisco MDS switch resumes issuing reads.

The default flow control buffering uses the **automatic** option. This option takes the WAN latencies and the speed of the tape into account to provide optimum performance. You can also specify a flow control buffer size (the maximum buffer size is 12 MB).

We recommend that you use the default option for flow-control buffering.

**Note**

Starting from Cisco MDS NX-OS Release 7.3(0)DY(1), FCIP tape acceleration will work with five TCP connections.

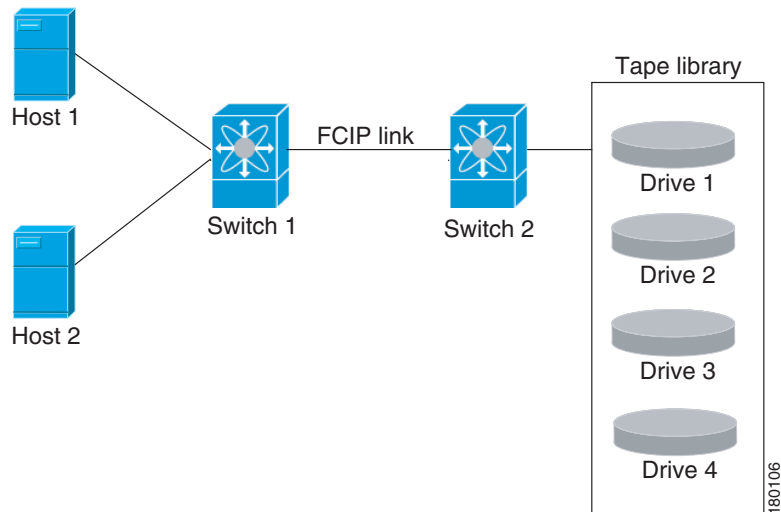
**Tip**

Do not enable time-stamp control on an FCIP interface with tape acceleration configured.

### Tape Library LUN Mapping for FCIP Tape Acceleration

If a tape library provides logical unit (LU) mapping and FCIP tape acceleration is enabled, you must assign a unique LU number (LUN) to each physical tape drive accessible through a target port.

[Figure 2-12](#) shows tape drives connected to Switch 2 through a single target port. If the tape library provides LUN mapping, then all the four tape drives should be assign unique LUNs.

**Figure 2-12 FCIP LUN Mapping Example**

For the mappings described in [Table 2-2](#) and [Table 2-3](#), Host 1 has access to Drive 1 and Drive 2, and Host 2 has access to Drive 3 and Drive 4.

[Table 2-2](#) describes correct tape library LUN mapping.

**Table 2-2 Correct LUN Mapping Example with Single Host Access**

Host	LUN Mapping	Drive
Host 1	LUN 1	Drive 1
	LUN 2	Drive 2
Host 2	LUN 3	Drive 3
	LUN 4	Drive 4

[Table 2-3](#) describes incorrect tape library LUN mapping.

**Table 2-3 Incorrect LUN Mapping Example with Single Hosts Access**

Host	LUN Mapping	Drive
Host 1	LUN 1	Drive 1
	LUN 2	Drive 2
Host 2	LUN 1	Drive 3
	LUN 2	Drive 4

Another example setup is when a tape drive is shared by multiple hosts through a single tape port. For instance, Host 1 has access to Drive 1 and Drive 2, and Host 2 has access to Drive 2, Drive 3, and Drive 4. A correct LUN mapping configuration for such a setup is shown in [Table 2-4](#).

**Table 2-4 Correct LUN Mapping Example with Multiple Host Access**

Host	LUN Mapping	Drive
Host 1	LUN 1	Drive 1
	LUN 2	Drive 2

**Table 2-4 Correct LUN Mapping Example with Multiple Host Access**

Host	LUN Mapping	Drive
Host 2	LUN 2	Drive 2
	LUN 3	Drive 3
	LUN 4	Drive 4

## Configuring FCIP Tape Acceleration



**Note** In an FCIP tape acceleration link, if the trunk mode is **on** for TA enabled links, then the trunk mode allowed VSAN should be configured such that each VSAN's traffic passes through only one link. If the traffic passes through multiple links, it may cause traffic failures.

To enable FCIP tape acceleration, follow these steps:

	Command	Purpose
<b>Step 1</b>	<code>switch1# configure terminal</code>	Enters configuration mode.
<b>Step 2</b>	<code>switch1(config)# interface fcip 5</code>	Creates an FCIP interface (5).
<b>Step 3</b>	<code>switch1(config-if)# write-accelerator tape-accelerator</code>	Enables tape acceleration (and Write Acceleration—if not already enabled).
<b>Step 4</b>	<code>switch1(config-if)# write-accelerator tape-accelerator flow-control-buffer-size auto</code>	Enables tape acceleration with automatic flow control (default).
<b>Step 5</b>	<code>switch1(config-if)# write-accelerator tape-accelerator flow-control-buffer-size 2048</code>	Sets tape acceleration flow control buffer size to 2 MB.
<b>Step 6</b>	<code>switch1(config-if)# no write-accelerator tape-accelerator</code>	(Optional) Disables tape acceleration (default) and resets the FCIP link.  <b>Note</b> The Write Acceleration feature remains enabled.
<b>Step 7</b>	<code>switch1(config-if)# no write-accelerator tape-accelerator flow-control-buffer-size 2048</code>	(Optional) Changes the flow control buffer size to the default value of automatic. The tape acceleration and Write Acceleration features remain enabled. This command does not reset the FCIP link.
<b>Step 8</b>	<code>switch1(config-if)# no write-accelerator</code>	(Optional) Disables both the Write Acceleration and tape acceleration features and resets the FCIP link.

## Displaying Tape Acceleration Activity Information

[Example 2-13](#) through [Example 2-16](#) show how to display information about tape acceleration activity.

### **Example 2-13 Displaying Information About Tapes for Which Exchanges are Tape Accelerated**

```
switch# show fcip tape-session summary
```

-----

Tunnel	Tunnel End	host-fcid	tape-fcid	lun	vsan	TCP Connection
16	host-end	0x7c0006	0x390006	0x0000	3000	0
16	host-end	0x7c0004	0x390004	0x0000	3000	0
16	host-end	0x7c0003	0x390003	0x0000	3000	0
16	host-end	0x7c0007	0x390007	0x0000	3000	0
16	host-end	0x7c0005	0x390005	0x0000	3000	0
16	host-end	0x7c0000	0x390000	0x0000	3000	0
16	host-end	0x7c0002	0x390002	0x0000	3000	0

**Example 2-14 Displaying Information About Tapes for Which Exchanges are Tape Accelerated at the Host-End FCIP Link**

```
switch# show fcip tape-session tunnel 1 host-end

HOST TAPE SESSIONS (1 entries TOTAL entries 1)

Host Tape Session #1
  FCID 0xEF0001, VSAN 1, LUN 0x0002
  Outstanding Exchanges 0, Outstanding Writes 0
  Target End Write Buffering 0 Bytes, Auto Max Writes 3
  Flags 0x0, FSM state Non TA Mode
  Cached Reads 0
  First index 0xffffffff7, Last index 0xffffffff7, RA index 0x0000f99a
  Current index=0xffffffffe, Els Oxid 0xfff7
  Hosts 1
    FCID 0x770100
```

**Example 2-15 Displaying Information About Tapes for Which Exchanges are Tape Accelerated at the Target-End FCIP Link**

```
switch# show fcip tape-session tunnel 1 targ-end

TARGET TAPE SESSIONS (1 entries TOTAL entries 1)

Target Tape Session #1
  FCID 0xEF0001, VSAN 1, LUN 0x0002
  Outstanding Exchanges 0, Outstanding Writes 0
  Host End Read Buffering 0 Bytes, Auto Max Read Blocks 3
  Flags 0x800, Timer Flags 0x0
  FSM State Default, Prev FSM State Bypass
  Relative Block offset 0
  First index 0xffffffff7, Last index 0xffffffff7, RA index 0x0000f99a
  Current index=0xffffffffe, Els Oxid 0xfff7
  Hosts 1
    FCID 0x770100
```

**Example 2-16 Displays Detailed FCIP Interface Tape Acceleration Counter Information, if Enabled**

```
switch# show interface fcip 1 counters
fcip1
  TCP Connection Information
  ....
  Tape Accelerator statistics
    1 Host Tape Sessions
    0 Target Tape Sessions
  Host End statistics
    Received 31521 writes, 31521 good status, 0 bad status
```

```

Sent 31517 proxy status, 4 not proxied
Estimated Write buffer 0 writes 0 bytes
Received 31526 reads, 10 status
Sent 31516 cached reads
Read buffer 0 reads, 0 bytes
Host End error recovery statistics
Sent REC 0, received 0 ACCs, 0 Rejects
Sent ABTS 0, received 0 ACCs
Received 31 RECs, sent 2 ACCs, 0 Rejects
Received 0 SRRs, sent 0 ACCs, 0 Rejects
Received 0 TMF commands
Target End statistics
Received 0 writes, 0 good status, 0 bad status
Write Buffer 0 writes, 0 bytes
Received 0 reads, 0 good status, 0 bad status
Sent 0 reads, received 0 good status, 0 bad status
Sent 0 rewinds, received 0 good status, 0 bad status
Estimated Read buffer 0 reads, 0 bytes
Target End error recovery statistics
Sent REC 0, received 0 ACCs, 0 Rejects
Sent SRR 0, received 0 ACCs
Sent ABTS 0, received 0 ACCs
Received 0 TMF commands

```

## FCIP Compression

The FCIP compression option allows IP packets to be compressed on an FCIP link. This option is enabled per FCIP link. The FCIP maximum bandwidth configuration is calculated on the size of the FC frames. Since compression is done at the IP layer and FC is above the IP layer, enabling compression will not cause FCIP interfaces to transmit more than without it (that is, not increase FC throughput). Rather, it helps in reducing the amount of IP traffic sent over the IP network (that is, reduces the IP load). By default, FCIP compression is disabled. When enabled without specifying a compression mode, a compression algorithm appropriate for the FCIP service engine and link speed (as configured in the TCP parameters of the FCIP profile) is automatically used.



### Note

The main purpose of the FCIP compression feature is to increase throughput on low bandwidth IP connections which are hitting maximum bandwidth usage. Depending on the IP Services switch or module used, the performance of the built-in IP compression engine can be significantly lower than the maximum line rate of IPStorage ports. Therefore, configuring FCIP compression on high bandwidth links can be detrimental to the overall application level performance.

The Cisco MDS 9250i switch and Cisco 24/10 port SAN Extension Module supports Auto, Mode1 and Mode2 compression modes. All of these modes internally use the hardware compression engine in the module. Auto mode is enabled by default. Mode2 uses a larger batch size for compression than Auto-mode, which results in higher compression throughput. However, Mode2 incurs a small latency due to the compression throughput. For those deployments where aggressive throughput is most important, Mode2 can be used. Mode1 gives the best compression ratio when compared to all other modes. For those deployments where compression ratio is most important, Mode1 can be used.



### Note

If both ends of an FCIP link are running Cisco MDS NX-OS Release 8.1(1) or later, and you enable compression at one end of the FCIP link, be sure to enable it at the other end of the link also.

**Note**

When using FCIP compression, the rates specified in **tcp max-bandwidth-xxxx** and **min-available-bandwidth-xxxx** in the FCIP profile are in compressed bites.

## Configuring FCIP Compression

To enable FCIP compression, follow these steps:

	Command	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters configuration mode.
<b>Step 2</b>	switch(config)# <b>interface fcip 51</b>	Creates an FCIP interface (51).
<b>Step 3</b>	switch(config-if)# <b>ip-compression mode2</b>	Enables high compression.
<b>Step 4</b>	switch(config-if)# <b>ip-compression auto</b>	(Optional) Defaults to using the <b>auto</b> mode.
<b>Step 5</b>	switch(config-if)# <b>no ip-compression</b>	(Optional) Disables (default) the FCIP compression feature.

## Displaying FCIP Compression Information

[Example 2-17](#) and [Example 2-19](#) show how to display FCIP compression information.

### **Example 2-17 Displaying Detailed FCIP Interface Compression Information, if Enabled**

```
switch# show interface fcip 4 counters
fcip4
  TCP Connection Information
  ...
  IP compression statistics
    208752 rxbytes, 208752 rxbytes compressed
    5143584 txbytes
      0 txbytes compressed, 5143584 txbytes non-compressed
      1.00 tx compression ratio
```

### **Example 2-18 Displaying the Compression Engine Statistics for the 9250i**

```
switch# (config-vsan-db)# show ips stats hw-comp interface IPStorage 1/1
HW Compression statistics for port IPStorage1/1
  Compression stats
    10444189094728 input bytes, 2822607905236 output compressed bytes
    85952406 input pkts, 85952065 output compressed pkts
  Decompression stats
    8596899248 input compressed bytes, 27669956608 output bytes
    45879853 input compressed pkts, 45879669 output pkts
  Passthru stats
    0 input bytes, 0 output bytes
    0 input pkts, 0 output pkts
  Miscellaneous stats
    0 min input pktlen, 638570 max input pktlen
    0 min output pktlen, 185641 max output pktlen
    0 len mismatch, 0 incomplete processing
    0 invalid result, 0 invalid session drop
    0 comp expanded
  Errors stats
```



```

0 decomp tx error, 0 post comp error
0 post decomp error, 0 comp packets expanded

```

### Example 2-19 Displaying the Compression Engine Statistics for 24/10 port SAN Extension Module

```

switch# show ips stats hw-comp interface iPStorage 5/1

HW Compression statistics for port IPStorage5/1
  Compression stats
    53280732 input bytes, 44561835 output compressed bytes
    544700 input pkts, 544700 output compressed pkts
  Decompression stats
    41760802 input compressed bytes, 49574684 output bytes
    511886 input compressed pkts, 511886 output pkts
  Passthru stats
    0 input bytes, 0 output bytes
    0 input pkts, 0 output pkts
  Miscellaneous stats
    0 min input pktlen, 3816 max input pktlen
    0 min output pktlen, 1485 max output pktlen
    0 len mismatch, 0 incomplete processing
    0 invalid result, 0 invalid session drop
    0 comp expanded
  Errors stats
    0 decomp tx error, 0 post comp error
    0 post decomp error, 0 comp packets expanded

```

## Configuring FCIP Links for Maximum Performance

This section describes how to configure FCIP links for optimum performance between two Cisco MDS 9250i switches, or two 24/10 port SAN Extension Modules. We recommend that the maximum and minimum bandwidth parameters in an FCIP profile be the same on both the sides.



### Note

- FCIP links with a **tcp max-bandwidth-mbps** of 33 Mbps or less will result in FSPF cost of 30000. This makes the interface unusable. Starting from Cisco MDS NX-OS Releases 8.2(1), the FSPF cost for low bandwidth FCIP links is set to 28999. Because this value is less than the FSPF maximum cost of 30000, and it will allow the traffic to be routed across the interface. It also allows additional FC or FCoE hops (including the FCIP hop) in the end-to-end path. The total FSPF cost of these additional hops should not exceed 1000, because the path will not be usable. If the FSPF cost of 28999 is not applicable for a specific topology, it should be manually configured using the **fspf cost interface** configuration command. To check the FSPF cost of an interface, use the **show fspf interface** command. For more information on FSPF Cost, see the [Cisco MDS Fabric Configuration Guide](#).
- FSPF equal cost multipath (ECMP) cannot be used to load balance the traffic across different types of ISLs. In other words, two or more equal cost ISLs of a different type between two switches (e.g. FCIP + FC, or FCIP + FCoE) is not supported.
- On Cisco MDS 24/10 Port SAN Extension Module, configuring multiple ECMP port channels with FCIP members in the same VSAN is not a valid configuration. If this is configured, then traffic will flow through only one of the port channels.

## Configuring FCIP Links for Maximum Performance on a Cisco MDS 9250i Switch

To achieve maximum FCIP performance in 10 Gbps mode, the following configuration is recommended:

- 
- Step 1** Create an FCIP link on the IPStorage port.  
If more than two FCIP links are bound to an IPStorage interface at 10 Gbps, the combined maximum bandwidth of all links bound to that interface must not exceed 10 Gbps.
- Step 2** Set the TCP maximum and minimum bandwidth to 5000 Mbps and 4000 Mbps respectively (default value).
- Step 3** Configure five TCP connections on each FCIP link.
- Step 4** Set the MTU size to 2500 on the IPStorage port.
- 

To achieve maximum FCIP performance in 10 Gbps mode, follow these configuration steps:

	<b>Command</b>	<b>Purpose</b>
<b>Step 1</b>	<code>switch# configure terminal</code>	Enters global configuration mode.
<b>Step 2</b>	<code>switch(config)# fcip profile profile-id</code>	Configures an FCIP profile and enters FCIP profile configuration mode.
<b>Step 3</b>	<code>switch(config-profile)# ip address ip-address</code>	Assigns an IP address to the FCIP profile. The assigned IP address can be an IPv4 or an IPv6 address.
<b>Step 4</b>	<code>switch(config-profile)# tcp max-bandwidth-mbps 5000 min-available-bandwidth-mbps 4000 round-trip-time-ms milliseconds</code>	Sets the maximum and minimum available bandwidth of the FCIP link to 5000 Mbps and 4000 Mbps respectively, and configures the round-trip time in milliseconds.
<b>Step 5</b>	<code>switch(config-profile)# exit</code>	Exits FCIP profile configuration mode and returns to global configuration mode.
<b>Step 6</b>	<code>switch(config)# interface fcip interface-number</code>	Enters FCIP interface configuration mode.
<b>Step 7</b>	<code>switch(config-if)# use-profile profile-id</code>	Binds the specified profile to the FCIP link.
<b>Step 8</b>	<code>switch(config-if)# peer-info ipaddr ip-address</code>	Configures the peer IP address (IPv4 or IPv6).
<b>Step 9</b>	<code>switch(config-if)# tcp-connections 5</code>	Sets the number of TCP connections to 5. This value must be the same at the peer end.
<b>Step 10</b>	<code>switch(config-if)# no shutdown</code>	Enables the FCIP interface.
<b>Step 11</b>	<code>switch(config-if)# exit</code>	Exits FCIP interface configuration mode and returns to global configuration mode.
<b>Step 12</b>	<code>switch(config)# interface IPStorage slot-number/port-number</code>	Enters IPStorage interface configuration mode.
<b>Step 13</b>	<code>switch(config-if)# ip address ip-address subnet-mask</code>	Assigns an IP address to the interface.
<b>Step 14</b>	<code>switch(config-if)# switchport mtu 2500</code>	Sets the MTU size to 2500 for the interface. The valid range for MTU is from 576 to 9216.

	Command	Purpose
Step 15	switch(config-if)# <b>no shutdown</b>	Enables the interface.
Step 16	switch(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.

To achieve maximum FCIP performance in 1 Gbps mode, the following configuration is recommended:

**Step 1** Create an FCIP link on the IPStorage port.



**Note** If more than one FCIP link is bound to an IPStorage interface at 1 Gbps, the combined maximum bandwidth of all links bound to that interface must not exceed 1 Gbps.

**Step 2** Set the TCP maximum and minimum bandwidth as 1000 Mbps and 800 Mbps respectively.



**Note** If the TCP maximum bandwidth is set to any value more than 1000 Mbps, we recommend that you set the number of TCP connections to five.

**Step 3** Configure two TCP connections on each FCIP link.

**Step 4** Set the MTU size to 2500 for the IPStorage port.

**Step 5** Enable compression on each FCIP link.

To achieve maximum FCIP performance in 1 Gbps mode, follow these configuration steps:

	Command	Purpose
Step 1	switch# <b>configure terminal</b>	Enters global configuration mode.
Step 2	switch(config)# <b>fcip profile</b> <i>profile-id</i>	Configures an FCIP profile and enters FCIP profile configuration mode.
Step 3	switch(config-profile)# <b>ip address</b> <i>ip-address</i>	Assigns an IP address to the FCIP profile. The assigned IP address can be an IPv4 or an IPv6 address.
Step 4	switch(config-profile)# <b>tcp</b> <b>max-bandwidth-mbps</b> 1000 <b>min-available-bandwidth-mbps</b> 800 <b>round-trip-time-ms</b> <i>milliseconds</i>	Sets the maximum and minimum available bandwidth of the FCIP link to 1000 Mbps and 800 Mbps respectively, and configures the round-trip time in milliseconds.
Step 5	switch(config-profile)# <b>exit</b>	Exits FCIP profile configuration mode and returns to global configuration mode.
Step 6	switch(config)# <b>interface fcip</b> <i>interface-number</i>	Enters FCIP interface configuration mode.
Step 7	switch(config-if)# <b>use-profile</b> <i>profile-id</i>	Binds the specified profile to the FCIP link.
Step 8	switch(config-if)# <b>peer-info ipaddr</b> <i>ip-address</i>	Configures the peer IP address (IPv4 or IPv6).

	Command	Purpose
Step 9	switch(config-if)# <b>tcp-connections 2</b>	Sets the number of TCP connections to 2. This value must be the same at the peer end.
Step 10	switch(config-if)# <b>ip-compression mode2</b>	Sets the compression algorithm to <b>mode2</b> for the interface. The other modes that can be set are <b>auto</b> and <b>mode1</b> .
Step 11	switch(config-if)# <b>no shutdown</b>	Enables the FCIP interface.
Step 12	switch (config-if)# <b>exit</b>	Exits FCIP interface configuration mode and returns to global configuration mode.
Step 13	switch(config)# <b>interface IPStorage slot-number/port-number</b>	Enters IPStorage interface configuration mode.
Step 14	switch(config-if)# <b>ip address ip-address subnet-mask</b>	Assigns an IP address to the interface.
Step 15	switch(config-if)# <b>switchport mtu 2500</b>	Sets the MTU size to 2500 for the interface. The valid range for MTU is from 576 to 9216.
Step 16	switch(config-if)# <b>no shutdown</b>	Enables the interface.
Step 17	switch(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.

### Configuring FCIP Links for Maximum Performance on Cisco MDS 24/10 port SAN Extension Module and M9220i switch

To achieve maximum FCIP performance in 40 Gbps mode, the following configuration is recommended: The maximum bandwidth of FCIP tunnel is 10 Gbps. Therefore, configure four FCIP tunnels on the 40 Gbps IPS port.



#### Note

- For maximum performance, create four VLAN sub interfaces on the 40 Gbps IPStorage port. On each VLAN subinterface, create FCIP tunnel.
- Releases prior to Cisco MDS NX-OS Rel 9.3(1), the maximum throughput on a single FCIP tunnel on Cisco MDS 9220i is 7 Gbps. On the 40 Gbps IPS port, the maximum throughput is 28.5 Gbps when 4 FCIP tunnels are created on separate VLAN subinterfaces.
- From the Release Cisco MDS NX-OS Rel 9.3(1), the maximum throughput on a single FCIP tunnel on Cisco MDS 9220i is 10Gbps. On the 40 Gbps IPS port, the maximum throughput is 34.6 Gbps when 4 FCIP tunnels are created on separate VLAN subinterfaces.

To achieve maximum FCIP performance in 40 Gbps mode, follow these configuration steps to configure four FCIP tunnels:

- 
- Step 1** Create VLAN sub interfaces on the 40 Gbps IPStorage port.
  - Step 2** Create an FCIP link on each VLAN sub interface.
  - Step 3** Set the TCP maximum and minimum bandwidth to 10000 Mbps (10 Gbps) and 8000 Mbps (8Gbps) respectively (default value).
  - Step 4** Configure five TCP connections on each FCIP link.
  - Step 5** Set the MTU size to 2500 on the IPStorage port.
-

To achieve maximum FCIP performance in 40 Gbps mode, follow these configuration steps:

	<b>Command</b>	<b>Purpose</b>
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>interface IPStorage</b> <i>slot-number/port-number VLAN-ID</i>	Configure VLAN subinterface (VLAN ID) on 40 Gbps IPStorage port
<b>Step 3</b>	switch(config-if)# <b>ip address</b> <i>ip-address</i> <i>subnet-mask</i>	Assigns an IP address to the VLAN subinterface.
<b>Step 4</b>	switch(config-if)# <b>switchport mtu</b> 2500	Sets the MTU size to 2500 for the VLAN subinterface. The valid range for MTU is from 576 to 9216.
<b>Step 5</b>	switch(config-if)# <b>no shutdown</b>	Enables the VLAN subinterface.
<b>Step 6</b>	switch(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.
<b>Step 7</b>	switch(config)# <b>fcip profile</b> <i>profile-id</i>	Configures an FCIP profile and enters FCIP profile configuration mode.
<b>Step 8</b>	switch(config-profile)# <b>ip address</b> <i>ip-address</i>	Assign IP address of VLAN subinterface configured in Step 3 to the FCIP profile.
<b>Step 9</b>	switch(config-profile)# <b>tcp</b> <b>max-bandwidth-mbps</b> 10000 <b>min-available-bandwidth-mbps</b> 8000 <b>round-trip-time-ms</b> <i>milliseconds</i>	Sets the maximum and minimum available bandwidth of the FCIP link to 10000 Mbps and 8000 Mbps respectively, and configures the round-trip time in milliseconds.
<b>Step 10</b>	switch(config-profile)# <b>exit</b>	Exits FCIP profile configuration mode and returns to global configuration mode.
<b>Step 11</b>	switch(config)# <b>interface fcip</b> <i>interface-number</i>	Enters FCIP interface configuration mode.
<b>Step 12</b>	switch(config-if)# <b>use-profile</b> <i>profile-id</i>	Binds the specified profile to the FCIP link.
<b>Step 13</b>	switch(config-if)# <b>peer-info</b> <i>ipaddr</i> <i>ip-address</i>	Configures the peer IP address (IPv4 or IPv6).
<b>Step 14</b>	switch(config-if)# <b>tcp-connections</b> 5	Sets the number of TCP connections to 5. This value must be the same at the peer end.
<b>Step 15</b>	switch(config-if)# <b>no shutdown</b>	Enables the FCIP interface.
<b>Step 16</b>	switch(config-if)# <b>exit</b>	Exits FCIP interface configuration mode and returns to global configuration mode.

To achieve maximum FCIP performance in 25 Gbps mode, the following configuration is recommended: The maximum bandwidth of FCIP tunnel is 10 Gbps. Therefore, configure two FCIP tunnels on each 25 Gbps IPS port.



**Note**

For maximum performance, create two VLAN sub interfaces on each 25 Gbps IPStorage port. On each VLAN subinterface, create FCIP tunnel.

- Step 1** Create VLAN sub interfaces on the 25 Gbps IPStorage port.
- Step 2** Create an FCIP link on each VLAN sub interface.

- Step 3** Set the TCP maximum and minimum bandwidth to 10000 Mbps (10 Gbps) and 8000 Mbps (8Gbps) respectively (default value).
- Step 4** Configure five TCP connections on each FCIP link.
- Step 5** Set the MTU size to 2500 on the IPStorage port.

To achieve maximum FCIP performance in 25 Gbps mode, follow these configuration steps:

	<b>Command</b>	<b>Purpose</b>
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>interface IPStorage</b> <i>slot-number/port-number</i> VLAN-ID	Configure VLAN subinterface (VLAN ID) on 25Gbps IPStorage port
<b>Step 3</b>	switch(config-if)# <b>ip address</b> <i>ip-address</i> <i>subnet-mask</i>	Assigns an IP address to the VLAN subinterface.
<b>Step 4</b>	switch(config-if)# <b>switchport mtu</b> 2500	Sets the MTU size to 2500 for the VLAN subinterface. The valid range for MTU is from 576 to 9216.
<b>Step 5</b>	switch(config-if)# <b>no shutdown</b>	Enables the VLAN subinterface.
<b>Step 6</b>	switch(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.
<b>Step 7</b>	switch(config)# <b>fcip profile</b> <i>profile-id</i>	Configures an FCIP profile and enters FCIP profile configuration mode.
<b>Step 8</b>	switch(config-profile)# <b>ip address</b> <i>ip-address</i>	Assign IP address of VLAN subinterface configured in Step 3 to the FCIP profile.
<b>Step 9</b>	switch(config-profile)# <b>tcp</b> <b>max-bandwidth-mbps</b> 10000 <b>min-available-bandwidth-mbps</b> 8000 <b>round-trip-time-ms</b> <i>milliseconds</i>	Sets the maximum and minimum available bandwidth of the FCIP link to 10000 Mbps and 8000 Mbps respectively, and configures the round-trip time in milliseconds.
<b>Step 10</b>	switch(config-profile)# <b>exit</b>	Exits FCIP profile configuration mode and returns to global configuration mode.
<b>Step 11</b>	switch(config)# <b>interface fcip</b> <i>interface-number</i>	Enters FCIP interface configuration mode.
<b>Step 12</b>	switch(config-if)# <b>use-profile</b> <i>profile-id</i>	Binds the specified profile to the FCIP link.
<b>Step 13</b>	switch(config-if)# <b>peer-info ipaddr</b> <i>ip-address</i>	Configures the peer IP address (IPv4 or IPv6).
<b>Step 14</b>	switch(config-if)# <b>tcp-connections</b> 5	Sets the number of TCP connections to 5. This value must be the same at the peer end.
<b>Step 15</b>	switch(config-if)# <b>no shutdown</b>	Enables the FCIP interface.
<b>Step 16</b>	switch(config-if)# <b>exit</b>	Exits FCIP interface configuration mode and returns to global configuration mode.

To achieve maximum FCIP performance in 10 Gbps mode, the following configuration is recommended:



**Note**

In the releases prior to Cisco MDS NX-OS Release 9.3(1), the maximum throughput on a single FCIP tunnel is 7 Gbps. For maximum performance, create two fcip tunnels on 10 Gbps IPS ports.

- Step 1** Create an FCIP link on the IPStorage port.  
If more than two FCIP links are bound to an IPStorage interface at 10 Gbps, the combined maximum bandwidth of all links bound to that interface must not exceed 10 Gbps.
- Step 2** Set the TCP maximum and minimum bandwidth to 10000 Mbps and 8000 Mbps respectively (default value).
- Step 3** Configure five TCP connections on each FCIP link.
- Step 4** Set the MTU size to 2500 on the IPStorage port.

To achieve maximum FCIP performance in 10 Gbps mode, follow these configuration steps:

	<b>Command</b>	<b>Purpose</b>
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>fcip profile</b> <i>profile-id</i>	Configures an FCIP profile and enters FCIP profile configuration mode.
<b>Step 3</b>	switch(config-profile)# <b>ip address</b> <i>ip-address</i>	Assigns an IP address to the FCIP profile. The assigned IP address can be an IPv4 or an IPv6 address.
<b>Step 4</b>	switch(config-profile)# <b>tcp</b> <b>max-bandwidth-mbps</b> 10000 <b>min-available-bandwidth-mbps</b> 8000 <b>round-trip-time-ms</b> <i>milliseconds</i>	Sets the maximum and minimum available bandwidth of the FCIP link to 10000 Mbps and 8000 Mbps respectively, and configures the round-trip time in milliseconds.
<b>Step 5</b>	switch(config-profile)# <b>exit</b>	Exits FCIP profile configuration mode and returns to global configuration mode.
<b>Step 6</b>	switch(config)# <b>interface fcip</b> <i>interface-number</i>	Enters FCIP interface configuration mode.
<b>Step 7</b>	switch(config-if)# <b>use-profile</b> <i>profile-id</i>	Binds the specified profile to the FCIP link.
<b>Step 8</b>	switch(config-if)# <b>peer-info ipaddr</b> <i>ip-address</i>	Configures the peer IP address (IPv4 or IPv6).
<b>Step 9</b>	switch(config-if)# <b>tcp-connections</b> 5	Sets the number of TCP connections to 5. This value must be the same at the peer end.
<b>Step 10</b>	switch(config-if)# <b>no shutdown</b>	Enables the FCIP interface.
<b>Step 11</b>	switch(config-if)# <b>exit</b>	Exits FCIP interface configuration mode and returns to global configuration mode.
<b>Step 12</b>	switch(config)# <b>interface IPStorage</b> <i>slot-number/port-number</i>	Enters IPStorage interface configuration mode.
<b>Step 13</b>	switch(config-if)# <b>ip address</b> <i>ip-address</i> <i>subnet-mask</i>	Assigns an IP address to the interface.
<b>Step 14</b>	switch(config-if)# <b>switchport mtu</b> 2500	Sets the MTU size to 2500 for the interface. The valid range for MTU is from 576 to 9216.
<b>Step 15</b>	switch(config-if)# <b>no shutdown</b>	Enables the interface.
<b>Step 16</b>	switch(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.

To achieve maximum FCIP performance in 1 Gbps mode, the following configuration is recommended:

**Step 1** Create an FCIP link on the IPStorage port.



**Note**

If more than one FCIP link is bound to an IPStorage interface at 1 Gbps, the combined maximum bandwidth of all links bound to that interface must not exceed 1 Gbps.

**Step 2** Set the TCP maximum and minimum bandwidth as 1000 Mbps and 800 Mbps respectively.



**Note**

If the TCP maximum bandwidth is set to a value that is more than 1000 Mbps, we recommend that you set the number of TCP connections to five.

**Step 3** Configure two TCP connections on each FCIP link.

**Step 4** Set the MTU size to 2500 for the IPStorage port.

To achieve maximum FCIP performance in 1 Gbps mode, follow these configuration steps:

	<b>Command</b>	<b>Purpose</b>
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>fcip profile</b> <i>profile-id</i>	Configures an FCIP profile and enters FCIP profile configuration mode.
<b>Step 3</b>	switch(config-profile)# <b>ip address</b> <i>ip-address</i>	Assigns an IP address to the FCIP profile. The assigned IP address can be an IPv4 or an IPv6 address.
<b>Step 4</b>	switch(config-profile)# <b>tcp</b> <b>max-bandwidth-mbps</b> 1000 <b>min-available-bandwidth-mbps</b> 800 <b>round-trip-time-ms</b> <i>milliseconds</i>	Sets the maximum and minimum available bandwidth of the FCIP link to 1000 Mbps and 800 Mbps respectively, and configures the round-trip time in milliseconds.
<b>Step 5</b>	switch(config-profile)# <b>exit</b>	Exits FCIP profile configuration mode and returns to global configuration mode.
<b>Step 6</b>	switch(config)# <b>interface fcip</b> <i>interface-number</i>	Enters FCIP interface configuration mode.
<b>Step 7</b>	switch(config-if)# <b>use-profile</b> <i>profile-id</i>	Binds the specified profile to the FCIP link.
<b>Step 8</b>	switch(config-if)# <b>peer-info</b> <i>ipaddr</i> <i>ip-address</i>	Configures the peer IP address (IPv4 or IPv6).
<b>Step 9</b>	switch(config-if)# <b>tcp-connections</b> 2	Sets the number of TCP connections to 2. This value must be the same at the peer end.
<b>Step 10</b>	switch(config-if)# <b>ip-compression</b> <b>mode2</b>	Sets the compression algorithm to <b>mode2</b> for the interface. The other modes that can be set are <b>auto</b> and <b>mode1</b> .
<b>Step 11</b>	switch (config-if)# <b>no shutdown</b>	Enables the FCIP interface.
<b>Step 12</b>	switch (config-if)# <b>exit</b>	Exits FCIP interface configuration mode and returns to global configuration mode.
<b>Step 13</b>	switch(config)# <b>interface IPStorage</b> <i>slot-number/port-number</i>	Enters IPStorage interface configuration mode.



	Command	Purpose
Step 14	switch(config-if)# <b>ip address</b> <i>ip-address</i> <i>subnet-mask</i>	Assigns an IP address to the interface.
Step 15	switch(config-if)# <b>switchport mtu</b> 2500	Sets the MTU size to 2500 for the interface. The valid range for MTU is from 576 to 9216.
Step 16	switch(config-if)# <b>no shutdown</b>	Enables the interface.
Step 17	switch(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.

## Verifying FCIP Configuration

To verify FCIP configurations, use the following commands:

Command	Purpose
<b>show fcip host-map</b> <i>fcip-id</i>	Displays the information for a specified map.
<b>show fcip profile</b> <i>profile-id</i>	Displays the information for a profile.
<b>show fcip summary</b>	Displays summary information.
<b>show interface fcip</b>	Displays the status of an interface.
<b>show interface fcip</b> <i>fcip-id</i> <b>counters</b>	Displays the interface counter information.
<b>show interface fcip</b> <i>fcip-id</i> <b>counters brief</b>	Displays brief information of interface counters.
<b>show interface fcip</b> <i>fcip-id</i> <b>description</b>	Displays the interface description.
<b>show fcip target-map</b>	Displays information for a specified target map.
<b>show fcip tape-session summary</b>	Displays tape session information.
<b>show fcip tape-session tunnel 1 host-end</b>	Displays information for a specified FCIP link ID.
<b>show fcip tape-session tunnel 1 targ-end</b>	Displays information for the target end.
<b>show ips stats hw-comp all</b>	Displays hardware compression statistics.
<b>show port-channel database</b>	Displays port channel database information.

## Default Settings for FCIP Parameters

Table 2-5 lists the default settings for FCIP parameters.

**Table 2-5 Default FCIP Parameters**

<b>Parameters</b>	<b>Default</b>
TCP default port for FCIP	3225
Base port for TCP connections to peer	2
Minimum retransmit time	200 milliseconds
Keepalive timeout	60 sec
Maximum retransmissions	4 retransmissions
PMTU discovery	Enabled
PMTU enable reset timeout	3600 seconds
SACK	Enabled
Maximum bandwidth (Cisco MDS 24/10 port SAN Extension Module)	10 Gbps
Maximum bandwidth (Cisco MDS 9220i Fabric Switch)	10 Gbps
Maximum bandwidth (Cisco MDS 9250i Multiservice Fabric Switch)	5 Gbps
Minimum available bandwidth (Cisco MDS 24/10 port SAN Extension Module)	8 Gbps
Minimum available bandwidth (Cisco MDS 9220i Fabric Switch)	8 Gbps
Minimum available bandwidth (Cisco MDS 9250i Multiservice Fabric Switch)	4 Gbps
Round trip time	1 millisecond
Buffer size	0 KB
Control TCP and data connection	No packets are transmitted
TCP congestion window monitoring	Enabled
Burst size	50 KB
TCP connection mode	Active mode
FCIP timestamp	Disabled
Acceptable difference range to accept packets	+/- 2000 milliseconds
B port keepalive responses	Disabled
Write Acceleration	Disabled
Tape Acceleration	Disabled