CHAPTER 17

Configuring Fabric Security

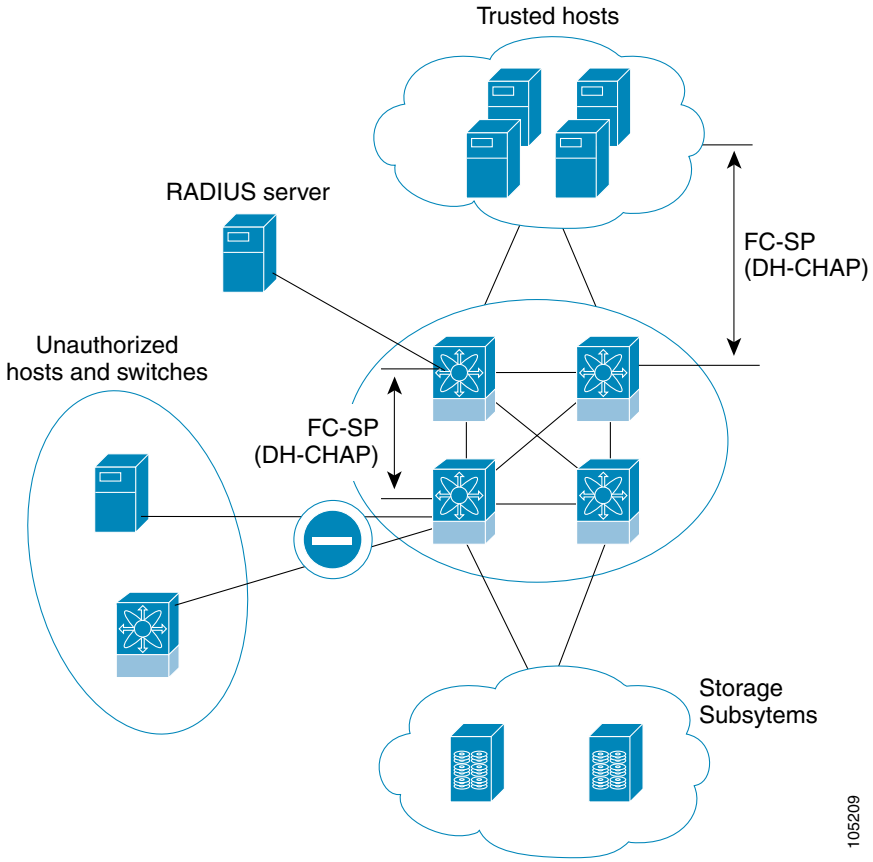
Fibre Channel Security Protocol (FC-SP) capabilities in Cisco MDS SAN-OS Release 1.3(x) provides switch-switch and host-switch authentication to overcome security challenges for enterprise-wide fabrics. Diffie-Hellman Challenge Handshake Authentication Protocol (DHCHAP) is an FC-SP protocol implemented in this release to provide authentication between Cisco MDS 9000 Family switches and other devices. It consists of the CHAP protocol combined with the Diffie-Hellman exchange.

This chapter includes the following sections:

About Fabric Authentication

All switches in the Cisco MDS 9000 Family enable fabric-wide authentication from one switch to another switch, or from a switch to a host. These switch and host authentications are performed locally or remotely in each fabric. As storage islands are consolidated and migrated to enterprise-wide fabrics new security challenges arise. The approach of securing storage islands cannot always be guaranteed in enterprise-wide fabrics. For example, in a campus environment with geographically distributed switches someone could maliciously interconnect incompatible switches or you could accidentally do so, resulting in Inter-Switch Link (ISL) isolation and link disruption. This need for physical security is addressed by switches in the Cisco MDS 9000 Family (see Figure 17-1).

Figure 17-1 Switch and Host Authentication



Note Fibre Channel (FC) host bus adapters (HBAs) with appropriate firmware and drivers are required for host-switch authentication.

About DHCHAP

DHCHAP is an authentication protocol that authenticates the devices connecting to a switch. Fibre Channel authentication allows only trusted devices to be added to a fabric, thus preventing unauthorized devices from accessing the switch.

Note The terms FC-SP and DHCHAP are used interchangeably in this chapter.

DHCHAP is a mandatory password-based, key-exchange authentication protocol that supports both switch-to-switch and host-to-switch authentication. DHCHAP negotiates hash algorithms and DH groups before performing authentication. It supports MD-5 and SHA-1 algorithm-based authentication.

Configuring the DHCHAP feature requires the ENTERPRISE_PKG license (see Chapter 3, "Obtaining and Installing Licenses").

DHCHAP Compatibility with Existing Cisco MDS Features

This sections identifies the impact of configuring the DHCHAP feature along with existing Cisco MDS features:

- PortChannel interfaces—If DHCHAP is enabled for ports belonging to a PortChannel, DHCHAP authentication is performed at the physical interface level, not at the PortChannel level.
- FCIP interfaces—The DHCHAP protocol works with the FCIP interface just as it would with a physical interface.
- Port security or fabric binding—Fabric binding policies are enforced based on identities authenticated by DHCHAP.
- VSANs—DHCHAP authentication is not done on a per-VSAN basis.
- High availability—DHCHAP authentication works transparently with existing HA features.

Configuring DHCHAP Authentication

The DHCHAP authentication process is outlined below and explained in the following sections.

To configure DHCHAP authentication using the local password database, follow these steps:

Step 1 Enable DHCHAP.

Step 2 Identify and configure the DHCHAP authentication modes.

Step 3 Configure the hash algorithm and DH group.

Step 4 Configure the DHCHAP password for the local switch and other switches in the fabric.

Step 5 Configure the DHCHAP timeout value for reauthentication.

Step 6 Verify the DHCHAP configuration.

DHCHAP Configuration

By default, the DHCHAP feature is disabled in all switches in the Cisco MDS 9000 Family.

You must explicitly enable the DHCHAP feature to access the configuration and verification commands for fabric authentication. When you disable this feature, all related configurations are automatically discarded.

Enabling DHCHAP

To enable DHCHAP for a Cisco MDS switch, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# fcsp enable`	Enables the DHCHAP in this switch.
	`switch(config)# no fcsp enable`	Disables (default) the DHCHAP in this switch.

DHCHAP Authentication Modes

The DHCHAP authentication status for each interface depends on the configured DHCHAP port mode.

When the DHCHAP feature is enabled in a switch, each Fibre Channel interface or FCIP interface may be configured to be in one of four DHCHAP port modes:

- On—During switch initialization, if the connecting device supports DHCHAP authentication, the software performs the authentication sequence. If the connecting device does not support DHCHAP authentication, the software moves the link to an isolated state.
- Auto-Active—During switch initialization, if the connecting device supports DHCHAP authentication, the software performs the authentication sequence. If the connecting device does not support DHCHAP authentication, the software continues with the rest of the initialization sequence.
- Auto-Passive (default)—The switch does not initiate DHCHAP authentication, but participates in DHCHAP authentication if the connecting device initiates DHCHAP authentication.
- Off—The switch does not support DHCHAP authentication. Authentication messages sent to such ports return error messages to the initiating switch.

Note Whenever DHCHAP port mode is changed to a mode other than the Off mode, reauthentication is performed.

Table 17-1 identifies the switch-to-switch authentication behavior between two Cisco MDS switches in various modes.

Table 17-1 DHCHAP Authentication Status Between Two MDS Switches

Switch N DHCHAP Modes	Switch 1 DHCHAP Modes			
	on	**auto-active**	**auto-passive**	**off**
on	FC-SP authentication is performed.	FC-SP authentication is performed.	FC-SP authentication is performed.	Link is brought down.
auto-Active				FC-SP authentication is *not* performed.
auto-Passive			FC-SP authentication is *not* performed.	
off	Link is brought down.	FC-SP authentication is *not* performed.		

Enabling DHCHAP Modes

To enable the DHCHAP mode for a particular interface, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# interface fc2/1-3` `switch(config-if)#`	Enters the interface submode.
Step 3	`switch(config-if)# fcsp on`	Sets the DHCHAP mode for the selected interfaces to be in the on state.
	`switch(config-if)# no fcsp on`	Reverts to the factory default of auto-passive for these three interfaces.
Step 4	`switch(config-if)# fcsp auto-active 0`	Changes the DHCHAP authentication mode for the selected interfaces to auto-active. The 0 indicates that the port does not perform authentication
	`switch(config-if)# fcsp auto-active 120`	Changes the DHCHAP authentication mode to auto-active for the selected ports to reauthenticate every two hours (120 minutes) after the initialization authentication.
	`switch(config-if)# fcsp auto-active`	Changes the DHCHAP authentication mode to auto-active for the selected ports.

DHCHAP Hash Algorithm Configuration

Cisco MDS switches support a default hash algorithm priority list of MD-5 followed by SHA-1 for DHCHAP authentication.

Tip If you change the hash algorithm configuration, then change it globally for all switches in the fabric.

Caution RADIUS and TACACS+ protocols always use MD-5 for CHAP authentication. Using SHA-1 as the hash algorithm may prevent RADIUS and TACACS+ usage—even if these AAA protocols are enabled for DHCHAP authentication.

Changing the Hash Algorithm

To change the hash algorithm, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# fcsp dhchap hash sha1`	Configures the use of only the SHA-1 hash algorithm.
	`switch(config)# fcsp dhchap hash MD5`	Configures the use of only the MD-5 hash algorithm.
	`switch(config)# fcsp dhchap hash md5 sha1`	Defines the use of the default hash algorithm priority list of MD-5 followed by SHA-1 for DHCHAP authentication.
	`switch(config)# no fcsp dhchap hash sha1`	Reverts to the factory default priority list of the MD-5 hash algorithm followed by the SHA-1 hash algorithm.

DHCHAP Group Configuration

All switches in the Cisco MDS Family support all DHCHAP groups specified in the standard: 0 (null DH group which does not perform the Diffie-Hellman exchange), 1, 2, 3, or 4.

Tip If you change the DH group configuration, ensure to change it globally for all switches in the fabric.

Configuring DH Group Settings

To change the DH group settings, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# fcsp dhchap group 2 3 4`	Prioritizes the use of DH group 2, 3, and 4 in the configured order.
	`switch(config)# no fcsp dhchap group 0`	Reverts to the DHCHAP factory default order of 0, 4, 1, 2, and 3.

DHCHAP Password Configuration

DHCHAP authentication in each direction requires a shared secret password between the connected devices. To do this, you can use one of three approaches to manage passwords for all switches in the fabric that participate in DHCHAP.

- Approach 1—Use the same password for all switches in the fabric. This is the simplest approach. When you add a new switch, you use the same password to authenticate that switch in this fabric. It is also the most vulnerable approach if someone from the outside maliciously attempts to access any one switch in the fabric
- Approach 2—Use a different password for each switch and maintain that password list in each switch in the fabric. When you add a new switch, you create a new password list and update all switches with the new list. Accessing one switch yields the password list for all switches in that fabric.
- Approach 3—Use different passwords for different switches in the fabric. When you add a new switch, multiple new passwords corresponding to each switch in the fabric must be generated and configured in each switch. Even if one switch is compromised, the password of other switches are still protected. This approach requires considerable password maintenance by the user.

Tip We recommend using RADIUS or TACACS+ for fabrics with more than five switches. If you need to use a local password database, you can continue to do so using Approach 3 and using the Cisco MDS 9000 Family Fabric Manager to manage the password database. Refer to the *Cisco MDS 9000 Family Fabric Manager Configuration Guide* for further information.

Note All passwords are restricted to 64 alphanumeric characters and can be changed, but not deleted.

Configuring the DHCHAP Password for the Local Switch

To configure the DHCHAP password for the local switch, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.

	Command	Purpose
Step 2	`switch(config)# fcsp dhchap password 0 mypassword`	Configures a clear text password for the local switch.
	`switch(config)# fcsp dhchap password 0 mypassword 30:11:bb:cc:dd:33:11:22`	Configures a clear text password for the local switch to be used for the device with the specified WWN.
	`switch(config)# no fcsp dhchap password 0 mypassword 30:11:bb:cc:dd:33:11:22`	Removes the clear text password for the local switch to be used for the device with the specified WWN.
	`switch(config)# fcsp dhchap password 7 sfsfdf`	Configures a password entered in an encrypted format for the local switch.
	`switch(config)# fcsp dhchap password 7 sfsfdf 29:11:bb:cc:dd:33:11:22`	Configures a password entered in an encrypted format for the local switch to be used for the device with the specified WWN.
	`switch(config)# no fcsp dhchap password 7 sfsfdf 29:11:bb:cc:dd:33:11:22`	Removes the password entered in an encrypted format for the local switch to be used for the device with the specified WWN.
	`switch(config)# fcsp dhchap password mypassword1`	Configures a clear text password for the local switch to be used with any connecting device.

Password Configuration for Other Devices

You can configure passwords in the local authentication database for other devices in a fabric. The other devices are identified by their device name, which is also know as the switch WWN or device WWN. The password is restricted to 64 characters and can be specified in clear text (0) or in encrypted text (7).

Note The switch WWN identifies the physical switch. This WWN is used to authenticate the switch and is different from the VSAN node WWN.

Locally Configuring the Device Name

To locally configure the device name of another switch in the fabric, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# fcsp dhchap devicename 00:11:22:33:44:aa:bb:cc password NewPassword`	Configures a password for another switch in the fabric that is identified by the switch WWN device name.
	`switch(config)# no fcsp dhchap devicename 00:11:22:33:44:aa:bb:cc password NewPassword`	Removes the password entry for this switch from the local authentication database.
	`switch(config)# fcsp dhchap devicename 00:11:55:66:00:aa:bb:cc password 0 NewPassword`	Configures a clear text password for another switch in the fabric that is identified by the switch WWN device name.
	`switch(config)# fcsp dhchap devicename 00:11:22:33:55:aa:bb:cc password 7 asdflkjh`	Configures a password entered in an encrypted format for another switch in the fabric that is identified by the switch WWN device name.

DHCHAP Timeout Value

During the DHCHAP protocol exchange, if the MDS switch does not receive the expected DHCHAP message within a specified time interval, authentication failure is assumed. The time ranges from 20 (no authentication is performed) to 1000 seconds. The default is 30 seconds.

When changing the timeout value, consider the following factors:

- The existing RADIUS and TACACS+ timeout values.
- The same value must also be configured all switches in the fabric.

Configuring the Timeout Value

To configure the DHCHAP timeout value, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# fcsp timeout 60`	Configures the reauthentication timeout to be 60 seconds.
	`switch(config)# no fcsp timeout 60`	Reverts to the factory default of 30 seconds.

Displaying Protocol Security Information

Use the **show fcsp** commands to display configurations for the local database (see Example 17-1 through 17-6).

Example 17-1 Displays DHCHAP Configurations in FC Interfaces

```
switch# show fcsp interface fc1/9

fc1/9:
        fcsp authentication mode:SEC_MODE_ON
        Status: Successfully authenticated
```

Example 17-2 Displays DHCHAP Statistics for a FC Interface

```
switch# show fcsp interface fc1/9 statistics

fc1/9:
        fcsp authentication mode:SEC_MODE_ON
        Status: Successfully authenticated
        Statistics:
        FC-SP Authentication Succeeded:5
        FC-SP Authentication Failed:0
        FC-SP Authentication Bypassed:0
```

Example 17-3 Displays the FC-SP WWN of the Device Connected through a Specified Interface

```
switch# show fcsp interface fc 2/1 wwn

fc2/1:
        fcsp authentication mode:SEC_MODE_ON
        Status: Successfully authenticated
        Other device's WWN:20:00:00:e0:8b:0a:5d:e7
```

Example 17-4 Displays Hash Algorithm and DHCHAP Groups Configured for the Local Switch

```
switch# show fcsp dhchap
Supported Hash algorithms (in order of preference):
DHCHAP_HASH_MD5
DHCHAP_HASH_SHA_1

Supported Diffie Hellman group ids (in order of preference):
DHCHAP_GROUP_NULL
DHCHAP_GROUP_1536
DHCHAP_GROUP_1024
DHCHAP_GROUP_1280
DHCHAP_GROUP_2048
```

Example 17-5 Displays the DHCHAP Local Password Database

```
switch# show fcsp dhchap database
DHCHAP Local Password:
        Non-device specific password:mypassword1
        Password for device with WWN:29:11:bb:cc:dd:33:11:22 is pjoalf
        Password for device with WWN:30:11:bb:cc:dd:33:11:22 is mypassword

Other Devices' Passwords:
        Password for device with WWN:00:11:22:33:44:aa:bb:cc is NewPassword
```

Example 17-6 Displays the ASCII Representation of the Device WWN

```
switch# show fcsp asciiwwn 30:11:bb:cc:dd:33:11:22
Ascii representation of WWN to be used with AAA servers:Ox_3011bbccdd331122
```

Tip Use the ASCII representation of the device WWN (identified in bold in Example 17-6) to configure the switch information on RADIUS and TACACS+ servers.

DHCHAP AAA Authentication

You can individually set authentication options using the **aaa authentication dhchap** command. If authentication is not configured, local authentication is used by default.

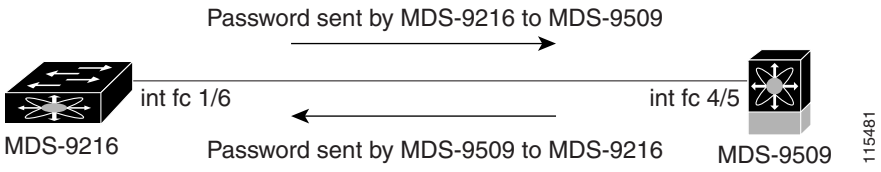
To configure the AAA authentication, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# aaa authentication dhchap default group TacacsServer1`	Enables DHCHAP to use the TACACS+ server group (in this example, TacacsServer1) for authentication.
	`switch(config)# aaa authentication dhchap default local`	Enables DHCHAP for local authentication.
	`switch(config)# aaa authentication dhchap default group RadiusServer1`	Enables DHCHAP to use the RADIUS server group (in this example, RadiusServer1) for authentication.

Sample Configuration

This section provides the steps to configure the example illustrated in Figure 17-2.

Figure 17-2 Sample DHCHAP Authentication



To configure the authentication setup shown in Figure 17-2, follow these steps:

Step 1 Obtain the device name of the MDS 9216 Switch in the fabric, The MDS 9216 Switch in the fabric is identified by the switch WWN.

```
MDS-9216# show wwn switch
Switch WWN is 20:00:00:05:30:00:54:de
```

Step 2 Explicitly enable DHCHAP in this switch.

Note When you disable DHCHAP, all related configurations are automatically discarded.

```
MDS-9216(config)# fcsp enable
```

Step 3 Configure a clear text password for this switch. This password will be used by the connecting device.

```
MDS-9216(config)# fcsp dhchap password rtp9216
```

Step 4 Configures a password for another switch in the fabric that is identified by the switch WWN device name.

```
MDS-9216(config)# fcsp dhchap devicename 20:00:00:05:30:00:38:5e password rtp9509
```

Step 5 Enable the DHCHAP mode for the required Fibre Channel interface.

Note Whenever DHCHAP port mode is changed to a mode other than the Off mode, reauthentication is performed.

```
MDS-9216(config)# interface fc 1/16
MDS-9216(config-if)# fcsp on
```

Step 6 Verify the protocol security information configured in this switch by displaying the DHCHAP local password database.

```
MDS-9216# show fcsp dhchap database
DHCHAP Local Password:
        Non-device specific password:upt9216
Other Devices' Passwords:
        Password for device with WWN:20:00:00:05:30:00:38:5e is upt9509
```

Step 7 Display the DHCHAP configuration in the Fibre Channel Interface

```
MDS-9216# show fcsp interface fc 1/6
```

```
fc1/6
        fcsp authentication mode:SEC_MODE_ON
        Status:Successfully authenticated
```

Step 8 Repeat these steps on the connecting MDS 9509 Switch.

```
MDS-9509# show wwn switch
Switch WWN is 20:00:00:05:30:00:38:5e
MDS-9509(config)# fcsp enable
MDS-9509(config)# fcsp dhchap password rtp9509
MDS-9509(config)# fcsp dhchap devicename 20:00:00:05:30:00:54:de password rtp9216
MDS-9509(config)# interface fc 4/5
MDS-9509(config-if)# fcsp on
MDS-9509# show fcsp dhchap database
DHCHAP Local Password:
        Non-device specific password:upt9509
Other Devices' Passwords:
        Password for device with WWN:20:00:00:05:30:00:54:de is upt9216
MDS-9509# show fcsp interface fc 4/5
Fc4/5
        fcsp authentication mode:SEC_MODE_ON
        Status:Successfully authenticated
```

You have now enabled and configured DHCHAP authentication for the sample setup in Figure

Default Settings

Table 17-2 lists the default settings for all fabric security features in any switch.

Table 17-2 Default Fabric Security Settings

Parameters	Default
DHCHAP feature	Disabled.
DHCHAP hash algorithm	A priority list of MD-5 followed by SHA-1 for DHCHAP authentication.
DHCHAP authentication mode	Auto-passive.
DHCHAP group default priority exchange order	0, 4, 1, 2, and 3 respectively.
DHCHAP timeout value	30 seconds.