



Configuring Cisco TrustSec Fibre Channel Link Encryption

This chapter provides an overview of the Cisco TrustSec Fibre Channel (FC) Link Encryption feature and describes how to configure and set up link-level encryption between switches.

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Cisco TrustSec FC Link Encryption Terminology

The following Cisco TrustSec FC Link Encryption-related terms are used in this chapter:

- Galois Counter Mode (GCM)—A block cipher mode of operation providing confidentiality and data-origin authentication.
- Galois Message Authentication Code (GMAC)—A block cipher mode of operation providing only data-origin authentication. It is the authentication-only variant of GCM.
- Security Association (SA)—A connection that handles the security credentials and controls how they propagate between switches. The SA includes parameters such as salt and keys.
- Key—A 128-bit hexadecimal string that is used for frame encryption and decryption. The default value is zero.
- Salt —A 32-bit hexadecimal number that is used during encryption and decryption. The same salt must be configured on both sides of the connection to ensure proper communication. The default value is zero.
- Security Parameters Index (SPI) number—A 32-bit number that identifies the SA to be configured to the hardware. The range is from 256 to 65536.

Support for AES Encryption

The Advanced Encryption Standard (AES) is the symmetric cipher algorithm that provides a high-level of security, and can accept different key sizes.

The Cisco TrustSec FC Link Encryption feature supports the 128-bit AES for security encryption and enables either AES-GCM or AES-GMAC for an interface. The AES-GCM mode provides encryption and authentication of the frames and AES-GMAC provides only the authentication of the frames that are being passed between the two peers.

About Cisco TrustSec FC Link Encryption

Cisco TrustSec FC Link Encryption is an extension of the Fibre Channel-Security Protocol (FC-SP) feature and uses the existing FC-SP architecture to provide integrity and confidentiality of transactions. Encryption is now added to the peer authentication capability to provide security and prevent unwanted traffic interception. Peer authentication is implemented according to the FC-SP standard using the Diffie-Hellman Challenge Handshake Authentication Protocol (DHCHAP) protocol.



Note Cisco TrustSec FC Link Encryption is currently only supported between Cisco MDS switches. This feature is not supported when you downgrade to software versions which do not have the Encapsulating Security Protocol (ESP) support.

This section includes the following topics:

Supported Modules

The following modules are supported for the Cisco TrustSec FC Link Encryption feature:

- 2/4/8/10/16 Gbps 48-ports Advanced Fibre Channel module (DS-X9448-768K9)
- 32-port 8-Gbps Advanced Fibre Channel Switching module (DS-X9232-256K9)
- 48-port 8-Gbps Advanced Fibre Channel Switching module (DS-X9248-256K9)
- 1/2/4/8 Gbps 24-Port Fibre Channel switching module (DS-X9224-96K9)
- 1/2/4/8 Gbps 48-Port Fibre Channel switching module (DS-X9248-96K9)
- 1/2/4/8 Gbps 4/44-Port Fibre Channel switching module (DS-X9248-48K9)
- 2/4/8/10/16 Gbps 96-ports Fibre Channel Switching Module (DS-C9396S-K9)
- 24/10 port SAN Extension module (DS-X9334-K9)
- 48 port 32 Gbps Fibre Channel Switching Module (DS-X9648-1536K9)—support for Cisco TrustSec FC Link Encryption is available only on ports 9-12, 25-28, and 41-44.
- Cisco MDS 9220i SAN Extension Switch—support for Cisco TrustSec FC Link Encryption is available only on ports 9-12 and full licensed model is not required for using this feature.
- Cisco MDS 9132T Fibre Channel Switch—support for Cisco TrustSec FC Link Encryption is available only on ports 9-12, 25-28.
- Cisco MDS 9148T Fibre Channel Switch—support for Cisco TrustSec FC Link Encryption is available only on ports 9-12, 25-28 and 41-44.

- Cisco MDS 9396T Fibre Channel Switch—support for Cisco TrustSec FC Link Encryption is available only on 9-12, 25-28, 41-44 base ports, and 57-60, 73-76 and 89-92 LEM ports as applicable.

Enabling Cisco TrustSec FC Link Encryption

By default, the FC-SP feature and the Cisco TrustSec FC Link Encryption feature are disabled in all switches in the Cisco MDS 9000 Family.

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

To enable FC-SP for a Cisco MDS switch, follow these steps:

Procedure

- Step 1** switch# **configure terminal**
Enters configuration mode.
- Step 2** switch(config)# **feature fcsp**
Enables the FC-SP feature.
- Step 3** switch(config)# **no feature fcsp**
(Optional) Disables (default) the FC-SP feature in this switch.
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Example

Configuring the Cisco TrustSec FC Link Encryption feature requires the ENTERPRISE_PKG license. For more information, refer to the *Cisco MDS 9000 Family NX-OS Licensing Guide*.

Setting Up Security Associations

To perform encryption between the switches, a security association (SA) needs to be set up. An administrator manually configures the SA before the encryption can take place. The SA includes parameters such as keys and salt, that are required for encryption. You can set up to 2000 SAs in a switch.

To set up an SA between two switches, follow these steps:

Procedure

- Step 1** switch# **configure terminal**
Enters configuration mode.
- Step 2** switch(config)# **fcsp esp sa spi_number**

Enters into SA submode for configuring SAs. The range of spi_number is from 256 to 65536.

- Step 3** switch(config)# **no fcsp esp sa spi_number**
 (Optional) Deletes the SA between the switches.¹

Example

To determine which ports are using the SA, use the show running-config fcsp command. Refer to the [Viewing Running System Information, on page 8](#).



Note Cisco TrustSec FC Link Encryption is currently supported only on DHCHAP on and off modes.

Setting Up Security Association Parameters

To set up the SA parameters, such as keys and salt, follow these steps:

Procedure

- Step 1** switch# **configure terminal**
 Enters configuration mode.
- Step 2** switch(config)# **fcsp esp sa spi_number**
 Enters into SA submode for configuring SAs. The range of spi_number is from 256 to 65536.
- Step 3** switch(config-sa)# **key key**
 Configures the key for the SA. Maximum size of key is 34.
- Step 4** switch(config-sa)# **no key key**
 (Optional) Removes the key from the SA.
- Step 5** switch(config-sa)# **salt salt**
 Configures the salt for the SA. The range is from 0x0 to 0xffffffff.
- Step 6** switch(config-sa)# **no salt salt**
 (Optional) Removes the salt for the SA.
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¹ If the specified SA is currently programmed to the ports, this command returns an error saying that the SA is in use.

Configuring ESP Settings

This section includes the following topics:

Configuring ESP on Ingress and Egress Ports

Once the SA is created, you need to configure Encapsulating Security Protocol (ESP) on the ports. You should specify the egress and ingress ports for the encryption and decryption of packets between the network peers. The egress SA specifies which keys or parameters are to be used for encrypting the packets that leave the switch. The ingress SA specifies which keys or parameters are to be used to decrypt the packets entering that particular port.



Note While configuring ESP, only E and Auto port modes are supported.

This section covers the following topics:

Configuring ESP on Ingress Port

To configure SA to the ingress hardware, follow these steps:

Procedure

- | | |
|---------------|---|
| Step 1 | <code>switch# configure terminal</code>
Enters the configuration mode. |
| Step 2 | <code>switch(config)# interface fc x/y</code>
Configures the FC interface on slot x, port y.
Note Selecting a portchannel will apply the configuration on all members of the portchannel. |
| Step 3 | <code>switch(config-if)# fcsp esp manual</code>
Enters the ESP configuration submode. |
| Step 4 | <code>switch(config-if-esp)# ingress-sa spi_number</code>
Configures the SA to the ingress hardware. |
| Step 5 | <code>switch (config-if-esp)# no ingress-sa spi_number</code>
(Optional) Removes the SA from the ingress hardware. ² |
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Configuring ESP on Egress Ports

To configure SA to the egress hardware, follow these steps:

² If SA is not configured in the ingress port, then running this command returns an error message.

Procedure

- Step 1** switch# **configure terminal**
Enters the configuration mode.
- Step 2** switch(config)# **interface fc x/y**
Configures the FC interface on slot x, port y.
- Note** Selecting a portchannel will apply the configuration on all members of the portchannel.
- Step 3** switch(config-if)# **fcsp esp manual**
Enters the ESP configuration submenu.
- Step 4** switch(config-if-esp)# **egress-sa spi_number**
Configures the SA to the egress hardware.
- Step 5** switch(config-if)# **no fcsp esp manual**
(Optional) Removes the SA from the ingress and egress hardware.³
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Example



- Note** To apply the SA to the ingress and egress hardware of an interface, the interface needs to be in the admin shut mode.
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Configuring ESP Modes

Configure the ESP settings for the ports as GCM to enable message authentication and encryption or as GMAC to enable message authentication.

The default ESP mode is AES-GCM.

This section covers the following topics:

Configuring AES-GCM

To configure the AES-GCM mode, follow these steps:

Procedure

- Step 1** switch# **configure terminal**
Enters the configuration mode.

³ If SA is not configured in the egress port, then running this command returns an error message.

- Step 2** `switch(config)# interface fc x/y`
Configures the FC interface on slot x, port y.
- Note** Selecting a portchannel would apply the configuration on all members of the portchannel.
- Step 3** `switch(config-if)# fcsp esp manual`
Enters the ESP configuration submode to configure the ESP settings on each port.
- Step 4** `switch(config-if-esp)# mode gcm`
Sets the GCM mode for the interface.
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Configuring AES-GMAC

To configure AES-GMAC mode, follow these steps:

Procedure

- Step 1** `switch# configure terminal`
Enters the configuration mode.
- Step 2** `switch(config)# interface fc x/y`
Configures the FC interface on slot x, port y.
- Note** Selecting a portchannel would apply the configuration on all members of the portchannel.
- Step 3** `switch(config-if)# fcsp esp manual`
Enters the ESP configuration submode to configure the ESP settings on each port.
- Step 4** `switch(config-if-esp)# mode gmac`
Sets the GMAC mode for the interface.
- Step 5** `switch(config-if-esp)# no mode gmac`
(Optional) Removes the GMAC mode from the interface and applies the default AES-GCM mode.
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Best Practices for Changing Keys

After the SA is applied to the ingress and egress ports, you should change the keys periodically in the configuration. The keys should be changed sequentially to avoid traffic disruption.

As an example, consider that a security association has been created between two switches, Switch1 and Switch2. The SA is configured on the ingress and egress ports as shown in the following example:

```
switch# configure terminal
switch(config)# interface fc1/1
switch(config-if)# fcsp esp manual
switch(config-if)# ingress-sa 256
switch(config-if)# egress-sa 256
```

To change the keys for these switches, follow these steps:

Procedure

Step 1 Add a new SA on Switch1 and Switch2.

```
switch# configure terminal
switch(config)# fcsp esp sa 257
switch(config-sa)# key 0xAC9EF8BC8DB2DBD2008D184F794E0C38
switch(config-sa)# salt 0x1234
```

Step 2 Configure the ingress SA on Switch1.

```
switch# configure terminal
switch(config)# interface fc1/1
switch(config-if)# fcsp esp manual
switch(config-if)# ingress-sa 257
```

Step 3 Configure the ingress and the egress SA on Switch2.

```
switch# configure terminal
switch(config)# interface fc1/1
switch(config-if)# fcsp esp manual
switch(config-if)# ingress-sa 257
switch(config-if)# egress-sa 257
```

Step 4 Configure the egress SA on Switch1.

```
switch# configure terminal
switch(config)# interface fc1/1
switch(config-if)# fcsp esp manual
switch(config-if)# egress-sa 257
```

Step 5 Remove the previously configured ingress SA from both the switches.

```
switch# configure terminal
switch(config)# interface fc1/1
switch(config-if)# fcsp esp manual
switch(config-if)# no ingress-sa 256
```
