

This section introduces the basic concepts, methodology, and general troubleshooting guidelines for problems that may occur when configuring IPsec and using the Cisco MDS 9000 Family of multilayer directors and fabric switches.

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Troubleshooting IPsec

This section describes how to troubleshoot IP security (IPsec) and Internet Key Exchange (IKE) encryption in the Cisco MDS 9000 Family. It includes the following sections:

- Overview
- Initial Troubleshooting Checklist
- IPsec Issues

Overview

The IPsec protocol is a framework of open standards that provides data confidentiality, data integrity, and data authentication between participating peers. It was developed by the Internet Engineering Task Force (IETF). IPsec provides security services at the IP layer, including protecting one or more data flows between a pair of hosts, between a pair of security gateways, or between a security gateway and a host. IPsec is supported for iSCSI and FCIP using IKE and Encapsulated Security Protocol (ESP) in tunnel mode.

This section contains the following topics:

- IPsec Compatibility
- Supported IPsec and IKE Algorithms for Microsoft Windows and Linux Platforms
- IKE Allowed Transforms
- IPsec Allowed Transforms

IPsec Compatibility


IPsec features are compatible with the following Cisco MDS 9000 Family hardware:

- Cisco 14/2-port Multiprotocol Services (MPS-14/2) modules in Cisco MDS 9200 switches or Cisco MDS 9500 directors
- Cisco MDS 9216i Switch with the MPS-14/2 capability in the integrated supervisor module. Refer to the *Cisco MDS 9200 Series Hardware Installation Guide* for more information on the Cisco MDS 9216i Switch.
- The IPsec feature is not supported on the management interface.

 **Note:** IPsec and IKE are not supported by the Cisco Fabric Switch HP c-Class BladeSystem and the Cisco Fabric Switch for IBM BladeCenter.

IPsec features are compatible with the following fabric setup:

- Two connected Cisco MDS 9200 switches or Cisco MDS 9500 directors running Cisco MDS SAN-OS Release 2.0(1b) or later.
- A Cisco MDS 9200 switches or Cisco MDS 9500 directors running Cisco MDS SAN-OS Release 2.0(1b) or later connected to any IPsec compliant device.
- The following features are not supported in the Cisco SAN-OS implementation of the IPsec feature:
 - ◆ Authentication Header (AH)
 - ◆ Transport mode
 - ◆ Security association bundling
 - ◆ Manually configuring security associations
 - ◆ Per host security association option in a crypto map
 - ◆ Security association idle timeout
 - ◆ Dynamic crypto maps
 - ◆ IPv6

 **Note:** Any reference to crypto maps in this document only refers to static crypto maps.

- For IPsec to interoperate effectively with Microsoft iSCSI initiators, specify the TCP protocol and the local iSCSI TCP port number (default 3260) in the IPv4-ACL. This configuration ensures the speedy recovery of encrypted iSCSI sessions following disruptions such as Gigabit Ethernet interfaces shutdowns, VRRP switchovers, and port failures. The following example of a IPv4-ACL entry shows that the MDS switch IPv4 address is 10.10.10.50 and remote Microsoft host running encrypted iSCSI sessions is 10.10.10.16:

```
switch(config)# '''ip access-list aclmsiscsi2 permit tcp 10.10.10.50 0.0.0.0 range port
3260 3260 10.10.10.16 0.0.0.0
'''
```

 **Note:** Cisco MDS IKEv2 will not interoperate with other IKEv2 implementations.

Supported IPsec and IKE Algorithms for Microsoft Windows and Linux Platforms

Table 22-1 lists the supported and verified settings for IPsec and IKE encryption authentication algorithms on the Microsoft Windows and Linux platforms.

Table 22-1 IPsec and IKE for Windows and Linux

Platform	IKE	IPsec
Microsoft iSCSI initiator, Microsoft IPsec implementation on Microsoft Windows 2000 platform	3DES, SHA-1 or MD5, DH group 2	3DES, SHA-1
Cisco iSCSI initiator, Free Swan IPsec implementation on Linux platform	3DES, MD5, DH group 1	3DES, MD5

IKE Allowed Transforms

Table 22-2 provides a list of allowed transform combinations for IKE.

Table 22-2 IKE Transform Configuration Parameters

Parameter	Accepted Values	Default Value
Encryption algorithm	56-bit DES-CBC 168-bit DES (3DES) 128-bit AES	3DES
Hash algorithm	SHA-1 (HMAC variant) MD5 (HMAC variant)	SHA-1
Authentication method	Preshared keys RSA signatures in digital certificates	Preshared keys
DH group identifier	768-bit DH 1024-bit DH 1536-bit DH	768-bit DH (1)

IPsec Allowed Transforms

Table 22-3 provides a list of allowed transform combinations for IPsec.

Table 22-3 IPsec Transform Configuration Parameters

Parameter	Accepted Values
Encryption algorithm	56-bit DES-CBC

	168-bit DES 128-bit AES-CBC 128-bit AES-CTR ^[#wpxref36846 1] 256-bit AES-CBC 256-bit AES-CTR ¹
Hash/authentication algorithm ¹ (optional)	SHA-1 (HMAC variant) MD5 (HMAC variant) AES-XCBC-MAC

¹ If you configure the AES counter (CTR) mode, you must also configure the authentication algorithm.

Initial Troubleshooting Checklist

Begin troubleshooting IPsec issues by checking the following issues:

Checklist	Check off
Verify licensing requirements. See <i>Cisco MDS 9000 Family Fabric Manager Configuration Guide</i> .	
Verify that IKE has been configured for IPsec.	
Verify the digital certificates configuration if it is enabled for IPsec. See Chapter 24, "Troubleshooting Digital Certificates."	
Verify that there are matching IKE policies defined at each peer.	
Verify that you have refreshed SAs after any IKEv2 reconfiguration.	
Verify that you have configured mirror crypto map ACLs at the peer for every crypto map ACL configured locally.	

Common Troubleshooting Tools in Fabric Manager

Choose **Switches > Security > IPsec** to access IPsec.

Choose **Switches > Security > IKE** to access IKE.

Common Troubleshooting Commands in the CLI

Use the following commands to troubleshoot IPsec issues:

- **show crypto transform-set domain ipsec**
- **show crypto global domain ipsec**
- **show crypto global domain ipsec security-association lifetime**

- **show crypto sad domain ipsec**

Use the following internal commands to gather more information for IPsec issues:

- **show ipsec internal error** ? Displays a log of error history.
- **show ipsec internal mem-stats detail** ? Displays memory usage.
- **show ipsec internal event-history msgs** ? Displays a log of message history.

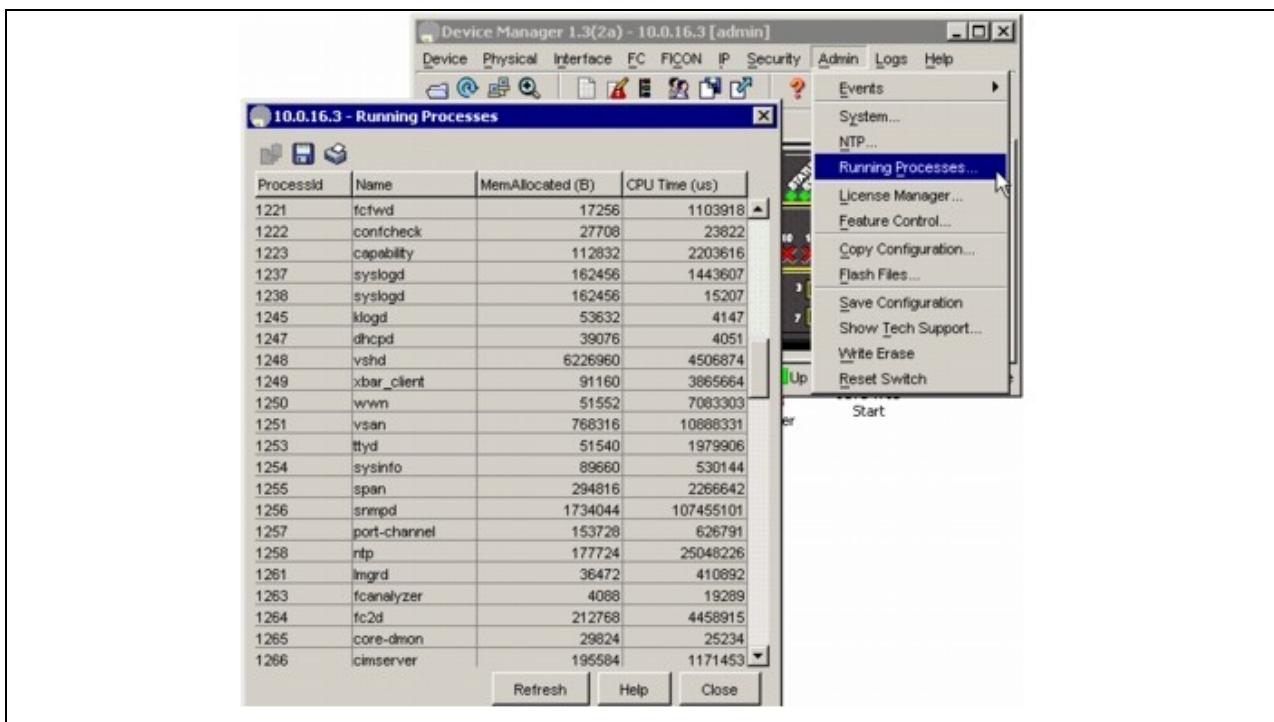
Use the following commands to gather information from the hardware accelerator:

- **show ipsec internal crypto-accelerator interface gigabit 2/1 sad inbound/outbound sa-index** ? Displays detailed information of an SA from the hardware accelerator.
- **show ipsec internal crypto-accelerator interface gigabit 2/1 stats** ? Displays detailed information per interface from the hardware accelerator.

IPsec Issues

This section provides the procedures required to troubleshoot IKE and IPsec issues in an FCIP configuration. Figure 22-1 shows a simple FCIP configuration where FCIP Tunnel 2 carries encrypted data between switches MDS A and MDS C.

Figure 22-1 Simple FCIP Configuration



This section includes the following topics:

- Verifying IKE Configuration Compatibility
- Verifying IPsec Configuration Compatibility Using Fabric Manager
- Verifying IPsec Configuration Compatibility Using the CLI
- Verifying Security Policy Databases Compatibility
- Verifying Interface Status Using Fabric Manager
- Verifying Interface Status Using the CLI

- Verifying Security Associations
- Security Associations Do Not Re-Key
- Clearing Security Associations
- Debugging the IPsec Process
- Debugging the IKE Process
- Obtaining Statistics from the IPsec Process

Verifying IKE Configuration Compatibility

To verify the compatibility of the IKE configurations of MDS A and MDS C shown in Figure 22-1, follow these steps:

-
1. Ensure that the preshared keys are identical on each switch. Use the **show crypto ike domain ipsec key** CLI command on both switches. Command outputs for the configuration shown in Figure 22-1 follow:

```
MDSA# show crypto ike domain ipsec key
key ctct address 10.10.100.232
```

```
MDSC# show crypto ike domain ipsec key
key ctct address 10.10.100.231
```

2. Ensure that at least one matching policy that has the same encryption algorithm, hash algorithm, and Diffie-Hellman (DH) group is configured on each switch. Issue the **show crypto ike domain ipsec policy** command on both switches. Example command outputs for the configuration shown in Figure 22-1 are given below:

```
MDSA# show crypto ike domain ipsec policy
Priority 1, auth pre-shared, lifetime 86300 secs, encryption 3des, hash md5, DH group 1
```

```
MDSC# show crypto ike domain ipsec policy
Priority 1, auth pre-shared, lifetime 86300 secs, encryption 3des, hash md5, DH group 1
```

Verifying IPsec Configuration Compatibility Using Fabric Manager

To verify the compatibility of the IPsec configurations of MDS A and MDS C shown in Figure 22-1 using Fabric Manager, follow these steps:

-
1. Choose **Switches > Security > IPSEC** and select the **CryptoMap Set Entry** tab. Verify that the Peer Address, IpFilter, Lifetime, and PFS fields match for MDS A and MDS C.
 2. Click the **Transform Set** tab and verify that the transform set on both switches match.
 3. Click the **Interfaces** tab and verify that the crypto map set is applied to the correct interface on both switches.
 4. In Device Manager, choose **IP > ACLs** and verify that the ACLs used in the crypto map in Step 1 are compatible on both switches.
-

Verifying IPsec Configuration Compatibility Using the CLI

To verify the compatibility of the IPsec configurations of MDS A and MDS C shown in Figure 22-1 using the CLI, follow these steps:

1. Use the **show crypto map domain ipsec** command and the **show crypto transform-set domain ipsec** command. The following command outputs display the fields discussed in Step 2 through Step 7.

```
MDSA# show crypto map domain ipsec
Crypto Map "cmap-01" 1 ipsec
-->      Peer = 10.10.100.232
-->      IP ACL = acl1
        permit ip 10.10.100.231 255.255.255.255 10.10.100.232 255.255.255.255
        Transform-sets: tfs-02,
-->      Security Association Lifetime: 3000 gigabytes/120 seconds
-->      PFS (Y/N): Y
-->      PFS Group: group5
--> Interface using crypto map set cmap-01:
        GigabitEthernet7/1
MDSC# show crypto map domain ipsec
Crypto Map "cmap-01" 1 ipsec
-->      Peer = 10.10.100.231
-->      IP ACL = acl1
        permit ip 10.10.100.232 255.255.255.255 10.10.100.231 255.255.255.255
        Transform-sets: tfs-02,
-->      Security Association Lifetime: 3000 gigabytes/120 seconds
-->      PFS (Y/N): Y
-->      PFS Group: group5
-->Interface using crypto map set cmap-01:
        GigabitEthernet1/2
MDSA# show crypto transform-set domain ipsec
Transform set:tfs-01 {esp-3des null}
        will negotiate {tunnel}
-->Transform set:tfs-02 {esp-3des esp-md5-hmac}
        will negotiate {tunnel}
Transform set:ipsec_default_transform_set {esp-aes 128 esp-sha1-hmac}
        will negotiate {tunnel}
MDSC# show crypto transform-set domain ipsec
Transform set:tfs-01 {esp-3des null}
        will negotiate {tunnel}
--> Transform set:tfs-02 {esp-3des esp-md5-hmac}
        will negotiate {tunnel}
Transform set:ipsec_default_transform_set {esp-aes 128 esp-sha1-hmac}
        will negotiate {tunnel}
```

2. Ensure that the ACLs are compatible in the **show crypto map domain ipsec** command outputs for both switches.

3. Ensure that the peer configuration is correct in the **show crypto map domain ipsec** command outputs for both switches.

4. Ensure that the transform sets are compatible in the **show crypto transform-set domain ipsec** command outputs for both switches.

5. Ensure that the PFS settings in the **show crypto map domain ipsec** command outputs are configured the same on both switches.

6. Ensure that the security association (SA) lifetime settings in the **show crypto map domain ipsec** command outputs are large enough to avoid excessive re-keys (the default settings ensure this).

7. Ensure that the crypto map set is applied to the correct interface in the **show crypto map domain ipsec** command outputs for both switches.

Verifying Security Policy Databases Compatibility


To verify that the security policy databases (SPDs) are compatible on both switches, follow these steps:

1. Issue the **show crypto spd domain ipsec** command on both switches to display the SPD. The command outputs follow:

```
MDSA# show crypto spd domain ipsec
Policy Database for interface:GigabitEthernet7/1, direction:Both
# 0: deny udp any port eq 500 any <-----Clear test policies for IKE
# 1: deny udp any any port eq 500 <-----Clear test policies for IKE
# 2: permit ip 10.10.100.231 255.255.255.255 10.10.100.232 255.255.255.255
--># 127: deny ip any any <-----Clear test policy for all other traffic
```

```
MDSC# show crypto spd domain ipsec
Policy Database for interface:GigabitEthernet1/2, direction:Both
# 0: deny udp any port eq 500 any
# 1: deny udp any any port eq 500
--># 2: permit ip 10.10.100.232 255.255.255.255 10.10.100.231 255.255.255.255
# 127: deny ip any any
```

2. Issue the **show ipsec internal crypto-accelerator interface gigabitethernet slot/port spd inbound** command on both switches to display SPD information from the crypto-accelerator.

 **Note:** To issue commands with the **internal** keyword, you must have an account that is a member of the **network-admin** group.

The example command outputs follow:

```
MDSA# show ipsec internal crypto-accelerator interface gigabitethernet 7/1 spd inbound
Inbound Policy 0 :
Source IP Address :*
Destination IP Address :*
Source port :500, Destination port :* Protocol UDP
Physical port:0/0, Vlan_id:0/0
Action cleartext
Inbound Policy 1 :
Source IP Address :*
Destination IP Address :*
Source port :*, Destination port :500 Protocol UDP
Physical port:0/0, Vlan_id:0/0
Action cleartext
Inbound Policy 2 :
Source IP Address :10.10.100.232/255.255.255.255
Destination IP Address :10.10.100.231/255.255.255.255
Source port :*, Destination port :* Protocol *
Physical port:0/1, Vlan_id:0/4095
Action ipsec
Inbound Policy 127 :
```


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```
Source IP Address :*
Destination IP Address :*
Source port :*, Destination port :* Protocol *
Physical port:0/0, Vlan_id:0/0
Action cleartext
```

```
MDSC# show ipsec internal crypto-accelerator interface gigabitethernet 1/2 spd inbound
Inbound Policy 0 :
Source IP Address :*
Destination IP Address :*
Source port :500, Destination port :* Protocol UDP
Physical port:0/0, Vlan_id:0/0
Action cleartext
Inbound Policy 1 :
Source IP Address :*
Destination IP Address :*
Source port :*, Destination port :500 Protocol UDP
Physical port:0/0, Vlan_id:0/0
Action cleartext
Inbound Policy 2 :
Source IP Address :10.10.100.231/255.255.255.255
Destination IP Address :10.10.100.232/255.255.255.255
Source port :*, Destination port :* Protocol *
Physical port:1/1, Vlan_id:0/4095
Action ipsec
Inbound Policy 127 :
Source IP Address :*
Destination IP Address :*
Source port :*, Destination port :* Protocol *
Physical port:0/0, Vlan_id:0/0
Action cleartext
```

Verifying Interface Status Using Fabric Manager

To verify the status of the interfaces using Fabric Manager, follow these steps:

1. Choose **Switches > Interfaces > GigabitEthernet** to verify that the interfaces are up and their IP addresses are correct.
2. Choose **ISLs > FCIP** and select the **Tunnels** tab. Verify that each interface is using the correct profile, the peer Internet addresses are configured correctly, and the FCIP tunnels are compatible.

Verifying Interface Status Using the CLI

To verify the status of the interfaces using the CLI, follow these steps:

1. Issue the **show interface gigabitethernet** command on both switches. Verify that the interfaces are up and their IP addresses are correct. Issue the **no shutdown** command if necessary. The command outputs follow:

```
MDSA# show interface gigabitethernet 7/1
-->GigabitEthernet7/1 is up
   Hardware is GigabitEthernet, address is 0005.3001.804e
-->   Internet address is 10.10.100.231/24
      MTU 1500 bytes
      Port mode is IPS
      Speed is 1 Gbps
      Beacon is turned off
```

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```
Auto-Negotiation is turned on
5 minutes input rate 7728 bits/sec, 966 bytes/sec, 8 frames/sec
5 minutes output rate 7968 bits/sec, 996 bytes/sec, 8 frames/sec
7175 packets input, 816924 bytes
  0 multicast frames, 0 compressed
  0 input errors, 0 frame, 0 overrun 0 fifo
7285 packets output, 840018 bytes, 0 underruns
  0 output errors, 0 collisions, 0 fifo
  0 carrier errors
```

```
MDSC# show interface gigabitethernet 1/2
-->GigabitEthernet1/2 is up
  Hardware is GigabitEthernet, address is 0005.3001.7f0f
-->  Internet address is 10.10.100.232/24
  MTU 1500 bytes
  Port mode is IPS
  Speed is 1 Gbps
  Beacon is turned off
  Auto-Negotiation is turned on
  5 minutes input rate 7528 bits/sec, 941 bytes/sec, 8 frames/sec
  5 minutes output rate 7288 bits/sec, 911 bytes/sec, 8 frames/sec
  7209 packets input, 835518 bytes
    0 multicast frames, 0 compressed
    0 input errors, 0 frame, 0 overrun 0 fifo
  7301 packets output, 827630 bytes, 0 underruns
    0 output errors, 0 collisions, 0 fifo
    0 carrier errors
```

2. Issue the **show interface fcip** command on both switches. Verify that each interface is using the correct profile, the peer Internet addresses are configured correctly, and the FCIP tunnels are compatible. Issue the **no shutdown** command if necessary. The command outputs follow:

```
MDSA# show interface fcip 1
fcip1 is trunking
  Hardware is GigabitEthernet
  Port WWN is 21:90:00:0d:ec:02:64:80
  Peer port WWN is 20:14:00:0d:ec:08:5f:c0
  Admin port mode is auto, trunk mode is on
  Port mode is TE
  Port vsan is 1
  Speed is 1 Gbps
  Trunk vsans (admin allowed and active) (1,100,200,302-303,999,3001-3060)
  Trunk vsans (up) (1)
  Trunk vsans (isolated) (100,200,302-303,999,3001-3060)
  Trunk vsans (initializing) ( )
-->  Using Profile id 1 (interface GigabitEthernet7/1)
  Peer Information
-->  Peer Internet address is 10.10.100.232 and port is 3225
-->  FCIP tunnel is protected by IPsec
  Write acceleration mode is off
  Tape acceleration mode is off
  Tape Accelerator flow control buffer size is automatic
  IP Compression is disabled
Special Frame is disabled
  Maximum number of TCP connections is 2
  Time Stamp is disabled
  QOS control code point is 0
  QOS data code point is 0
  B-port mode disabled
  TCP Connection Information
    2 Active TCP connections
    Control connection:Local 10.10.100.231:3225, Remote 10.10.100.232:65492
```

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```
Data connection:Local 10.10.100.231:3225, Remote 10.10.100.232:65494
20 Attempts for active connections, 0 close of connections
TCP Parameters
  Path MTU 1400 bytes
  Current retransmission timeout is 200 ms
  Round trip time:Smoothed 2 ms, Variance:3
  Advertized window:Current:118 KB, Maximum:14 KB, Scale:6
  Peer receive window:Current:128 KB, Maximum:128 KB, Scale:6
  Congestion window:Current:14 KB, Slow start threshold:204 KB
  Current Send Buffer Size:14 KB, Requested Send Buffer Size:0 KB
  CWM Burst Size:50 KB
5 minutes input rate 2960 bits/sec, 370 bytes/sec, 4 frames/sec
5 minutes output rate 3184 bits/sec, 398 bytes/sec, 4 frames/sec
3628 frames input, 340644 bytes
  3610 Class F frames input, 338396 bytes
  18 Class 2/3 frames input, 2248 bytes
  0 Reass frames
  0 Error frames timestamp error 0
3624 frames output, 359140 bytes
  3608 Class F frames output, 357332 bytes
  16 Class 2/3 frames output, 1808 bytes
  0 Error frames

MDSC# show interface fcip 1
fcip1 is trunking
  Hardware is GigabitEthernet
  Port WWN is 20:14:00:0d:ec:08:5f:c0
  Peer port WWN is 21:90:00:0d:ec:02:64:80
  Admin port mode is auto, trunk mode is on
  Port mode is TE
  Port vsan is 1
  Speed is 1 Gbps
  Trunk vsans (admin allowed and active) (1)
  Trunk vsans (up) (1)
  Trunk vsans (isolated) ( )
  Trunk vsans (initializing) ( )
-->      Using Profile id 1 (interface GigabitEthernet1/2)
Peer Information
-->      Peer Internet address is 10.10.100.231 and port is 3225
-->      FCIP tunnel is protected by IPsec
Write acceleration mode is off
Tape acceleration mode is off
Tape Accelerator flow control buffer size is automatic
IP Compression is disabled
Special Frame is disabled
Maximum number of TCP connections is 2
Time Stamp is disabled
QOS control code point is 0
QOS data code point is 0
B-port mode disabled
TCP Connection Information
  2 Active TCP connections
    Control connection:Local 10.10.100.232:65492, Remote 10.10.100.231:3225
    Data connection:Local 10.10.100.232:65494, Remote 10.10.100.231:3225
    22 Attempts for active connections, 1 close of connections
TCP Parameters
  Path MTU 1400 bytes
  Current retransmission timeout is 200 ms
  Round trip time:Smoothed 2 ms, Variance:3
  Advertized window:Current:128 KB, Maximum:14 KB, Scale:6
  Peer receive window:Current:118 KB, Maximum:118 KB, Scale:6
  Congestion window:Current:15 KB, Slow start threshold:204 KB
  Current Send Buffer Size:14 KB, Requested Send Buffer Size:0 KB
```

```
CWM Burst Size:50 KB
5 minutes input rate 3192 bits/sec, 399 bytes/sec, 4 frames/sec
5 minutes output rate 2960 bits/sec, 370 bytes/sec, 4 frames/sec
3626 frames input, 359324 bytes
  3610 Class F frames input, 357516 bytes
  16 Class 2/3 frames input, 1808 bytes
  1 Reass frames
  0 Error frames timestamp error 0
3630 frames output, 340828 bytes
  3612 Class F frames output, 338580 bytes
  18 Class 2/3 frames output, 2248 bytes
  0 Error frames
```

Verifying Security Associations

To verify security associations (SAs), follow these steps:


1. Issue the **show crypto sad domain ipsec** command to verify the current peer, mode, and inbound and outbound index of each switch. The example command outputs follow:

```
MDSA# show crypto sad domain ipsec
interface:GigabitEthernet7/1
  Crypto map tag:cmap-01, local addr. 10.10.100.231
  protected network:
  local ident (addr/mask):(10.10.100.231/255.255.255.255)
  remote ident (addr/mask):(10.10.100.232/255.255.255.255)
-->   current_peer:10.10.100.232
  local crypto endpt.:10.10.100.231, remote crypto endpt.:10.10.100.232
-->   mode:tunnel, crypto algo:esp-3des, auth algo:esp-md5-hmac
  tunnel id is:1
-->   current outbound spi:0x822a202 (136487426), index:1
  lifetimes in seconds::3600
  lifetimes in bytes::483183820800
-->   current inbound spi:0x38147002 (940863490), index:1
  lifetimes in seconds::3600
  lifetimes in bytes::483183820800
```

```
MDSC# show crypto sad domain ipsec
interface:GigabitEthernet1/2
  Crypto map tag:cmap-01, local addr. 10.10.100.232
  protected network:
  local ident (addr/mask):(10.10.100.232/255.255.255.255)
  remote ident (addr/mask):(10.10.100.231/255.255.255.255)
-->   current_peer:10.10.100.231
  local crypto endpt.:10.10.100.232, remote crypto endpt.:10.10.100.231
-->   mode:tunnel, crypto algo:esp-3des, auth algo:esp-md5-hmac
  tunnel id is:1
-->   current outbound spi:0x38147002 (940863490), index:513
  lifetimes in seconds::3600
  lifetimes in bytes::483183820800
-->   current inbound spi:0x822a202 (136487426), index:513
  lifetimes in seconds::3600
  lifetimes in bytes::483183820800
```

2. The SA index can be used to look at the SA in the crypto-accelerator. Issue the **show ipsec internal crypto-accelerator interface gigabitethernet slot/port sad [inbound | outbound] sa-index** command to display the inbound or outbound SA information. The hard limit bytes and soft limit bytes fields display the

lifetime in bytes. The hard limit expiry secs and the soft limit expiry secs fields display the lifetime in seconds.

 **Note:** To issue commands with the **internal** keyword, you must have an account that is a member of the network-admin group.

The command outputs follow:

```
MDSA# show ipsec internal crypto-accelerator interface gigabitethernet 7/1 sad inbound 1
sw172.22.48.91# show ipsec internal crypto-accelerator interface gigabitethernet 7/1 sad
inbound 1
Inbound SA 1 :
  Mode :Tunnel, flags:0x4923000000000000
  IPsec mode is ESP
  Encrypt algorithm is DES/3DES
  Auth algorithm is MD5
  Source ip address 10.10.100.232/255.255.255.255
  Destination ip address 10.10.100.231/255.255.255.255
  Physical port 0, mask:0x1
  Misc select 0 mask:0x0
  Vlan 0 mask:0xfff
  Protocol 0 mask:0x0
  Source port no 0 mask:0x0
  Dest port no 0 mask:0x0
-->     Hard limit 483183820800 bytes
-->     Soft limit 401042571264 bytes
  SA byte count 845208 bytes <----Elapsed traffic
  SA user byte count 845208 bytes <----Elapsed traffic
  Error count:auth:0, pad:0, replay:0
  Packet count 7032
-->     Hard limit expiry 1100652419 secs (since January 1, 1970), remaining 219 7 secs
-->     Soft limit expiry 1100652386 secs (since January 1, 1970), remaining 216 4 secs
  Sequence number:7033
  Antireplay window:0xffffffff.0xffffffff.0xffffffff.0xffffffff
```

```
MDSC# show ipsec internal crypto-accelerator interface gigabitethernet 1/2 sad inbound 513
Inbound SA 513 :
  Mode :Tunnel, flags:0x4923000000000000
  IPsec mode is ESP
  Encrypt algorithm is DES/3DES
  Auth algorithm is MD5
  Source ip address 10.10.100.231/255.255.255.255
  Destination ip address 10.10.100.232/255.255.255.255
  Physical port 1, mask:0x1
  Misc select 0 mask:0x0
  Vlan 0 mask:0xfff
  Protocol 0 mask:0x0
  Source port no 0 mask:0x0
  Dest port no 0 mask:0x0
-->     Hard limit 483183820800 bytes
-->     Soft limit 420369924096 bytes
  SA byte count 873056 bytes <----Elapsed traffic
  SA user byte count 873056 bytes <----Elapsed traffic
  Error count:auth:0, pad:0, replay:0
  Packet count 7137
-->     Hard limit expiry 1100652419 secs (since January 1, 1970), remaining 214 1 secs
-->     Soft limit expiry 1100652394 secs (since January 1, 1970), remaining 211 6 secs
  Sequence number:7138
  Antireplay window:0xffffffff.0xffffffff.0xffffffff.0xffffffff
```

```
MDSA# show ipsec internal crypto-accelerator interface gigabitethernet 7/1 sad outbound 1
Outbound SA 1 :
  SPI 136487426 (0x822a202), MTU 1400, MTU_delta 4
  Mode :Tunnel, flags:0x92100000000000
  IPsec mode is ESP
  Tunnel options index:0, ttl:0x40, flags:0x1
  Encrypt algorithm is DES/3DES
  Auth algorithm is MD5
  Tunnel source ip address 10.10.100.231
  Tunnel destination ip address 10.10.100.232
-->      Hard limit 483183820800 bytes
-->      Soft limit 376883380224 bytes
  SA byte count 874544 bytes <----Elapsed traffic
  SA user byte count 874544 bytes <----Elapsed traffic
  Packet count 7150
-->      Hard limit expiry 1100652419 secs (since January 1, 1970), remaining 208 9 secs
-->      Soft limit expiry 1100652384 secs (since January 1, 1970), remaining 205 4 secs
  Outbound MAC table index:1
  Sequence number:7151
```

```
MDSC# show ipsec internal crypto-accelerator interface gigabitethernet 1/2 sad outbound
513
Outbound SA 513 :
  SPI 940863490 (0x38147002), MTU 1400, MTU_delta 4
  Mode :Tunnel, flags:0x92100000000000
  IPsec mode is ESP
  Tunnel options index:0, ttl:0x40, flags:0x1
  Encrypt algorithm is DES/3DES
  Auth algorithm is MD5
  Tunnel source ip address 10.10.100.232
  Tunnel destination ip address 10.10.100.231
-->      Hard limit 483183820800 bytes
-->      Soft limit 449360953344 bytes
  SA byte count 855648 bytes <----Elapsed traffic
  SA user byte count 855648 bytes <----Elapsed traffic
  Packet count 7122
-->      Hard limit expiry 1100652419 secs (since January 1, 1970), remaining 206 4 secs
-->      Soft limit expiry 1100652397 secs (since January 1, 1970), remaining 204 2 secs
  Outbound MAC table index:125
  Sequence number:7123
```

Security Associations Do Not Rekey

A lifetime counter (in seconds and bytes) is maintained as soon as an SA is created. When the time limit expires, the SA is no longer operational and is automatically renegotiated (rekeyed) if traffic is present. If there is no traffic, the SA will not be rekeyed and the tunnel will go down.

The rekey operation starts when the soft lifetime expires. That happens approximately 20 to 30 seconds before the time-based lifetime expires, or when approximately 10 to 20 percent of the bytes are remaining in the bytes-based lifetime.

To troubleshoot this problem, follow these steps:

-
1. Verify that traffic was flowing when the soft SA lifetime expired.
 2. Verify that the configurations are still compatible.

Clearing Security Associations

To clear a specific SA, obtain the SA index value and issue the **clear crypto sa domain ipsec interface gigabitethernet slot/port outbound sa-index** command.

To obtain the SA index value, issue the **show crypto sad domain ipsec** command.

Debugging the IPsec Process

Use the following commands to print debug messages to the console:

- **debug ipsec error** for error messages.
- **debug ipsec warning** for warning messages.
- **debug ipsec config** for configuration messages.
- **debug ipsec flow** for SA related messages.

Debugging the IKE Process

Use the following commands to show the internal state of the IKE process:

- **show crypto ike domain ipsec initiator**
- **show crypto ike domain ipsec sa**

Obtaining Statistics from the IPsec Process

To obtain statistics from the IPsec process, issue the **show crypto global domain ipsec** command and the **show crypto global domain ipsec interface gigabitethernet slot/port** command. The **show crypto global domain ipsec** command output displays statistics for all SAs. Command output follows:

```
MDSA# show crypto global domain ipsec
IPSec global statistics:
  Number of crypto map sets:1
  IKE transaction stats:0 num, 64 max
  Inbound SA stats:1 num
  Outbound SA stats:1 num
```

The **show crypto global domain ipsec interface gigabitethernet slot/port** command output displays interface level statistics. Example command output follows:

```
MDSA# show crypto global domain ipsec interface gigabitethernet 7/1
IPSec interface statistics:
  IKE transaction stats:0 num
  Inbound SA stats:1 num, 512 max
  Outbound SA stats:1 num, 512 max
```

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