

# Configuring IPsec Between a Catalyst 4224 Access Gateway Switch and a Cisco IOS Router

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## Introduction

This document illustrates the sample configuration of IPsec between a Cisco Catalyst 4224 Access Gateway Switch and a Cisco router that runs Cisco IOS® Software. Encryption is done between VLAN1 of the access gateway (where the crypto map is applied) and the FastEthernet0/1 interface of the router.

## Prerequisites

### Requirements

There are no specific prerequisites for this document.

### Components Used

The information in this document is based on these software and hardware versions:

- Cisco IOS Software Release 12.(1)14
- IOS c4224 Software 12.2(2)YC1

The information presented in this document was created from devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If you are working in a live network, ensure that you understand the potential impact of any command before using it.

### Conventions

For more information on document conventions, refer to Cisco Technical Tips Conventions.

# Configure

In this section, you are presented with the information to configure the features described in this document.

**Note:** To find additional information on the commands used in this document, use the Command Lookup Tool (registered customers only).

## Network Diagram

This document uses this network setup:



## Configurations

This document uses these configurations:

- Catalyst 4224 Access Gateway Switch
- Cisco IOS Router

### Catalyst 4224 Access Gateway Switch

```
triana#show version
Cisco Internetwork Operating System Software
IOS (tm) c4224 Software (c4224-IK903SX3-M), Version 12.2(2)YC1,
EARLY DEPLOYMENT RELEASE SOFTWARE (fc2)

26 FastEthernet/IEEE 802.3 interface(s)
2 Serial(sync/async) network interface(s)
2 Channelized E1/PRI port(s)
1 Virtual Private Network (VPN) Module(s)

!--- Access gateway has onboard encryption service adapter.

8 Voice FXS interface(s)
256K bytes of non-volatile configuration memory.
31744K bytes of processor board System flash (Read/Write)

Configuration register is 0x2102

triana#show run
Building configuration...

Current configuration : 5111 bytes
!
! Last configuration change at 13:56:01 UTC Wed May 29 2002
! NVRAM config last updated at 13:56:03 UTC Wed May 29 2002
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
```



```

!
no spanning-tree optimize bpdu transmission
no spanning-tree vlan 1
no spanning-tree vlan 2
no spanning-tree vlan 3
!
controller E1 2/0
!
controller E1 2/1
!
translation-rule 1
  Rule 0 ^... 1
!
translation-rule 2
  Rule 0 ^10.. 0
  Rule 1 ^11.. 1
  Rule 2 ^12.. 2
  Rule 3 ^13.. 3
  Rule 4 ^14.. 4
  Rule 5 ^15.. 5
  Rule 6 ^16.. 6
  Rule 7 ^17.. 7
  Rule 8 ^18.. 8
  Rule 9 ^19.. 9
!
translation-rule 6
  Rule 0 ^112. 119
!
translation-rule 7
  Rule 0 ^1212 1196
!
translation-rule 3
  Rule 0 ^. 0
!
translation-rule 9
  Rule 0 ^. 9
!
translation-rule 99
  Rule 0 ^90.. 0
  Rule 1 ^91.. 1
  Rule 2 ^92.. 2
  Rule 3 ^93.. 3
  Rule 4 ^94.. 4
  Rule 5 ^95.. 5
  Rule 6 ^96.. 6
  Rule 7 ^97.. 7
  Rule 8 ^98.. 8
  Rule 9 ^99.. 9
!
translation-rule 999
  Rule 0 ^2186 1196
!
translation-rule 1122
  Rule 0 ^1122 528001
  Rule 1 ^1121 519352
!
translation-rule 20
  Rule 0 ^000 500
!
!
!
interface Loopback0
  no ip address
!

```

```

interface FastEthernet0/0
  no ip address
  duplex auto
  speed auto
!
interface Serial1/0
  no ip address
  no fair-queue
!
interface Serial1/1
  no ip address
!
interface FastEthernet5/0
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/1
  no ip address
  shutdown
  duplex auto
  speed auto
  switchport voice vlan 3
  spanning-tree portfast
!

!--- For the lab setup, a host is connected on this port.

interface FastEthernet5/2
  no ip address
  duplex auto
  speed auto

!--- Place the port in VLAN 2.

switchport access vlan 2
  spanning-tree portfast
!
interface FastEthernet5/3
  no ip address
  shutdown
  duplex auto
  speed auto
  switchport access vlan 999
  spanning-tree portfast
!
interface FastEthernet5/4
  no ip address
  duplex auto
  speed auto
  switchport access vlan 2
  switchport voice vlan 3
  spanning-tree portfast
!
interface FastEthernet5/5
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/6
  no ip address
  duplex auto
  speed auto
!

```

```
interface FastEthernet5/7
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/8
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/9
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/10
  no ip address
  duplex auto
  speed auto
  switchport trunk allowed vlan 1-3
  switchport mode trunk

!--- By default, the port belongs to VLAN 1.

interface FastEthernet5/11
no ip address
duplex auto
speed auto
!
interface FastEthernet5/12
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/13
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/14
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/15
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/16
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/17
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/18
  no ip address
  duplex auto
  speed auto
!
```

```

interface FastEthernet5/19
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/20
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/21
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/22
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/23
  no ip address
  duplex auto
  speed auto
!
interface FastEthernet5/24
  no ip address
  duplex auto
  speed auto
!

!--- Define an IP address and apply crypto map to enable
!--- IPSec processing on this interface.

interface Vlan 1
  ip address 209.165.201.5 255.255.255.224
  crypto map mymap
!

!--- Define an IP address for VLAN 2.

interface Vlan 2
  ip address 192.168.10.1 255.255.255.0
!
ip classless
ip route 10.48.66.0 255.255.254.0 209.165.201.6
no ip http server
!
!
ip access-list extended cryptoacl
  remark This is crypto ACL
  permit ip 192.168.10.0 0.0.0.255 10.48.66.0 0.0.1.255
call rsvp-sync
!
voice-port 4/0
  output attenuation 0
!
voice-port 4/1
  output attenuation 0
!
voice-port 4/2
  output attenuation 0
!
voice-port 4/3

```

```

    output attenuation 0
    !
voice-port 4/4
    output attenuation 0
    !
voice-port 4/5
    output attenuation 0
    !
voice-port 4/6
    output attenuation 0
    !
voice-port 4/7
    output attenuation 0
    !
mgcp
no mgcp timer receive-rtcp
!
mgcp profile default
!
dial-peer cor custom
!
!
!
dial-peer voice 1 voip
!
dial-peer voice 2 pots
    shutdown
!
!
line con 0
    exec-timeout 0 0
    length 0
line vty 0 4
    password ww
    login
!
end

 triana#

```

### Cisco IOS Router

```

brussels#show run
Building configuration...

Current configuration : 1538 bytes
!
! Last configuration change at 17:16:19 UTC Wed May 29 2002
! NVRAM config last updated at 13:58:44 UTC Wed May 29 2002
!
version 12.1
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname brussels
!
enable secret 5 $1$/vuT$081TvZgSFJ0xq5uTFc94u.
!
!
!
!

```

```

!
!
ip subnet-zero
no ip domain-lookup
!
ip cef
ip audit notify log
ip audit po max-events 100
!
!

/--- Define Phase 1 policy.

crypto isakmp policy 10
  authentication pre-share
crypto isakmp key yoursecretkey address 209.165.201.5
!
!

/--- Define the encryption policy for this setup.

crypto ipsec transform-set basic esp-des esp-md5-hmac
!

/--- Define a static crypto map entry for the remote PIX
/--- with mode ipsec-isakmp.
/--- This indicates that Internet Key Exchange (IKE)
/--- is used to establish the IPsec
/--- security associations for protecting the traffic
/--- specified by this crypto map entry.

crypto map vpnmap 10 ipsec-isakmp
  set peer 209.165.201.5
  set transform-set basic
  match address cryptoacl
!
!
!
!
!
!
interface FastEthernet0/0
  ip address 10.48.66.34 255.255.254.0
  no ip mroute-cache
  duplex auto
  speed auto
!
interface Serial0/0
  no ip address
  shutdown
!

/--- Enable crypto processing on the interface
/--- where traffic leaves the network.

interface FastEthernet0/1
  ip address 209.165.201.6 255.255.255.224
  no ip mroute-cache
  duplex auto
  speed auto
  crypto map vpnmap
!
interface Serial0/1
  no ip address

```

```

shutdown
!
interface Group-Async1
no ip address
encapsulation ppp
async mode dedicated
ppp authentication pap
group-range 33 40
!
ip classless
ip route 192.168.10.0 255.255.255.0 209.165.201.5
ip http server
!
!
!---- This access list defines interesting traffic for IPsec.

ip access-list extended cryptoacl
permit ip 10.48.66.0 0.0.1.255 192.168.10.0 0.0.0.255
!
!
line con 0
exec-timeout 0 0
length 0
line 33 40
modem InOut
line aux 0
line vty 0 4
login local
!
end

```

## Verify

This section provides information you can use to confirm your configuration is working properly. Verification of IPsec operation is done with **debug** commands. An extended ping is attempted from the router to a host behind the access gateway.

Certain **show** commands are supported by the Output Interpreter Tool ( registered customers only) , which allows you to view an analysis of **show** command output.

- **show debug** Displays the current debug settings.
- **show crypto isakmp sa** Displays all current IKE security associations (SAs) at a peer.
- **show crypto ipsec sa** Displays the settings used by current SAs.

## Troubleshoot

This section provides information you can use to troubleshoot your configuration.

### Troubleshooting Commands

**Note:** Before issuing **debug** commands, please see Important Information on Debug Commands.

- **debug crypto ipsec** Displays IPsec events.
- **debug crypto isakmp** Displays messages about IKE events.
- **debug crypto engine** Displays information from the crypto engine.

## Sample Debugs

This section provides sample debug output for the access gateway and the router.

- Catalyst 4224 Access Gateway Switch
- Cisco IOS Router

### Catalyst 4224 Access Gateway Switch

```
triana#debug crypto ipsec
Crypto IPSEC debugging is on
triana#debug crypto isakmp
Crypto ISAKMP debugging is on
triana#debug crypto engine
Crypto Engine debugging is on
triana#show debug

Cryptographic Subsystem:
  Crypto ISAKMP debugging is on
  Crypto Engine debugging is on
  Crypto IPSEC debugging is on
triana#
May 29 18:01:57.746: ISAKMP (0:0): received packet from 209.165.201.6 (N) NEW SA
May 29 18:01:57.746: ISAKMP: local port 500, remote port 500
May 29 18:01:57.746: ISAKMP (0:1): Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
Old State = IKE_READY New State = IKE_R_MM1
May 29 18:01:57.746: ISAKMP (0:1): processing SA payload. message ID = 0
May 29 18:01:57.746: ISAKMP (0:1): found peer pre-shared key
    matching 209.165.201.6

!--- 4224 access gateway checks the attributes for Internet Security
!--- Association & Key Management Protocol (ISAKMP) negotiation
!--- against the policy it has in its local configuration.

May 29 18:01:57.746: ISAKMP (0:1): Checking ISAKMP transform 1
    against priority 10 policy
May 29 18:01:57.746: ISAKMP:          encryption DES-CBC
May 29 18:01:57.746: ISAKMP:          hash SHA
May 29 18:01:57.746: ISAKMP:          default group 1
May 29 18:01:57.746: ISAKMP:          auth pre-share

!--- The received attributes are acceptable
!--- against the configured set of attributes.

May 29 18:01:57.746: ISAKMP (0:1): atts are acceptable. Next payload is 0
May 29 18:01:57.746: CryptoEngine0: generate alg parameter
May 29 18:01:57.746: CryptoEngine0: CRYPTO_ISA_DH_CREATE(hw)(ipsec)
May 29 18:01:57.898: CRYPTO_ENGINE: Dh phase 1 status: 0
May 29 18:01:57.898: ISAKMP (0:1): Input = IKE_MESG_INTERNAL,
    IKE_PROCESS_MAIN_MODE Old State = IKE_R_MM1 New State = IKE_R_MM1

May 29 18:01:57.898: ISAKMP (0:1): SA is doing pre-shared key authentication
    using id type ID_IPV4_ADDR
May 29 18:01:57.898: ISAKMP (0:1): sending packet to 209.165.201.6 (R) MM_SA_SETUP
May 29 18:01:57.898: ISAKMP (0:1): Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
Old State = IKE_R_MM1 New State = IKE_R_MM2

May 29 18:01:58.094: ISAKMP (0:1): received packet from 209.165.201.6
    (R) MM_SA_SETUP
May 29 18:01:58.094: ISAKMP (0:1): Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
Old State = IKE_R_MM2 New State = IKE_R_MM3
```

```

May 29 18:01:58.098: ISAKMP (0:1): processing KE payload. message ID = 0
May 29 18:01:58.098: CryptoEngine0: generate alg parameter
May 29 18:01:58.098: CryptoEngine0: CRYPTO_ISA_DH_SHARE_SECRET(hw)(ipsec)
May 29 18:01:58.246: ISAKMP (0:1): processing NONCE payload. message ID = 0
May 29 18:01:58.246: ISAKMP (0:1): found peer pre-shared key matching 209.165.201.6
May 29 18:01:58.250: CryptoEngine0: create ISAKMP SKEYID for conn id 1
May 29 18:01:58.250: CryptoEngine0: CRYPTO_ISA_SA_CREATE(hw)(ipsec)
May 29 18:01:58.250: ISAKMP (0:1): SKEYID state generated
May 29 18:01:58.250: ISAKMP (0:1): processing vendor id payload
May 29 18:01:58.250: ISAKMP (0:1): speaking to another IOS box!
May 29 18:01:58.250: ISAKMP (0:1): Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
Old State = IKE_R_MM3 New State = IKE_R_MM3

May 29 18:01:58.250: ISAKMP (0:1): sending packet to 209.165.201.6 (R) MM_KEY_EXCH
May 29 18:01:58.250: ISAKMP (0:1): Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
Old State = IKE_R_MM3 New State = IKE_R_MM4

May 29 18:01:58.490: ISAKMP (0:1): received packet from 209.165.201.6
(R) MM_KEY_EXCH
May 29 18:01:58.490: CryptoEngine0: CRYPTO_ISA_IKE_DECRYPT(hw)(ipsec)
May 29 18:01:58.490: ISAKMP (0:1): Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
Old State = IKE_R_MM4 New State = IKE_R_MM5

May 29 18:01:58.490: ISAKMP (0:1): processing ID payload. message ID = 0
May 29 18:01:58.490: ISAKMP (0:1): processing HASH payload. message ID = 0
May 29 18:01:58.490: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:58.490: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec)
May 29 18:01:58.490: ISAKMP (0:1): SA has been authenticated with 209.165.201.6

!--- Phase 1 authentication is successful and the SA is authenticated.

May 29 18:01:58.494: ISAKMP (0:1): Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
Old State = IKE_R_MM5 New State = IKE_R_MM5

May 29 18:01:58.494: ISAKMP (1): ID payload
      next-payload : 8
      type          : 1
      protocol      : 17
      port          : 500
      length        : 8
May 29 18:01:58.494: ISAKMP (1): Total payload length: 12
May 29 18:01:58.494: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:58.494: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec)
May 29 18:01:58.494: CryptoEngine0: clear dh number for conn id 1
May 29 18:01:58.494: CryptoEngine0: CRYPTO_ISA_DH_DELETE(hw)(ipsec)
May 29 18:01:58.494: CryptoEngine0: CRYPTO_ISA_IKE_ENCRYPT(hw)(ipsec)
May 29 18:01:58.494: ISAKMP (0:1): sending packet to 209.165.201.6 (R) QM_IDLE
May 29 18:01:58.498: ISAKMP (0:1): Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
Old State = IKE_R_MM5 New State = IKE_P1_COMPLETE

May 29 18:01:58.518: ISAKMP (0:1): received packet from 209.165.201.6 (R) QM_IDLE
May 29 18:01:58.518: CryptoEngine0: CRYPTO_ISA_IKE_DECRYPT(hw)(ipsec)
May 29 18:01:58.518: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:58.518: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec)
May 29 18:01:58.522: ISAKMP (0:1): processing HASH payload.
      message ID = -1809462101
May 29 18:01:58.522: ISAKMP (0:1): processing SA payload.
      message ID = -1809462101

May 29 18:01:58.522: ISAKMP (0:1): Checking IPSec proposal 1
May 29 18:01:58.522: ISAKMP: transform 1, ESP_DES
May 29 18:01:58.522: ISAKMP:   attributes in transform:
May 29 18:01:58.522: ISAKMP:     encaps is 1
May 29 18:01:58.522: ISAKMP:     SA life type in seconds

```

```

May 29 18:01:58.522: ISAKMP:      SA life duration (basic) of 3600
May 29 18:01:58.522: ISAKMP:      SA life type in kilobytes
May 29 18:01:58.522: ISAKMP:      SA life duration (VPI) of 0x0 0x46 0x50 0x0
May 29 18:01:58.522: ISAKMP:      authenticator is HMAC-MD5
May 29 18:01:58.522: validate proposal 0
May 29 18:01:58.522: ISAKMP (0:1): atts are acceptable.
May 29 18:01:58.522: IPSEC(validate_proposal_request): proposal part #1,

!--- After the attributes are negotiated,
!--- IKE asks IPSec to validate the proposal.

(key eng. msg.) dest= 209.165.201.5, src= 209.165.201.6,
dest_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
src_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 0s and 0kb,
spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4

!--- spi is still zero because SAs have not been set.

May 29 18:01:58.522: validate proposal request 0
May 29 18:01:58.522: ISAKMP (0:1): processing NONCE payload.
message ID = -1809462101
May 29 18:01:58.522: ISAKMP (0:1): processing ID payload.
message ID = -1809462101
May 29 18:01:58.522: ISAKMP (1): ID_IPV4_ADDR_SUBNET src 10.48.66.0/255.255.254.0
prot 0 port 0
May 29 18:01:58.522: ISAKMP (0:1): processing ID payload.
message ID = -1809462101
May 29 18:01:58.522: ISAKMP (1): ID_IPV4_ADDR_SUBNET dst 192.168.10.0/255.255.255.0
prot 0 port 0
May 29 18:01:58.522: ISAKMP (0:1): asking for 1 spis from ipsec
May 29 18:01:58.522: ISAKMP (0:1): Node -1809462101, Input = IKE_MSG_FROM_PEER,
IKE_QM_EXCH
Old State = IKE_QM_READY New State = IKE_QM_SPI_STARVE

May 29 18:01:58.526: IPSEC(key_engine): got a queue event...
May 29 18:01:58.526: IPSEC(spi_response): getting spi 3384026087 for SA
from 209.165.201.6 to 209.165.201.5 for prot 3
May 29 18:01:58.526: ISAKMP: received ke message (2/1)
May 29 18:01:58.774: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:58.774: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec)
May 29 18:01:58.774: CryptoEngine0: CRYPTO_ISA_IKE_ENCRYPT(hw)(ipsec)
May 29 18:01:58.774: ISAKMP (0:1): sending packet to 209.165.201.6 (R) QM_IDLE
May 29 18:01:58.774: ISAKMP (0:1): Node -1809462101, Input = IKE_MSG_FROM_IPSEC,
IKE_SPI_REPLY
Old State = IKE_QM_SPI_STARVE New State = IKE_QM_R_QM2

May 29 18:01:58.830: ISAKMP (0:1): received packet from 209.165.201.6 (R) QM_IDLE
May 29 18:01:58.830: CryptoEngine0: CRYPTO_ISA_IKE_DECRYPT(hw)(ipsec)
May 29 18:01:58.834: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:58.834: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec)
May 29 18:01:58.834: ipsec allocate flow 0
May 29 18:01:58.834: ipsec allocate flow 0
May 29 18:01:58.834: CryptoEngine0: CRYPTO_ISA_IPSEC_KEY_CREATE(hw)(ipsec)
May 29 18:01:58.834: CryptoEngine0: CRYPTO_ISA_IPSEC_KEY_CREATE(hw)(ipsec)
May 29 18:01:58.838: ISAKMP (0:1): Creating IPSec SAs
May 29 18:01:58.838: inbound SA from 209.165.201.6 to 209.165.201.5
(proxy 10.48.66.0 to 192.168.10.0)
May 29 18:01:58.838: has spi 0xC9B423E7 and conn_id 50 and flags 4
May 29 18:01:58.838: lifetime of 3600 seconds
May 29 18:01:58.838: lifetime of 4608000 kilobytes
May 29 18:01:58.838: outbound SA from 209.165.201.5 to 209.165.201.6
(proxy 192.168.10.0 to 10.48.66.0)

```

```

May 29 18:01:58.838:      has spi 561973207 and conn_id 51 and flags 4
May 29 18:01:58.838:      lifetime of 3600 seconds
May 29 18:01:58.838:      lifetime of 4608000 kilobytes
May 29 18:01:58.838: ISAKMP (0:1): deleting node -1809462101 error FALSE reason
      "quick mode done (await())"
May 29 18:01:58.838: ISAKMP (0:1): Node -1809462101, Input = IKE_MSG_FROM_PEER,
      IKE_QM_EXCH
Old State = IKE_QM_R_QM2  New State = IKE_QM_PHASE2_COMPLETE

May 29 18:01:58.838: IPSEC(key_engine): got a queue event...
May 29 18:01:58.838: IPSEC(initialize_sas): ,
      (key eng. msg.) dest= 209.165.201.5, src= 209.165.201.6,
      dest_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
      src_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
      protocol= ESP, transform= esp-des esp-md5-hmac ,
      lifedur= 3600s and 4608000kb,
      spi= 0xC9B423E7(3384026087), conn_id= 50, keysize= 0, flags= 0x4

!--- IPsec SAs are now initialized and encrypted
!--- communication can now take place.

May 29 18:01:58.838: IPSEC(initialize_sas): ,
      (key eng. msg.) src= 209.165.201.5, dest= 209.165.201.6,
      src_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
      dest_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
      protocol= ESP, transform= esp-des esp-md5-hmac ,
      lifedur= 3600s and 4608000kb,
      spi= 0x217F07D7(561973207), conn_id= 51, keysize= 0, flags= 0x4

!--- IPsec SAs are now initialized and encrypted
!--- communication can now take place.

May 29 18:01:58.838: IPSEC(create_sa): sa created,
      (sa) sa_dest= 209.165.201.5, sa_prot= 50,
      sa_spi= 0xC9B423E7(3384026087),
      sa_trans= esp-des esp-md5-hmac , sa_conn_id= 50
May 29 18:01:58.838: IPSEC(create_sa): sa created,
      (sa) sa_dest= 209.165.201.6, sa_prot= 50,
      sa_spi= 0x217F07D7(561973207),
      sa_trans= esp-des esp-md5-hmac , sa_conn_id= 51

!--- Observe that two IPsec SAs are created.
!--- Recollect that IPsec SAs are bidirectional.

 triana#
 triana#
 triana#
 triana#show crypto isakmp sa
dst          src          state          conn-id  slot
209.165.201.5  209.165.201.6  QM_IDLE          &n bsp;  1      0

 triana#show crypto ipsec sa

interface: Vlan 1
  Crypto map tag: mymap, local addr. 209.165.201.5

  local ident (addr/mask/prot/port): (192.168.10.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port): (10.48.66.0/255.255.254.0/0/0)
  current_peer: 209.165.201.6
    PERMIT, flags={origin_is_acl,}
    #pkts encaps: 4, #pkts encrypt: 4, #pkts digest 4
    #pkts decaps: 4, #pkts decrypt: 4, #pkts verify 4
    #pkts compressed: 0, #pkts decompressed: 0
    #pkts not compressed: 0, #pkts compr. failed: 0, #pkts decompress failed: 0

```

```

#send errors 0, #recv errors 0

local crypto endpt.: 209.165.201.5, remote crypto endpt.: 209.165.201.6
path mtu 1500, media mtu 1500
current outbound spi: 217F07D7

inbound esp sas:
  spi: 0xC9B423E7(3384026087)
    transform: esp-des esp-md5-hmac ,
    in use settings ={Tunnel, }
    slot: 0, conn id: 50, flow_id: 1, crypto map: mymap
    sa timing: remaining key lifetime (k/sec): (4607998/3536)
    IV size: 8 bytes
    replay detection support: Y

inbound ah sas:

inbound pcp sas:

outbound esp sas:
  spi: 0x217F07D7(561973207)
    transform: esp-des esp-md5-hmac ,
    in use settings ={Tunnel, }
    slot: 0, conn id: 51, flow_id: 2, crypto map: mymap
    sa timing: remaining key lifetime (k/sec): (4607999/3536)
    IV size: 8 bytes
    replay detection support: Y

outbound ah sas:

outbound pcp sas:

triana#

```

## Cisco IOS Router

```

brussels#show debug
Cryptographic Subsystem:
  Crypto ISAKMP debugging is on
  Crypto Engine debugging is on
  Crypto IPSEC debugging is on
brussels#p
Protocol [ip]:
Target IP address: 192.168.10.5
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: fastethernet0/0
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.5, timeout is 2 seconds:

May 29 18:01:54.285: IPSEC(sa_request): ,
  (key eng. msg.) src= 209.165.201.6, dest= 209.165.201.5,
  src_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
  dest_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
  protocol= ESP, transform= esp-des esp-md5-hmac ,

```

```

    lifedur= 3600s and 4608000kb,
    spi= 0x217F07D7(561973207), conn_id= 0, keysize= 0, flags= 0x4004
May 29 18:01:54.285: ISAKMP: received ke message (1/1)
May 29 18:01:54.285: ISAKMP: local port 500, remote port 500
May 29 18:01:54.289: ISAKMP (0:1): beginning Main Mode exchange
May 29 18:01:54.289: ISAKMP (1): sending packet to 209.165.201.5 (I) MM_NO_STATE
May 29 18:01:54.461: ISAKMP (1): received packet from 209.165.201.5 (I) MM_NO_STATE
May 29 18:01:54.461: ISAKMP (0:1): processing SA payload. message ID = 0
May 29 18:01:54.461: ISAKMP (0:1): Checking ISAKMP transform 1
    against priority 10 policy
May 29 18:01:54.465: ISAKMP:      encryption DES-CBC
May 29 18:01:54.465: ISAKMP:      hash SHA
May 29 18:01:54.465: ISAKMP:      default group 1
May 29 18:01:54.465: ISAKMP:      auth pre-share
May 29 18:01:54.465: ISAKMP (0:1): atts are acceptable. Next payload is 0
May 29 18:01:54.465: CryptoEngine0: generate alg parameter
May 29 18:01:54.637: CRYPTO_ENGINE: Dh phase 1 status: 0
May 29 18:01:54.637: CRYPTO_ENGINE: Dh phase 1 status: 0
May 29 18:01:54.637: ISAKMP (0:1): SA is doing pre-shared key authentication
May 29 18:01:54.637: ISAKMP (1): SA is doing pre-shared key authentication using
    id type ID_IPV4_ADDR
May 29 18:01:54.641: ISAKMP (1): sending packet to 209.165.201.5 (I) MM_SA_SETUP
May 29 18:01:54.805: ISAKMP (1): received packet from 209.165.201.5 (I) MM_SA_SETUP
May 29 18:01:54.805: ISAKMP (0:1): processing KE payload. message ID = 0
May 29 18:01:54.805: CryptoEngine0: generate alg parameter
May 29 18:01:55.021: ISAKMP (0:1): processing NONCE payload. messa!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 20/21/24 ms
brussels#ge ID = 0
May 29 18:01:55.021: CryptoEngine0: create ISAKMP SKEYID for conn id 1
May 29 18:01:55.025: ISAKMP (0:1): SKEYID state generated
May 29 18:01:55.029: ISAKMP (0:1): processing vendor id payload
May 29 18:01:55.029: ISAKMP (0:1): speaking to another IOS box!
May 29 18:01:55.029: ISAKMP (1): ID payload
    next-payload : 8
    type          : 1
    protocol      : 17
    port          : 500
    length        : 8
May 29 18:01:55.029: ISAKMP (1): Total payload length: 12
May 29 18:01:55.029: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:55.033: ISAKMP (1): sending packet to 209.165.201.5 (I) MM_KEY_EXCH
May 29 18:01:55.049: ISAKMP (1): received packet from 209.165.201.5 (I) MM_KEY_EXCH
May 29 18:01:55.053: ISAKMP (0:1): processing ID payload. message ID = 0
May 29 18:01:55.053: ISAKMP (0:1): processing HASH payload. message ID = 0
May 29 18:01:55.053: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:55.057: ISAKMP (0:1): SA has been authenticated with 209.165.201.5

!--- Phase 1 is completed and Phase 2 starts now.

May 29 18:01:55.057: ISAKMP (0:1): beginning Quick Mode exchange,
    M-ID of -1809462101
May 29 18:01:55.061: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:55.065: ISAKMP (1): sending packet to 209.165.201.5 (I) QM_IDLE
May 29 18:01:55.065: CryptoEngine0: clear dh number for conn id 1
May 29 18:01:55.337: ISAKMP (1): received packet from 209.165.201.5 (I) QM_IDLE
May 29 18:01:55.341: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:55.345: ISAKMP (0:1): processing SA payload. message ID = -1809462101
May 29 18:01:55.345: ISAKMP (0:1): Checking IPsec proposal 1
May 29 18:01:55.345: ISAKMP: transform 1, ESP_DES
May 29 18:01:55.345: ISAKMP:      attributes in transform:
May 29 18:01:55.345: ISAKMP:      encaps is 1
May 29 18:01:55.345: ISAKMP:      SA life type in seconds
May 29 18:01:55.345: ISAKMP:      SA life duration (basic) of 3600
May 29 18:01:55.345: ISAKMP:      SA life type in kilobytes

```

```
May 29 18:01:55.345: ISAKMP: SA life duration (VPI) of 0x0 0x46 0x50 0x0
May 29 18:01:55.349: ISAKMP: authenticator is HMAC-MD5
May 29 18:01:55.349: validate proposal 0
May 29 18:01:55.349: ISAKMP (0:1): atts are acceptable.
May 29 18:01:55.349: IPSEC(validate_proposal_request): proposal part #1,
```

```
!--- After negotiating the attributes, IKE asks IPsec to
!--- validate the proposal.
```

```
(key eng. msg.) dest= 209.165.201.5, src= 209.165.201.6,
  dest_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
  src_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
  protocol= ESP, transform= esp-des esp-md5-hmac ,
  lifedur= 0s and 0kb,
  spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4
```

```
!--- spi is still zero because SAs have not been set.
```

```
May 29 18:01:55.353: validate proposal request 0
May 29 18:01:55.357: ISAKMP (0:1): processing NONCE payload.
  message ID = -1809462101
May 29 18:01:55.357: ISAKMP (0:1): processing ID payload. message ID = -1809462101
May 29 18:01:55.357: ISAKMP (0:1): processing ID payload. message ID = -1809462101
May 29 18:01:55.357: CryptoEngine0: generate hmac context for conn id 1
May 29 18:01:55.361: ipsec allocate flow 0
May 29 18:01:55.361: ipsec allocate flow 0
May 29 18:01:55.369: ISAKMP (0:1): Creating IPsec SAs
May 29 18:01:55.369: inbound SA from 209.165.201.5 to 209.165.201.6
  (proxy 192.168.10.0 to 10.48.66.0)
May 29 18:01:55.369: has spi 561973207 and conn_id 2000 and flags 4
May 29 18:01:55.373: lifetime of 3600 seconds
May 29 18:01:55.373: lifetime of 4608000 kilobytes
May 29 18:01:55.373: outbound SA from 209.165.201.6 to 209.165.201.5
  (proxy 10.48.66.0 to 192.168.10.0)
May 29 18:01:55.373: has spi -910941209 and conn_id 2001 and flags 4
May 29 18:01:55.373: lifetime of 3600 seconds
May 29 18:01:55.373: lifetime of 4608000 kilobytes
May 29 18:01:55.377: ISAKMP (1): sending packet to 209.165.201.5 (I) QM_IDLE
May 29 18:01:55.377: ISAKMP (0:1): deleting node -1809462101 error FALSE reason ""
May 29 18:01:55.381: IPSEC(key_engine): got a queue event...
May 29 18:01:55.381: IPSEC(initialize_sas): ,
  (key eng. msg.) dest= 209.165.201.6, src= 209.165.201.5,
  dest_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
  src_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
  protocol= ESP, transform= esp-des esp-md5-hmac ,
  lifedur= 3600s and 4608000kb,
  spi= 0x217F07D7(561973207), conn_id= 2000, keysize= 0, flags= 0x4
```

```
!--- IPsec SAs are now initialized and encrypted
!--- communication can now take place.
```

```
May 29 18:01:55.381: IPSEC(initialize_sas): ,
  (key eng. msg.) src= 209.165.201.6, dest= 209.165.201.5,
  src_proxy= 10.48.66.0/255.255.254.0/0/0 (type=4),
  dest_proxy= 192.168.10.0/255.255.255.0/0/0 (type=4),
  protocol= ESP, transform= esp-des esp-md5-hmac ,
  lifedur= 3600s and 4608000kb,
  spi= 0xC9B423E7(3384026087), conn_id= 2001, keysize= 0, flags= 0x4
```

```
!--- IPsec SAs are now initialized and encrypted
!--- communication can now take place.
```

```
May 29 18:01:55.385: IPSEC(create_sa): sa created,
  (sa) sa_dest= 209.165.201.6, sa_prot= 50,
```

```
sa_spi= 0x217F07D7(561973207),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2000
May 29 18:01:55.385: IPSEC(create_sa): sa created,
(sa) sa_dest= 209.165.201.5, sa_prot= 50,
sa_spi= 0xC9B423E7(3384026087),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2001
```

```
!--- Observe that two IPSec SAs are created.
!--- Recollect that IPSec SAs are bidirectional.
```

```
brussels#
```

```
brussels#show crypto isakmp sa
      dst          src          state          conn-id  slot
209.165.201.5    209.165.201.6    QM_IDLE        1        0
```

```
brussels#show crypto ipsec sa
```

```
interface: FastEthernet0/1
```

```
  Crypto map tag: vpnmap, local addr. 209.165.201.6
```

```
local ident (addr/mask/prot/port): (10.48.66.0/255.255.254.0/0/0)
remote ident (addr/mask/prot/port): (192.168.10.0/255.255.255.0/0/0)
current_peer: 209.165.201.5
  PERMIT, flags={origin_is_acl,}
#pkts encaps: 4, #pkts encrypt: 4, #pkts digest 4
#pkts decaps: 4, #pkts decrypt: 4, #pkts verify 4
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0, #pkts decompress failed: 0
#send errors 1, #recv errors 0
```

```
local crypto endpt.: 209.165.201.6, remote crypto endpt.: 209.165.201.5
path mtu 1500, media mtu 1500
current outbound spi: C9B423E7
```

```
inbound esp sas:
```

```
spi: 0x217F07D7(561973207)
  transform: esp-des esp-md5-hmac ,
  in use settings ={Tunnel, }
  slot: 0, conn id: 2000, flow_id: 1, crypto map: vpnmap
  sa timing: remaining key lifetime (k/sec): (4607998/3560)
  IV size: 8 bytes
  replay detection support: Y
```

```
inbound ah sas:
```

```
inbound pcp sas:
```

```
outbound esp sas:
```

```
spi: 0xC9B423E7(3384026087)
  transform: esp-des esp-md5-hmac ,
  in use settings ={Tunnel, }
  slot: 0, conn id: 2001, flow_id: 2, crypto map: vpnmap
  sa timing: remaining key lifetime (k/sec): (4607999/3560)
  IV size: 8 bytes
  replay detection support: Y
```

```
outbound ah sas:
```

```
outbound pcp sas:
```

```
brussels#
```

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- [IPSec Support Page](#)
- [An Introduction to IPSec](#)
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