

Configuring IPsec Between a Router and a PIX Using the nat 0 access-list Command

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Introduction

This document illustrates an IP Security (IPsec) configuration between a router and a Cisco Secure PIX Firewall. We want to use private internal IP addresses when passing traffic between the headquarters LAN and the remote LANs, and to translate the LAN hosts to routable IP addresses when users access the Internet. However, users can also access public pages on the Internet without their traffic going through the tunnel using the **route-map** command.

Refer to ASA/PIX : Security Appliance to an IOS Router LAN-to-LAN IPsec Tunnel Configuration Example in order to learn more about the scenario where a LAN-to-LAN tunnels between a router and the Cisco Security Appliances PIX/ASA.

Before You Begin

Conventions

For more information on document conventions, see the Cisco Technical Tips Conventions.

Prerequisites

There are no specific prerequisites for this document.

Components Used

The information in this document is based on the software and hardware versions below.

- Cisco Router with Cisco IOS® Software Release 12.0(7)T
- Cisco PIX Firewall Version 5.1(1)

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.

Background Theory

On the PIX, the **access-list** and **nat 0** commands work together. When a user on the 10.1.1.0 network goes to the 10.2.2.0 network, we use the access list to permit the 10.1.1.0 network traffic to be encrypted without Network Address Translation (NAT). However, when those same users go anywhere else, they are translated to the 172.17.63.210 address through Port Address Translation (PAT). On the router, the **route-map** and **access-list** commands are used to permit the 10.2.2.0 network traffic to be encrypted without NAT. However, when those same users go anywhere else, they are translated to the 172.17.63.210 address through Port Address Translation (PAT).

The following are configuration commands required on the PIX firewall in order for traffic not to run through PAT over the tunnel, and traffic to the Internet to run through PAT.

```
access-list nonat permit ip 10.1.1.0 255.255.255.0 10.2.2.0 255.255.255.0
nat (inside) 0 access-list nonat
nat (inside) 1 10.1.1.0 255.255.255.0 0 0
```

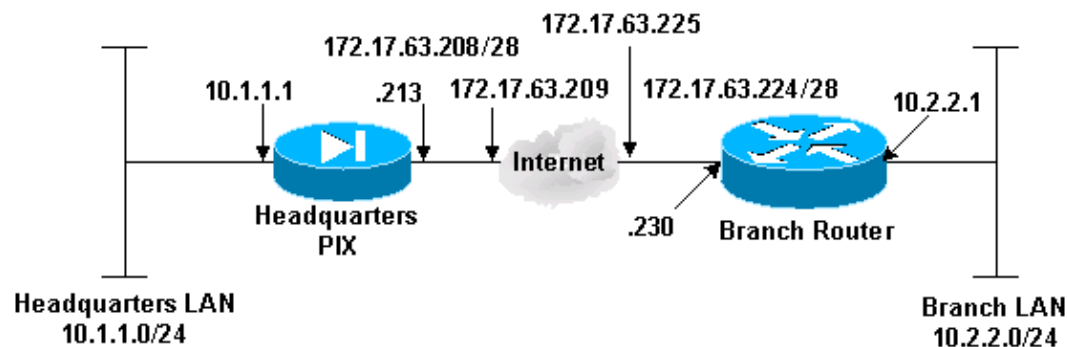
Configure

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 IOS Command Lookup tool.

Network Diagram

This document uses the network setup shown in the diagram below.



Configurations

This document uses the configurations shown below.

Headquarters PIX
PIX Version 5.1(1) nameif ethernet0 outside security0 nameif ethernet1 inside security100 <i>!--- Traffic to the router:</i>

```
access-list ipsec permit ip 10.1.1.0 255.255.255.0 10.2.2.0 255.255.255.0
```

```
!--- Do not Network Address Translate (NAT) traffic to the router:
```

```
access-list nonat permit ip 10.1.1.0 255.255.255.0 10.2.2.0 255.255.255.0
```

```
enable password 8Ry2YjIyt7RRXU24 encrypted
```

```
passwd 2KFQnbNIdI.2KYOU encrypted
```

```
hostname HQ_PIX
```

```
fixup protocol ftp 21
```

```
fixup protocol http 80
```

```
fixup protocol smtp 25
```

```
fixup protocol h323 1720
```

```
fixup protocol rsh 514
```

```
fixup protocol sqlnet 1521
```

```
names
```

```
pager lines 24
```

```
no logging timestamp
```

```
no logging standby
```

```
no logging console
```

```
no logging monitor
```

```
no logging buffered
```

```
no logging trap
```

```
no logging history
```

```
logging facility 20
```

```
logging queue 512
```

```
interface ethernet0 auto
```

```
interface ethernet1 auto
```

```
mtu outside 1500
```

```
mtu inside 1500
```

```
ip address outside 172.17.63.213 255.255.255.240
```

```
ip address inside 10.1.1.1 255.255.255.0
```

```
no failover
```

```
failover timeout 0:00:00
```

```
failover ip address outside 0.0.0.0
```

```
failover ip address inside 0.0.0.0
```

```
arp timeout 14400
```

```
global (outside) 1 172.17.63.210
```

```
!--- Do not NAT traffic to the router:
```

```
nat (inside) 0 access-list nonat
```

```
nat (inside) 1 10.1.1.0 255.255.255.0 0 0
```

```
conduit permit icmp any any
```

```
route outside 0.0.0.0 0.0.0.0 172.17.63.209 1
```

```
timeout xlate 3:00:00 conn 1:00:00 half-closed 0:10:00 udp 0:02:00
```

```
timeout rpc 0:10:00 h323 0:05:00
```

```
timeout uauth 0:05:00 absolute
```

```
aaa-server TACACS+ protocol tacacs+
```

```
aaa-server RADIUS protocol radius
```

```
aaa-server partner protocol tacacs+
```

```
no snmp-server location
```

```
no snmp-server contact
```

```
snmp-server community public
```

```
no snmp-server enable traps
```

```
floodguard enable
```

```
!--- IPSec policies:
```

```
sysopt connection permit-ipsec
```

```
crypto ipsec transform-set avalanche esp-des esp-md5-hmac
```

```
crypto ipsec security-association lifetime seconds 3600
```

```
crypto map forsberg 21 ipsec-isakmp
```

```
crypto map forsberg 21 match address ipsec
```

```
crypto map forsberg 21 set peer 172.17.63.230
```

```
crypto map forsberg 21 set transform-set avalanche
```

```
crypto map forsberg interface outside
```

```
!--- IKE policies:
```

```
isakmp enable outside
isakmp key westernfinal2000 address 172.17.63.230 netmask 255.255.255.255
isakmp identity address
isakmp policy 21 authentication pre-share
isakmp policy 21 encryption des
isakmp policy 21 hash md5
isakmp policy 21 group 1
telnet timeout 5
terminal width 80
Cryptochecksum:e36245da9428c4c07b489f787c8ccd3b
: end
```

Branch Router

```
Current configuration:
```

```
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Branch_Router
!
!
!
!
!
!
ip subnet-zero
!
!
!--- IKE policies:

crypto isakmp policy 11
  hash md5
  authentication pre-share
crypto isakmp key westernfinal2000 address 172.17.63.213
!
!
!--- IPsec policies:

crypto ipsec transform-set sharks esp-des esp-md5-hmac
!
!
crypto map nolan 11 ipsec-isakmp
  set peer 172.17.63.213
  set transform-set sharks

!--- Include the private-network-to-private-network traffic
!--- in the encryption process.

match address 120
!
!
!
interface Ethernet0
  ip address 172.17.63.230 255.255.255.240
  no ip directed-broadcast
  ip nat outside
```

```

no ip route-cache
crypto map nolan
!
interface Ethernet1
 ip address 10.2.2.1 255.255.255.0
 no ip directed-broadcast
 ip nat inside
!
interface Serial0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 shutdown
 no fair-queue
!
interface Serial1
 no ip address
 no ip directed-broadcast
 shutdown
!
ip nat pool branch 172.17.63.230 172.17.63.230 netmask 255.255.255.240

!--- Except the private network from the NAT process:

ip nat inside source route-map nonat pool branch overload
ip classless
ip route 0.0.0.0 0.0.0.0 172.17.63.225
no ip http server

!--- Include the private-network-to-private-network traffic
!--- in the encryption process:

access-list 120 permit ip 10.2.2.0 0.0.0.255 10.1.1.0 0.0.0.255

!--- Except the private network from the NAT process:

access-list 130 deny ip 10.2.2.0 0.0.0.255 10.1.1.0 0.0.0.255
access-list 130 permit ip 10.2.2.0 0.0.0.255 any

!--- Except the private network from the NAT process:

route-map nonat permit 10
 match ip address 130
!
!
line con 0
 transport input none
line 1 16
line aux 0
line vty 0 4
!
end

```

Verify

This section provides information you can use to confirm your configuration is working properly.

Certain **show** commands are supported by the Output Interpreter tool, which allows you to view an analysis of **show** command output.

- **show crypto isakmp sa** – View all current IKE security associations (SAs) at a peer.
- **show crypto ipsec sa** – Shows the settings used by current [IPSec] security associations.

- **show crypto engine connections active** – (Router only) Shows current connections and information regarding encrypted and decrypted packets.

Troubleshoot

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

Troubleshooting Commands

Certain **show** commands are supported by the Output Interpreter tool, which allows you to view an analysis of **show** command output.

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

The following debugs must be running on both IPsec peers.

- **debug crypto isakmp** – (Router & PIX) Displays errors during Phase 1.
- **debug crypto ipsec** – (Router & PIX) Displays errors during Phase 2.
- **debug crypto engine** – (Router only) Displays information from the crypto engine.

Clearing security associations must be done on both peers. The PIX commands are performed in enable mode; the router commands are performed in non-enable mode.

- **clear crypto isakmp sa** – (PIX) Clears the Phase 1 security associations.
- **clear crypto ipsec sa** – (PIX) Clears the Phase 2 security associations.
- **clear crypto isakmp** – (Router) Clears the Phase 1 security associations.
- **clear crypto sa** – (Router) Clears the Phase 2 security associations.

Sample debug Output

- Headquarters PIX Debugs
- Branch Router Debugs

Headquarters PIX Debugs

```
ISAKMP (0): beginning Main Mode exchange
IPSEC(ipsec_encap): crypto map check deny

02303: sa_request,
      (key eng. msg.) src= 172.17.63.213, dest= 172.17.63.230,
      src_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
      dest_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
      protocol= ESP, transform= esp-des esp-md5-hmac ,
      lifedur= 28800s and 4608000kb,
      spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4004

crypto_isakmp_process_block: src 172.17.63.230,
      dest 172.17.63.213
OAK_MM exchange
ISAKMP (0): processing SA payload. message ID = 0

ISAKMP (0): Checking ISAKMP transform 1 against priority
      21 policy
ISAKMP:      encryption DES-CBC
ISAKMP:      hash MD5
ISAKMP:      default group 1
```

```
ISAKMP:      auth pre-share
ISAKMP:      life type in seconds
ISAKMP:      life duration (basic) of 3600
ISAKMP (0):  atts are acceptable. Next payload is 0
ISAKMP (0):  SA is doing pre-shared key authentication
              using id type ID_IPV4_ADDR
return status is IKMP_NO_ERRORIPSEC(ipsec_encap): crypto
              map check deny
```

```
crypto_isakmp_process_block: src 172.17.63.230,
                              dest 172.17.63.213
```

```
OAK_MM exchange
```

```
ISAKMP (0):  processing KE payload. message ID = 0
```

```
ISAKMP (0):  processing NONCE payload. message ID = 0
```

```
ISAKMP (0):  processing vendor id payload
```

```
ISAKMP (0):  speaking to another IOS box!
```

```
ISAKMP (0):  ID payload
              next-payload : 8
              type         : 1
              protocol     : 17
              port         : 500
              length       : 8
```

```
ISAKMP (0):  Total payload length: 12
return status is IKMP_NO_ERRORIPSEC(ipsec_encap):
              crypto map check deny
```

```
crypto_isakmp_process_block: src 172.17.63.230,
                              dest 172.17.63.213
```

```
OAK_MM exchange
```

```
ISAKMP (0):  processing ID payload. message ID = 0
```

```
ISAKMP (0):  processing HASH payload. message ID = 0
```

```
ISAKMP (0):  SA has been authenticated
```

```
ISAKMP (0):  beginning Quick Mode exchange, M-ID of
              -1448244754:a9ad89eeIPSEC(key_engine): got a
              queue even
```

```
IPSEC(spi_response): getting spi 0x5cfcf6e9(1560082153)
                    for SA from 172.17.63.230 to
                    172.17.63.213 for prot 3
```

```
return status is IKMP_NO_ERROR
```

```
crypto_isakmp_process_block: src 172.17.63.230,
                              dest 172.17.63.213
```

```
OAK_QM exchange
```

```
oakley_process_quick_mode:
```

```
OAK_QM_IDLE
```

```
ISAKMP (0):  processing SA payload. message ID =
              -1448244754
```

```
ISAKMP : Checking IPsec proposal 1
```

```
ISAKMP: transform 1, ESP_DES
```

```
ISAKMP:  attributes in transform:
```

```
ISAKMP:      encaps is 1
```

```
ISAKMP:      SA life type in seconds
```

```
ISAKMP:      SA life duration (basic) of 28800
```

```
ISAKMP:      SA life type in kilobytes
```

```
ISAKMP:      SA life duration (VPI) of 0x0
              0x46 0x50 0x0
```

```
ISAKMP:      authenticator is HMAC-MD5
```

```
ISAKMP (0): atts are acceptable.IPSEC
(validate_proposal_request):
proposal part #1,
(key eng. msg.) dest= 172.17.63.230,
src= 172.17.63.213,
dest_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
src_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 0s and 0kb,
spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4

ISAKMP (0): processing NONCE payload. message ID =
-1448244754

ISAKMP (0): processing ID payload. message ID =
-1448244754
ISAKMP (0): processing ID payload. message ID =
-1448244754
ISAKMP (0): processing NOTIFY payload 96 protocol 3
spi 1510339082, message ID = -1448244754
ISAKMP (0): processing responder lifetime
ISAKMP (0): responder lifetime of
3600sIPSEC(map_alloc_entry):
allocating entry 3

IPSEC(map_alloc_entry): allocating entry 4

ISAKMP (0): Creating IPsec SAs
inbound SA from 172.17.63.230 to
172.17.63.213
(proxy 10.2.2.0 to 10.1.1.0)
has spi 1560082153 and conn_id 3 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
outbound SA from 172.17.63.213 to
172.17.63.230
(proxy 10.1.1.0 to 10.2.2.0)
has spi 183633242 and conn_id 4 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytesIPSEC(key_engine):
got a queue event...
IPSEC(initialize_sas): ,
(key eng. msg.) dest= 172.17.63.213, src=
172.17.63.230,
dest_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
src_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0x5cfcf6e9(1560082153), conn_id= 3, keysize= 0,
flags= 0x4
IPSEC(initialize_sas): ,
(key eng. msg.) src= 172.17.63.213, dest=
172.17.63.230,
src_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
dest_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0xaf2055a(183633242), conn_id= 4, keysize= 0,
flags= 0x4

return status is IKMP_NO_ERROR602301: sa created,
(sa) sa_dest= 172.17.63.213, sa_prot= 50,
sa_spi= 0x5cfcf6e9(1560082153),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 3
602301: sa created,
```



```
(sa) sa_dest= 172.17.63.230, sa_prot= 50,  
sa_spi= 0xaf2055a(183633242),  
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 4
```


Branch Router Debugs

```
Branch_Router#  
01:27:08: ISAKMP (0): received packet from 172.17.63.213  
      (N) NEW SA  
01:27:08: ISAKMP (0:1): processing SA payload.  
      message ID = 0  
01:27:08: ISAKMP (0:1): Checking ISAKMP transform 1  
      against priority 11 policy  
01:27:08: ISAKMP:      encryption DES-CBC  
01:27:08: ISAKMP:      hash MD5  
01:27:08: ISAKMP:      default group 1  
01:27:08: ISAKMP:      auth pre-share  
01:27:08: ISAKMP:      life type in seconds  
01:27:08: ISAKMP:      life duration (basic) of 3600  
01:27:08: ISAKMP (0:1): atts are acceptable. Next  
      payload is 0  
01:27:08: CryptoEngine0: generate alg parameter  
01:27:10: CRYPTO_ENGINE: Dh phase 1 status: 0  
01:27:10: CRYPTO_ENGINE: Dh phase 1 status: 0  
01:27:10: ISAKMP (0:1): SA is doing pre-shared key  
      authentication  
01:27:10: ISAKMP (1): SA is doing pre-shared key  
      authentication using id type ID_IPV4_ADDR  
01:27:10: ISAKMP (1): sending packet to 172.17.63.213  
      (R) MM_SA_SETUP  
01:27:10: ISAKMP (1): received packet from 172.17.63.213  
      (R) MM_SA_SETUP  
01:27:10: ISAKMP (0:1): processing KE payload. message  
      ID = 0  
01:27:10: CryptoEngine0: generate alg parameter  
01:27:12: ISAKMP (0:1): processing NONCE payload.  
      message ID = 0  
01:27:12: CryptoEngine0: create ISAKMP SKEYID for  
      conn id 1  
01:27:12: ISAKMP (0:1): SKEYID state generated  
01:27:12: ISAKMP (0:1): processing vendor id payload  
01:27:12: ISAKMP (0:1): speaking to another IOS box!  
01:27:12: ISAKMP (1): sending packet to 172.17.63.213 (R)  
      MM_KEY_EXCH  
01:27:12: ISAKMP (1): received packet from 172.17.63.213  
      (R) MM_KEY_EXCH  
01:27:12: ISAKMP (0:1): processing ID payload.  
      message ID = 0  
01:27:12: ISAKMP (0:1): processing HASH payload.  
      message ID = 0  
01:27:12: CryptoEngine0: generate hmac context for  
      conn id 1  
01:27:12: ISAKMP (0:1): SA has been authenticated  
      with 172.17.63.213  
01:27:12: ISAKMP (1): ID payload  
      next-payload : 8  
      type          : 1  
      protocol      : 17  
      port          : 500  
      length        : 8  
01:27:12: ISAKMP (1): Total payload length: 12  
01:27:12: CryptoEngine0: generate hmac context  
      for conn id 1  
01:27:12: CryptoEngine0: clear dh number for  
      conn id 1  
01:27:12: ISAKMP (1): sending packet to
```

172.17.63.213 (R) QM_IDLE
01:27:12: ISAKMP (1): received packet from
172.17.63.213 (R) QM_IDLE
01:27:12: CryptoEngine0: generate hmac context for
conn id 1
01:27:12: ISAKMP (0:1): processing SA payload.
message ID = -1448244754
01:27:12: ISAKMP (0:1): Checking IPsec proposal 1
01:27:12: ISAKMP: transform 1, ESP_DES
01:27:12: ISAKMP: attributes in transform:
01:27:12: ISAKMP: encaps is 1
01:27:12: ISAKMP: SA life type in seconds
01:27:12: ISAKMP: SA life duration (basic)
of 28800
01:27:12: ISAKMP: SA life type in kilobytes
01:27:12: ISAKMP: SA life duration (VPI) of
0x0 0x46 0x50 0x0
01:27:12: ISAKMP: authenticator is HMAC-MD5
01:27:12: validate proposal 0
01:27:12: ISAKMP (0:1): atts are acceptable.
01:27:12: IPSEC(validate_proposal_request):
proposal part #1, (key eng. msg.)
dest= 172.17.63.230, src= 172.17.63.213,
dest_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
src_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 0s and 0kb,
spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4
01:27:13: validate proposal request 0
01:27:13: ISAKMP (0:1): processing NONCE payload.
message ID = -1448244754
01:27:13: ISAKMP (0:1): processing ID payload.
message ID = -1448244754
01:27:13: ISAKMP (1): ID_IPV4_ADDR_SUBNET src
10.1.1.0/255.255.255.0 prot 0 port 0
01:27:13: ISAKMP (0:1): processing ID payload.
message ID = -1448244754
01:27:13: ISAKMP (1): ID_IPV4_ADDR_SUBNET dst
10.2.2.0/255.255.255.0 prot 0 port 0
01:27:13: IPSEC(key_engine): got a queue event...
01:27:13: IPSEC(spi_response): getting spi 183633242
for SA
from 172.17.63.213 to 172.17.63.230 for prot 3
01:27:13: CryptoEngine0: generate hmac context for
conn id 1
01:27:13: ISAKMP (1): sending packet to 172.17.63.213
(R) QM_IDLE
01:27:13: ISAKMP (1): received packet from 172.17.63.213
(R) QM_IDLE
01:27:13: CryptoEngine0: generate hmac context
for conn id 1
01:27:13: ipsec allocate flow 0
01:27:13: ipsec allocate flow 0
01:27:13: ISAKMP (0:1): Creating IPsec SAs
01:27:13: inbound SA from 172.17.63.213
to 172.17.63.230 (proxy 10.1.1.0 to 10.2.2.0)
01:27:13: has spi 183633242 and conn_id 2000
and flags 4
01:27:13: lifetime of 28800 seconds
01:27:13: lifetime of 4608000 kilobytes
01:27:13: outbound SA from 172.17.63.230
to 172.17.63.213 (proxy 10.2.2.0 to 10.1.1.0)
01:27:13: has spi 1560082153 and conn_id
2001 and flags 4
01:27:13: lifetime of 28800 seconds
01:27:13: lifetime of 4608000 kilobytes

```
01:27:13: ISAKMP (0:1): deleting node -1448244754
01:27:13: IPSEC(key_engine): got a queue event...
01:27:13: IPSEC(initialize_sas): ,
    (key eng. msg.) dest= 172.17.63.230, src=
    172.17.63.213,
    dest_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
    src_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= esp-des esp-md5-hmac ,
    lifedur= 28800s and 4608000kb,
    spi= 0xAF2055A(183633242), conn_id= 2000,
    keysize= 0, flags= 0x4
01:27:13: IPSEC(initialize_sas): ,
    (key eng. msg.) src= 172.17.63.230,
    dest= 172.17.63.213,
    src_proxy= 10.2.2.0/255.255.255.0/0/0 (type=4),
    dest_proxy= 10.1.1.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= esp-des esp-md5-hmac ,
    lifedur= 28800s and 4608000kb,
    spi= 0x5CF6E9(1560082153), conn_id= 2001,
    keysize= 0, flags= 0x4
01:27:13: IPSEC(create_sa): sa created,
    (sa) sa_dest= 172.17.63.230, sa_prot= 50,
    sa_spi= 0xAF2055A(183633242),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2000
01:27:13: IPSEC(create_sa): sa created,
    (sa) sa_dest= 172.17.63.213, sa_prot= 50,
    sa_spi= 0x5CF6E9(1560082153),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2001
```

Related Information

- [PIX Command Reference](#)
- [PIX IPSec](#)
- [PIX IPSec Configuration Guide](#)
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