

# デジタル証明書を使用するルータと PIX 間の LAN-to-LAN IPSec の設定方法

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## 概要

このドキュメントでは、デジタル証明書を使用して LAN-to-LAN IPSec を実装するように Cisco ルータおよび Cisco Secure PIX Firewall を設定する方法について説明します。この設定を行うには、次の作業を行う必要があります。

1. ルータおよび PIX を設定します。
2. ルータおよび PIX 上にデジタル証明書を取得します。
3. ルータおよび PIX 上に IKE および IPSec ポリシーを設定し、IPSec を使用して暗号化するトラフィック (対象トラフィック) をアクセス リストによって定義します。

# はじめに

## 表記法

ドキュメント表記の詳細は、『[シスコテクニカルティップスの表記法](#)』を参照してください。

## 前提条件

このドキュメントに関する固有の要件はありません。

## 使用するコンポーネント

このドキュメントの情報は、次のソフトウェアとハードウェアのバージョンに基づくものです。

- Cisco 1700 ルータ
- Cisco IOS® ソフトウェア バージョン 12.2(6)
- Cisco PIX Firewall 520
- PIX Firewall バージョン 6.0.1

このドキュメントの情報は、特定のラボ環境にあるデバイスに基づいて作成されたものです。このドキュメントで使用するすべてのデバイスは、クリアな（デフォルト）設定で作業を開始しています。対象のネットワークが実稼働中である場合には、どのような作業についても、その潜在的な影響について確実に理解しておく必要があります。

## 背景理論

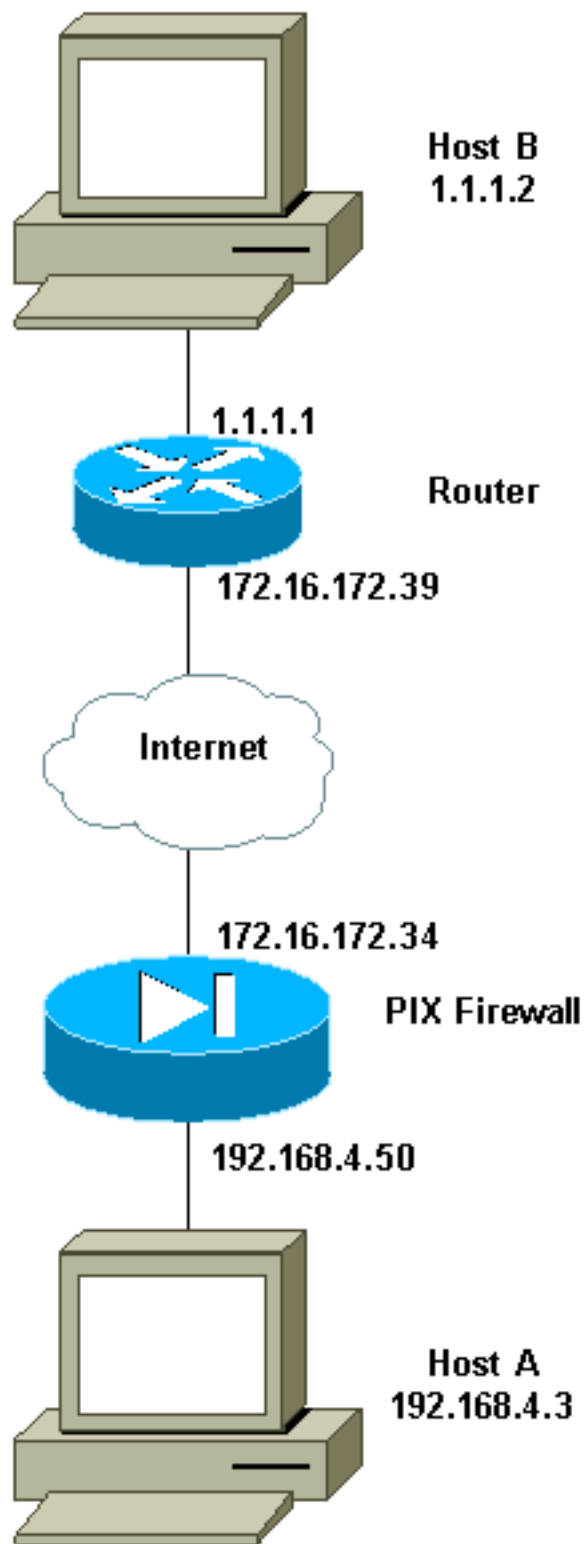
ここに示す例では、ホスト A のネットワーク アドレス（ソース アドレス）とホスト B のネットワーク アドレス（宛先アドレス）を、IPSec が PIX 上で暗号化するトラフィックとして定義します。ルータ上のアクセスリストは PIX 上のアクセスリストのミラー イメージです。

PIX およびルータの設定により、これら 2 つのデバイスの LAN 内部に存在するホストは、IPSec トンネルを通過する際にプライベート アドレスを使用します。PIX では、`access-list` および `nat 0` コマンドが連携して機能します。192.168.4.0 ネットワーク上のホスト A が 1.1.1.0 ネットワークにアクセスする際、アクセス リストによって、192.168.4.0 ネットワークのトラフィックをネットワーク アドレス変換（NAT）を行わずに暗号化できます。しかし、同じユーザが他の場所にアクセスするときは、ポート アドレス変換（PAT）によってアドレス 172.16.172.57 に変換されます。ルータでは、`route-map` および `access-list` コマンドにより、NAT を行わずに 1.1.1.0 ネットワークトラフィックを暗号化できます。ただし、同じホスト B が他の場所にアクセスする場合、PAT によってアドレス 172.16.172.39 に変換されます。

設定をテストするために、PIX Firewall の背後にあるホスト A からルータの背後にあるホスト B に ping を送信します。IP パケットが PIX Firewall に到達したとき、アクセスリストに一致したため、IPSec ネゴシエーションが開始されます。したがって、IPSec ネゴシエーション中は、PIX が発信側でルータが応答側になります。トラブルシューティング目的で、PIX とルータの両方で暗号化のデバッグを検査する必要があります。

## ネットワーク図

このドキュメントでは次の図に示すネットワーク



## ルータおよび PIX Firewall の設定

### 設定

この項では、このドキュメントで説明する機能の設定に必要な情報を提供します。

- [ルータの設定例](#)
- [PIX の設定例](#)

## ルータの設定例

```
1720-1#show running-config
Building configuration...

Current configuration : 8694 bytes
!
! Last configuration change at 20:17:48 PST Thu Jan 10
2002
! NVRAM config last updated at 20:19:27 PST Thu Jan 10
2002
!
version 12.2
no parser cache
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 1720-1
!
no logging buffered
enable secret 5 $1$6jAs$tNxI1a/2DYFAtPLYCDXjo/
enable password ww
!
username cisco password 0 cisco
username all
memory-size iomem 15
clock timezone PST -8
ip subnet-zero
no ip domain-lookup
ip domain-name cisco.com
!
ip ssh time-out 120
ip ssh authentication-retries 3
!
!
!
crypto ca identity vpn
  enrollment retry count 20
  enrollment mode ra
  enrollment url http://171.69.89.16:80
  query url ldap://171.69.89.16
crypto ca certificate chain vpn
  certificate 3B2FD652
    308202C4 3082022D A0030201 0202043B 2FD65230 0D06092A
864886F7 0D010105
      0500302D 310B3009 06035504 06130275 73310E30 0C060355
040A1305 63697363
        6F310E30 0C060355 040B1305 736A7670 6E301E17 0D303230
31313130 33303631
          345A170D 30333031 31313033 33363134 5A304E31 0B300906
03550406 13027573
            310E300C 06035504 0A130563 6973636F 310E300C 06035504
0B130573 6A76706E
              311F301D 06092A86 4886F70D 01090216 10313732 302D312E
63697363 6F2E636F
                6D305C30 0D06092A 864886F7 0D010101 0500034B 00304802
4100A085 B4A756F8
                  CEB91F2E 52E2A23F 847EC95F 44F65AF2 EBC1F816 081CC61F
AB077482 F1FAD124
                    2444B9F6 6B9EC48E 1B1EB5B9 D0E802BA B9A57048 EBB8CD18
773F0203 010001A3
                      82011230 82010E30 0B060355 1D0F0404 030205A0 301B0603
551D1104 14301282
```

10313732 302D312E 63697363 6F2E636F 6D302B06 03551D10  
04243022 800F3230  
30323031 31313033 30363134 5A810F32 30303230 39323331  
35333631 345A304F  
0603551D 1F044830 463044A0 42A040A4 3E303C31 0B300906  
03550406 13027573  
310E300C 06035504 0A130563 6973636F 310E300C 06035504  
0B130573 6A76706E  
310D300B 06035504 03130443 524C3130 1F060355 1D230418  
30168014 46C1609C  
DBEA53EE 80A48060 1A96583B 0DF80D2F 301D0603 551D0E04  
160414B1 2707AB30  
F7CFDC79 C554D1AE 3208EF16 CF96ED30 09060355 1D130402  
30003019 06092A86  
4886F67D 07410004 0C300A1B 0456352E 30030204 B0300D06  
092A8648 86F70D01  
01050500 03818100 E82DE82B AE5C7F80 EB9CED1A 306F36E6  
437DA791 81D53CF3  
0E561C8A 7A168EDE 6728F371 3EB90B21 CC40E1F3 CA4ED98F  
CDFA6E15 A2C0AA38  
4AE137C7 281AA7EC AD26D550 4E4AAA0B E0C588F8 661C4031  
ACF35F7B 28330B64  
667E00E3 832AED7F 08D5EA3D 33CCB2BE E73DC41A B40A9B64  
4CD2D98C 6943AE84  
55605741 E136A6BD  
quit  
certificate ra-sign 3B2FD319  
308202FF 30820268 A0030201 0202043B 2FD31930 0D06092A  
864886F7 0D010105  
0500302D 310B3009 06035504 06130275 73310E30 0C060355  
040A1305 63697363  
6F310E30 0C060355 040B1305 736A7670 6E301E17 0D303130  
36313932 32303333  
315A170D 30343036 31393232 33333331 5A304531 0B300906  
03550406 13027573  
310E300C 06035504 0A130563 6973636F 310E300C 06035504  
0B130573 6A76706E  
31163014 06035504 03130D46 69727374 204F6666 69636572  
30819F30 0D06092A  
864886F7 0D010101 05000381 8D003081 89028181 00E85434  
395790E9 416ED13D  
72F1A411 333A0984 66B8F68A 0ECA7E2B CBC40C39 A21E2D8A  
5F94772D 69846720  
73227891 E43D46B6 B2D1DDC5 385C5135 DB2075F1 4D252ACF  
AC80DA4C 2111946F  
26F7193B 8EA1CA66 8332D2A1 5310B2D7 07C985A8 0B44CE37  
BC95EAFB C328D4C6  
73B3B35E 0F6D25F5 DCAC6AFA 2DAAD6D1 47BB3396 E1020301  
0001A382 01123082  
010E300B 0603551D 0F040403 02078030 2B060355 1D100424  
3022800F 32303031  
30363139 32323033 33315A81 0F323030 33303732 37303233  
3333315A 301B0603  
551D0904 14301230 1006092A 864886F6 7D07441D 31030201  
00304F06 03551D1F  
04483046 3044A042 A040A43E 303C310B 30090603 55040613  
02757331 0E300C06  
0355040A 13056369 73636F31 0E300C06 0355040B 1305736A  
76706E31 0D300B06  
03550403 13044352 4C31301F 0603551D 23041830 16801446  
C1609CDB EA53EE80  
A480601A 96583B0D F80D2F30 1D060355 1D0E0416 04147BD2  
620C611F 3AC69FB3  
155FD8F9 8A7CF353 3A583009 0603551D 13040230 00301906

092A8648 86F67D07  
4100040C 300A1B04 56352E30 030204B0 300D0609 2A864886  
F70D0101 05050003  
8181003A A6431D7D 1979DDF9 CC99D8F8 CC987F67 DBF67280  
2A9418E9 C6255B08  
DECDE1C2 50FCB1A6 544F1D51 C214162E E2403DAB 2F1294C4  
841240ED FD6F799C  
130A0B24 AC74DD74 C60EB5CD EC648631 E0B88B3F 3D19A2E1  
6492958E 9F64746E  
45C080AE E5A6C245 7827D7B1 380A6FE8 A01D9022 7F52AD9C  
B596743A 853549C5 771DA2  
quit  
certificate ra-encrypt 3B2FD318  
308202D0 30820239 A0030201 0202043B 2FD31830 0D06092A  
864886F7 0D010105  
0500302D 310B3009 06035504 06130275 73310E30 0C060355  
040A1305 63697363  
6F310E30 0C060355 040B1305 736A7670 6E301E17 0D303130  
36313932 32303333  
  
315A170D 30343036 31393232 33333331 5A304531 0B300906  
03550406 13027573  
310E300C 06035504 0A130563 6973636F 310E300C 06035504  
0B130573 6A76706E  
31163014 06035504 03130D46 69727374 204F6666 69636572  
30819F30 0D06092A  
864886F7 0D010101 05000381 8D003081 89028181 00BFC427  
727E15E9 30CB1BCB  
C0EFFF2F 3E4916D4 EC365F57 C13D1356 6388E66D 7BCCBCB9  
04DA2E7C C9639F31  
AF15E7B1 E698A33C 0EB447E4 B3B72EC8 766EADCF 9883E612  
AD782E39 B0603A90  
0322CE78 D6735E07 BDC022F1 1164EC9E 31FC5309 9AA9DC1D  
69ECC316 8727A6CB  
ADCFB488 FF904D6D 9D9E5778 05B24D4B BB5B4F5F 4D020301  
0001A381 E43081E1  
300B0603 551D0F04 04030205 20301B06 03551D09 04143012  
30100609 2A864886  
F67D0744 1D310302 0100304F 0603551D 1F044830 463044A0  
42A040A4 3E303C31  
0B300906 03550406 13027573 310E300C 06035504 0A130563  
6973636F 310E300C  
06035504 0B130573 6A76706E 310D300B 06035504 03130443  
524C3130 1F060355  
1D230418 30168014 46C1609C DBEA53EE 80A48060 1A96583B  
0DF80D2F 301D0603  
551D0E04 16041400 A7C3DD9F 9FAB0A25 E1485FC7 DB88A63F  
78CE4830 09060355  
1D130402 30003019 06092A86 4886F67D 07410004 0C300A1B  
0456352E 30030204  
B0300D06 092A8648 86F70D01 01050500 03818100 69105382  
0BE0BA59 B0CD2652  
9C6A4585 940C7882 DCEB1D1E 610B8525 0C032A76 2C8758C2  
F5CA1EF4 B946848A  
C49047D5 6D1EF218 FA082A00 16CCD9FC 42DF3B05 A8EF2AAD  
151637DE 67885BB2  
BA0BB6A1 308F63FF 21C3CB00 9272257A 3C292645 FD62D486  
C247F067 301C2FEE  
5CF6D12B 6CFA1DAA E74E8B8E 5B017A2E 5BB6C5F9  
quit  
certificate ca 3B2FD307  
308202E4 3082024D A0030201 0202043B 2FD30730 0D06092A  
864886F7 0D010105  
0500302D 310B3009 06035504 06130275 73310E30 0C060355

```
040A1305 63697363
 6F310E30 0C060355 040B1305 736A7670 6E301E17 0D303130
36313932 32303234
 305A170D 32313036 31393232 33323430 5A302D31 0B300906
03550406 13027573
 310E300C 06035504 0A130563 6973636F 310E300C 06035504
0B130573 6A76706E
 30819F30 0D06092A 864886F7 0D010101 05000381 8D003081
89028181 00E8C25B
 EDF4A6EE A352B142 C16578F4 FBDAF45E 4F2F7733 8D2B8879
96138C63 1DB713BF
 753BF845 2D7E600F AAF4D75B 9E959513 BB13FF13 36696F48
86C464F2 CF854A66
 4F8E83F8 025F216B A44D4BB2 39ADD1A5 1BCCF812 09A19BDC
468EEAE1 B6C2A378
 69C81348 1A9CD61C 551216F2 8B168FBB 94CBEF37 E1D9A8F7
80BBC17F D1020301
 0001A382 010F3082 010B3011 06096086 480186F8 42010104
04030200 07304F06
 03551D1F 04483046 3044A042 A040A43E 303C310B 30090603
55040613 02757331
 0E300C06 0355040A 13056369 73636F31 0E300C06 0355040B
1305736A 76706E31
 0D300B06 03550403 13044352 4C31302B 0603551D 10042430
22800F32 30303130
 36313932 32303234 305A810F 32303231 30363139 32323332
34305A30 0B060355
 1D0F0404 03020106 301F0603 551D2304 18301680 1446C160
9CDBEA53 EE80A480
 601A9658 3B0DF80D 2F301D06 03551D0E 04160414 46C1609C
DBEA53EE 80A48060
 1A96583B 0DF80D2F 300C0603 551D1304 05300301 01FF301D
06092A86 4886F67D
 07410004 10300E1B 0856352E 303A342E 30030204 90300D06
092A8648 86F70D01
 01050500 03818100 7E3DBAC4 8CAE7D5A B19C0625 8780D222
F965A1A2 C0C25B84
 CBC5A203 BF50FAC4 9656699A 52D8CB46 40776237 87163118
8F3C0F47 D2CAA36B
 6AB34F99 AB71269E 78C0AC10 DA0B9EC5 AE448B46 701254CF
3EBC64C1 5DBB2EE5
 56C0140B B0C83497 D79FB148 80018F51 3A4B6174 590B85AA
9CE3B391 629406AA
 7CE9CC0D 01593E6B
quit
!
crypto isakmp policy 10
 hash md5
crypto isakmp identity hostname
!
!
crypto ipsec transform-set myset esp-des esp-md5-hmac
!
!

crypto map vpn 10 ipsec-isakmp
 set peer 172.16.172.34
 set transform-set myset
 match address 130
!
!
!
!
!
```

```

interface Loopback0
 ip address 10.10.10.1 255.255.255.0
!
interface Loopback1
 ip address 121.1.1.1 255.255.255.0
!
interface Loopback88
 ip address 88.88.88.88 255.255.255.255
!
interface FastEthernet0
 ip address 172.16.172.39 255.255.255.240
 ip nat outside
 speed auto
 crypto map vpn
!
interface Serial0
 ip nat inside
 ip address 1.1.1.1 255.255.255.252
!
 ip nat inside source route-map nonat interface
 FastEthernet0 overload
 ip classless
 ip route 0.0.0.0 0.0.0.0 172.16.172.33
 no ip http server
 ip pim bidir-enable
!
 access-list 120 deny ip 1.1.1.0 0.0.0.255 192.168.4.0
 0.0.0.255
 access-list 120 permit ip 1.1.1.0 0.0.0.255 any
 access-list 130 permit ip 1.1.1.0 0.0.0.255 192.168.4.0
 0.0.0.255
 route-map nonat permit 10
 match ip address 120
!
 line con 0
 line aux 0
 line vty 0 4
 exec-timeout 0 0
 password cisco
 no login
 line vty 5 15
 login
!
 no scheduler allocate
end

```

## PIX の設定例

```

pix520-1# write terminal
Building configuration...
: Saved
:
PIX Version 6.0(1)
nameif ethernet0 outside security0
nameif ethernet1 inside security100
enable password 2KFQnbNIdI.2KYOU encrypted
passwd 2KFQnbNIdI.2KYOU encrypted
hostname pix520-1
domain-name vpn.com
fixup protocol ftp 21
fixup protocol http 80
fixup protocol h323 1720
fixup protocol rsh 514
fixup protocol smtp 25
fixup protocol sqlnet 1521

```



```
fixup protocol sip 5060
fixup protocol skinny 2000
names
access-list 130 permit ip 192.168.4.0 255.255.255.0
1.1.1.0 255.255.255.0
access-list 140 permit ip 192.168.4.0 255.255.255.0
1.1.1.0 255.255.255.0
no pager
logging on
logging monitor debugging
logging buffered debugging
logging trap debugging
logging history debugging
logging host outside 192.168.2.6
interface ethernet0 auto
interface ethernet1 auto
mtu outside 1500
mtu inside 1500
ip address outside 172.16.172.34 255.255.255.240
ip address inside 192.168.4.50 255.255.255.0
ip audit info action alarm
ip audit attack action alarm
no failover
failover timeout 0:00:00
failover poll 15
failover ip address outside 0.0.0.0
failover ip address inside 0.0.0.0
pdm history enable
arp timeout 14400
global (outside) 1 172.16.172.57 netmask 255.255.255.255
nat (inside) 0 access-list 140
nat (inside) 1 0.0.0.0 0.0.0.0 0 0
route outside 0.0.0.0 0.0.0.0 172.16.172.33 1
timeout xlate 3:00:00
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 rpc
0:10:00
h323 0:05:00 sip 0:30:00 sip_media 0:02:00
timeout uauth 0:05:00 absolute
aaa-server TACACS+ protocol tacacs+
aaa-server RADIUS protocol radius
aaa-server mytest protocol tacacs+
aaa-server nasir protocol radius
snmp-server host outside 192.168.2.6
no snmp-server location
no snmp-server contact
snmp-server community public
snmp-server enable traps
floodguard enable
sysopt connection permit-ipsec
no sysopt route dnat
crypto ipsec transform-set myset esp-des esp-md5-hmac
crypto map mymap 5 ipsec-isakmp
crypto map mymap 5 match address 130
crypto map mymap 5 set peer 172.16.172.39
crypto map mymap 5 set transform-set myset
crypto map mymap interface outside
isakmp enable outside
isakmp policy 10 authentication rsa-sig
isakmp policy 10 encryption des
isakmp policy 10 hash md5
isakmp policy 10 group 1
isakmp policy 10 lifetime 86400
ca identity cisco 171.69.89.16:/cgi-bin 171.69.89.16
ca configure cisco ra 20 5
```

```
telnet 192.168.4.0 255.255.255.0 inside
telnet 171.69.89.82 255.255.255.255 inside
telnet 192.168.4.3 255.255.255.255 inside
telnet timeout 5
ssh 172.0.0.0 255.0.0.0 outside
ssh 171.0.0.0 255.255.255.0 outside
ssh 171.0.0.0 255.0.0.0 outside
ssh 171.0.0.0 255.0.0.0 inside
ssh timeout 60
terminal width 80
Cryptochecksum:c2d5976fc87875678356cf83b135bb8c
: end
[OK]
pix520-1#
```

## 証明書の取得

### ルータでの証明書の取得

このセクションでは、ルータ側でデジタル証明書を取得する方法について説明します。

1. ルータのホスト名および IP ドメイン名をまだ設定していない場合、これらを設定します。

```
pix520-1# write terminal
Building configuration...
: Saved
:
PIX Version 6.0(1)
nameif ethernet0 outside security0
nameif ethernet1 inside security100
enable password 2KFQnbNIdI.2KYOU encrypted
passwd 2KFQnbNIdI.2KYOU encrypted
hostname pix520-1
domain-name vpn.com
fixup protocol ftp 21
fixup protocol http 80
fixup protocol h323 1720
fixup protocol rsh 514
fixup protocol smtp 25
fixup protocol sqlnet 1521
fixup protocol sip 5060
fixup protocol skinny 2000
names
access-list 130 permit ip 192.168.4.0 255.255.255.0 1.1.1.0 255.255.255.0
access-list 140 permit ip 192.168.4.0 255.255.255.0 1.1.1.0 255.255.255.0
no pager
logging on
logging monitor debugging
logging buffered debugging
logging trap debugging
logging history debugging
logging host outside 192.168.2.6
interface ethernet0 auto
interface ethernet1 auto
mtu outside 1500
mtu inside 1500
ip address outside 172.16.172.34 255.255.255.240
ip address inside 192.168.4.50 255.255.255.0
ip audit info action alarm
ip audit attack action alarm
no failover
```

```

failover timeout 0:00:00
failover poll 15
failover ip address outside 0.0.0.0
failover ip address inside 0.0.0.0
pdm history enable
arp timeout 14400
global (outside) 1 172.16.172.57 netmask 255.255.255.255
nat (inside) 0 access-list 140
nat (inside) 1 0.0.0.0 0.0.0.0 0 0
route outside 0.0.0.0 0.0.0.0 172.16.172.33 1
timeout xlate 3:00:00
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 rpc 0:10:00
h323 0:05:00 sip 0:30:00 sip_media 0:02:00
timeout uauth 0:05:00 absolute
aaa-server TACACS+ protocol tacacs+
aaa-server RADIUS protocol radius
aaa-server mytest protocol tacacs+
aaa-server nasir protocol radius
snmp-server host outside 192.168.2.6
no snmp-server location
no snmp-server contact
snmp-server community public
snmp-server enable traps
floodguard enable
sysopt connection permit-ipsec
no sysopt route dnat
crypto ipsec transform-set myset esp-des esp-md5-hmac
crypto map mymap 5 ipsec-isakmp
crypto map mymap 5 match address 130
crypto map mymap 5 set peer 172.16.172.39
crypto map mymap 5 set transform-set myset
crypto map mymap interface outside
isakmp enable outside
isakmp policy 10 authentication rsa-sig
isakmp policy 10 encryption des
isakmp policy 10 hash md5
isakmp policy 10 group 1
isakmp policy 10 lifetime 86400
ca identity cisco 171.69.89.16:/cgi-bin 171.69.89.16
ca configure cisco ra 20 5
telnet 192.168.4.0 255.255.255.0 inside
telnet 171.69.89.82 255.255.255.255 inside
telnet 192.168.4.3 255.255.255.255 inside
telnet timeout 5
ssh 172.0.0.0 255.0.0.0 outside
ssh 171.0.0.0 255.255.255.0 outside
ssh 171.0.0.0 255.0.0.0 outside
ssh 171.0.0.0 255.0.0.0 inside
ssh timeout 60
terminal width 80
Cryptochecksum:c2d5976fc87875678356cf83b135bb8c
: end
[OK]

```

pix520-1# **注:** ホスト名および IP ドメイン名が必要な理由は、ルータに割り当てられたホスト名および IP ドメイン名に基づいて、ルータは IPsec により使用されるキーおよび証明書に対して完全修飾ドメイン名 ( FQDN ) を割り当てるためです。たとえば、証明書の名前「router.cisco.com」は、ルータのホスト名「router」と、ルータの IP ドメイン名「cisco.com」に基づきます。

- ルータの RSA キー ペアを生成します。これは、IKE キー管理メッセージに署名して暗号化するために使用されます。ルータの証明書を取得するために、キー ペアを生成する必要があります。1720-1(config)#crypto key generate rsa

The name for the keys will be: 1720-1.cisco.com  
Choose the size of the key modulus in the range of 360 to 2048 for your  
General Purpose Keys. Choosing a key modulus greater than 512 may take a few minutes.

How many bits in the modulus [512]:  
Generating RSA keys ...  
[OK]

1720-1(config)#**show crypto key mypubkey rsa** コマンドを使用して、ルータの RSA キーペアを表示します。1720-1#**sh cr key mypubkey rsa**

```
% Key pair was generated at: 19:26:22 PST Jan 10 2002
Key name: 1720-1.cisco.com
Usage: General Purpose Key
Key Data:
 305C300D 06092A86 4886F70D 01010105 00034B00 30480241 00A085B4 756F8CE
 B91F2E52 E2A23F84 7EC95F44 F65AF2EB C1F81608 1CC61FAB 077482F1 FAD12424
 44B9F66B 9EC48E1B 1EB5B9D0 E802BAB9 A57048EB B8CD1877 3F020301 0001
```

```
% Key pair was generated at: 19:26:24 PST Jan 10 2002
Key name: 1720-1.cisco.com.server
Usage: Encryption Key
Key Data:
 307C300D 06092A86 4886F70D 01010105 00036B00 30680261 00C653F7 2AE7E397
 0041E273 BFCC0E35 E7AF9874 A73B77E8 B15EF54A CA2417AD AB75BAD9 BA1540F4
 3DB849BD B70DF4D8 EBBBE7ED AB93BE4B 5C1E9E6A 560A9C8A 12D7CBE3 060DBE7E
 8C1667AE 93993049 DA362602 4E4D9EF8 2F8C4777 30F9F958 7F020301 0001
```

1720-1#

3. 認証局 ( CA ) サーバを宣言して、ルータと CA の間の通信パラメータを設定します。登録局を使用する場合、登録局 ( RA ) モードも指定する必要があります。ルータが適切な証明書失効リスト ( CRL ) にアクセスできない場合であっても、他のピアの証明書をルータで受け入れるようにするには、**crl optional** コマンドを使用します。1720-1(config)# **crypto ca identity vpn**

```
1720-1(ca-identity)#enrollment url http://171.69.89.16:80
1720-1(ca-identity)# query url ldap://171.69.89.16
1720-1(ca-identity)# enrollment retry count 20
1720-1(ca-identity)# enrollment retry period 5
1720-1(ca-identity)# enrollment mode ra
1720-1(ca-identity)#exit
```

4. ルータは、CA の公開キーが含まれている CA の自己署名証明書を取得することによって、CA を認証する必要があります。CA はそれ自体の証明書に署名するため、CA 管理者に連絡を取って CA 証明書のフィンガープリントを比較することによって、CA の公開キーを手動で認証する必要があります。この例では、CA の証明書を受け取った後、証明書をコマンドステートメントに入力するのではなく、2 つのフィンガープリントを比較することによって公開キーを手動で認証します。1720-1(config)#**cr ca authenticate vpn**

```
Certificate has the following attributes:
Fingerprint: 1FCDF2C8 2DEDA6AC 4819D4C4 B4CFF2F5
% Do you accept this certificate? [yes/no]: y
```

1720-1(config)#**sh crypto ca cert** コマンドを使用して CA および RA 証明書を表示し、認証に成功したことを確認します。1720-1#**sh cr ca cert**

RA Signature Certificate

**Status: Available**

```
!--- The authentication was successful. Certificate Serial Number: 3B2FD319 Key Usage:
Signature Issuer: OU = sjvpn O = cisco C = us Subject: CN = First Officer OU = sjvpn O =
cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity
Date: start date: 14:03:31 PST Jun 19 2001 end date: 14:33:31 PST Jun 19 2004 Associated
Identity: vpn RA KeyEncipher Certificate Status: Available
!--- The authentication was successful. Certificate Serial Number: 3B2FD318 Key Usage:
Encryption Issuer: OU = sjvpn O = cisco C = us Subject: CN = First Officer OU = sjvpn O =
```

```
cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpjn, O = cisco, C = us Validity
Date: start date: 14:03:31 PST Jun 19 2001 end date: 14:33:31 PST Jun 19 2004 Associated
Identity: vpn CA Certificate Status: Available
!--- The authentication was successful. Certificate Serial Number: 3B2FD307 Key Usage:
General Purpose Issuer: OU = sjvpjn O = cisco C = us Subject: OU = sjvpjn O = cisco C = us
CRL Distribution Point: CN = CRL1, OU = sjvpjn, O = cisco, C = us Validity Date: start date:
14:02:40 PST Jun 19 2001 end date: 14:32:40 PST Jun 19 2021 Associated Identity: vpn
```

5. ルータの RSA キー ペアそれぞれに対する署名付き証明書を CA から取得します。汎用の RSA キーを生成した場合、ルータは 1 つの RSA キー ペアを持ち、1 つの証明書のみが必要です。特殊用途の RSA キーを生成した場合、ルータは 2 つの RSA キー ペアを持ち、2 つの証明書が必要です。証明書が CA サーバ上で設定されている場合、CA 管理者に連絡を取ってルータ証明書を手動で認可する必要があります。また、登録時にパスワードの指定を求めるように CA サーバが設定されている場合、CA 管理者に連絡を取ってこのパスワードを尋ねてください。この例では、登録時にパスワードを指定しなくてもよいように CA サーバが設定されています。1720-1(config)#cr ca enroll vpn

```
%
% Start certificate enrollment ..
% Create a challenge password. You will need to verbally provide this
password to the CA Administrator in order to revoke your certificate.
For security reasons your password will not be saved in the configuration.
Please make a note of it.
```

Password:

Re-enter password:

```
% The subject name in the certificate will be: 1720-1.cisco.com
% Include the router serial number in the subject name? [yes/no]: n
% Include an IP address in the subject name? [yes/no]: n
Request certificate from CA? [yes/no]: y
% Certificate request sent to Certificate Authority
% The certificate request fingerprint will be displayed.
% The 'show crypto ca certificate' command will also show the fingerprint.
```

```
1720-1(config)# Fingerprint: A1D6C28B 6575AD08 F0B656D4 7161F76F
```

3d09h: CRYPTO\_PKI: status = 102: certificate request pending 登録用コマンドの実行後、ルータは CA サーバと通信して証明書の取得を試行します。証明書の手動認証が必要になるように CA サーバが設定されていれば、この間に CA 管理者に連絡を取る必要があります。sh crypto ca cert コマンドを使用してルータ証明書を表示し、登録に成功したことを確認します。次の例で、証明書は承認されていません。1720-1#sh crypto ca cert

```
RA Signature Certificate
Status: Available
Certificate Serial Number: 3B2FD319
Key Usage: Signature
Issuer:
  OU = sjvpjn
  O = cisco
  C = us
Subject:
  CN = First Officer
  OU = sjvpjn
  O = cisco
  C = us
CRL Distribution Point:
  CN = CRL1, OU = sjvpjn, O = cisco, C = us
Validity Date:
  start date: 14:03:31 PST Jun 19 2001
  end date: 14:33:31 PST Jun 19 2004
Associated Identity: vpn
```

RA KeyEncipher Certificate

Status: Available  
Certificate Serial Number: 3B2FD318  
Key Usage: Encryption  
Issuer:  
OU = sjvpn  
O = cisco  
C = us  
Subject:  
CN = First Officer  
OU = sjvpn  
O = cisco  
C = us  
CRL Distribution Point:  
CN = CRL1, OU = sjvpn, O = cisco, C = us  
Validity Date:  
start date: 14:03:31 PST Jun 19 2001  
end date: 14:33:31 PST Jun 19 2004  
Associated Identity: vpn

CA Certificate

Status: Available  
Certificate Serial Number: 3B2FD307  
Key Usage: General Purpose  
Issuer:  
OU = sjvpn  
O = cisco  
C = us  
Subject:  
OU = sjvpn  
O = cisco  
C = us  
CRL Distribution Point:  
CN = CRL1, OU = sjvpn, O = cisco, C = us  
Validity Date:  
start date: 14:02:40 PST Jun 19 2001  
end date: 14:32:40 PST Jun 19 2021  
Associated Identity: vpn

Certificate

Subject Name Contains:  
Name: 1720-1.cisco.com  
Status: Pending  
*!--- The certificate is still pending.* Key Usage: General Purpose Fingerprint: A1D6C28B  
6575AD08 F0B656D4 7161F76F Associated Identity: vpn 次の出力例では、CA から証明書を受け  
取ったことを示しています。3d09h: %CRYPTO-6-CERTRET: Certificate received from  
Certificate Authority 1720-1#sh crypto ca cert  
Certificate

Status: Available  
*!--- This status indicates that the certificates were successfully received.* Certificate  
Serial Number: 3B2FD652 Key Usage: General Purpose Issuer: OU = sjvpn O = cisco C = us  
Subject Name Contains: Name: 1720-1.cisco.com CRL Distribution Point: CN = CRL1, OU =  
sjvpn, O = cisco, C = us Validity Date: start date: 19:06:14 PST Jan 10 2002 end date:  
19:36:14 PST Jan 10 2003 Associated Identity: vpn RA Signature Certificate Status:  
Available Certificate Serial Number: 3B2FD319 Key Usage: Signature Issuer: OU = sjvpn O =  
cisco C = us Subject: CN = First Officer OU = sjvpn O = cisco C = us CRL Distribution  
Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 14:03:31 PST Jun  
19 2001 end date: 14:33:31 PST Jun 19 2004 Associated Identity: vpn RA KeyEncipher  
Certificate Status: Available Certificate Serial Number: 3B2FD318 Key Usage: Encryption  
Issuer: OU = sjvpn O = cisco C = us Subject: CN = First Officer OU = sjvpn O = cisco C = us  
CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date:

```
14:03:31 PST Jun 19 2001 end date: 14:33:31 PST Jun 19 2004 Associated Identity: vpn CA
Certificate Status: Available Certificate Serial Number: 3B2FD307 Key Usage: General
Purpose Issuer: OU = sjvpn O = cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn,
O = cisco, C = us Validity Date: start date: 14:02:40 PST Jun 19 2001 end date: 14:32:40
PST Jun 19 2021 Associated Identity: vpn
```

6. 手動により、CA に対して CRL を要求することができます。ルータ上の CRL を更新するには、次のコマンドを使用します。1720-1(config)#crypto ca crl request vpn

```
1720-1(config)#exit
```

**show crypto ca crls** コマンドを使用して CRL を表示します。1720-1#sh crypto ca crls

```
CRL Issuer Name:
  OU = sjvpn, O = cisco, C = us
LastUpdate: 16:17:34 PST Jan 10 2002
NextUpdate: 17:17:34 PST Jan 11 2002
Retrieved from CRL Distribution Point:
  LDAP: CN = CRL1, OU = sjvpn, O = cisco, C = us
```

```
1720-1#
```

7. **write mem** コマンドを発行して設定を保存します。1720-1# wr m

```
Building configuration?
```

```
[OK]
```

```
1720-1#
```

## PIX での証明書の取得

PIX ファイアウォール側で証明書を取得するには、ルータと同じ手順を実行します。ただし、PIX のコマンド構文は異なります。

1. ホスト名と IP ドメイン名を設定します。

```
hostname pix520-1
domain-name vpn.com
```

2. RSA キー ペアを生成します。pix520-1(config)# ca generate rsa key 512

**show ca mypubkey rsa** コマンドを使用して RSA キー ペアを表示します。pix520-1(config)# sh ca mypubkey rsa

```
% Key pair was generated at: 04:54:34 Jan 11 2002
```

```
Key name: pix520-1.vpn.com
Usage: General Purpose Key
Key Data:
```

```
305c300d 06092a86 4886f70d 01010105 00034b00 30480241 009d95d5 e1147546
1f9ef873 81a36256 4b81388b 188fbc66 40fc4c56 c1801311 ff450cca e8d715c3
ffb8fa28 d347120f ae8a9972 3a88321c a71c1c7f ef29b810 2f020301 0001
```

```
pix520-1(config)#
```

3. CA サーバを宣言します。pix520-1(config)# ca identity cisco 171.69.89.16 171.69.89.16

```
pix520-1(config)# ca configure cisco ra 20 5
```

4. CA を認証します。pix520-1(config)# ca authenticate cisco

```
Certificate has the following attributes:
```

```
Fingerprint: 1fcdcf2c8 2deda6ac 4819d4c4 b4cff2f5
```

pix520-1(config)# **show ca cert** コマンドを使用して、PIX 上の CA 証明書を表示します。

```
pix520-1(config)# sh ca cert
```

```
CA Certificate
```

```
Status: Available !--- The authentication was successful. Certificate Serial Number:
3b2fd307 Key Usage: General Purpose OU = sjvpn O = cisco C = us CRL Distribution Point: CN
= CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 22:02:40 Jun 19 2001 end
date: 22:32:40 Jun 19 2021 RA Signature Certificate Status: Available !--- The
authentication was successful. Certificate Serial Number: 3b2fd319 Key Usage: Signature CN
= First Officer OU = sjvpn O = cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn,
```

```
O = cisco, C = us Validity Date: start date: 22:03:31 Jun 19 2001 end date: 22:33:31 Jun 19 2004 RA KeyEncipher Certificate Status: Available !--- The authentication was successful. Certificate Serial Number: 3b2fd318 Key Usage: Encryption CN = First Officer OU = sjvpn O = cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 22:03:31 Jun 19 2001 end date: 22:33:31 Jun 19 2004
```

5. CA に対して CRL を要求します。pix520-1(config)# **ca enroll cisco 171.69.89.16**

```
%  
% Start certificate enrollment ..  
  
% The subject name in the certificate will be: pix520-1.vpn.com  
  
% Certificate request sent to Certificate Authority  
% The certificate request fingerprint will be displayed.
```

```
pix520-1(config)# Fingerprint: 6961df68 d3b5e667 8903a66b 969eee64
```

```
CRYPTO_PKI: status = 102: certificate request pending
```

```
CRYPTO_PKI: status = 102: certificate request pending 証明書が CA によって認可されました
```

```
o pix520-1(config)#
```

```
pix520-1(config)# show ca cert
```

```
Certificate
```

```
Status: Available
```

```
!--- The enrollment was successful. Certificate Serial Number: 3b2fd653 Key Usage: General Purpose Subject Name Name: pix520-1.vpn.com CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 04:13:45 Jan 11 2002 end date: 04:43:45 Jan 11 2003 RA Signature Certificate Status: Available !--- The enrollment was successful. Certificate Serial Number: 3b2fd319 Key Usage: Signature CN = First Officer OU = sjvpn O = cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 22:03:31 Jun 19 2001 end date: 22:33:31 Jun 19 2004 CA Certificate Status: Available !--- The enrollment was successful. Certificate Serial Number: 3b2fd307 Key Usage: General Purpose OU = sjvpn O = cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 22:02:40 Jun 19 2001 end date: 22:32:40 Jun 19 2021 RA KeyEncipher Certificate Status: Available !--- The enrollment was successful. Certificate Serial Number: 3b2fd318 Key Usage: Encryption CN = First Officer OU = sjvpn O = cisco C = us CRL Distribution Point: CN = CRL1, OU = sjvpn, O = cisco, C = us Validity Date: start date: 22:03:31 Jun 19 2001 end date: 22:33:31 Jun 19 2004 pix520-1(config)# pix520-1(config)# ca crl request cisco
```

6. **sh ca crl** コマンドを使用して CRL を表示します。pix520-1(config)# **sh ca crl**

```
CRL:
```

```
CRL Issuer Name:
```

```
OU = sjvpn, O = cisco, C = us
```

```
LastUpdate: 00:17:34 Jan 11 2002
```

```
NextUpdate: 01:17:34 Jan 12 2002
```

```
pix520-1(config)#
```

7. PIX 上で証明書を保存するには、次のコマンドを使用します。pix520-1(config)# **ca save all**

```
pix520-1(config)#
```

## 確認

このセクションでは、設定が正常に動作しているかどうかを確認する際に役立つ情報を提供しています。

特定の **show** コマンドは、[Output Interpreter Tool](#) (登録ユーザ専用) によってサポートされています。このツールを使用すると、**show** コマンド出力の分析を表示できます。



show コマンドは、PIX およびルータ上で実行できます。

- **show crypto isakmp sa** : ピア上の現在の IKE セキュリティ アソシエーション ( SA ) をすべて表示します。
- **show crypto ipsec sa** : 現在の IPsec セキュリティ アソシエーションで使用されている設定を表示します。
- **show crypto engine connections active** : ( ルータのみ ) 現在の接続と、暗号化および復号化されたパケットに関する情報を表示します。
- **show crypto ca crls** : ( ルータのみ ) ルータ上の現在の CRL を表示します。
- **show crypto ca certificates** : ( ルータのみ ) ルータ、CA サーバ、およびルータ上の RA 証明書を表示します。証明書分散ポイント ( CDP ) も表示します。
- **show ca certificates** : ( PIX のみ ) PIX、CA、および RA 証明書を表示します。ルータと異なり、CDP を表示しません。
- **show ca crl** : ( PIX のみ ) PIX 上の CRL を表示します。
- **show clock** : ルータおよび PIX 上の現在時刻を表示します ( イネーブル モードから ) 。

## ルータの show コマンドからの出力例

```
1720-1#sh cr isa sa
dst          src          state          conn-id      slot
172.16.172.39 172.16.172.34 QM_IDLE       110          0

1720-1#sh cr map
      Interfaces using crypto map mymap:

Crypto Map "vpn" 10 ipsec-isakmp
  Peer = 172.16.172.34
  Extended IP access list 130
    access-list 130 permit ip 1.1.1.0 0.0.0.255 192.168.4.0 0.0.0.255
  Current peer: 172.16.172.34
  Security association lifetime: 4608000 kilobytes/3600 seconds
  PFS (Y/N): N
  Transform sets={ myset, }
  Interfaces using crypto map vpn:
    FastEthernet0
  Interfaces using crypto map certificate:

1720-1#sh cr isa policy
Protection suite of priority 10
  encryption algorithm:  DES - Data Encryption Standard
(56 bit keys).
  hash algorithm:       Message Digest 5
  authentication method: Rivest-Shamir-Adleman Signature
  Diffie-Hellman group: #1 (768 bit)
  lifetime:            86400 seconds, no volume limit
Default protection suite
  encryption algorithm:  DES - Data Encryption Standard
(56 bit keys).
  hash algorithm:       Secure Hash Standard
  authentication method: Rivest-Shamir-Adleman Signature
  Diffie-Hellman group: #1 (768 bit)
  lifetime:            86400 seconds, no volume limit

1720-1#
1720-1#sh cr ipsec sa

interface: FastEthernet0
  Crypto map tag: vpn, local addr. 172.16.172.39
```

```

local ident (addr/mask/prot/port):
(1.1.1.0/255.255.255.0/0/0)
remote ident (addr/mask/prot/port):
(192.168.4.0/255.255.255.0/0/0)
current_peer: 172.16.172.34
  PERMIT, flags={origin_is_acl,}
  #pkts encaps: 3, #pkts encrypt: 3, #pkts digest 3
  #pkts decaps: 3, #pkts decrypt: 3, #pkts verify 3
  #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.: 172.16.172.39,
remote crypto endpt.: 172.16.172.34
path mtu 1500, media mtu 1500
current outbound spi: 3803A0C1

```

```

inbound esp sas:
  spi: 0xD740971C(3611334428)
    transform: esp-des esp-md5-hmac ,
    in use settings = {Tunnel, }
    slot: 0, conn id: 200, flow_id: 1,
crypto map: vpn
  sa timing: remaining key lifetime
(k/sec): (4607999/3150)
  IV size: 8 bytes
  replay detection support: Y

```

inbound ah sas:

inbound pcp sas:

```

outbound esp sas:
  spi: 0x3803A0C1(939761857)
    transform: esp-des esp-md5-hmac ,
    in use settings = {Tunnel, }
    slot: 0, conn id: 201, flow_id: 2,
crypto map: vpn
  sa timing: remaining key lifetime
(k/sec): (4607999/3141)
  IV size: 8 bytes
  replay detection support: Y

```

outbound ah sas:

outbound pcp sas:

1720-1#

1720-1# **sh cr en conn ac**

ID	Interface	IP-Address	State	Algorithm	Encrypt	Decrypt
110	FastEthernet0	172.16.172.39	set	HMAC_MD5+DES_56_CB	0	0
114	FastEthernet0	172.16.172.39	alloc	NONE	0	0
115	FastEthernet0	172.16.172.39	alloc	NONE	0	0
116	FastEthernet0	172.16.172.39	alloc	NONE	0	0
117	FastEthernet0	172.16.172.39	alloc	NONE	0	0
200	FastEthernet0	172.16.172.39	set	HMAC_MD5+DES_56_CB	0	3
201	FastEthernet0	172.16.172.39	set	HMAC_MD5+DES_56_CB	3	0

1720-1#**sh clock**

## PIX の show コマンドからの出力例

```
pix520-1# sh cr isa sa
Total      : 1
Embryonic  : 0
  dst      src      state    pending  created
  172.16.172.39  172.16.172.34  QM_IDLE    0        1
pix520-1#

pix520-1# sh cr map

Crypto Map: "mymap" interfaces: { outside }

Crypto Map "mymap" 5 ipsec-isakmp
  Peer = 172.16.172.39
  access-list 130 permit ip
  192.168.4.0 255.255.255.0 1.1.1.0 255.255.255.0 (hitcnt=91)
  Current peer: 172.16.172.39
  Security association lifetime:
4608000 kilobytes/28800 seconds
  PFS (Y/N): N
  Transform sets={ myset, }
pix520-1# sh cr isa policy
Protection suite of priority 10
  encryption algorithm:  DES - Data Encryption Standard (
56 bit keys).
  hash algorithm:        Message Digest 5
  authentication method: Rivest-Shamir-Adleman Signature
  Diffie-Hellman group:  #1 (768 bit)
  lifetime:              86400 seconds, no volume limit
Default protection suite
  encryption algorithm:  DES - Data Encryption Standard
(56 bit keys).
  hash algorithm:        Secure Hash Standard
  authentication method: Rivest-Shamir-Adleman Signature
  Diffie-Hellman group:  #1 (768 bit)
  lifetime:              86400 seconds,
no volume limit
pix520-1#
pix520-1# sh cr ipsec sa

interface: outside
  Crypto map tag: mymap, local addr. 172.16.172.34

  local ident (addr/mask/prot/port):
(192.168.4.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port):
(1.1.1.0/255.255.255.0/0/0)
  current_peer: 172.16.172.39
    PERMIT, flags={origin_is_acl,}
    #pkts encaps: 3, #pkts encrypt: 3, #pkts digest 3
    #pkts decaps: 3, #pkts decrypt: 3, #pkts verify 3
    #pkts compressed: 0, #pkts decompressed: 0
    #pkts not compressed: 0, #pkts compr. failed: 0,
#pkts decompress failed: 0
    #send errors 2, #recv errors 0

  local crypto endpt.: 172.16.172.34, remote
crypto endpt.: 172.16.172.39
  path mtu 1500, ipsec overhead 56, media mtu 1500
  current outbound spi: d740971c
```

```
inbound esp sas:
spi: 0x3803a0c1(939761857)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 4, crypto map: mymap
sa timing: remaining key lifetime
(k/sec): (4607999/2971)
IV size: 8 bytes
replay detection support: Y
```

```
inbound ah sas:
```

```
inbound pcp sas:
```

```
outbound esp sas:
spi: 0xd740971c(3611334428)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 3, crypto map: mymap
sa timing: remaining key lifetime
(k/sec): (4607999/2971)
IV size: 8 bytes
replay detection support: Y
```

```
outbound ah sas:
```

```
outbound pcp sas:
```

```
pix520-1# pix520-1# sh cr en
Crypto Engine Connection Map:
size = 8, free = 6, used = 2, active = 2
pix520-1#
```

```
pix520-1# sh clock
09:27:54 Jan 11 2002
pix520-1#
```

## トラブルシューティング

ここでは、設定のトラブルシューティングに役立つ情報について説明します。

### トラブルシューティングのためのコマンド

特定の **show** コマンドは、[Output Interpreter Tool](#) ( [登録ユーザ専用](#) ) によってサポートされています。このツールを使用すると、**show** コマンド出力の分析を表示できます。

**注:** **debug** コマンドを使用する前に、『[debug コマンドに関する重要な情報](#)』を参照してください。

両方の IPSec ピアで、次のデバッグを実行している必要があります。

- **debug crypto isakmp** : ( ルータおよび PIX ) フェーズ 1 中のエラーを表示します。

- **debug crypto ipsec** : ( ルータおよび PIX ) フェーズ 2 中のエラーを表示します。
- **debug crypto engine** : ( ルータのみ ) 暗号化エンジンからの情報を表示します。
- **debug crypto pki transactions** : ( ルータのみ ) ルータの公開鍵インフラストラクチャ ( PKI ) トランザクションに関する情報を表示します。
- **debug crypto pki messages** : ( ルータのみ ) PKI 入出力メッセージに関する情報を表示します。
- **debug crypto ca** : ( PIX のみ ) PKI トランザクションおよび入出力メッセージに関する情報を表示します。

両方のピアで、セキュリティ アソシエーションをクリアする必要があります。PIX コマンドはイネーブル モードで実行され、ルータ コマンドは非イネーブル モードで実行されます。

- **clear crypto isakmp sa** : ( PIX ) フェーズ 1 のセキュリティ アソシエーションをクリアします。
- **clear crypto ipsec sa** : ( PIX ) フェーズ 2 のセキュリティ アソシエーションをクリアします。
- **clear crypto isakmp** : ( ルータ ) フェーズ 1 のセキュリティ アソシエーションをクリアします。
- **clear crypto sa** : ( ルータ ) フェーズ 2 のセキュリティ アソシエーションをクリアします。

## ルータからの証明書のデバッグ例

このセクションでは、CA サーバからの証明書の取得中に、次の PKI デバッグ コマンドを実行したときにルータから得られるデバッグを示します。これらのデバッグは、成功したセッションから得られたものです。

```
1720-1#debug cr pki transactions
Crypto PKI Trans debugging is on
1720-1#debug cr pki messages
Crypto PKI Msg debugging is on
```

```
1720-1(config)#cr ca authenticate vpn
Certificate has the following attributes:
Fingerprint: 1FCDF2C8 2DEDA6AC 4819D4C4 B4CFF2F5
% Do you accept this certificate? [yes/no]:
08:48:10: CRYPTO_PKI: Sending CA Certificate Request:
GET /cgi-bin/pkiclient.exe?operation=GetCACert&message =vpn HTTP/1.0
```

```
08:48:10: CRYPTO_PKI: can not resolve server name/IP address
08:48:10: CRYPTO_PKI: Using unresolved IP Address 171.69.89.16
08:48:10: CRYPTO_PKI: http connection opened
08:48:11: CRYPTO_PKI: HTTP response header:
HTTP/1.1 200 OK
Date: Fri, 11 Jan 2002 19:10:53 Pacific Standard Time
Server: Entrust/VPNConnector v5.0
Connection: close
Content-Type: application/x-x509-ra-ca-certs
```

Content-Type indicates we have received CA and RA certificates.

```
08:48:11: CRYPTO_PKI:CA and RA certs:
```

```
08:48:11:      30 82 08 EA 06 09 2A 86 48 86 F7 0D 01 07 02 A0
08:48:11:      82 08 DB 30 82 08 D7 02 01 01 31 00 30 0B 06 09
08:48:11:      2A 86 48 86 F7 0D 01 07 01 A0 82 08 BF 30 82 02
```

```
!--- Hex data omitted. 08:48:11: 14 06 03 55 04 03 13 0D 46 69 72 73 74 20 4F 66 08:48:11: 66
69 63 65 72 30 81 9F 30 0D 06 09 2A 86 48 86 08:48:11: 80 01 8F 51 3A 4B 61 74 59 0B 85 AA 9C E3
B3 91 08:48:11: 62 94 06 AA 7C E9 CC 0D 01 59 3E 6B 31 00 08:48:11: 08:48:11: CRYPTO_PKI: Error:
Certificate, private key or CRL was not found while selecting certificate chain 08:48:11:
CRYPTO_PKI: WARNING: A certificate chain could not be constructed while selecting certificate
status 08:48:11: CRYPTO_PKI: Error: Certificate, private key or CRL was not found while
selecting certificate chain 08:48:11: CRYPTO_PKI: WARNING: A certificate chain could not be
constructed while selecting certificate status 08:48:11: CRYPTO_PKI: crypto_process_ra_certs()
For:vpn 08:48:11: CRYPTO_PKI: crypto_set_ra_pubkey() (using global_auth_context) 08:48:11:
CRYPTO_PKI: crypto_set_ra_pubkey() (using global_auth_context) 08:48:11: CRYPTO_PKI: transaction
GetCACert completed 08:48:11: CRYPTO_PKI: CA certificate received. 08:48:11: CRYPTO_PKI: CA
certificate received. % Please answer 'yes' or 'no'. % Do you accept this certificate? [yes/no]:
```

**Y**

```
1720-1(config)#
```

```
08:49:08: CRYPTO_PKI: crypto_process_ra_certs() For:vpn
```

```
1720-1(config)#cr ca enroll vpn
```

```
%
```

```
% Start certificate enrollment ..
```

```
% Create a challenge password. You will need to verbally
provide this password to the CA Administrator in order
to revoke your certificate. For security reasons your
password will not be saved in the configuration.
Please make a note of it.
```

```
Password:
```

```
Re-enter password:
```

```
% The subject name in the certificate will be: 1720-1.cisco.com
```

```
% Include the router serial number in the subject name? [yes/no]: n
```

```
% Include an IP address in the subject name? [yes/no]: n
```

```
Request certificate from CA? [yes/no]: y
```

```
% Certificate request sent to Certificate Authority
```

```
% The certificate request fingerprint will be displayed.
```

```
% The 'show crypto ca certificate' command will also show
```

```
% the fingerprint.
```

```
1720-1(config)# Fingerprint: CB9730B0 5EAAEBCB CC04C77B 2B7F253D
```

```
08:51:09: CRYPTO_PKI: transaction PKCSReq completed
```

```
08:51:09: CRYPTO_PKI: status:
```

```
08:51:10: CRYPTO_PKI:Write out pkcs#10 content:272
```

```
08:51:10: 30 82 01 0C 30 81 B7 02 01 00 30 21 31 1F 30 1D
```

```
08:51:10: 06 09 2A 86 48 86 F7 0D 01 09 02 16 10 31 37 32
```

```
!--- Hex data omitted. 08:51:10: 8F 87 32 4A 25 27 2A 9B 17 F1 1F C5 67 1E 2A D2 08:51:10:
```

```
08:51:10: CRYPTO_PKI:Enveloped Data ... 08:51:10: 30 80 06 09 2A 86 48 86 F7 0D 01 07 03 A0 80
```

```
30 !--- Hex data omitted. 08:51:10: 2F C8 94 16 FE 2F 1B 00 00 00 00 00 00 00 00 00 08:51:10: 00
```

```
08:51:10: 08:51:10: CRYPTO_PKI:Signed Data 1311 bytes 08:51:10: 30 80 06 09 2A 86 48 86 F7 0D 01
```

```
07 02 A0 80 30 08:51:10: 80 02 01 01 31 0E 30 0C 06 08 2A 86 48 86 F7 0D !--- Hex data omitted.
```

```
08:51:10: D0 56 7D 24 59 9C DE 00 00 00 00 00 00 00 00 08:51:10: 08:51:10: CRYPTO_PKI: can not
```

```
resolve server name/IP address 08:51:10: CRYPTO_PKI: Using unresolved IP Address 171.69.89.16
```

```
08:51:10: CRYPTO_PKI: http connection opened 08:51:13: CRYPTO_PKI: received msg of 656 bytes
```

```
08:51:13: CRYPTO_PKI: HTTP response header: HTTP/1.1 200 OK Date: Fri, 11 Jan 2002 19:13:55
```

```
Pacific Standard Time Server: Entrust/VPNConnector v5.0 Connection: close Content-Type:
```

```
application/x-pki-message 08:51:13: CRYPTO_PKI:Received pki message: 487 types 08:51:13: 30 82
```

```
01 E3 06 09 2A 86 48 86 F7 0D 01 07 02 A0 !--- Hex data omitted. 08:51:13: E6 E3 CC 8B 6C 5E 74
```

```
9E 6A 0B 7D E1 B7 31 A0 EF 08:51:13: 02 1B C6 F3 C2 B9 86 08:51:13: 08:51:13: CRYPTO_PKI: signed
```

```
attr: pki-message-type: 13 01 33 08:51:13: 08:51:13: CRYPTO_PKI: signed attr: pki-status: 13 01
```

```
33 08:51:13: 08:51:13: CRYPTO_PKI: signed attr: pki-recipient-nonce: 08:51:13: 04 20 32 46 37 30
```

```
36 35 37 45 39 44 43 31 36 31 08:51:13: 39 31 34 39 30 32 33 34 46 35 42 44 30 46 41 31
```

```
08:51:13: 46 34 08:51:13: 08:51:13: CRYPTO_PKI: signed attr: pki-transaction-id: 08:51:13: 13 20
```

```
35 33 43 46 43 31 35 30 37 36 42 33 35 42 08:51:13: 37 30 42 43 42 39 39 36 44 36 42 46 39 32 38
```

```
30 08:51:13: 37 35 08:51:13: 08:51:13: CRYPTO_PKI: status = 102: certificate request pending
```

```
08:51:13: CRYPTO_PKI:Write out getcert initial content:84 08:51:13: 30 52 30 2D 31 0B 30 09 06
```

```
03 55 04 06 13 02 75 08:51:13: 73 31 0E 30 0C 06 03 55 04 0A 13 05 63 69 73 63 08:51:13: 6F 31
0E 30 0C 06 03 55 04 0B 13 05 73 6A 76 70 08:51:13: 6E 30 21 31 1F 30 1D 06 09 2A 86 48 86 F7 0D
01 08:51:13: 09 02 16 10 31 37 32 30 2D 31 2E 63 69 73 63 6F 08:51:13: 2E 63 6F 6D 08:51:13:
08:51:13: CRYPTO_PKI:Enveloped Data ... 08:51:13: 30 80 06 09 2A 86 48 86 F7 0D 01 07 03 A0 80
30 !--- Hex data omitted. 08:51:13: 08:51:13: CRYPTO_PKI:Signed Data 1738 bytes 08:51:13: 30 80
06 09 2A 86 48 86 F7 0D 01 07 02 A0 80 30 !--- Hex data omitted. 08:51:14: 59 DA 00 00 00 00 00
00 00 00 08:51:14: 08:51:14: CRYPTO_PKI: can not resolve server name/IP address 08:51:14:
CRYPTO_PKI: Using unresolved IP Address 171.69.89.16 08:51:14: CRYPTO_PKI: http connection
opened 08:51:36: CRYPTO_PKI: received msg of 656 bytes 08:51:36: CRYPTO_PKI: HTTP response
header: HTTP/1.1 200 OK Date: Fri, 11 Jan 2002 19:13:58 Pacific Standard Time Server:
Entrust/VPNConnector v5.0 Connection: close Content-Type: application/x-pki-message 08:51:36:
CRYPTO_PKI:Received pki message: 487 types 08:51:36: 30 82 01 E3 06 09 2A 86 48 86 F7 0D 01 07
02 A0 08:51:36: 82 01 D4 30 82 01 D0 02 01 01 31 0E 30 0C 06 08 !--- Hex data omitted. 08:51:36:
E6 E3 CC 8B 6C 5E 74 9E 6A 0B 7D E1 B7 31 A0 EF 08:51:36: 02 1B C6 F3 C2 B9 86 08:51:36:
08:51:36: CRYPTO_PKI: signed attr: pki-message-type: 13 01 33 08:51:36: 08:51:36: CRYPTO_PKI:
signed attr: pki-status: 13 01 33 08:51:36: 08:51:36: CRYPTO_PKI: signed attr: pki-recipient-
nonce: 08:51:36: 04 20 32 46 37 30 36 35 37 45 39 44 43 31 36 31 08:51:36: 39 31 34 39 30 32 33
34 46 35 42 44 30 46 41 31 08:51:36: 46 34 08:51:36: 08:51:36: CRYPTO_PKI: signed attr: pki-
transaction-id: 08:51:36: 13 20 35 33 43 46 43 31 35 30 37 36 42 33 35 42 08:51:36: 37 30 42 43
42 39 39 36 44 36 42 46 39 32 38 30 08:51:36: 37 35 08:51:36: 08:51:36: CRYPTO_PKI: status =
102: certificate request pending 08:51:46: CRYPTO_PKI: All sockets are closed. 08:51:56:
CRYPTO_PKI: All sockets are closed. 08:52:36: CRYPTO_PKI: resend GetCertInitial, 1 08:52:36:
CRYPTO_PKI: resend GetCertInitial for session: 0 08:52:36: CRYPTO_PKI: can not resolve server
name/IP address 08:52:36: CRYPTO_PKI: Using unresolved IP Address 171.69.89.16 08:52:36:
CRYPTO_PKI: http connection opened 08:52:38: CRYPTO_PKI: received msg of 1647 bytes 08:52:38:
CRYPTO_PKI: HTTP response header: HTTP/1.1 200 OK Date: Fri, 11 Jan 2002 19:15:20 Pacific
Standard Time Server: Entrust/VPNConnector v5.0 Connection: close Content-Type: application/x-
pki-message 08:52:38: CRYPTO_PKI:Received pki message: 1478 types 08:52:38: 30 82 05 C2 06 09 2A
86 48 86 F7 0D 01 07 02 A0 !--- Hex data omitted. 08:52:38: B4 0D EC 6D 61 9B 08:52:38:
08:52:38: CRYPTO_PKI: signed attr: pki-message-type: 13 01 33 08:52:38: 08:52:38: CRYPTO_PKI:
signed attr: pki-status: 13 01 30 08:52:38: 08:52:38: CRYPTO_PKI: signed attr: pki-recipient-
nonce: 08:52:38: 04 20 32 41 35 44 31 31 42 34 43 39 46 31 34 32 08:52:38: 30 30 38 34 32 43 35
45 38 36 44 44 43 41 45 44 08:52:38: 33 34 08:52:38: 08:52:38: CRYPTO_PKI: signed attr: pki-
transaction-id: 08:52:38: 13 20 35 33 43 46 43 31 35 30 37 36 42 33 35 42 08:52:38: 37 30 42 43
42 39 39 36 44 36 42 46 39 32 38 30 08:52:38: 37 35 08:52:38: 08:52:38: CRYPTO_PKI: status =
100: certificate is granted !--- Certificate is granted by the CA. 08:52:38: CRYPTO_PKI:Verified
signed data 985 bytes: 08:52:38: 30 82 03 D5 06 09 2A 86 48 86 F7 0D 01 07 03 A0 !--- Hex data
omitted. 08:52:38: 39 DE 0A 10 3B D1 17 30 79 83 E0 54 D9 59 47 13 08:52:38: 86 9A E5 5D F8 45
3D 61 63 08:52:38: 08:52:38: CRYPTO_PKI:Decrypted enveloped content: 08:52:38: 30 82 02 F3 06 09
2A 86 48 86 F7 0D 01 07 02 A0 08:52:38: 82 02 E4 30 82 02 E0 02 01 01 31 00 30 0B 06 09 !--- Hex
data omitted. 08:52:39: CE 33 54 B3 4A 62 23 65 6E B1 83 D9 7C 24 87 A5 08:52:39: E8 FF D8 50 6F
31 00 08:52:39: 08:52:39: CRYPTO_PKI: All enrollment requests completed. 08:52:39: %CRYPTO-6-
CERTRET: Certificate received from Certificate Authority 08:52:49: CRYPTO_PKI: All enrollment
requests completed.
```

## PIX からの証明書のデバッグ例

このセクションでは、CA サーバからの証明書の取得中に、次の PKI デバッグ コマンドを実行したときに PIX から得られるデバッグを示します。これらのデバッグは、成功したセッションから得られたものです。

```
pix520-1(config)#
pix520-1(config)# debug cr ca
pix520-1(config)#

pix520-1(config)# ca configure cisco ra 20 5

pix520-1(config)# ca authenticate cisco

CI thread sleeps!
Crypto CA thread wakes up!
CRYPTO_PKI: http connection opened
```

Certificate has the following attributes:

Fingerprint: 1fcdf2c8 2deda6ac 4819d4c4 b4cff2f5

PKI: key process suspended and continued

CRYPTO\_PKI: WARNING: A certificate chain could not be constructed while selecting certificate status

CRYPTO\_PKI: WARNING: A certificate chain could not be constructed while selecting certificate status

CRYPTO\_PKI: Name: CN = First Officer, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = First Officer, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: transaction GetCACert completed

CRYPTO\_PKI: Name: CN = First Officer, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = First Officer, OU = sjvpn, O = cisco, C = us

Crypto CA thread sleeps!

pix520-1(config)# !

pix520-1(config)# **sh ca cert**

CA

CRYPTO\_PKI: Name: OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = CRL1, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = First Officer, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = CRL1, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = First Officer, OU = sjvpn, O = cisco, C = us

CRYPTO\_PKI: Name: CN = CRL1, OU = sjvpn, O = cisco, C = us Certificate

Status: Available

Certificate Serial Number: 3b2fd307

Key Usage: General Purpose

OU = sjvpn

O = cisco

C = us

CRL Distribution Point:

CN = CRL1, OU = sjvpn, O = cisco, C = us

Validity Date:

start date: 22:02:40 Jun 19 2001

end date: 22:32:40 Jun 19 2021

RA Signature Certificate

Certificate Serial Number: 3b2fd319

Key Usage: Signature

CN = First Officer

OU = sjvpn

O = cisco

C = us

CRL Distribution Point:

CN = CRL1, OU = sjvpn, O = cisco, C = us

Validity Date:

start date: 22:03:31 Jun 19 2001

end date: 22:33:31 Jun 19 2004

RA KeyEncipher Certificate

Status: Available

Certificate Serial Number: 3b2fd318

Key Usage: Encryption

CN = First Officer

OU = sjvpn

O = cisco

C = us

CRL Distribution Point:



```
CN = CRL1, OU = sjvpn, O = cisco, C = us
Validity Date:
  start date: 22:03:31 Jun 19 2001

  end   date: 22:33:31 Jun 19 2004
```

```
pix520-1(config)#
Status: Available
```

```
pix520-1(config)# ca enroll cisco 171.69.89.16
```

```
CI thread sleeps!
% Crypto CA thread wakes up!
% Start certificate enrollment ..

% The subject name in the certificate will be: pix520-1.vpn.com
```

```
% Certificate request sent to Certificate Authority
% The certificate request fingerprint will be displayed.
```

```
pix520-1(config)#      Fingerprint:  bc923bc0 ee66b336 08a513b1 a226c5c8
```

```
CRYPTO_PKI: transaction PKCSReq completed
CRYPTO_PKI: status:
Crypto CA thread sleeps!
PKI: key process suspended and continued
CRYPTO_PKI: http connection opened
CRYPTO_PKI:  received msg of 656 bytes
CRYPTO_PKI: WARNING: Certificate, private key or CRL was
not found while selecting CRL
```

```
CRYPTO_PKI: signed attr: pki-message-type:
13 01 33
CRYPTO_PKI: signed attr: pki-status:
13 01 33
CRYPTO_PKI: signed attr: pki-recipient-nonce:
04 20 30 36 38 33 34 44 35 46 30 44 31 37 42 39 42 30 30 44
37 37 42 33 44 37 39 42 45 43 43 43 41 41
CRYPTO_PKI: signed attr: pki-transaction-id:
13 20 64 38 32 36 37 37 34 33 31 39 62 65 65 31 62 65 34 36
65 33 63 32 38 37 66 61 65 31 31 36 64 32
CRYPTO_PKI: status = 102: certificate request pending
CRYPTO_PKI: All sockets are closed.
CRYPTO_PKI: All sockets are closed.
CRYPTO_PKI: resend GetCertInitial for session: 0
CRYPTO_PKI: http connection opened
```

```
!--- The certificate has been granted by CA! CRYPTO_PKI: received msg of 1720 bytes CRYPTO_PKI:
WARNING: Certificate, private key or CRL was not found while selecting CRL PKI: key process
suspended and continued CRYPTO_PKI: signed attr: pki-message-type: 13 01 33 CRYPTO_PKI: signed
attr: pki-status: 13 01 30 CRYPTO_PKI: signed attr: pki-recipient-nonce: 04 20 34 42 41 36 31 31
31 42 42 35 42 38 42 43 44 31 36 31 34 30 34 44 45 34 45 33 33 41 34 41 46 36 CRYPTO_PKI: signed
attr: pki-transaction-id: 13 20 64 38 32 36 37 37 34 33 31 39 62 65 65 31 62 65 34 36 65 33 63
32 38 37 66 61 65 31 31 36 64 32 CRYPTO_PKI: status = 100: certificate is granted CRYPTO_PKI:
WARNING: Certificate, private key or CRL was not found while selecting CRL CRYPTO_PKI: All
enrollment requests completed. CRYPTO_PKI: All enrollment requests completed. CRYPTO_PKI:
WARNING: Certificate, private key or CRL was not found while selecting CRL
```

## [ルータからの IPsec のデバッグ例](#)

このセクションでは、両方の IPsec ピアが IPsec トンネルのネゴシエーションを実行しているときに、ルータから得られる IPsec デバッグを示します。

```
1720-1#debug crypto ipsec
1720-1#debug crypto isakmp
1720-1#debug crypto engine
1720-1#sh debug
Cryptographic Subsystem:
  Crypto ISAKMP debugging is on
  Crypto Engine debugging is on
  Crypto IPSEC debugging is on
1720-1#

3d11h: ISAKMP (0:0): received packet from 172.16.172.34 (N) NEW SA
3d11h: ISAKMP: local port 500, remote port 500
3d11h: ISAKMP (0:110): processing SA payload. message ID = 0
3d11h: ISAKMP (0:110): Checking ISAKMP transform 1 against
priority 10 policy
3d11h: ISAKMP:      encryption DES-CBC
3d11h: ISAKMP:      hash MD5
3d11h: ISAKMP:      default group 1
3d11h: ISAKMP:      auth RSA sig
!--- IKE phase one is accepting certificates as the authentication method. 3d11h: ISAKMP
(0:110): atts are acceptable. Next payload is 3 3d11h: CryptoEngine0: generate alg parameter
3d11h: CryptoEngine0: CRYPTO_ISA_DH_CREATE(hw)(ipsec) 3d11h: CRYPTO_ENGINE: Dh phase 1 status: 0
3d11h: ISAKMP (0:110): SA is doing RSA signature authentication using id type ID_FQDN 3d11h:
ISAKMP (0:110): sending packet to 172.16.172.34 (R) MM_SA_SETUP 3d11h: ISAKMP (0:110): received
packet from 172.16.172.34 (R) MM_SA_SETUP 3d11h: ISAKMP (0:110): processing KE payload. message
ID = 0 3d11h: CryptoEngine0: generate alg parameter 3d11h: CryptoEngine0:
CRYPTO_ISA_DH_SHARE_SECRET(hw)(ipsec) 3d11h: ISAKMP (0:110): processing NONCE payload. message
ID = 0 3d11h: CryptoEngine0: calculate pkey hmac for conn id 110 3d11h: CryptoEngine0:
CRYPTO_ISA_IKE_HMAC(hw)(ipsec) 3d11h: CryptoEngine0: create ISAKMP SKEYID for conn id 110 3d11h:
CryptoEngine0: CRYPTO_ISA_SA_CREATE(hw)(ipsec) 3d11h: ISAKMP (0:110): SKEYID state generated
3d11h: ISAKMP (0:110): processing CERT_REQ payload. message ID = 0 3d11h: ISAKMP (0:110): peer
wants a CT_X509_SIGNATURE cert 3d11h: ISAKMP (0:110): peer want cert issued by OU = sjvpn, O =
cisco, C = us 3d11h: ISAKMP (0:110): processing vendor id payload 3d11h: ISAKMP (0:110):
processing vendor id payload 3d11h: ISAKMP (0:110): processing vendor id payload 3d11h: ISAKMP
(0:110): speaking to another IOS box! 3d11h: ISAKMP (0:110): sending packet to 172.16.172.34 (R)
MM_KEY_EXCH 3d11h: ISAKMP (0:110): received packet from 172.16.172.34 (R) MM_KEY_EXCH 3d11h:
CryptoEngine0: CRYPTO_ISA_IKE_DECRYPT(hw)(ipsec) 3d11h: ISAKMP (0:110): processing ID payload.
message ID = 0 3d11h: ISAKMP (0:110): processing CERT payload. message ID = 0 3d11h: ISAKMP
(0:110): processing a CT_X509_SIGNATURE cert 3d11h: ISAKMP (0:110): processing SIG payload.
message ID = 0 3d11h: ISAKMP (110): sa->peer.name = , sa->peer_id.id.id_fqdn.fqdn = pix520-
1.vpn.com 3d11h: Crypto engine 0: RSA decrypt with public key 3d11h: CryptoEngine0:
CRYPTO_RSA_PUB_DECRYPT 3d11h: CryptoEngine0: generate hmac context for conn id 110 3d11h:
CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec) 3d11h: ISAKMP (0:110): SA has been authenticated
with 172.16.172.34 3d11h: ISAKMP (110): ID payload next-payload : 6 type : 2 protocol : 17 port
: 500 length : 20 3d11h: ISAKMP (110): Total payload length: 24 3d11h: CryptoEngine0: generate
hmac context for conn id 110 3d11h: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec) 3d11h: Crypto
engine 0: RSA encrypt with private key 3d11h: CryptoEngine0: CRYPTO_RSA_PRIV_ENCRYPT 3d11h:
CRYPTO_ENGINE: key process suspended and continued 3d11h: CryptoEngine0: clear dh number for
conn id 1 3d11h: CryptoEngine0: CRYPTO_ISA_DH_DELETE(hw)(ipsec) 3d11h: CryptoEngine0:
CRYPTO_ISA_IKE_ENCRYPT(hw)(ipsec) 3d11h: ISAKMP (0:110): sending packet to 172.16.172.34 (R)
QM_IDLE 3d11h: ISAKMP (0:110): received packet from 172.16.172.34 (R) QM_IDLE 3d11h:
CryptoEngine0: CRYPTO_ISA_IKE_DECRYPT(hw)(ipsec) 3d11h: CryptoEngine0: generate hmac context for
conn id 110 3d11h: CryptoEngine0: CRYPTO_ISA_IKE_HMAC(hw)(ipsec) 3d11h: ISAKMP (0:110):
processing HASH payload. message ID = -140325145 3d11h: ISAKMP (0:110): processing SA payload.
message ID = -140325145 3d11h: ISAKMP (0:110): Checking IPsec proposal 1 3d11h: ISAKMP:
transform 1, ESP_DES 3d11h: ISAKMP: attributes in transform: 3d11h: ISAKMP: encaps is 1 3d11h:
ISAKMP: SA life type in seconds 3d11h: ISAKMP: SA life duration (basic) of 28800 3d11h: ISAKMP:
SA life type in kilobytes 3d11h: ISAKMP: SA life duration (VPI) of 0x0 0x46 0x50 0x0 3d11h:
ISAKMP: authenticator is HMAC-MD5 3d11h: validate proposal 0 3d11h: ISAKMP (0:110): atts are
acceptable. 3d11h: IPSEC(validate_proposal_request): proposal part #1, (key eng. msg.) INBOUND
```

```
local= 172.16.172.39, remote= 172.16.172.34, local_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
remote_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-
hmac , lifedur= 0s and 0kb, spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4 3d11h: validate
proposal request 0 3d11h: ISAKMP (0:110): processing NONCE payload. message ID = -140325145
3d11h: ISAKMP (0:110): processing ID payload. message ID = -140325145 3d11h: ISAKMP (0:110):
processing ID payload. message ID = -140325145 3d11h: ISAKMP (0:110): asking for 1 spis from
ipsec 3d11h: IPSEC(key_engine): got a queue event... 3d11h: IPSEC(spi_response): getting spi
3611334428 for SA from 172.16.172.39 to 172.16.172.34 for prot 3 3d11h: ISAKMP: received ke
message (2/1) 3d11h: CryptoEngine0: generate hmac context for conn id 110 3d11h: CryptoEngine0:
CRYPTO_ISA_IKE_HMAC(hw)(ipsec) 3d11h: CryptoEngine0: CRYPTO_ISA_IKE_ENCRYPT(hw)(ipsec) 3d11h:
ISAKMP (0:110): sending packet to 172.16.172.34 (R) QM_IDLE 3d11h: ISAKMP (0:110): received
packet from 172.16.172.34 (R) QM_IDLE 3d11h: CryptoEngine0: CRYPTO_ISA_IKE_DECRYPT(hw)(ipsec)
3d11h: CryptoEngine0: generate hmac context for conn id 110 3d11h: CryptoEngine0:
CRYPTO_ISA_IKE_HMAC(hw)(ipsec) 3d11h: ipsec allocate flow 0 3d11h: ipsec allocate flow 0 3d11h:
CryptoEngine0: CRYPTO_ISA_IPSEC_KEY_CREATE(hw)(ipsec) 3d11h: CryptoEngine0:
CRYPTO_ISA_IPSEC_KEY_CREATE(hw)(ipsec) 3d11h: ISAKMP (0:110): Creating IPsec SAs 3d11h: inbound
SA from 172.16.172.34 to 172.16.172.39 (proxy 192.168.4.0 to 1.1.1.0) 3d11h: has spi 0xD740971C
and conn_id 200 and flags 4 3d11h: lifetime of 28800 seconds 3d11h: lifetime of 4608000
kilobytes 3d11h: outbound SA from 172.16.172.39 to 172.16.172.34 (proxy 1.1.1.0 to 192.168.4.0 )
3d11h: has spi 939761857 and conn_id 201 and flags C 3d11h: lifetime of 28800 seconds 3d11h:
lifetime of 4608000 kilobytes 3d11h: ISAKMP (0:110): deleting node -140325145 error FALSE reason
"quick mode done (await())" 3d11h: IPSEC(key_engine): got a queue event... 3d11h:
IPSEC(initialize_sas): , (key eng. msg.) INBOUND local= 172.16.172.39, remote= 172.16.172.34,
local_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4), remote_proxy= 192.168.4.0/255.255.255.0/0/0
(type=4), protocol= ESP, transform= esp-des esp-md5-hmac , lifedur= 28800s and 4608000kb, spi=
0xD740971C(3611334428), conn_id= 200, keysize= 0, flags= 0x4 3d11h: IPSEC(initialize_sas): ,
(key eng. msg.) OUTBOUND local= 172.16.172.39, remote= 172.16.172.34, local_proxy=
1.1.1.0/255.255.255.0/0/0 (type=4), remote_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac , lifedur= 28800s and 4608000kb, spi=
0x3803A0C1(939761857), conn_id= 201, keysize= 0, flags= 0xC 3d11h: IPSEC(create_sa): sa created,
(sa) sa_dest= 172.16.172.39, sa_prot= 50, sa_spi= 0xD740971C(3611334428), sa_trans= esp-des esp-
md5-hmac , sa_conn_id= 200 3d11h: IPSEC(create_sa): sa created, (sa) sa_dest= 172.16.172.34,
sa_prot= 50, sa_spi= 0x3803A0C1(939761857), sa_trans= esp-des esp-md5-hmac , sa_conn_id= 201
3d11h: ISAKMP (0:108): purging SA., sa=811A823C, delme=811A823C 3d11h: CryptoEngine0: delete
connection 108 3d11h: CryptoEngine0: CRYPTO_ISA_SA_DELETE(hw)(ipsec) 3d11h: ISAKMP (0:107):
purging SA., sa=811FE440, delme=811FE440 3d11h: CryptoEngine0: delete connection 107 3d11h:
CryptoEngine0: CRYPTO_ISA_SA_DELETE(hw)(ipsec) 1720-1#
```

## PIXからのIPSecのデバッグ例

このセクションでは、両方のIPSecピアがIPSecトンネルのネゴシエーションを実行しているときに、PIXから得られるIPSecデバッグを示します。

```
pix520-1# debug crypto ipsec
pix520-1# debug crypto isakmp
pix520-1# sh debug
debug crypto ipsec 1
debug crypto isakmp 1
debug fover status
    tx      Off
    rx      Off
    open    Off
    cable   Off
    txdmp   Off
    rxdmp   Off
    ifc     Off
    rxip    Off
    txip    Off
    get     Off
    put     Off
    verify  Off
    switch  Off
    fail    Off
```

fmsg Off

ISAKMP (0): beginning Main Mode exchange

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

ISAKMP (0): Checking ISAKMP transform 1 against  
priority 10 policy

ISAKMP: encryption DES-CBC

ISAKMP: hash MD5

ISAKMP: default group 1

ISAKMP: auth RSA sig

ISAKMP (0): atts are acceptable. Next payload is 0

ISAKMP (0): SA is doing RSA signature authentication  
using id type ID\_FQDN

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

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

ISAKMP (0): processing CERT\_REQ payload. message ID = 0

ISAKMP (0): peer wants a CT\_X509\_SIGNATURE cert

ISAKMP (0): processing vendor id payload

ISAKMP (0): speaking to another IOS box!

ISAKMP (0): ID payload

next-payload : 6

type : 2

protocol : 17

port : 500

length : 20

ISAKMP (0): Total payload length: 24

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

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

ISAKMP (0): processing a CT\_X509\_SIGNATURE cert

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

ISAKMP (0): sa->peer.name = , sa->peer\_id.id.id\_fqdn.fqdn =  
1720-1.cisco.com

ISAKMP (0): SA has been authenticated

ISAKMP (0): beginning Quick Mode exchange,

M-ID of -140325145:f7a2cee7IPSEC(key\_engine):

got a queue event...

IPSEC(spi\_response): getting spi 0x3803a0c1(939761857)

for SA from 172.16.172.39 to 172.16.172.34 for prot 3

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_QM exchange

oakley\_process\_quick\_mode:

OAK\_QM\_IDLE

ISAKMP (0): processing SA payload.

```
message ID = 4154642151
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= 172.16.172.39,
src= 172.16.172.34,
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
src_proxy= 192.168.4.0/255.255.255.0/0/0 (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 = 4154642151

ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing NOTIFY payload 24576
protocol 3 spi 3611334428,
message ID = 4154642151
ISAKMP (0): processing responder lifetime
ISAKMP (0): responder lifetime of 3600s
ISAKMP (0): Creating IPSec SAs
inbound SA from 172.16.172.39 to
172.16.172.34 (proxy 1.1.1.0 to 192.168.4.0)
has spi 939761857 and conn_id 4 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
outbound SA from 172.16.172.34 to
172.16.172.39 (proxy 192.168.4.0 to 1.1.1.0)
has spi 3611334428 and conn_id 3 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
IPSEC(key_engine): got a queue event...
IPSEC(initialize_sas): ,
(key eng. msg.) dest= 172.16.172.34, src= 172.16.172.39,
dest_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
src_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0x3803a0c1(939761857), conn_id= 4, keysize= 0,
flags= 0x4
IPSEC(initialize_sas): ,
(key eng. msg.) src= 172.16.172.34, dest= 172.16.172.39,
src_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0xd740971c(3611334428), conn_id= 3, keysize= 0,
flags= 0x4

return status is IKMP_NO_ERROR
```

```
pix520-1(config)#
```

## 潜在的な問題

このセクションでは、ルータおよび PIX 上で証明書を取得するときに発生する一般的な間違いの症状、原因、および解決策について説明します。

### ISAKMP の ID が一致しない

ルータおよび PIX は、IPSec によって使用されるキーおよび証明書に対して FQDN を割り当てます。IKE つまりフェーズ 1 のネゴシエーション中、ルータまたは IOS は証明書内の FQDN をチェックします。したがって、PIX およびルータのアドレスでなく ISAKMP の ID をホスト名として使用する必要があります。次の例では、ルータまたは IOS が証明書内の FQDN をチェックしています。

```
pix520-1# debug crypto ipsec
pix520-1# debug crypto isakmp
pix520-1# sh debug
debug crypto ipsec 1
debug crypto isakmp 1
debug fover status
    tx      Off
    rx      Off
    open    Off
    cable   Off
    txdmp   Off
    rxdmp   Off
    ifc     Off
    rxip    Off
    txip    Off
    get     Off
    put     Off
    verify  Off
    switch  Off
    fail    Off
    fmsg    Off

ISAKMP (0): beginning Main Mode exchange

crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0): processing SA payload. message ID = 0

ISAKMP (0): Checking ISAKMP transform 1 against
priority 10 policy
ISAKMP:      encryption DES-CBC
ISAKMP:      hash MD5
ISAKMP:      default group 1
ISAKMP:      auth RSA sig
ISAKMP (0): atts are acceptable. Next payload is 0
ISAKMP (0): SA is doing RSA signature authentication
using id type ID_FQDN
return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0): processing KE payload. message ID = 0

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

```
ISAKMP (0): processing CERT_REQ payload. message ID = 0
ISAKMP (0): peer wants a CT_X509_SIGNATURE cert
ISAKMP (0): processing vendor id payload

ISAKMP (0): speaking to another IOS box!

ISAKMP (0): ID payload
    next-payload : 6
    type          : 2
    protocol      : 17
    port          : 500
    length        : 20
ISAKMP (0): Total payload length: 24
return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0): processing ID payload. message ID = 0
ISAKMP (0): processing CERT payload. message ID = 0
ISAKMP (0): processing a CT_X509_SIGNATURE cert
ISAKMP (0): processing SIG payload. message ID = 0
ISAKMP (0): sa->peer.name = , sa->peer_id.id.id_fqdn.fqdn =
1720-1.cisco.com
ISAKMP (0): SA has been authenticated

ISAKMP (0): beginning Quick Mode exchange,
M-ID of -140325145:f7a2cee7IPSEC(key_engine):
got a queue event...
IPSEC(spi_response): getting spi 0x3803a0c1(939761857)
    for SA from 172.16.172.39 to 172.16.172.34 for prot 3

return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_QM exchange
oakley_process_quick_mode:
OAK_QM_IDLE
ISAKMP (0): processing SA payload.
message ID = 4154642151
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= 172.16.172.39,
src= 172.16.172.34,
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
src_proxy= 192.168.4.0/255.255.255.0/0/0 (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 = 4154642151
```

```
ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing NOTIFY payload 24576
      protocol 3 spi 3611334428,
      message ID = 4154642151
ISAKMP (0): processing responder lifetime
ISAKMP (0): responder lifetime of 3600s
ISAKMP (0): Creating IPsec SAs
      inbound SA from 172.16.172.39 to
172.16.172.34 (proxy 1.1.1.0 to 192.168.4.0)
      has spi 939761857 and conn_id 4 and flags 4
      lifetime of 3600 seconds
      lifetime of 4608000 kilobytes
      outbound SA from 172.16.172.34 to
172.16.172.39 (proxy 192.168.4.0 to 1.1.1.0)
      has spi 3611334428 and conn_id 3 and flags 4
      lifetime of 3600 seconds
      lifetime of 4608000 kilobytes
IPSEC(key_engine): got a queue event...
IPSEC(initialize_sas): ,
      (key eng. msg.) dest= 172.16.172.34, src= 172.16.172.39,
      dest_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
      src_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
      protocol= ESP, transform= esp-des esp-md5-hmac ,
      lifedur= 3600s and 4608000kb,
      spi= 0x3803a0c1(939761857), conn_id= 4, keysize= 0,
      flags= 0x4
IPSEC(initialize_sas): ,
      (key eng. msg.) src= 172.16.172.34, dest= 172.16.172.39,
      src_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
      dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
      protocol= ESP, transform= esp-des esp-md5-hmac ,
      lifedur= 3600s and 4608000kb,
      spi= 0xd740971c(3611334428), conn_id= 3, keysize= 0,
      flags= 0x4

return status is IKMP_NO_ERROR
```

```
pix520-1(config)#
```

**ルータのデバッグ :**

```
pix520-1# debug crypto ipsec
pix520-1# debug crypto isakmp
pix520-1# sh debug
debug crypto ipsec 1
debug crypto isakmp 1
debug fover status
      tx      Off
      rx      Off
      open    Off
      cable   Off
      txdmp   Off
      rxdmp   Off
      ifc     Off
      rxip    Off
      txip    Off
      get     Off
      put     Off
      verify  Off
      switch  Off
      fail    Off
```



fmsg Off

ISAKMP (0): beginning Main Mode exchange

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

ISAKMP (0): Checking ISAKMP transform 1 against  
priority 10 policy

ISAKMP: encryption DES-CBC

ISAKMP: hash MD5

ISAKMP: default group 1

ISAKMP: auth RSA sig

ISAKMP (0): atts are acceptable. Next payload is 0

ISAKMP (0): SA is doing RSA signature authentication

using id type ID\_FQDN

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

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

ISAKMP (0): processing CERT\_REQ payload. message ID = 0

ISAKMP (0): peer wants a CT\_X509\_SIGNATURE cert

ISAKMP (0): processing vendor id payload

ISAKMP (0): speaking to another IOS box!

ISAKMP (0): ID payload

next-payload : 6

type : 2

protocol : 17

port : 500

length : 20

ISAKMP (0): Total payload length: 24

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

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

ISAKMP (0): processing a CT\_X509\_SIGNATURE cert

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

ISAKMP (0): sa->peer.name = , sa->peer\_id.id.id\_fqdn.fqdn =

1720-1.cisco.com

ISAKMP (0): SA has been authenticated

ISAKMP (0): beginning Quick Mode exchange,

M-ID of -140325145:f7a2cee7IPSEC(key\_engine):

got a queue event...

IPSEC(spi\_response): getting spi 0x3803a0c1(939761857)

for SA from 172.16.172.39 to 172.16.172.34 for prot 3

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_QM exchange

oakley\_process\_quick\_mode:

OAK\_QM\_IDLE

ISAKMP (0): processing SA payload.

```
message ID = 4154642151
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= 172.16.172.39,
src= 172.16.172.34,
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
src_proxy= 192.168.4.0/255.255.255.0/0/0 (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 = 4154642151

ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing NOTIFY payload 24576
protocol 3 spi 3611334428,
message ID = 4154642151
ISAKMP (0): processing responder lifetime
ISAKMP (0): responder lifetime of 3600s
ISAKMP (0): Creating IPSec SAs
inbound SA from 172.16.172.39 to
172.16.172.34 (proxy 1.1.1.0 to 192.168.4.0)
has spi 939761857 and conn_id 4 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
outbound SA from 172.16.172.34 to
172.16.172.39 (proxy 192.168.4.0 to 1.1.1.0)
has spi 3611334428 and conn_id 3 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
IPSEC(key_engine): got a queue event...
IPSEC(initialize_sas): ,
(key eng. msg.) dest= 172.16.172.34, src= 172.16.172.39,
dest_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
src_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0x3803a0c1(939761857), conn_id= 4, keysize= 0,
flags= 0x4
IPSEC(initialize_sas): ,
(key eng. msg.) src= 172.16.172.34, dest= 172.16.172.39,
src_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0xd740971c(3611334428), conn_id= 3, keysize= 0,
flags= 0x4

return status is IKMP_NO_ERROR
```

pix520-1(config)#

## PIX のデバッグ :

pix520-1# **debug crypto ipsec**

pix520-1# **debug crypto isakmp**

pix520-1# **sh debug**

debug crypto ipsec 1

debug crypto isakmp 1

debug fover status

tx Off

rx Off

open Off

cable Off

txdmp Off

rxdmp Off

ifc Off

rxip Off

txip Off

get Off

put Off

verify Off

switch Off

fail Off

fmsg Off

ISAKMP (0): beginning Main Mode exchange

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

ISAKMP (0): Checking ISAKMP transform 1 against

priority 10 policy

ISAKMP: encryption DES-CBC

ISAKMP: hash MD5

ISAKMP: default group 1

ISAKMP: auth RSA sig

ISAKMP (0): atts are acceptable. Next payload is 0

ISAKMP (0): SA is doing RSA signature authentication

using id type ID\_FQDN

return status is IKMP\_NO\_ERROR

crypto\_isakmp\_process\_block: src 172.16.172.39,

dest 172.16.172.34

OAK\_MM exchange

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

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

ISAKMP (0): processing CERT\_REQ payload. message ID = 0

ISAKMP (0): peer wants a CT\_X509\_SIGNATURE cert

ISAKMP (0): processing vendor id payload

ISAKMP (0): speaking to another IOS box!

ISAKMP (0): ID payload

next-payload : 6

type : 2

protocol : 17

port : 500

length : 20

ISAKMP (0): Total payload length: 24

```
return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0): processing ID payload. message ID = 0
ISAKMP (0): processing CERT payload. message ID = 0
ISAKMP (0): processing a CT_X509_SIGNATURE cert
ISAKMP (0): processing SIG payload. message ID = 0
ISAKMP (0): sa->peer.name = , sa->peer_id.id.id_fqdn.fqdn =
1720-1.cisco.com
ISAKMP (0): SA has been authenticated
```

```
ISAKMP (0): beginning Quick Mode exchange,
M-ID of -140325145:f7a2cee7IPSEC(key_engine):
got a queue event...
IPSEC(spi_response): getting spi 0x3803a0c1(939761857)
  for SA from 172.16.172.39 to 172.16.172.34 for prot 3
```

```
return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_QM exchange
oakley_process_quick_mode:
OAK_QM_IDLE
ISAKMP (0): processing SA payload.
message ID = 4154642151
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= 172.16.172.39,
src= 172.16.172.34,
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
src_proxy= 192.168.4.0/255.255.255.0/0/0 (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 = 4154642151
```

```
ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing ID payload.
message ID = 4154642151
ISAKMP (0): processing NOTIFY payload 24576
  protocol 3 spi 3611334428,
  message ID = 4154642151
ISAKMP (0): processing responder lifetime
ISAKMP (0): responder lifetime of 3600s
ISAKMP (0): Creating IPsec SAs
  inbound SA from 172.16.172.39 to
172.16.172.34 (proxy 1.1.1.0 to 192.168.4.0)
  has spi 939761857 and conn_id 4 and flags 4
  lifetime of 3600 seconds
```

```
lifetime of 4608000 kilobytes
outbound SA from 172.16.172.34 to
172.16.172.39 (proxy 192.168.4.0 to 1.1.1.0)
has spi 3611334428 and conn_id 3 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
IPSEC(key_engine): got a queue event...
IPSEC(initialize_sas): ,
(key eng. msg.) dest= 172.16.172.34, src= 172.16.172.39,
dest_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
src_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0x3803a0c1(939761857), conn_id= 4, keysize= 0,
flags= 0x4
IPSEC(initialize_sas): ,
(key eng. msg.) src= 172.16.172.34, dest= 172.16.172.39,
src_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0xd740971c(3611334428), conn_id= 3, keysize= 0,
flags= 0x4

return status is IKMP_NO_ERROR
```

```
pix520-1(config)#
```

## 時刻と日付の不一致

PIX およびルータ上の証明書は、次の例で示すように一定の期間有効です。

```
pix520-1# debug crypto ipsec
pix520-1# debug crypto isakmp
pix520-1# sh debug
debug crypto ipsec 1
debug crypto isakmp 1
debug fover status
tx      Off
rx      Off
open    Off
cable   Off
txdmp   Off
rxdmp   Off
ifc     Off
rxip    Off
txip    Off
get     Off
put     Off
verify  Off
switch  Off
fail    Off
fmsg    Off

ISAKMP (0): beginning Main Mode exchange

crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0): processing SA payload. message ID = 0

ISAKMP (0): Checking ISAKMP transform 1 against
priority 10 policy
```

```
ISAKMP:      encryption DES-CBC
ISAKMP:      hash MD5
ISAKMP:      default group 1
ISAKMP:      auth RSA sig
ISAKMP (0):  atts are acceptable. Next payload is 0
ISAKMP (0):  SA is doing RSA signature authentication
using id type ID_FQDN
return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0):  processing KE payload. message ID = 0

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

ISAKMP (0):  processing CERT_REQ payload. message ID = 0
ISAKMP (0):  peer wants a CT_X509_SIGNATURE cert
ISAKMP (0):  processing vendor id payload

ISAKMP (0):  speaking to another IOS box!

ISAKMP (0):  ID payload
      next-payload : 6
      type          : 2
      protocol      : 17
      port          : 500
      length        : 20
ISAKMP (0):  Total payload length: 24
return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_MM exchange
ISAKMP (0):  processing ID payload. message ID = 0
ISAKMP (0):  processing CERT payload. message ID = 0
ISAKMP (0):  processing a CT_X509_SIGNATURE cert
ISAKMP (0):  processing SIG payload. message ID = 0
ISAKMP (0):  sa->peer.name = , sa->peer_id.id.id_fqdn.fqdn =
1720-1.cisco.com
ISAKMP (0):  SA has been authenticated

ISAKMP (0):  beginning Quick Mode exchange,
M-ID of -140325145:f7a2cee7IPSEC(key_engine):
got a queue event...
IPSEC(spi_response): getting spi 0x3803a0c1(939761857)
      for SA from 172.16.172.39 to 172.16.172.34 for prot 3

return status is IKMP_NO_ERROR
crypto_isakmp_process_block: src 172.16.172.39,
dest 172.16.172.34
OAK_QM exchange
oakley_process_quick_mode:
OAK_QM_IDLE
ISAKMP (0):  processing SA payload.
message ID = 4154642151
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= 172.16.172.39,
src= 172.16.172.34,
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
src_proxy= 192.168.4.0/255.255.255.0/0/0 (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 = 4154642151

ISAKMP (0):  processing ID payload.
message ID = 4154642151
ISAKMP (0):  processing ID payload.
message ID = 4154642151
ISAKMP (0):  processing NOTIFY payload 24576
protocol 3 spi 3611334428,
message ID = 4154642151
ISAKMP (0):  processing responder lifetime
ISAKMP (0):  responder lifetime of 3600s
ISAKMP (0):  Creating IPsec SAs
inbound SA from 172.16.172.39 to
172.16.172.34 (proxy 1.1.1.0 to 192.168.4.0)
has spi 939761857 and conn_id 4 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
outbound SA from 172.16.172.34 to
172.16.172.39 (proxy 192.168.4.0 to 1.1.1.0)
has spi 3611334428 and conn_id 3 and flags 4
lifetime of 3600 seconds
lifetime of 4608000 kilobytes
IPSEC(key_engine): got a queue event...
IPSEC(initialize_sas): ,
(key eng. msg.) dest= 172.16.172.34, src= 172.16.172.39,
dest_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
src_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0x3803a0c1(939761857), conn_id= 4, keysize= 0,
flags= 0x4
IPSEC(initialize_sas): ,
(key eng. msg.) src= 172.16.172.34, dest= 172.16.172.39,
src_proxy= 192.168.4.0/255.255.255.0/0/0 (type=4),
dest_proxy= 1.1.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb,
spi= 0xd740971c(3611334428), conn_id= 3, keysize= 0,
flags= 0x4

return status is IKMP_NO_ERROR
```

pix520-1(config)#

次の **show** コマンド出力も時間間隔を示しています。

1720-1#sh crypto ca crls

```
CRL Issuer Name:
OU = sjvnp, O = cisco, C = us
LastUpdate: 16:17:34 PST Jan 10 2002
NextUpdate: 17:17:34 PST Jan 11 2002
Retrieved from CRL Distribution Point:
```

```
LDAP: CN = CRL1, OU = sjvpn, O = cisco, C = us
```

ルータまたは PIX のクロックの日付および時刻が、証明書の開始日と終了日の間 ( および CRL の次回更新と最終更新の間 ) に該当しない場合、フェーズ 1 ネゴシエーション中に次のエラーが表示されます。

ルータのデバッグ :

```
1720-1#sh crypto ca crls
CRL Issuer Name:
  OU = sjvpn, O = cisco, C = us
  LastUpdate: 16:17:34 PST Jan 10 2002
  NextUpdate: 17:17:34 PST Jan 11 2002
  Retrieved from CRL Distribution Point:
    LDAP: CN = CRL1, OU = sjvpn, O = cisco, C = us
```

この例で、ルータ時刻は 1993 年 2 月 28 日 16:07:02 に設定されており、CA が求める有効期間内にありません。この問題を解決するには、ルータに適切な時刻を設定します。

```
1720-1#clock set 01:05:01 january 11 2002
1720-1#sh clock
01:05:04.903 PST Fri Jan 11 2002
1720-1#
```

### [HTTP/TCP ポート 80 がブロックされる](#)

ルータおよび PIX は、CA サーバへの認証および登録中に TCP ポート 80 を使用します。登録または認証に関する問題がある場合、ルータおよび PIX と CA サーバの間で HTTP/TCP ポート 80 がブロックされていないか確認してください。

### [PIX またはルータに CRL がない](#)

PIX またはルータに `crl optional` コマンドを指定しなかったため、これら両方のデバイスは、フェーズ 1 ネゴシエーション中に CRL をチェックします。CRL が存在しない場合、次のエラーが表示されます。

PIX のデバッグ :

```
1720-1#clock set 01:05:01 january 11 2002
1720-1#sh clock
01:05:04.903 PST Fri Jan 11 2002
1720-1#
```

この問題を解決するには、`ca crl request ca nickname` コマンドを発行して CA サーバから証明書を取得してください。ここでは `cr ca crl request Cisco` が使用されています。

### [証明書および RSA キー ペアの削除](#)

デジタル証明書または RSA キー ペアをルータまたは PIX から削除することが必要な場合もあります。

### [ルータ証明書および RSA キー ペアの削除](#)

コマンド :

- `no crypto ca identity ca nickname` : ルータ証明書を削除します。
- `crypto key zeroize rsa` : RSA キー ペアを削除します。



証明書を削除するには、次の例を実行してください。

```
1720-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
1720-1(config)#no crypto ca identity vpn
% Removing an identity will destroy all certificates received from
the related Certificate Authority.

Are you sure you want to do this? [yes/no]: y
% Be sure to ask the CA administrator to revoke your certificates.

No enrollment sessions are currently active.
```

```
1720-1(config)#
1720-1#sh cr ca cert
1720-1#
!--- The certificates are no longer available.
ルータ上の RSA キー ペアを削除するには、次の例を実行してください。
```

```
1720-1(config)#crypto key zeroize rsa
% Keys to be removed are named 1720-1.cisco.com.
Do you really want to remove these keys? [yes/no]: y
1720-1(config)#.
```

```
1720-1#sh crypto key mypubkey rsa
1720-1#
!-- The RSA key pairs are no longer available.
```

## PIX 証明書および RSA キー ペアの削除

コマンド :

- **no ca identity ca nickname** : PIX から証明書を削除します。
- **ca zeroize rsa** : PIX から RSA キー ペアを削除します。

PIX 上の証明書を削除するには、次の例を実行してください。

```
pix520-1(config)# no ca identity cisco
% Removing the identity will destroy all certificates.
% Be sure to ask the CA administrator to revoke your certificates.
```

```
pix520-1(config)# sh cr ca cert
pix520-1(config)#
!--- The certificates are no longer available.
```

PIX 上の RSA キー ペアを削除するには、次の例を実行してください。

```
pix520-1(config)# ca zeroize rsa
```

```
pix520-1(config)# sh ca mypubkey rsa
!--- The RSA key pairs are no longer available.
```

## 関連情報

- [IPSec に関するサポート ページ](#)
- [PIX に関するサポート ページ](#)
- [Requests for Comments \( RFC \)](#)
- [テクニカルサポート - Cisco Systems](#)