

Cisco IOS和StrongSwan之间的IKEv1/IKEv2配置示例

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简介

本文档提供Cisco IOS®和strongSwan之间LAN到LAN(L2L)VPN的配置示例。同时显示Internet密钥交换版本1(IKEv1)和Internet密钥交换版本2(IKEv2)配置。

先决条件

要求

Cisco 建议您了解以下主题：

- 有关Linux配置的基本知识
- 有关Cisco IOS上VPN配置的知识
- 了解以下协议：IKEv1IKEv2互联网协议安全(IPSec)

使用的组件

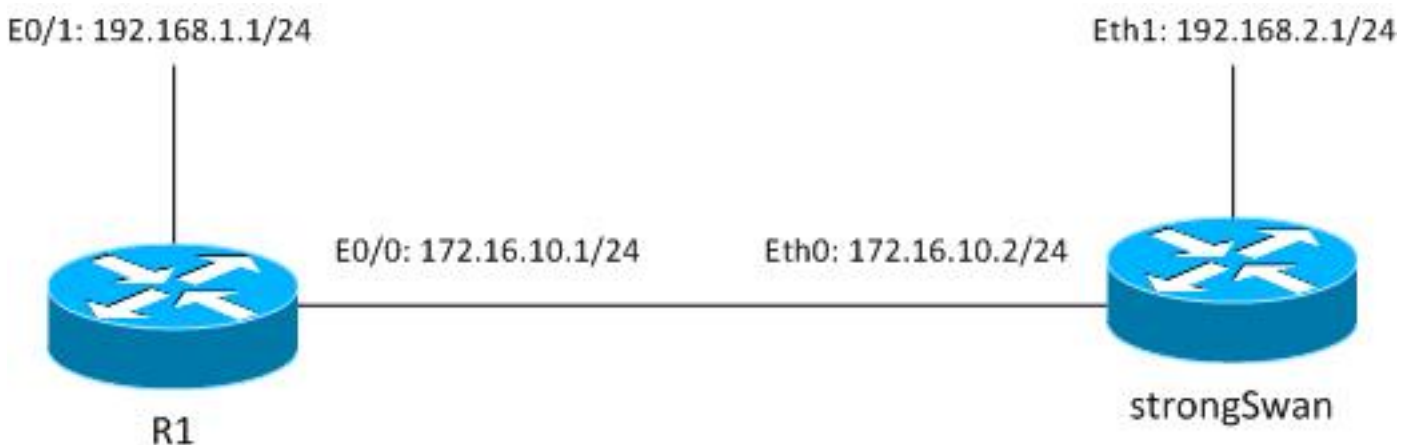
本文档中的信息基于以下软件版本：

- 思科IOS版本15.3T
- strongSwan 5.0.4
- Linux内核3.2.12

配置

网络图

两个示例的拓扑相同，即Cisco IOS和StrongSwan之间的L2L隧道。



流量在192.168.1.0/24<->192.168.2.0/24之间受到保护。

开源L2L IPSec VPN

有几个开源项目利用互联网密钥交换(IKE)和IPSec协议构建安全L2L隧道：

- 免费安全广域网 (免费S/WAN) : 历史记录 , 未主动维护
- ipsec工具 : racoon — 不支持IKEv2 , 旧版Linux内核2.6
- 奥彭斯万 : 非常基本的IKEv2支持、较旧的Linux内核2.6和更早的API , 未主动维护
- strongSwan:支持IKEv2和EAP/移动扩展、使用NETKEY API (内核2.6及更高版本中本机IPSec实施的名称) 的新Linux内核3.x及更高版本 , 并主动维护 , 详细记录

目前 , 最佳选择通常是强天鹅。在配置上与Openswan相似 , 但有几个细微差异。本指南重点介绍StrongSwan和Cisco IOS配置。

Cisco IOS和StrongSwan之间的IKEv1

Cisco IOS配置

```
crypto isakmp policy 10
  encr aes
  authentication pre-share
  group 5
crypto isakmp key cisco address 172.16.10.2

crypto ipsec transform-set TS esp-aes esp-sha-hmac
mode tunnel

crypto map cmap 10 ipsec-isakmp
  set peer 172.16.10.2
  set transform-set TS
  match address cryptoacl

interface Ethernet0/1
  ip address 192.168.1.1 255.255.255.0

interface Ethernet0/0
  ip address 172.16.10.1 255.255.255.0
  crypto map cmap

ip access-list extended cryptoacl
  permit ip 192.168.1.0 0.0.0.255 192.168.2.0 0.0.0.255
```

strongSwan配置

左侧与strongSwan相关 , 右侧为远程 (本例中为Cisco IOS) 。

/etc/ipsec.conf

```
config setup
  # strictcrulpolicy=yes
  # uniqueids = no

conn %default
  ikelifetime=1440m
  keylife=60m
  rekeymargin=3m
  keyingtries=1
  keyexchange=ikev1
  authby=secret
```

```
conn ciscoios
 left=172.16.10.2 #strongswan outside address
 leftsubnet=192.168.2.0/24 #network behind strongswan
 leftid=172.16.10.2 #IKEID sent by strongswan
 leftfirewall=yes
 right=172.16.10.1 #IOS outside address
 rightsubnet=192.168.1.0/24 #network behind IOS
 rightid=172.16.10.1 #IKEID sent by IOS
 auto=add
 ike=aes128-md5-modp1536 #P1: modp1536 = DH group 5
 esp=aes128-sha1 #P2
```

默认情况下，Cisco IOS使用地址作为IKE ID — 这就是为什么地址被用作“rightid”和“leftid”。strongSwan与Cisco IOS一样，支持下一代加密(Suite B) — 因此可以将4096 Diffie-Hellman(DH)密钥与AES256和SHA512一起使用。

对于auto参数，已使用“add”参数。这会在隧道收到有趣流量后启动隧道。为了立即启动它，可以使用“start”参数。

```
/etc/ipsec.secrets
```

```
172.16.10.2 172.16.10.1 : PSK cisco
```

对于IKEv1，两个密钥需要相同，在本例中为“cisco”。

Cisco IOS与StrongSwan之间的IKEv2

Cisco IOS配置

```
crypto ikev2 proposal ikev2proposal
 encryption aes-cbc-128
 integrity sha1
 group 5
```

```
crypto ikev2 policy ikev2policy
 match fvrfl any
 proposal ikev2proposal
```

```
crypto ikev2 keyring keys
 peer strongswan
 address 172.16.10.2
 pre-shared-key local cisco
 pre-shared-key remote cisco
```

```
crypto ikev2 profile ikev2profile
 match identity remote address 172.16.10.2 255.255.255.255
 authentication remote pre-share
 authentication local pre-share
 keyring local keys
```

```
crypto ipsec transform-set TS esp-aes esp-sha-hmac
 mode tunnel
```

```
crypto map cmap 10 ipsec-isakmp
  set peer 172.16.10.2
  set transform-set TS
  set ikev2-profile ikev2profile
  match address cryptoacl

interface Ethernet0/1
  ip address 192.168.1.1 255.255.255.0

interface Ethernet0/0
  ip address 172.16.10.1 255.255.255.0
  crypto map cmap

ip access-list extended cryptoacl
  permit ip 192.168.1.0 0.0.0.255 192.168.2.0 0.0.0.255
```

strongSwan配置

与IKEv1相比，只有两项更改：密钥交换，可能还有密钥。

/etc/ipsec.conf

```
config setup
  # strictcrlpolicy=yes
  # uniqueids = no

conn %default
  ikelifetime=1440m
  keylife=60m
  rekeymargin=3m
  keyingtries=1
  keyexchange=ikev1
  authby=secret

conn ciscoios
  left=172.16.10.2
  leftsubnet=192.168.2.0/24
  leftid=172.16.10.2
  leftfirewall=yes
  right=172.16.10.1
  rightsubnet=192.168.1.0/24
  rightid=172.16.10.1
  auto=add
  ike=aes128-sha1-modp1536
  esp=aes128-sha1
  keyexchange=ikev2
```

/etc/ipsec.secrets

```
172.16.10.2 : PSK "cisco"
172.16.10.1 : PSK "cisco"
```

在IKEv2中，每个站点的密钥可以不同。

验证

有关验证过程，请参阅故障排除部分。

故障排除

本部分提供的信息可用于对配置进行故障排除。

Cisco IOS和StrongSwan之间的IKEv1

Cisco IOS

```
R1#ping 192.168.2.1 source e0/1 repeat 1
```

Cisco IOS触发的隧道建立

```
*May 24 18:02:48.464: IPSEC(sa_request): ,
(key eng. msg.) OUTBOUND local= 172.16.10.1:500, remote= 172.16.10.2:500,
  local_proxy= 192.168.1.0/255.255.255.0/256/0,
  remote_proxy= 192.168.2.0/255.255.255.0/256/0,
  protocol= ESP, transform= esp-aes esp-sha-hmac (Tunnel),
  lifedur= 3600s and 4608000kb,
  spi= 0x0(0), conn_id= 0, keysize= 128, flags= 0x0
*May 24 18:02:48.465: ISAKMP:(0): SA request profile is (NULL)
*May 24 18:02:48.465: ISAKMP: Created a peer struct for 172.16.10.2, peer port 500
*May 24 18:02:48.465: ISAKMP: New peer created peer = 0xF334E7E0 peer_handle =
0x80000006
*May 24 18:02:48.465: ISAKMP: Locking peer struct 0xF334E7E0, refcount 1 for
isakmp_initiator
*May 24 18:02:48.465: ISAKMP: local port 500, remote port 500
*May 24 18:02:48.465: ISAKMP: set new node 0 to QM_IDLE
*May 24 18:02:48.465: ISAKMP: Find a dup sa in the avl tree during calling
isadb_insert sa = F49C9890
*May 24 18:02:48.465: ISAKMP:(0):Can not start Aggressive mode, trying Main mode.
*May 24 18:02:48.465: ISAKMP:(0):found peer pre-shared key matching 172.16.10.2
*May 24 18:02:48.465: ISAKMP:(0): constructed NAT-T vendor-rfc3947 ID
*May 24 18:02:48.465: ISAKMP:(0): constructed NAT-T vendor-07 ID
*May 24 18:02:48.465: ISAKMP:(0): constructed NAT-T vendor-03 ID
*May 24 18:02:48.465: ISAKMP:(0): constructed NAT-T vendor-02 ID
*May 24 18:02:48.465: ISAKMP:(0):Input = IKE_MESG_FROM_IPSEC, IKE_SA_REQ_MM
*May 24 18:02:48.465: ISAKMP:(0):Old State = IKE_READY New State = IKE_I_MM1

*May 24 18:02:48.465: ISAKMP:(0): beginning Main Mode exchange
*May 24 18:02:48.465: ISAKMP:(0): sending packet to 172.16.10.2 my_port 500
peer_port 500 (I) MM_NO_STATE
*May 24 18:02:48.465: ISAKMP:(0):Sending an IKE IPv4 Packet.
*May 24 18:02:48.466: ISAKMP (0): received packet from 172.16.10.2 dport 500
sport 500 Global (I) MM_NO_STATE
*May 24 18:02:48.466: ISAKMP:(0):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
*May 24 18:02:48.466: ISAKMP:(0):Old State = IKE_I_MM1 New State = IKE_I_MM2

*May 24 18:02:48.466: ISAKMP:(0): processing SA payload. message ID = 0
*May 24 18:02:48.466: ISAKMP:(0): processing vendor id payload
*May 24 18:02:48.466: ISAKMP:(0): vendor ID seems Unity/DPD but major 215 mismatch
*May 24 18:02:48.466: ISAKMP:(0): vendor ID is XAUTH
*May 24 18:02:48.466: ISAKMP:(0): processing vendor id payload
```

```

*May 24 18:02:48.466: ISAKMP:(0): vendor ID is DPD
*May 24 18:02:48.466: ISAKMP:(0): processing vendor id payload
*May 24 18:02:48.466: ISAKMP:(0): vendor ID seems Unity/DPD but major 69 mismatch
*May 24 18:02:48.466: ISAKMP (0): vendor ID is NAT-T RFC 3947
*May 24 18:02:48.466: ISAKMP:(0):found peer pre-shared key matching 172.16.10.2
*May 24 18:02:48.466: ISAKMP:(0): local preshared key found
*May 24 18:02:48.466: ISAKMP : Scanning profiles for xauth ...
*May 24 18:02:48.466: ISAKMP:(0):Checking ISAKMP transform 1 against priority
10 policy
*May 24 18:02:48.466: ISAKMP:      encryption AES-CBC
*May 24 18:02:48.466: ISAKMP:      keylength of 128
*May 24 18:02:48.466: ISAKMP:      hash SHA
*May 24 18:02:48.466: ISAKMP:      default group 5
*May 24 18:02:48.466: ISAKMP:      auth pre-share
*May 24 18:02:48.466: ISAKMP:      life type in seconds
*May 24 18:02:48.466: ISAKMP:      life duration (VPI) of  0x0 0x1 0x51 0x80
*May 24 18:02:48.466: ISAKMP:(0):atts are acceptable. Next payload is 0
*May 24 18:02:48.466: ISAKMP:(0):Acceptable atts:actual life: 0
*May 24 18:02:48.466: ISAKMP:(0):Acceptable atts:life: 0
*May 24 18:02:48.466: ISAKMP:(0):Fill atts in sa vpi_length:4
*May 24 18:02:48.466: ISAKMP:(0):Fill atts in sa life_in_seconds:86400
*May 24 18:02:48.466: ISAKMP:(0):Returning Actual lifetime: 86400
*May 24 18:02:48.466: ISAKMP:(0)::Started lifetime timer: 86400.

*May 24 18:02:48.466: ISAKMP:(0): processing vendor id payload
*May 24 18:02:48.466: ISAKMP:(0): vendor ID seems Unity/DPD but major 215 mismatch
*May 24 18:02:48.466: ISAKMP:(0): vendor ID is XAUTH
*May 24 18:02:48.466: ISAKMP:(0): processing vendor id payload
*May 24 18:02:48.466: ISAKMP:(0): vendor ID is DPD
*May 24 18:02:48.466: ISAKMP:(0): processing vendor id payload
*May 24 18:02:48.466: ISAKMP:(0): vendor ID seems Unity/DPD but major 69 mismatch
*May 24 18:02:48.466: ISAKMP (0): vendor ID is NAT-T RFC 3947
*May 24 18:02:48.466: ISAKMP:(0):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
*May 24 18:02:48.466: ISAKMP:(0):Old State = IKE_I_MM2  New State = IKE_I_MM2

*May 24 18:02:48.466: ISAKMP:(0): sending packet to 172.16.10.2 my_port 500
peer_port 500 (I) MM_SA_SETUP
*May 24 18:02:48.466: ISAKMP:(0):Sending an IKE IPv4 Packet.
*May 24 18:02:48.466: ISAKMP:(0):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
*May 24 18:02:48.466: ISAKMP:(0):Old State = IKE_I_MM2  New State = IKE_I_MM3

*May 24 18:02:48.474: ISAKMP (0): received packet from 172.16.10.2 dport 500 sport
500 Global (I) MM_SA_SETUP
*May 24 18:02:48.474: ISAKMP:(0):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
*May 24 18:02:48.474: ISAKMP:(0):Old State = IKE_I_MM3  New State = IKE_I_MM4

*May 24 18:02:48.474: ISAKMP:(0): processing KE payload. message ID = 0
*May 24 18:02:48.482: ISAKMP:(0): processing NONCE payload. message ID = 0
*May 24 18:02:48.482: ISAKMP:(0):found peer pre-shared key matching 172.16.10.2
*May 24 18:02:48.482: ISAKMP:received payload type 20
*May 24 18:02:48.482: ISAKMP (1003): His hash no match - this node outside NAT
*May 24 18:02:48.482: ISAKMP:received payload type 20
*May 24 18:02:48.482: ISAKMP (1003): No NAT Found for self or peer
*May 24 18:02:48.482: ISAKMP:(1003):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
*May 24 18:02:48.482: ISAKMP:(1003):Old State = IKE_I_MM4  New State = IKE_I_MM4

*May 24 18:02:48.482: ISAKMP:(1003):Send initial contact
*May 24 18:02:48.482: ISAKMP:(1003):SA is doing pre-shared key authentication using
id type ID_IPV4_ADDR
*May 24 18:02:48.482: ISAKMP (1003): ID payload
      next-payload : 8
      type          : 1
      address       : 172.16.10.1
      protocol      : 17

```

```

    port          : 500
    length        : 12
*May 24 18:02:48.482: ISAKMP:(1003):Total payload length: 12
*May 24 18:02:48.482: ISAKMP:(1003): sending packet to 172.16.10.2 my_port 500
peer_port 500 (I) MM_KEY_EXCH
*May 24 18:02:48.482: ISAKMP:(1003):Sending an IKE IPv4 Packet.
*May 24 18:02:48.482: ISAKMP:(1003):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
*May 24 18:02:48.482: ISAKMP:(1003):Old State = IKE_I_MM4 New State = IKE_I_MM5

*May 24 18:02:48.483: ISAKMP (1003): received packet from 172.16.10.2 dport 500
sport 500 Global (I) MM_KEY_EXCH
*May 24 18:02:48.483: ISAKMP:(1003): processing ID payload. message ID = 0
*May 24 18:02:48.483: ISAKMP (1003): ID payload
    next-payload : 8
    type          : 1
    address       : 172.16.10.2
    protocol      : 0
    port         : 0
    length       : 12
*May 24 18:02:48.483: ISAKMP:(0):: peer matches *none* of the profiles
*May 24 18:02:48.483: ISAKMP:(1003): processing HASH payload. message ID = 0
*May 24 18:02:48.483: ISAKMP:(1003):SA authentication status:
    authenticated
*May 24 18:02:48.483: ISAKMP:(1003):SA has been authenticated with 172.16.10.2
*May 24 18:02:48.483: ISAKMP: Trying to insert a peer 172.16.10.1/172.16.10.2/500/,
and inserted successfully F334E7E0.
*May 24 18:02:48.483: ISAKMP:(1003):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
*May 24 18:02:48.483: ISAKMP:(1003):Old State = IKE_I_MM5 New State = IKE_I_MM6

*May 24 18:02:48.483: ISAKMP:(1003):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
*May 24 18:02:48.483: ISAKMP:(1003):Old State = IKE_I_MM6 New State = IKE_I_MM6

*May 24 18:02:48.487: ISAKMP:(1003):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
*May 24 18:02:48.487: ISAKMP:(1003):Old State = IKE_I_MM6 New State = IKE_P1_COMPLETE

*May 24 18:02:48.487: ISAKMP:(1003):beginning Quick Mode exchange, M-ID of 2605730229
*May 24 18:02:48.487: ISAKMP:(1003):QM Initiator gets spi
*May 24 18:02:48.487: ISAKMP:(1003): sending packet to 172.16.10.2 my_port 500
peer_port 500 (I) QM_IDLE
*May 24 18:02:48.487: ISAKMP:(1003):Sending an IKE IPv4 Packet.
*May 24 18:02:48.488: ISAKMP:(1003):Node 2605730229, Input = IKE_MESG_INTERNAL,
IKE_INIT_QM
*May 24 18:02:48.488: ISAKMP:(1003):Old State = IKE_QM_READY New State = IKE_QM_I_QM1
*May 24 18:02:48.488: ISAKMP:(1003):Input = IKE_MESG_INTERNAL, IKE_PHASE1_COMPLETE
*May 24 18:02:48.488: ISAKMP:(1003):Old State = IKE_P1_COMPLETE New State =
IKE_P1_COMPLETE

*May 24 18:02:48.488: ISAKMP (1003): received packet from 172.16.10.2 dport 500
sport 500 Global (I) QM_IDLE
*May 24 18:02:48.488: ISAKMP:(1003): processing HASH payload. message ID = 2605730229
*May 24 18:02:48.488: ISAKMP:(1003): processing SA payload. message ID = 2605730229
*May 24 18:02:48.488: ISAKMP:(1003):Checking IPsec proposal 1
*May 24 18:02:48.488: ISAKMP: transform 1, ESP_AES
*May 24 18:02:48.488: ISAKMP:   attributes in transform:
*May 24 18:02:48.488: ISAKMP:     key length is 128
*May 24 18:02:48.488: ISAKMP:     authenticator is HMAC-SHA
*May 24 18:02:48.488: ISAKMP:     encaps is 1 (Tunnel)
*May 24 18:02:48.488: ISAKMP:     SA life type in seconds
*May 24 18:02:48.488: ISAKMP:     SA life duration (basic) of 3600
*May 24 18:02:48.488: ISAKMP:     SA life type in kilobytes
*May 24 18:02:48.488: ISAKMP:     SA life duration (VPI) of 0x0 0x46 0x50 0x0
*May 24 18:02:48.488: ISAKMP:(1003):atts are acceptable.
*May 24 18:02:48.488: IPSEC(validate_proposal_request): proposal part #1
*May 24 18:02:48.488: IPSEC(validate_proposal_request): proposal part #1,

```



```

(key eng. msg.) INBOUND local= 172.16.10.1:0, remote= 172.16.10.2:0,
  local_proxy= 192.168.1.0/255.255.255.0/256/0,
  remote_proxy= 192.168.2.0/255.255.255.0/256/0,
  protocol= ESP, transform= NONE (Tunnel),
  lifedur= 0s and 0kb,
  spi= 0x0(0), conn_id= 0, keysize= 128, flags= 0x0
*May 24 18:02:48.488: Crypto mapdb : proxy_match
  src addr      : 192.168.1.0
  dst addr      : 192.168.2.0
  protocol      : 0
  src port      : 0
  dst port      : 0
*May 24 18:02:48.488: ISAKMP:(1003): processing NONCE payload. message ID = 2605730229
*May 24 18:02:48.488: ISAKMP:(1003): processing ID payload. message ID = 2605730229
*May 24 18:02:48.488: ISAKMP:(1003): processing ID payload. message ID = 2605730229
*May 24 18:02:48.488: ISAKMP:(1003):Node 2605730229, Input = IKE_MESG_FROM_PEER,
IKE_QM_EXCH
*May 24 18:02:48.488: ISAKMP:(1003):Old State = IKE_QM_I_QM1 New State =
IKE_QM_IPSEC_INSTALL_AWAIT
*May 24 18:02:48.488: IPSEC(key_engine): got a queue event with 1 KMI message(s)
*May 24 18:02:48.488: Crypto mapdb : proxy_match
  src addr      : 192.168.1.0
  dst addr      : 192.168.2.0
  protocol      : 256
  src port      : 0
  dst port      : 0
*May 24 18:02:48.488: IPSEC(crypto_ipsec_create_ipsec_sas): Map found cmap
*May 24 18:02:48.489: IPSEC(crypto_ipsec_sa_find_ident_head): reconnecting with the
same proxies and peer 172.16.10.2
*May 24 18:02:48.489: IPSEC(create_sa): sa created,
  (sa) sa_dest= 172.16.10.1, sa_proto= 50,
  sa_spi= 0x4C0D0EF0(1275924208),
  sa_trans= esp-aes esp-sha-hmac , sa_conn_id= 7
  sa_lifetime(k/sec)= (4608000/3600)
*May 24 18:02:48.489: IPSEC(create_sa): sa created,
  (sa) sa_dest= 172.16.10.2, sa_proto= 50,
  sa_spi= 0xC72072C6(3340792518),
  sa_trans= esp-aes esp-sha-hmac , sa_conn_id= 8
  sa_lifetime(k/sec)= (4608000/3600)

```

在两个阶段中，互联网安全关联和密钥管理协议(ISAKMP)和IPSec都处于启用状态。

Cisco IOS:检查IPSec计数器

```

R1#show crypto session detail
Crypto session current status

```

```

Code: C - IKE Configuration mode, D - Dead Peer Detection
K - Keepalives, N - NAT-traversal, T - cTCP encapsulation
X - IKE Extended Authentication, F - IKE Fragmentation

```

```

Interface: Ethernet0/0
Uptime: 00:00:05
Session status: UP-ACTIVE
Peer: 172.16.10.2 port 500 fvrf: (none) ivrf: (none)
  Phase1_id: 172.16.10.2
  Desc: (none)
IKEv1 SA: local 172.16.10.1/500 remote 172.16.10.2/500 Active
  Capabilities:(none) connid:1003 lifetime:23:59:54
IPSEC FLOW: permit ip 192.168.1.0/255.255.255.0 192.168.2.0/255.255.255.0
  Active SAs: 2, origin: crypto map

```

```
Inbound: #pkts dec'ed 0 drop 0 life (KB/Sec) 4164218/3594
Outbound: #pkts enc'ed 0 drop 0 life (KB/Sec) 4164218/3594A
```

发送100个数据包后：

```
R1#ping 192.168.2.1 source e0/1 repeat 100
Type escape sequence to abort.
Sending 100, 100-byte ICMP Echos to 192.168.2.1, timeout is 2 seconds:
Packet sent with a source address of 192.168.1.1
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (100/100), round-trip min/avg/max = 4/4/5 ms
R1#
```

```
R1#show crypto session detail
Crypto session current status
```

```
Code: C - IKE Configuration mode, D - Dead Peer Detection
K - Keepalives, N - NAT-traversal, T - cTCP encapsulation
X - IKE Extended Authentication, F - IKE Fragmentation

Interface: Ethernet0/0
Uptime: 00:00:09
Session status: UP-ACTIVE
Peer: 172.16.10.2 port 500 fvrf: (none) ivrf: (none)
  Phase1_id: 172.16.10.2
  Desc: (none)
IKEv1 SA: local 172.16.10.1/500 remote 172.16.10.2/500 Active
  Capabilities:(none) connid:1003 lifetime:23:59:50
IPSEC FLOW: permit ip 192.168.1.0/255.255.255.0 192.168.2.0/255.255.255.0
  Active SAs: 2, origin: crypto map
  Inbound: #pkts dec'ed 100 drop 0 life (KB/Sec) 4164202/3590
  Outbound: #pkts enc'ed 100 drop 0 life (KB/Sec) 4164202/3590
```

Cisco IOS:检验IKEv1和IPSec参数

```
R1#show crypto isakmp sa detail
```

```
Codes: C - IKE configuration mode, D - Dead Peer Detection
       K - Keepalives, N - NAT-traversal
       T - cTCP encapsulation, X - IKE Extended Authentication
       psk - Preshared key, rsig - RSA signature
       renc - RSA encryption
IPv4 Crypto ISAKMP SA

C-id  Local          Remote          I-VRF  Status Encr Hash  Auth DH Lifetime Cap.
-----
1003  172.16.10.1      172.16.10.2          ACTIVE aes sha  psk 5 23:59:35
      Engine-id:Conn-id = SW:3
```

```
R1#show crypto ipsec sa
```

```
interface: Ethernet0/0
  Crypto map tag: cmap, local addr 172.16.10.1

protected vrf: (none)
local ident (addr/mask/prot/port): (192.168.1.0/255.255.255.0/0/0)
remote ident (addr/mask/prot/port): (192.168.2.0/255.255.255.0/0/0)
current_peer 172.16.10.2 port 500
  PERMIT, flags={origin_is_acl,}
```

```
#pkts encaps: 100, #pkts encrypt: 100, #pkts digest: 100
#pkts decaps: 100, #pkts decrypt: 100, #pkts verify: 100
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0
#pkts not decompressed: 0, #pkts decompress failed: 0
#send errors 0, #recv errors 0

local crypto endpt.: 172.16.10.1, remote crypto endpt.: 172.16.10.2
plaintext mtu 1438, path mtu 1500, ip mtu 1500, ip mtu idb Ethernet0/0
current outbound spi: 0xC72072C6(3340792518)
PFS (Y/N): N, DH group: none
```

```
inbound esp sas:
spi: 0x4C0D0EF0(1275924208)
transform: esp-aes esp-sha-hmac ,
in use settings ={Tunnel, }
conn id: 7, flow_id: SW:7, sibling_flags 80000040, crypto map: cmap
sa timing: remaining key lifetime (k/sec): (4164202/3562)
IV size: 16 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)
```

```
inbound ah sas:
```

```
inbound pcp sas:
```

```
outbound esp sas:
spi: 0xC72072C6(3340792518)
transform: esp-aes esp-sha-hmac ,
in use settings ={Tunnel, }
conn id: 8, flow_id: SW:8, sibling_flags 80000040, crypto map: cmap
sa timing: remaining key lifetime (k/sec): (4164202/3562)
IV size: 16 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)
```

```
outbound ah sas:
```

```
outbound pcp sas:
```

这两个阶段都已启动。IPSec安全参数索引(SPI)已协商。发送100个数据包后，计数器已增加到100。

strongSwan:隧道建立

```
pluton# /etc/init.d/ipsec start
```

```
May 24 20:02:48 localhost charon: 10[NET] received packet: from 172.16.10.1[500]
to 172.16.10.2[500] (168 bytes)
May 24 20:02:48 localhost charon: 10[ENC] parsed ID_PROT request 0 [ SA V V V V ]
May 24 20:02:48 localhost charon: 10[IKE] received NAT-T (RFC 3947) vendor ID
May 24 20:02:48 localhost charon: 10[IKE] received draft-ietf-ipsec-nat-t-ike-07
vendor ID
May 24 20:02:48 localhost charon: 10[IKE] received draft-ietf-ipsec-nat-t-ike-03
vendor ID
May 24 20:02:48 localhost charon: 10[IKE] received draft-ietf-ipsec-nat-t-ike-02\n
vendor ID
May 24 20:02:48 localhost charon: 10[IKE] 172.16.10.1 is initiating a Main Mode IKE_SA
May 24 20:02:48 localhost charon: 10[IKE] 172.16.10.1 is initiating a Main Mode IKE_SA
May 24 20:02:48 localhost charon: 10[ENC] generating ID_PROT response 0 [ SA V V V ]
May 24 20:02:48 localhost charon: 10[NET] sending packet: from 172.16.10.2[500] to
```

```

172.16.10.1[500] (140 bytes)
May 24 20:02:48 localhost charon: 11[NET] received packet: from 172.16.10.1[500] to
172.16.10.2[500] (348 bytes)
May 24 20:02:48 localhost charon: 11[ENC] parsed ID_PROT request 0
[ KE No V V V NAT-D NAT-D ]
May 24 20:02:48 localhost charon: 11[ENC] generating ID_PROT response 0
[ KE No NAT-D NAT-D ]
May 24 20:02:48 localhost charon: 11[NET] sending packet: from 172.16.10.2[500]
to 172.16.10.1[500] (308 bytes)
May 24 20:02:48 localhost charon: 12[NET] received packet: from 172.16.10.1[500]
to 172.16.10.2[500] (108 bytes)
May 24 20:02:48 localhost charon: 12[ENC] parsed ID_PROT request 0
[ ID HASH N(INITIAL_CONTACT) ]
May 24 20:02:48 localhost charon: 12[CFG] looking for pre-shared key peer configs
matching 172.16.10.2...172.16.10.1[172.16.10.1]
May 24 20:02:48 localhost charon: 12[CFG] selected peer config "ciscoios"
May 24 20:02:48 localhost charon: 12[IKE] IKE_SA ciscoios{2} established between
172.16.10.2[172.16.10.2]...172.16.10.1[172.16.10.1]
May 24 20:02:48 localhost charon: 12[IKE] IKE_SA ciscoios{2} established between
172.16.10.2[172.16.10.2]...172.16.10.1[172.16.10.1]
May 24 20:02:48 localhost charon: 12[IKE] scheduling reauthentication in 3289s
May 24 20:02:48 localhost charon: 12[IKE] maximum IKE_SA lifetime 3469s
May 24 20:02:48 localhost charon: 12[ENC] generating ID_PROT response 0 [ ID HASH ]
May 24 20:02:48 localhost charon: 12[NET] sending packet: from 172.16.10.2[500] to
172.16.10.1[500] (76 bytes)
May 24 20:02:48 localhost charon: 14[NET] received packet: from 172.16.10.1[500] to
172.16.10.2[500] (188 bytes)
May 24 20:02:48 localhost charon: 14[ENC] parsed QUICK_MODE request 2605730229
[ HASH SA No ID ID ]
May 24 20:02:48 localhost charon: 14[IKE] received 3600s lifetime, configured 1200s
May 24 20:02:48 localhost charon: 14[IKE] received 4608000000 lifebytes, configured 0
May 24 20:02:48 localhost charon: 14[ENC] generating QUICK_MODE response 2605730229
[ HASH SA No ID ID ]
May 24 20:02:48 localhost charon: 14[NET] sending packet: from 172.16.10.2[500] to
172.16.10.1[500] (188 bytes)
May 24 20:02:48 localhost charon: 15[NET] received packet: from 172.16.10.1[500] to
172.16.10.2[500] (60 bytes)
May 24 20:02:48 localhost charon: 15[ENC] parsed QUICK_MODE request 2605730229 [ HASH ]
May 24 20:02:48 localhost charon: 15[IKE] CHILD_SA ciscoios{2} established with SPIs
c72072c6_i 4c0d0ef0_o and TS 192.168.2.0/24 === 192.168.1.0/24
May 24 20:02:48 localhost charon: 15[IKE] CHILD_SA ciscoios{2} established with SPIs
c72072c6_i 4c0d0ef0_o and TS 192.168.2.0/24 === 192.168.1.0/24
May 24 20:02:48 localhost vpn: + 172.16.10.1 192.168.1.0/24 == 172.16.10.1 --
172.16.10.2 == 192.168.2.0/24

```

这两个阶段都已启动。协商保护192.168.2.0/24和192.168.1.0/24之间流量的正确SPI。

strongSwan:验证IPSec连接状态

```

pluton ~ # ipsec statusall
Status of IKE charon daemon (strongSwan 5.0.4, Linux 3.2.12-gentoo, x86_64):
  uptime: 4 minutes, since May 24 20:02:15 2013
  malloc: sbrk 393216, mmap 0, used 274064, free 119152
  worker threads: 8 of 16 idle, 7/1/0/0 working, job queue: 0/0/0/0, scheduled: 4
  loaded plugins: charon mysql sqlite aes des sha1 sha2 md5 random nonce x509
  revocation constraints pubkey pkcs1 pkcs8 pgp dnskey pem openssl gcrypt fips-prf
  gmp xcbc cmac hmac attr kernel-netlink resolve socket-default stroke updown
  eap-identity eap-sim eap-aka eap-aka-3gpp2 eap-simaka-pseudonym eap-simaka-reauth
  eap-md5 eap-gtc eap-mschapv2 eap-radius xauth-generic
Listening IP addresses:
  10.0.0.100

```

```

192.168.10.1
172.16.10.2
192.168.2.1
Connections:
  ciscoios: 172.16.10.2...172.16.10.1 IKEv1
  ciscoios: local: [172.16.10.2] uses pre-shared key authentication
  ciscoios: remote: [172.16.10.1] uses pre-shared key authentication
  ciscoios: child: 192.168.2.0/24 === 192.168.1.0/24 TUNNEL
Security Associations (1 up, 0 connecting):
  ciscoios[2]: ESTABLISHED 4 minutes ago, 172.16.10.2[172.16.10.2]...
172.16.10.1[172.16.10.1]
  ciscoios[2]: IKEv1 SPIs: 278f22e3c3e5f606_i dbb5a27f3e0eccd1_r*,
pre-shared key reauthentication in 50 minutes
  ciscoios[2]: IKE proposal: AES_CBC_128/HMAC_SHA1_96/PRF_HMAC_SHA1/MODP_1536
  ciscoios{2}: INSTALLED, TUNNEL, ESP SPIs: c72072c6_i 4c0d0ef0_o
  ciscoios{2}: AES_CBC_128/HMAC_SHA1_96, 10000 bytes_i (100 pkts, 255s ago),
10000 bytes_o (100 pkts, 255s ago), rekeying in 11 minutes
  ciscoios{2}: 192.168.2.0/24 === 192.168.1.0/24

```

有关协商的ISAKMP和IPSec参数的详细信息可用。

strongSwan:验证IPSec策略

```

pluton ~ # ip -s xfrm policy
src 192.168.1.0/24 dst 192.168.2.0/24 uid 0
  dir fwd action allow index 258 priority 1859 share any flag (0x00000000)
  lifetime config:
    limit: soft (INF)(bytes), hard (INF)(bytes)
    limit: soft (INF)(packets), hard (INF)(packets)
    expire add: soft 0(sec), hard 0(sec)
    expire use: soft 0(sec), hard 0(sec)
  lifetime current:
    0(bytes), 0(packets)
    add 2013-05-24 20:02:48 use -
  tmpl src 172.16.10.1 dst 172.16.10.2
    proto esp spi 0x00000000(0) reqid 2(0x00000002) mode tunnel
    level required share any
    enc-mask ffffffff auth-mask ffffffff comp-mask ffffffff
src 192.168.1.0/24 dst 192.168.2.0/24 uid 0
  dir in action allow index 248 priority 1859 share any flag (0x00000000)
  lifetime config:
    limit: soft (INF)(bytes), hard (INF)(bytes)
    limit: soft (INF)(packets), hard (INF)(packets)
    expire add: soft 0(sec), hard 0(sec)
    expire use: soft 0(sec), hard 0(sec)
  lifetime current:
    0(bytes), 0(packets)
    add 2013-05-24 20:02:48 use 2013-05-24 20:02:56
  tmpl src 172.16.10.1 dst 172.16.10.2
    proto esp spi 0x00000000(0) reqid 2(0x00000002) mode tunnel
    level required share any
    enc-mask ffffffff auth-mask ffffffff comp-mask ffffffff
src 192.168.2.0/24 dst 192.168.1.0/24 uid 0
  dir out action allow index 241 priority 1859 share any flag (0x00000000)
  lifetime config:
    limit: soft (INF)(bytes), hard (INF)(bytes)
    limit: soft (INF)(packets), hard (INF)(packets)
    expire add: soft 0(sec), hard 0(sec)
    expire use: soft 0(sec), hard 0(sec)
  lifetime current:
    0(bytes), 0(packets)

```

```
add 2013-05-24 20:02:48 use 2013-05-24 20:02:56
tmpl src 172.16.10.2 dst 172.16.10.1
    proto esp spi 0x00000000(0) reqid 2(0x00000002) mode tunnel
    level required share any
    enc-mask ffffffff auth-mask ffffffff comp-mask ffffffff
```

以前的详细信息包括内部策略表。

Cisco IOS与StrongSwan之间的IKEv2

Cisco IOS

```
R1#ping 192.168.2.1 source e0/1 repeat 1
```

Cisco IOS触发的隧道建立

```
*May 24 19:14:10.485: IPSEC(sa_request): ,
(key eng. msg.) OUTBOUND local= 172.16.10.1:500, remote= 172.16.10.2:500,
  local_proxy= 192.168.1.0/255.255.255.0/256/0,
  remote_proxy= 192.168.2.0/255.255.255.0/256/0,
  protocol= ESP, transform= esp-aes esp-sha-hmac (Tunnel),
  lifedur= 3600s and 4608000kb,
  spi= 0x0(0), conn_id= 0, keysize= 128, flags= 0x0
*May 24 19:14:10.486: IKEv2:% Getting preshared key from profile keyring keys
*May 24 19:14:10.486: IKEv2:% Matched peer block 'strongswan'
*May 24 19:14:10.486: IKEv2:Searching Policy with fvrf 0, local address 172.16.10.1
*May 24 19:14:10.486: IKEv2:Found Policy 'ikev2policy'
*May 24 19:14:10.486: IKEv2:(SA ID = 1):[IKEv2 -> Crypto Engine] Computing DH public
key, DH Group 5
*May 24 19:14:10.486: IKEv2:(SA ID = 1):[Crypto Engine -> IKEv2] DH key Computation
PASSED
*May 24 19:14:10.486: IKEv2:(SA ID = 1):Request queued for computation of DH key
*May 24 19:14:10.486: IKEv2:IKEv2 initiator - no config data to send in IKE_SA_INIT exch
*May 24 19:14:10.486: IKEv2:(SA ID = 1):Generating IKE_SA_INIT message
*May 24 19:14:10.486: IKEv2:(SA ID = 1):IKE Proposal: 1, SPI size: 0
(initial negotiation),
Num. transforms: 4
  AES-CBC  SHA1  SHA96  DH_GROUP_1536_MODP/Group 5
*May 24 19:14:10.486: IKEv2:(SA ID = 1):Sending Packet [To 172.16.10.2:500/From
172.16.10.1:500/VRF i0:f0]
Initiator SPI : 9FFC38791FFEF212 - Responder SPI : 0000000000000000 Message id: 0
IKEv2 IKE_SA_INIT Exchange REQUEST
Payload contents:
  SA KE N VID VID NOTIFY(NAT_DETECTION_SOURCE_IP) NOTIFY(NAT_DETECTION_DESTINATION_IP)
*May 24 19:14:10.486: IKEv2:(SA ID = 1):Insert SA
*May 24 19:14:10.495: IKEv2:(SA ID = 1):Received Packet [From 172.16.10.2:500/To
172.16.10.1:500/VRF i0:f0]
Initiator SPI : 9FFC38791FFEF212 - Responder SPI : 6CDC17F5B0B10C1A Message id: 0
IKEv2 IKE_SA_INIT Exchange RESPONSE
Payload contents:
  SA KE N NOTIFY(NAT_DETECTION_SOURCE_IP) NOTIFY(NAT_DETECTION_DESTINATION_IP)
  NOTIFY(Unknown - 16404)
```

*May 24 19:14:10.495: IKEv2:(SA ID = 1):Processing IKE_SA_INIT message
*May 24 19:14:10.495: IKEv2:(SA ID = 1):Verify SA init message
*May 24 19:14:10.495: IKEv2:(SA ID = 1):Processing IKE_SA_INIT message
*May 24 19:14:10.495: IKEv2:(SA ID = 1):Checking NAT discovery
*May 24 19:14:10.495: IKEv2:(SA ID = 1):NAT not found
*May 24 19:14:10.495: IKEv2:(SA ID = 1):[IKEv2 -> Crypto Engine] Computing DH
secret key, DH Group 5
*May 24 19:14:10.504: IKEv2:(SA ID = 1):[Crypto Engine -> IKEv2] DH key Computation
PASSED
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Request queued for computation of DH secret
*May 24 19:14:10.504: IKEv2:(SA ID = 1):[IKEv2 -> Crypto Engine] Calculate SKEYSEED
and create rekeyed IKEv2 SA
*May 24 19:14:10.504: IKEv2:(SA ID = 1):[Crypto Engine -> IKEv2] SKEYSEED
calculation and creation of
rekeyed IKEv2 SA PASSED
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Completed SA init exchange
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Check for EAP exchange
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Generate my authentication data
*May 24 19:14:10.504: IKEv2:(SA ID = 1):**Use preshared key for id 172.16.10.1,**
key len 5
*May 24 19:14:10.504: IKEv2:[IKEv2 -> Crypto Engine] Generate IKEv2 authentication
data
*May 24 19:14:10.504: IKEv2:[Crypto Engine -> IKEv2] **IKEv2 authentication data
generation PASSED**
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Get my authentication method
*May 24 19:14:10.504: IKEv2:(SA ID = 1):My authentication method is 'PSK'
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Check for EAP exchange
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Generating IKE_AUTH message
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Constructing IDi payload: '172.16.10.1'
of type 'IPv4 address'
*May 24 19:14:10.504: IKEv2:(SA ID = 1):**ESP Proposal: 1**, SPI size: 4
(IPSec negotiation),
Num. transforms: 3
AES-CBC SHA96 Don't use ESN
*May 24 19:14:10.504: IKEv2:(SA ID = 1):Building packet for encryption.
Payload contents:
VID IDi AUTH SA TSi TSr NOTIFY(INITIAL_CONTACT) NOTIFY(SET_WINDOW_SIZE)
NOTIFY(ESP_TFC_NO_SUPPORT) NOTIFY(NON_FIRST_FRAGS)
*May 24 19:14:10.505: IKEv2:(SA ID = 1):**Sending Packet**
[To 172.16.10.2:500/From 172.16.10.1:500/VRF i0:f0]
Initiator SPI : 9FFC38791FFEF212 - Responder SPI : 6CDC17F5B0B10C1A Message id: 1
IKEv2 IKE_AUTH Exchange REQUEST
Payload contents:
ENCR

*May 24 19:14:10.522: IKEv2:(SA ID = 1):**Received Packet**
[From 172.16.10.2:500/To 172.16.10.1:500/VRF i0:f0]
Initiator SPI : 9FFC38791FFEF212 - Responder SPI : 6CDC17F5B0B10C1A Message id: 1
IKEv2 IKE_AUTH Exchange RESPONSE
Payload contents:
IDr AUTH SA TSi TSr NOTIFY(Unknown - 16403)

*May 24 19:14:10.522: IKEv2:(SA ID = 1):Process auth response notify
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Searching policy based on peer's
identity '172.16.10.2' of type 'IPv4 address'
*May 24 19:14:10.522: IKEv2:Searching Policy with fvrf 0, local address 172.16.10.1
*May 24 19:14:10.522: IKEv2:Found Policy 'ikev2policy'
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Verify peer's policy
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Peer's policy verified
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Get peer's authentication method
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Peer's authentication method is 'PSK'
*May 24 19:14:10.522: IKEv2:(SA ID = 1):**Get peer's preshared key for 172.16.10.2**

```

*May 24 19:14:10.522: IKEv2:(SA ID = 1):Verify peer's authentication data
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Use preshared key for id 172.16.10.2, key len 5
*May 24 19:14:10.522: IKEv2:[IKEv2 -> Crypto Engine] Generate IKEv2 authentication data
*May 24 19:14:10.522: IKEv2:[Crypto Engine -> IKEv2] IKEv2 authentication data
generation PASSED
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Verification of peer's authentication data
PASSED
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Check for EAP exchange
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Processing IKE_AUTH message
*May 24 19:14:10.522: IKEv2:KMI/verify policy/sending to IPSec:
    prot: 3 txfm: 12 hmac 2 flags 8177 keysize 128 IDB 0x0
*May 24 19:14:10.522: IPSEC(validate_proposal_request): proposal part #1
*May 24 19:14:10.522: IPSEC(validate_proposal_request): proposal part #1,
(key eng. msg.) INBOUND local= 172.16.10.1:0, remote= 172.16.10.2:0,
    local_proxy= 192.168.1.0/255.255.255.0/256/0,
    remote_proxy= 192.168.2.0/255.255.255.0/256/0,
    protocol= ESP, transform= NONE (Tunnel),
    lifedur= 0s and 0kb,
    spi= 0x0(0), conn_id= 0, keysize= 128, flags= 0x0
*May 24 19:14:10.522: Crypto mapdb : proxy_match
    src addr      : 192.168.1.0
    dst addr      : 192.168.2.0
    protocol      : 0
    src port      : 0
    dst port      : 0
*May 24 19:14:10.522: IKEv2:(SA ID = 1):IKEV2 SA created; inserting SA into database.
SA lifetime timer (86400 sec) started
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Session with IKE ID PAIR
(172.16.10.2, 172.16.10.1) is UP
*May 24 19:14:10.522: IKEv2:IKEv2 MIB tunnel started, tunnel index 1
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Load IPSEC key material
*May 24 19:14:10.522: IKEv2:(SA ID = 1):[IKEv2 -> IPsec] Create IPsec SA into
IPsec database
*May 24 19:14:10.522: IKEv2:(SA ID = 1):Asynchronous request queued

*May 24 19:14:10.522: IKEv2:(SA ID = 1):
*May 24 19:14:10.523: IPSEC(key_engine): got a queue event with 1 KMI message(s)
*May 24 19:14:10.523: Crypto mapdb : proxy_match
    src addr      : 192.168.1.0
    dst addr      : 192.168.2.0
    protocol      : 256
    src port      : 0
    dst port      : 0
*May 24 19:14:10.523: IPSEC(crypto_ipsec_create_ipsec_sas): Map found cmap
*May 24 19:14:10.523: IPSEC(crypto_ipsec_sa_find_ident_head): reconnecting with
the same proxies and peer 172.16.10.2
*May 24 19:14:10.523: IPSEC(create_sa): sa created,
(sa) sa_dest= 172.16.10.1, sa_proto= 50,
    sa_spi= 0xDF405365(3745534821),
    sa_trans= esp-aes esp-sha-hmac , sa_conn_id= 6
    sa_lifetime(k/sec)= (4608000/3600)
*May 24 19:14:10.523: IPSEC(create_sa): sa created,
(sa) sa_dest= 172.16.10.2, sa_proto= 50,
    sa_spi= 0xC0CC116C(3234599276),
    sa_trans= esp-aes esp-sha-hmac , sa_conn_id= 5
    sa_lifetime(k/sec)= (4608000/3600)
*May 24 19:14:10.523: IPSEC: Expand action denied, notify RP
*May 24 19:14:10.523: IKEv2:(SA ID = 1):[IPsec -> IKEv2] Creation of IPsec
SA into IPsec database PASSED

```

IKEv2会话已打开，并且已创建保护192.168.1.0/24和192.168.2.0/24之间流量的IPSec SA。

R1#show crypto session detail

Crypto session current status

Code: C - IKE Configuration mode, D - Dead Peer Detection
K - Keepalives, N - NAT-traversal, T - cTCP encapsulation
X - IKE Extended Authentication, F - IKE Fragmentation

Interface: Ethernet0/0

Uptime: 00:00:09

Session status: UP-ACTIVE

Peer: 172.16.10.2 port 500 fvrf: (none) ivrf: (none)

Phase1_id: 172.16.10.2

Desc: (none)

IKEv2 SA: local 172.16.10.1/500 remote 172.16.10.2/500 Active

Capabilities:(none) connid:1 lifetime:23:59:51

IPSEC FLOW: permit ip 192.168.1.0/255.255.255.0 192.168.2.0/255.255.255.0

Active SAs: 2, origin: crypto map

Inbound: #pkts dec'ed 0 drop 0 life (KB/Sec) 4375820/3590

Outbound: #pkts enc'ed 0 drop 0 life (KB/Sec) 4375820/3590

发送100个数据包后：

R1#ping 192.168.2.1 source 192.168.1.1 repeat 100

Type escape sequence to abort.

Sending 100, 100-byte ICMP Echos to 192.168.2.1, timeout is 2 seconds:

Packet sent with a source address of 192.168.1.1

!!

!!

Success rate is 100 percent (100/100), round-trip min/avg/max = 1/4/5 ms

R1#

R1#show crypto session detail

Crypto session current status

Code: C - IKE Configuration mode, D - Dead Peer Detection
K - Keepalives, N - NAT-traversal, T - cTCP encapsulation
X - IKE Extended Authentication, F - IKE Fragmentation

Interface: Ethernet0/0

Uptime: 00:00:15

Session status: UP-ACTIVE

Peer: 172.16.10.2 port 500 fvrf: (none) ivrf: (none)

Phase1_id: 172.16.10.2

Desc: (none)

IKEv2 SA: local 172.16.10.1/500 remote 172.16.10.2/500 Active

Capabilities:(none) connid:1 lifetime:23:59:45

IPSEC FLOW: permit ip 192.168.1.0/255.255.255.0 192.168.2.0/255.255.255.0

Active SAs: 2, origin: crypto map

Inbound: #pkts dec'ed 100 drop 0 life (KB/Sec) 4375803/3585

Outbound: #pkts enc'ed 100 drop 0 life (KB/Sec) 4375803/3585

计数器增加了100。

Cisco IOS:检验IKEv2和IPSec参数

Cisco IOS对IKEv2会话的统计信息/详细信息非常好：

R1#show crypto ikev2 sa detailed

IPv4 Crypto IKEv2 SA

| Tunnel-id | Local | Remote | fvr/ivrf | Status |
|-----------|-----------------|-----------------|-----------|--------|
| 1 | 172.16.10.1/500 | 172.16.10.2/500 | none/none | READY |

Encr: **AES-CBC, keysize: 128, Hash: SHA96, DH Grp:5**, Auth sign: PSK, Auth verify: PSK
Life/Active Time: 86400/152 sec
CE id: 1019, Session-id: 3
Status Description: Negotiation done
Local spi: 9FFC38791FFEF212 Remote spi: 6CDC17F5B0B10C1A
Local id: 172.16.10.1
Remote id: 172.16.10.2
Local req msg id: 2 Remote req msg id: 0
Local next msg id: 2 Remote next msg id: 0
Local req queued: 2 Remote req queued: 0
Local window: 5 Remote window: 1
DPD configured for 0 seconds, retry 0
Fragmentation not configured.
Extended Authentication not configured.
NAT-T is not detected
Cisco Trust Security SGT is disabled
Initiator of SA : Yes

IPv6 Crypto IKEv2 SA

R1#show crypto ipsec sa

interface: Ethernet0/0

Crypto map tag: cmap, local addr 172.16.10.1

protected vrf: (none)

local ident (addr/mask/prot/port): (192.168.1.0/255.255.255.0/0/0)

remote ident (addr/mask/prot/port): (192.168.2.0/255.255.255.0/0/0)

current_peer 172.16.10.2 port 500

PERMIT, flags={origin_is_acl,}

#pkts encaps: 100, #pkts encrypt: 100, #pkts digest: 100

#pkts decaps: 100, #pkts decrypt: 100, #pkts verify: 100

#pkts compressed: 0, #pkts decompressed: 0

#pkts not compressed: 0, #pkts compr. failed: 0

#pkts not decompressed: 0, #pkts decompress failed: 0

#send errors 0, #recv errors 0

local crypto endpt.: 172.16.10.1, remote crypto endpt.: 172.16.10.2

plaintext mtu 1438, path mtu 1500, ip mtu 1500, ip mtu idb Ethernet0/0

current outbound spi: 0xC0CC116C(3234599276)

PFS (Y/N): N, DH group: none

inbound esp sas:

spi: 0xDF405365(3745534821)

transform: esp-aes esp-sha-hmac ,

in use settings = {Tunnel, }

conn id: 6, flow_id: SW:6, sibling_flags 80000040, crypto map: cmap

sa timing: remaining key lifetime (k/sec): (4375803/3442)

IV size: 16 bytes

replay detection support: Y

Status: ACTIVE(ACTIVE)

inbound ah sas:

inbound pcp sas:

```
outbound esp sas:
spi: 0xC0CC116C(3234599276)
  transform: esp-aes esp-sha-hmac ,
  in use settings ={Tunnel, }
  conn id: 5, flow_id: SW:5, sibling_flags 80000040, crypto map: cmap
  sa timing: remaining key lifetime (k/sec): (4375803/3442)
  IV size: 16 bytes
  replay detection support: Y
  Status: ACTIVE(ACTIVE)
```

outbound ah sas:

outbound pcp sas:

strongSwan:隧道建立

```
May 24 21:14:10 localhost charon: 08[NET] received packet: from 172.16.10.1[500]
to 172.16.10.2[500] (400 bytes)
May 24 21:14:10 localhost charon: 08[ENC] parsed IKE_SA_INIT request 0
[ SA KE No V V N(NATD_S_IP) N(NATD_D_IP) ]
May 24 21:14:10 localhost charon: 08[ENC] received unknown vendor
ID: 43:49:53:43:4f:2d:44:45:54:45:2d:52:45:41:53:4f:4e
May 24 21:14:10 localhost charon: 08[ENC] received unknown vendor ID:
46:4c:45:58:56:50:4e:2d:53:55:50:50:4f:52:54:45:44
May 24 21:14:10 localhost charon: 08[IKE] 172.16.10.1 is initiating an IKE_SA
May 24 21:14:10 localhost charon: 08[IKE] 172.16.10.1 is initiating an IKE_SA
May 24 21:14:10 localhost charon: 08[ENC] generating IKE_SA_INIT response 0
[ SA KE No N(NATD_S_IP) N(NATD_D_IP) N(MULT_AUTH) ]
May 24 21:14:10 localhost charon: 08[NET] sending packet: from 172.16.10.2[500]
to 172.16.10.1[500] (376 bytes)
May 24 21:14:10 localhost charon: 07[NET] received packet: from 172.16.10.1[500]
to 172.16.10.2[500] (284 bytes)
May 24 21:14:10 localhost charon: 07[ENC] parsed IKE_AUTH request 1 [ V IDi AUTH
SA TSi TSr N(INIT_CONTACT) N(SET_WINSIZE) N(ESP_TFC_PAD_N) N(NON_FIRST_FRAG) ]
May 24 21:14:10 localhost charon: 07[CFG] looking for peer configs matching
172.16.10.2[%any]...172.16.10.1[172.16.10.1]
May 24 21:14:10 localhost charon: 07[CFG] selected peer config 'ciscoios'
May 24 21:14:10 localhost charon: 07[IKE] authentication of '172.16.10.1' with
pre-shared key successful
May 24 21:14:10 localhost charon: 07[IKE] received ESP_TFC_PADDING_NOT_SUPPORTED,
not using ESPv3 TFC padding
May 24 21:14:10 localhost charon: 07[IKE] authentication of '172.16.10.2' (myself)
with pre-shared key
May 24 21:14:10 localhost charon: 07[IKE] IKE_SA ciscoios[2] established between
172.16.10.2[172.16.10.2]...172.16.10.1[172.16.10.1]
May 24 21:14:10 localhost charon: 07[IKE] IKE_SA ciscoios[2] established between
172.16.10.2[172.16.10.2]...172.16.10.1[172.16.10.1]
May 24 21:14:10 localhost charon: 07[IKE] scheduling reauthentication in 3247s
May 24 21:14:10 localhost charon: 07[IKE] maximum IKE_SA lifetime 3427s
May 24 21:14:10 localhost charon: 07[IKE] CHILD_SA ciscoios{2} established with
SPIs c0cc116c_i df405365_o and TS 192.168.2.0/24 === 192.168.1.0/24
May 24 21:14:10 localhost charon: 07[IKE] CHILD_SA ciscoios{2} established with
SPIs c0cc116c_i df405365_o and TS 192.168.2.0/24 === 192.168.1.0/24
May 24 21:14:10 localhost vpn: + 172.16.10.1 192.168.1.0/24 == 172.16.10.1 --
172.16.10.2 == 192.168.2.0/24
```

隧道建立详细信息与IKEv1有点相似。

strongSwan:验证IPSec连接状态

```

pluton ~ # ipsec statusall
Status of IKE charon daemon (strongSwan 5.0.4, Linux 3.2.12-gentoo, x86_64):
  uptime: 2 minutes, since May 24 21:13:27 2013
  malloc: sbrk 393216, mmap 0, used 274864, free 118352
  worker threads: 8 of 16 idle, 7/1/0/0 working, job queue: 0/0/0/0, scheduled: 4
  loaded plugins: charon mysql sqlite aes des sha1 sha2 md5 random nonce x509
  revocation constraints pubkey pkcs1 pkcs8 pgp dnskey pem openssl gcrypt
  fips-prf gmp xcbc cmac hmac attr kernel-netlink resolve socket-default
  stroke updown eap-identity eap-sim eap-aka eap-aka-3gpp2 eap-simaka-pseudonym
  eap-simaka-reauth eap-md5 eap-gtc eap-mschapv2 eap-radius xauth-generic
Listening IP addresses:
  10.0.0.100
  192.168.10.1
  192.168.2.1
  172.16.10.2
Connections:
  ciscoios: 172.16.10.2...172.16.10.1 IKEv2
  ciscoios: local: [172.16.10.2] uses pre-shared key authentication
  ciscoios: remote: [172.16.10.1] uses pre-shared key authentication
  ciscoios: child: 192.168.2.0/24 === 192.168.1.0/24 TUNNEL
Security Associations (1 up, 0 connecting):
  ciscoios[2]: ESTABLISHED 116 seconds ago, 172.16.10.2[172.16.10.2]...
172.16.10.1[172.16.10.1]
  ciscoios[2]: IKEv2 SPIs: 12f2fe1f7938fc9f_i 1a0cb1b0f517dc6c_r*,
pre-shared key reauthentication in 52 minutes
  ciscoios[2]: IKE proposal: AES_CBC_128/HMAC_SHA1_96/PRF_HMAC_SHA1/MODP_1536
  ciscoios{2}: INSTALLED, TUNNEL, ESP SPIs: c0cc116c_i df405365_o
  ciscoios{2}: AES_CBC_128/HMAC_SHA1_96, 10000 bytes_i (100 pkts, 102s ago),
10000 bytes_o (100 pkts, 102s ago), rekeying in 12 minutes
  ciscoios{2}: 192.168.2.0/24 === 192.168.1.0/24

```

strongSwan:验证IPSec策略

```

pluton ~ # ip -s xfrm policy
src 192.168.1.0/24 dst 192.168.2.0/24 uid 0
  dir fwd action allow index 1154 priority 1859 share any flag (0x00000000)
lifetime config:
  limit: soft (INF)(bytes), hard (INF)(bytes)
  limit: soft (INF)(packets), hard (INF)(packets)
  expire add: soft 0(sec), hard 0(sec)
  expire use: soft 0(sec), hard 0(sec)
lifetime current:
  0(bytes), 0(packets)
  add 2013-05-24 21:14:10 use -
tmpl src 172.16.10.1 dst 172.16.10.2
  proto esp spi 0x00000000(0) reqid 2(0x00000002) mode tunnel
  level required share any
  enc-mask ffffffff auth-mask ffffffff comp-mask ffffffff
src 192.168.1.0/24 dst 192.168.2.0/24 uid 0
  dir in action allow index 1144 priority 1859 share any flag (0x00000000)
lifetime config:
  limit: soft (INF)(bytes), hard (INF)(bytes)
  limit: soft (INF)(packets), hard (INF)(packets)
  expire add: soft 0(sec), hard 0(sec)
  expire use: soft 0(sec), hard 0(sec)
lifetime current:
  0(bytes), 0(packets)
  add 2013-05-24 21:14:10 use 2013-05-24 21:14:23
tmpl src 172.16.10.1 dst 172.16.10.2
  proto esp spi 0x00000000(0) reqid 2(0x00000002) mode tunnel

```

```
level required share any
enc-mask ffffffff auth-mask ffffffff comp-mask ffffffff
src 192.168.2.0/24 dst 192.168.1.0/24 uid 0
dir out action allow index 1137 priority 1859 share any flag (0x00000000)
lifetime config:
limit: soft (INF)(bytes), hard (INF)(bytes)
limit: soft (INF)(packets), hard (INF)(packets)
expire add: soft 0(sec), hard 0(sec)
expire use: soft 0(sec), hard 0(sec)
lifetime current:
0(bytes), 0(packets)
add 2013-05-24 21:14:10 use 2013-05-24 21:14:23
tmpl src 172.16.10.2 dst 172.16.10.1
proto esp spi 0x00000000(0) reqid 2(0x00000002) mode tunnel
level required share any
enc-mask ffffffff auth-mask ffffffff comp-mask ffffffff
```

相关信息

- [奥彭斯万](#)
- [strongSwan用户文档](#)
- [FlexVPN和互联网密钥交换第2版配置指南，思科IOS版本15M&T](#)
- [技术支持和文档 - Cisco Systems](#)