Configurazione delle funzionalità di alta disponibilità per le VPN IPSec da sito a sito

Sommario

Introduzione

In questo documento vengono descritte le nuove funzionalità per l'elevata disponibilità delle reti VPN IPSec da sito a sito. Il protocollo HSRP (Hot Standby Router Protocol) viene spesso utilizzato per tenere traccia dello stato dell'interfaccia dei router e ottenere il failover tra i router. Tuttavia, poiché non esiste alcuna correlazione interna tra IPSec e HSRP, HSRP non tiene traccia dello stato delle associazioni di protezione IPSec e IPSec richiede schemi per la sincronizzazione con il failover HSRP quando questo si verifica. Di seguito sono riportati alcuni degli schemi utilizzati per creare un collegamento più stretto tra IPSec e HSRP:

- Il comando keepalive IKE (Internet Key Exchange) consente a IPSec di rilevare il failover HSRP in tempo.
- La mappa crittografica applicata a un'interfaccia di router specifica è collegata al gruppo HSRP già configurato su tale interfaccia in modo che IPSec riconosca la configurazione HSRP. In questo modo IPSec potrà inoltre utilizzare l'indirizzo IP virtuale HSRP come identità ISAKMP (Internet Security Association and Key Management Protocol) dei router HSRP.
- La funzionalità di reverse route injection (RRI) viene utilizzata per consentire l'aggiornamento dinamico delle informazioni di routing durante il failover di HSRP e IPSec.

Nota: questo documento descrive come usare il protocollo HSRP (Hot Standby Router Protocol) con VPN. HSRP viene inoltre utilizzato per tenere traccia dei collegamenti ISP non riusciti. Per configurare i collegamenti ISP ridondanti sui router, consultare il documento sull'[analisi dei livelli di servizio IP con l'operazione echo ICMP](#). Qui il dispositivo di origine è il router e il dispositivo di destinazione il dispositivo ISP.

Prerequisiti

Requisiti

Non sono previsti prerequisiti specifici per questo documento.

Componenti usati

Le informazioni fornite in questo documento si basano sulle seguenti versioni software e hardware:

- Cisco serie 7200 Router
- Software Cisco IOS® versione 12.3(7)T1, c7200-a3jk9s-mz.123-7.T1

Le informazioni discusse in questo documento fanno riferimento a dispositivi usati in uno specifico ambiente di emulazione. Su tutti i dispositivi menzionati nel documento la configurazione è stata ripristinata ai valori predefiniti. Se la rete è operativa, valutare attentamente eventuali conseguenze derivanti dall'uso dei comandi.

Convenzioni

Per ulteriori informazioni sulle convenzioni usate, consultare il documento Cisco sulle convenzioni nei suggerimenti tecnici.

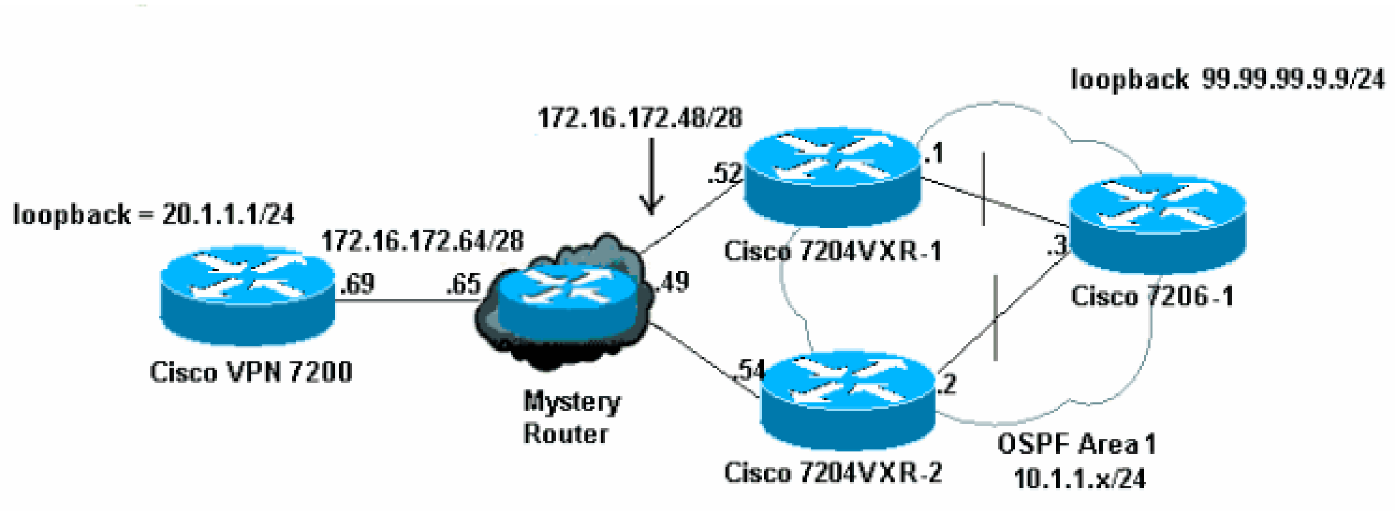
Configurazione

In questa sezione vengono presentate le informazioni necessarie per configurare le funzionalità descritte più avanti nel documento.

Nota: per ulteriori informazioni sui comandi menzionati in questa sezione, usare lo strumento di ricerca dei comandi (solo utenti registrati).

Esempio di rete

Nel documento viene usata questa impostazione di rete:



Configurazioni

Nel documento vengono usate queste configurazioni:

- Configurazione Cisco VPN 7200
- Configurazione Cisco 7204VXR-1
- Configurazione Cisco 7204VXR-2
- Configurazione di Cisco 7206-1

Configurazione Cisco VPN 7200

```
vpn7200#show run
Building configuration...

Current configuration : 1854 bytes
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname vpn7200
!
!
ip subnet-zero
ip cef
!--- Defines ISAKMP policy and IKE pre-shared key for !-
-- IKE authentication. Note that 172.16.172.53 is the !-
-- HSRP virtual IP address of the remote HSRP routers.
crypto isakmp policy 1 hash md5 authentication pre-share
crypto isakmp key cisco123 address 172.16.172.53 !---
IKE keepalive to detect the IPSec liveness of the remote
!--- VPN router. When HSRP failover happens, IKE
keepalive !--- will detect the HSRP router switchover.
crypto isakmp keepalive 10 ! ! crypto ipsec transform-
set myset esp-des esp-md5-hmac !--- Defines crypto map.
Note that the peer address is the !--- HSRP virtual IP
address of the remote HSRP routers. crypto map vpn 10
ipsec-isakmp set peer 172.16.172.53 set transform-set
myset match address 101 ! interface Loopback0 ip address
20.1.1.1 255.255.255.255 ! interface FastEthernet0/0 ip
address 10.48.66.66 255.255.254.0 duplex full speed 100
! interface FastEthernet0/1 ip address 172.16.172.69
255.255.255.240 duplex full speed 100 crypto map vpn !
ip classless ip route 10.1.1.0 255.255.255.0
172.16.172.65 ip route 99.99.99.99 255.255.255.255
172.16.172.65 ip route 172.16.172.48 255.255.255.240
172.16.172.65 no ip http server ! access-list 101 permit
ip 20.1.1.0 0.0.0.255 10.1.1.0 0.0.0.255 access-list 101
permit ip 20.1.1.0 0.0.0.255 host 99.99.99.99 ! line con
0 exec-timeout 0 0 line aux 0 line vty 0 4 login ! end
```

Configurazione Cisco 7204VXR-1

```
7204VXR-1#show run
Building configuration...

Current configuration : 1754 bytes
!
version 12.3
```

```
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname 7204VXR-1
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
ip subnet-zero
!
!
no ip domain lookup
!
!
ip cef!
!--- Defines ISAKMP policy. crypto isakmp policy 1 hash
md5 authentication pre-share crypto isakmp key cisco123
address 172.16.172.69 crypto isakmp keepalive 10 ! !
crypto ipsec transform-set myset esp-des esp-md5-hmac !-
-- Defines crypto map. Note that "reverse-route" !---
turns on the RRI feature. crypto map vpn 10 ipsec-isakmp
set peer 172.16.172.69 set transform-set myset match
address 101 reverse-route ! ! !--- Define HSRP under the
interface. HSRP will track the !--- internal interface
as well. HSRP group name must be !--- defined here and
will be used for IPSec configuration. !--- The
"redundancy" keyword in the crypto map command !---
specifies the HSRP group to which IPSec will couple. !--
- In normal circumstances, this router will be the HSRP
!--- primary router since it has higher priority than
the !--- other HSRP router. interface FastEthernet0/0 ip
address 172.16.172.52 255.255.255.240 duplex full speed
100 standby 1 ip 172.16.172.53 standby 1 priority 200
standby 1 preempt standby 1 name VPNHA standby 1 track
FastEthernet0/1 150 crypto map vpn redundancy VPNHA !
interface FastEthernet0/1 ip address 10.1.1.1
255.255.255.0 duplex full speed 100 ! interface ATM1/0
no ip address shutdown no atm ilmi-keepalive ! interface
FastEthernet3/0 no ip address shutdown duplex half !
interface ATM6/0 no ip address shutdown no atm ilmi-
keepalive !--- Define dynamic routing protocol and re-
distribute static !--- route. This enables dynamic
routing information update !--- during the HSRP/IPSec
failover. All the "VPN routes" !--- that are injected in
the routing table by RRI as static !--- routes will be
redistributed to internal networks. ! router ospf 1 log-
adjacency-changes redistribute static subnets network
10.1.1.0 0.0.0.255 area 0 ! ip classless ip route
172.16.172.64 255.255.255.240 172.16.172.49 no ip http
server no ip http secure-server ! ! !--- Defines VPN
traffic. The destination IP subnet will be !--- injected
into the routing table as static routes by RRI. access-
list 101 permit ip 10.1.1.0 0.0.0.255 20.1.1.0 0.0.0.255
access-list 101 permit ip host 99.99.99.99 20.1.1.0
0.0.0.255 ! line con 0 exec-timeout 0 0 stopbits 1 line
aux 0 stopbits 1 line vty 0 4 ! ! ! end
```

Configurazione Cisco 7204VXR-2

```
7204VXR-2#show run
```

```
Building configuration...

Current configuration : 2493 bytes
!
version 12.3
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname 7204VXR-2
!
boot-start-marker
boot system flash disk1:c7200-a3jk9s-mz.123-7.T1
boot-end-marker
!
no aaa new-model
ip subnet-zero
!
!
no ip domain lookup
ip host rund 10.48.92.61
!
!
ip cef
!
crypto isakmp policy 1
hash md5
authentication pre-share
crypto isakmp key cisco123 address 172.16.172.69
crypto isakmp keepalive 10
!
!
crypto ipsec transform-set myset esp-des esp-md5-hmac
!
crypto map vpn 10 ipsec-isakmp
set peer 172.16.172.69
set transform-set myset
match address 101
reverse-route
!
!--- During normal operational conditions this router !-
-- will be the standby router. interface FastEthernet0/0
ip address 172.16.172.54 255.255.255.240 ip directed-
broadcast duplex full standby 1 ip 172.16.172.53 standby
1 preempt standby 1 name VPNHA standby 1 track
FastEthernet1/0 crypto map vpn redundancy VPNHA !
interface FastEthernet1/0 ip address 10.1.1.2
255.255.255.0 ip directed-broadcast duplex full !
interface FastEthernet3/0 ip address 10.48.67.182
255.255.254.0 ip directed-broadcast shutdown duplex full
! router ospf 1 log-adjacency-changes redistribute
static subnets network 10.1.1.0 0.0.0.255 area 0 ! ip
classless ip route 172.16.172.64 255.255.255.240
172.16.172.49 no ip http server no ip http secure-server
! ! ! access-list 101 permit ip 10.1.1.0 0.0.0.255
20.1.1.0 0.0.0.255 access-list 101 permit ip host
99.99.99.99 20.1.1.0 0.0.0.255 ! line con 0 exec-timeout
0 0 transport preferred all transport output all
stopbits 1 line aux 0 transport preferred all transport
output all stopbits 1 line vty 0 4 login transport
preferred all transport input all transport output all !
! ! end
```

Configurazione di Cisco 7206-1

```
7206-1#show run
Building configuration...

Current configuration : 1551 bytes
!
version 12.2
no service pad
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
no service password-encryption
!
hostname 7206-1
!
ip subnet-zero
no ip source-route
ip cef
!
interface Loopback0
ip address 99.99.99.99 255.255.255.255
!
interface FastEthernet0/0
shutdown
duplex full
speed 100
!
!--- Define dynamic routing protocol. All the "VPN
routes" !--- will be learned and updated dynamically
from upstream HSRP !--- routers using the dynamic
routing protocols. interface FastEthernet0/1 ip address
10.1.1.3 255.255.255.0 duplex full speed 100 ! router
ospf 1 log-adjacency-changes passive-interface Loopback0
network 10.1.1.0 0.0.0.255 area 0 network 99.99.99.99
0.0.0.0 area 0 ! ip classless no ip http server ! ! !
line con 0 exec-timeout 0 0 line aux 0 line vty 0 4
login ! end
```

Come funziona?

In questo esempio viene illustrato il funzionamento congiunto del failover di HSRP e IPSec tramite l'installazione e la configurazione descritte in precedenza. In questo caso di studio vengono evidenziati tre aspetti:

- Failover HSRP a causa di un errore dell'interfaccia.
- Modalità di esecuzione del failover IPSec dopo il failover HSRP. Come si può vedere, il failover IPSec sarà "stateless".
- Modalità di aggiornamento dinamico e propagazione alle reti interne delle modifiche delle informazioni di routing causate dal failover.

Nota: il traffico di prova qui è costituito dai pacchetti Internet Control Message Protocol (ICMP) tra l'indirizzo IP di loopback di Cisco 7206-1 (99.99.99.99) e l'indirizzo IP di loopback di Cisco VPN 7200 (20.1.1.1) e simula il traffico VPN tra i due siti.

Circostanza normale (prima del failover)

Prima del failover, Cisco 7204VXR-1 è il router HSRP principale e Cisco VPN 7200 ha associazioni di protezione IPSec con Cisco 7204VXR-1.

Quando la mappa crittografica è configurata sull'interfaccia, la funzione RRI immette una route VPN corrispondente all'elenco di controllo di accesso (ACL) IPSec configurato e all'istruzione di comando **set peer** nella mappa crittografica. Questo router viene aggiunto alla tabella di routing del router HSRP 7204VXR-1 primario.

L'output del comando **debug crypto ipsec** indica che la route VPN 20.1.1/24 è stata aggiunta alla base delle informazioni di routing (RIB).

```
IPSEC(rte_mgr): VPN Route Added 20.1.1.0 255.255.255.0
via 172.16.172.69 in IP DEFAULT TABLE
```

La tabella di routing sul router HSRP primario restituisce una route statica a 20.1.1/24, che viene ridistribuita da Open Shortest Path First (OSPF) al router HSRP secondario, 7204VXR-2, e al router interno, 7206-1.

L'hop successivo per la route VPN 20.1.1/24 iniettata come route statica nel RIB del router 7204VXR-1 è l'indirizzo IP del peer di crittografia remoto. In questo caso, l'hop successivo per la route VPN 20.1.1/24 è 172.16.172.69. L'indirizzo IP dell'hop successivo della route VPN viene risolto tramite una ricerca ricorsiva della route, come mostrato nella tabella di inoltro Cisco Express:

```
7204VXR-1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF,
        IA - OSPF inter area, N1 - OSPF NSSA external type 1,
        N2 - OSPF NSSA external type 2, E1 - OSPF external type 1,
        E2 - OSPF external type 2, i - IS-IS, su - IS-IS summary,
        L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area,
        * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

    99.0.0.0/32 is subnetted, 1 subnets
O     99.99.99.99 [110/2] via 10.1.1.3, 00:11:21, FastEthernet0/1
    20.0.0.0/24 is subnetted, 1 subnets
S     20.1.1.0 [1/0] via 172.16.172.69
    172.16.0.0/28 is subnetted, 2 subnets
C     172.16.172.48 is directly connected, FastEthernet0/0
S      172.16.172.64 [1/0] via 172.16.172.49
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     10.1.1.0/24 is directly connected, FastEthernet0/1
S      10.48.66.0/23 [1/0] via 10.1.1.2
```

```
7204VXR-1#show ip cef 20.1.1.0 detail
20.1.1.0/24, version 66, epoch 0, cached adjacency 172.16.172.49
0 packets, 0 bytes
via 172.16.172.69, 0 dependencies, recursive
next hop 172.16.172.49, FastEthernet0/0 via 172.16.172.64/28
valid cached adjacency
```

Il router HSRP secondario e il router interno 7206-1 apprendono questa route VPN tramite OSPF/. Gli amministratori di rete non devono immettere manualmente la route statica. Inoltre, le modifiche di routing causate dal failover vengono aggiornate in modo dinamico.

```
7204VXR-2#show ip route
```

```
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF,
        IA - OSPF inter area, N1 - OSPF NSSA external type 1,
        N2 - OSPF NSSA external type 2, E1 - OSPF external type 1,
        E2 - OSPF external type 2, i - IS-IS, su - IS-IS summary,
        L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area,
        * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route

Gateway of last resort is 10.48.66.1 to network 0.0.0.0

    99.0.0.0/32 is subnetted, 1 subnets
O     99.99.99.99 [110/2] via 10.1.1.3, 00:29:31, FastEthernet1/0
    20.0.0.0/24 is subnetted, 1 subnets
O E2     20.1.1.0 [110/20] via 10.1.1.1, 00:11:06, FastEthernet1/0
    172.16.0.0/28 is subnetted, 2 subnets
C     172.16.172.48 is directly connected, FastEthernet0/0
S      172.16.172.64 [1/0] via 172.16.172.49
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      10.1.1.0/24 is directly connected, FastEthernet1/0
C      10.48.66.0/23 is directly connected, FastEthernet3/0
S*     0.0.0.0/0 [1/0] via 10.48.66.1


7206-1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF,
        IA - OSPF inter area, N1 - OSPF NSSA external type 1,
        N2 - OSPF NSSA external type 2, E1 - OSPF external type 1,
        E2 - OSPF external type 2, i - IS-IS, su - IS-IS summary,
        L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area,
        * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

    99.0.0.0/32 is subnetted, 1 subnets
C     99.99.99.99 is directly connected, Loopback0
    20.0.0.0/24 is subnetted, 1 subnets
O E2     20.1.1.0 [110/20] via 10.1.1.1, 00:14:01, FastEthernet0/1
    172.16.0.0/28 is subnetted, 1 subnets
O E2     172.16.172.64 [110/20] via 10.1.1.1, 00:32:21, FastEthernet0/1
                                     [110/20] via 10.1.1.2, 00:32:21, FastEthernet0/1
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     10.1.1.0/24 is directly connected, FastEthernet0/1
O E2     10.48.66.0/23 [110/20] via 10.1.1.2, 00:32:22, FastEthernet0/1
```

Il router 7204VXR-1 è il router HSRP primario che segue l'interfaccia interna Fa0/1.

```
7204VXR-1#show standby
FastEthernet0/0 - Group 1
State is Active
2 state changes, last state change 03:21:20
Virtual IP address is 172.16.172.53
Active virtual MAC address is 0000.0c07.ac01
Local virtual MAC address is 0000.0c07.ac01 (v1 default)
Hello time 3 sec, hold time 10 sec
Next hello sent in 0.172 secs
Preemption enabled
Active router is local
Standby router is 172.16.172.54,
   priority 100 (expires in 7.220 sec)
Priority 200 (configured 200)
```

```
Track interface FastEthernet0/1 state Up decrement 150
IP redundancy name is "VPNHA" (cfgd)
```

Èpossibile utilizzare il comando **show track** per visualizzare un elenco di tutti gli oggetti rilevati da HSRP.

```
7204VXR-1#show track
Track 1 (via HSRP)
Interface FastEthernet0/1 line-protocol
Line protocol is Up
1 change, last change 03:18:22
Tracked by:
HSRP FastEthernet0/0 1
```

Il router 7204VXR-2 è il router HSRP in standby. In condizioni operative normali, questo dispositivo segue l'interfaccia interna Fa1/0.

```
7204VXR-2#show standby
FastEthernet0/0 - Group 1
State is Standby
1 state change, last state change 02:22:30
Virtual IP address is 172.16.172.53
Active virtual MAC address is 0000.0c07.ac01
Local virtual MAC address is 0000.0c07.ac01 (v1 default)
Hello time 3 sec, hold time 10 sec
Next hello sent in 0.096 secs
Preemption enabled
Active router is 172.16.172.52,
   priority 200 (expires in 7.040 sec)
Standby router is local
Priority 100 (default 100)
Track interface FastEthernet1/0 state Up decrement 10
IP redundancy name is "VPNHA" (cfgd)
```

Questi comandi **show** relativi a IPSec restituiscono un output sul router Cisco VPN 7200 che dimostra le associazioni di protezione ISAKMP e IPSec tra Cisco VPN 7200 e il router HSRP primario, Cisco 7204VXR-1.

```
7204VXR-1#show crypto isakmp sa detail
Codes: C - IKE configuration mode, D - Dead Peer Detection
K - Keepalives, N - NAT-traversal
X - IKE Extended Authentication
psk - Preshared key, rsig - RSA signature
renc - RSA encryption

C-id       Local       Remote     I-VRF  Encr  Hash  Auth  DH  Lifetime  Cap.
1    172.16.172.53  172.16.172.69         des   md5   psk   1  23:49:52   K
Connection-id:Engine-id = 1:1(software)
```

```
7204VXR-1#show crypto ipsec sa
interface: FastEthernet0/0
Crypto map tag: vpn, local addr. 172.16.172.53

protected vrf:
local ident (addr/mask/prot/port): (99.99.99.99/255.255.255.255/0/0)
remote ident (addr/mask/prot/port): (20.1.1.0/255.255.255.0/0/0)
current_peer: 172.16.172.69:500
PERMIT, flags={origin_is_acl,}
```

```
#pkts encaps: 5, #pkts encrypt: 5, #pkts digest: 5
#pkts decaps: 5, #pkts decrypt: 5, #pkts verify: 5
#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.: 172.16.172.53, remote crypto endpt.: 172.16.172.69
path mtu 1500, media mtu 1500
current outbound spi: 44E0B22B

inbound esp sas:
spi: 0x5B23F22E(1529082414)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2000, flow_id: 1, crypto map: vpn
crypto engine type: Software, engine_id: 1
sa timing: remaining key lifetime (k/sec): (4504144/2949)
ike_cookies: B57A9DC9 FA2D627B F70FEDF6 FAAF9E34
IV size: 8 bytes
replay detection support: Y

inbound ah sas:

inbound pcp sas:

outbound esp sas:
spi: 0x44E0B22B(1155576363)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2001, flow_id: 2, crypto map: vpn
crypto engine type: Software, engine_id: 1
sa timing: remaining key lifetime (k/sec): (4504145/2949)
ike_cookies: B57A9DC9 FA2D627B F70FEDF6 FAAF9E34
IV size: 8 bytes
replay detection support: Y

outbound ah sas:

outbound pcp sas:
```

```
vpn7200#show crypto isakmp sa
dst            src             state     conn-id    slot
172.16.172.53  172.16.172.69   QM_IDLE   1          0
```

```
7204VXR-2#show crypto ipsec sa
interface: FastEthernet0/1
Crypto map tag: vpn, local addr. 172.16.172.69

local ident (addr/mask/prot/port): (20.1.1.0/255.255.255.0/0/0)
remote ident (addr/mask/prot/port): (99.99.99.99/255.255.255.255/0/0)
current_peer: 172.16.172.53
PERMIT, flags={origin_is_acl,}
#pkts encaps: 10, #pkts encrypt: 10, #pkts digest 10
#pkts decaps: 10, #pkts decrypt: 10, #pkts verify 10
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0, #pkts decompress failed: 0
#send errors 5, #recv errors 0

local crypto endpt.: 172.16.172.69, remote crypto endpt.: 172.16.172.53
path mtu 1500, ip mtu 1500
current outbound spi: 5B23F22E
```

```
inbound esp sas:
spi: 0x44E0B22B(1155576363)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2029, flow_id: 1, crypto map: vpn
sa timing: remaining key lifetime (k/sec): (4607997/2824)
IV size: 8 bytes
replay detection support: Y

inbound ah sas:

inbound pcp sas:

outbound esp sas:
spi: 0x5B23F22E(1529082414)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2030, flow_id: 2, crypto map: vpn
sa timing: remaining key lifetime (k/sec): (4607998/2824)
IV size: 8 bytes
replay detection support: Y

outbound ah sas:

outbound pcp sas:
```

Dopo il failover di HSRP e IPSec

Il failover è stato attivato chiudendo Fa0/0 su Cisco 7204VXR-1. Si verificherà un comportamento simile se l'altra interfaccia, Fa0/1, è inattiva perché anche HSRP tiene traccia dello stato di questa interfaccia.

Quando Cisco VPN 7200 non riceve risposta ai pacchetti IKE keepalive inviati al router HSRP primario, il router interrompe le associazioni di protezione IPSec.

Questo output del comando **debug crypto isakmp** mostra come IKE keepalive rileva l'interruzione del router primario:

```
ISAKMP (0:1): received packet from 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): processing HASH payload. message ID = 1585108592
ISAKMP (0:1): processing NOTIFY ITS_ALIVE protocol 1
spi 0, message ID = 1585108592, sa = 61C3E754
ISAKMP (0:1): sending packet to 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): purging node -1484552386
ISAKMP (0:1): deleting node 1585108592 error FALSE
   reason "informational (in) state 1"
ISAKMP (0:1): purging node 642343711
ISAKMP (0:1): sending packet to 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): purging node -523181212
ISAKMP (0:1): purging node -2089541867
ISAKMP (0:1): incrementing error counter on sa: PEERS_ALIVE_TIMER
ISAKMP (0:1): sending packet to 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): purging node 1671177686
ISAKMP (0:1): incrementing error counter on sa: PEERS_ALIVE_TIMER
ISAKMP (0:1): sending packet to 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): purging node 1706520344
ISAKMP (0:1): incrementing error counter on sa: PEERS_ALIVE_TIMER
ISAKMP (0:1): sending packet to 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): purging node 503375209
ISAKMP (0:1): incrementing error counter on sa: PEERS_ALIVE_TIMER
ISAKMP (0:1): sending packet to 172.16.172.53 (I) QM_IDLE
ISAKMP (0:1): purging node 1272270610
ISAKMP (0:1): incrementing error counter on sa: PEERS_ALIVE_TIMER
ISAKMP (0:1): peer not responding!
ISAKMP (0:1): peer does paranoid keepalives.

ISAKMP (0:1): phase 1 going away; let's be paranoid.
ISAKMP (0:1): Bring down phase 2's
ISAKMP (0:1): That phase 1 was the last one of its kind.
   Taking phase 2's with us.
ISAKMP (0:1): peer does paranoid keepalives.

ISAKMP (0:1): deleting SA reason "P1 errcounter exceeded
   (PEERS_ALIVE_TIMER)" state (I)
   QM_IDLE (peer 172.16.172.53) input queue 0
IPSEC(key_engine): got a queue event...
IPSEC(key_engine_delete_sas): rec'd delete notify from ISAKMP
IPSEC(key_engine_delete_sas): delete all SAs shared with 172.16.172.53
IPSEC(delete_sa): deleting SA,
(sa) sa_dest= 172.16.172.69, sa_prot= 50,
sa_spi= 0x44E0B22B(1155576363),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2029
IPSEC(delete_sa): deleting SA,
(sa) sa_dest= 172.16.172.53, sa_prot= 50,
sa_spi= 0x5B23F22E(1529082414),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2030
ISAKMP (0:1): sending packet to 172.16.172.53 (I) MM_NO_STATE
ISAKMP (0:1): purging node -248155233
ISAKMP (0:1): peer does paranoid keepalives.

IPSEC(key_engine): got a queue event...
IPSEC(key_engine_delete_sas): rec'd delete notify from ISAKMP
IPSEC(key_engine_delete_sas): delete all SAs shared with 172.16.172.53
ISAKMP (0:1): purging node 958118275
```

Quando si verifica il failover sul router HSRP primario Cisco 7204VXR-1, il dispositivo diventa un router di standby. Le associazioni di protezione ISAKMP e IPSec esistenti vengono eliminate. Il router HSRP secondario Cisco 7204VXR-2 diventa attivo e stabilisce nuove SA IPSec con Cisco VPN 7200.

L'output del comando **debug standby events** visualizza gli eventi correlati a HSRP.

```
HSRP: Fa0/0 API Software interface going down
HSRP: Fa0/0 API Software interface going down
HSRP: Fa0/0 Interface down
HSRP: Fa0/0 Grp 1 Active: b/HSRP disabled
HSRP: Fa0/0 Grp 1 Active router is unknown, was local
HSRP: Fa0/0 Grp 1 Standby router is unknown, was 172.16.172.54
HSRP: Fa0/0 Grp 1 Active -> Init
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Active -> Init
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Active -> Init
%CRYPTO-5-SESSION_STATUS: Crypto tunnel is DOWN.
   Peer 172.16.172.69:500 Id: 172.16.172.69
HSRP: Fa0/0 Grp 1 Redundancy enquiry for VPNHA succeeded
HSRP: Fa0/0 API Add active HSRP addresses to ARP table
%LINK-5-CHANGED: Interface FastEthernet0/0,
   changed state to administratively down
HSRP: API Hardware state change
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
   changed state to down
```

Poiché l'interfaccia è chiusa, lo stato dell'HSRP cambia in "Init".

```
paal#show standby
FastEthernet0/0 - Group 1
State is Init (interface down)
3 state changes, last state change 00:07:29
Virtual IP address is 172.16.172.53
Active virtual MAC address is unknown
Local virtual MAC address is 0000.0c07.ac01 (v1 default)
Hello time 3 sec, hold time 10 sec
Preemption enabled
Active router is unknown
Standby router is unknown
Priority 200 (configured 200)
Track interface FastEthernet0/1 state Up decrement 150
IP redundancy name is "VPNHA" (cfgd)
```

Cisco 7204VXR-2 diventa il router HSRP attivo e cambia il suo stato in "Attivo".

```
HSRP: Fa0/0 Grp 1 Standby: c/Active timer expired (172.16.172.52)
HSRP: Fa0/0 Grp 1 Active router is local, was 172.16.172.52
HSRP: Fa0/0 Grp 1 Standby router is unknown, was local
HSRP: Fa0/0 Grp 1 Standby -> Active (active 0->1, passive 2->1)
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Standby -> Active
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Standby -> Active
!--- VPN route 20.1.1.0/24 is added to the routing table. IPSEC(rte_mgr): VPN Route Added
20.1.1.0 255.255.255.0 via 172.16.172.69 in IP DEFAULT TABLE 7204VXR-2#show standby
FastEthernet0/0 - Group 1
State is Active
2 state changes, last state change 00:10:38
Virtual IP address is 172.16.172.53
Active virtual MAC address is 0000.0c07.ac01
Local virtual MAC address is 0000.0c07.ac01 (v1 default)
Hello time 3 sec, hold time 10 sec
Next hello sent in 0.116 secs
Preemption enabled
Active router is local
Standby router is unknown
Priority 100 (default 100)
Track interface FastEthernet1/0 state Up decrement 10
IP redundancy name is "VPNHA" (cfgd)
```

Se RRI è abilitato, le route VPN vengono aggiornate dinamicamente durante il failover. Il router statico 20.1.1.0/24 viene rimosso e il router Cisco 7204VXR-1 apprende il percorso dal router Cisco 7204VXR-2.

L'output del comando **show ip route** mostra questo aggiornamento dinamico.

```
7204VXR-1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF,
        IA - OSPF inter area, N1 - OSPF NSSA external type 1,
        N2 - OSPF NSSA external type 2, E1 - OSPF external type 1,
        E2 - OSPF external type 2, i - IS-IS, su - IS-IS summary,
        L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area,
        * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

99.0.0.0/32 is subnetted, 1 subnets
O  99.99.99.99 [110/2] via 10.1.1.3, 02:46:16, FastEthernet0/1
```

```
20.0.0.0/24 is subnetted, 1 subnets
O E2  20.1.1.0 [110/20] via 10.1.1.2, 00:08:35, FastEthernet0/1
172.16.0.0/28 is subnetted, 1 subnets
O E2  172.16.172.64 [110/20] via 10.1.1.2, 00:07:56, FastEthernet0/1
10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 10.1.1.0/24 is directly connected, FastEthernet0/1
S  10.48.66.0/23 [1/0] via 10.1.1.2
```

Il percorso VPN statico viene iniettato nella tabella di routing sul router Cisco 7204VXR-2.

```
7204VXR-2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF,
        IA - OSPF inter area, N1 - OSPF NSSA external type 1,
        N2 - OSPF NSSA external type 2, E1 - OSPF external type 1,
        E2 - OSPF external type 2, i - IS-IS, su - IS-IS summary,
        L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area,
        * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

99.0.0.0/32 is subnetted, 1 subnets
O  99.99.99.99 [110/2] via 10.1.1.3, 03:04:18, FastEthernet1/0
20.0.0.0/24 is subnetted, 1 subnets
S  20.1.1.0 [1/0] via 172.16.172.69
172.16.0.0/28 is subnetted, 2 subnets
C  172.16.172.48 is directly connected, FastEthernet0/0
S  172.16.172.64 [1/0] via 172.16.172.49
10.0.0.0/24 is subnetted, 1 subnets
C  10.1.1.0 is directly connected, FastEthernet1/0
```

Il router interno 7206-1 apprende la route 20.1.1/24 al peer VPN remoto dal router adiacente OSPF 7204VXR-2. Queste modifiche di routing si verificano in modo dinamico tramite la combinazione di HSRP/RRI e OSPF.

```
7206-1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF,
        IA - OSPF inter area, N1 - OSPF NSSA external type 1,
        N2 - OSPF NSSA external type 2, E1 - OSPF external type 1,
        E2 - OSPF external type 2, i - IS-IS, su - IS-IS summary,
        L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area,
        * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

    99.0.0.0/32 is subnetted, 1 subnets
C     99.99.99.99 is directly connected, Loopback0
    20.0.0.0/24 is subnetted, 1 subnets
O E2     20.1.1.0 [110/20] via 10.1.1.2, 00:13:55, FastEthernet0/1
    172.16.0.0/28 is subnetted, 1 subnets
O E2     172.16.172.64 [110/20] via 10.1.1.2, 00:13:17, FastEthernet0/1
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     10.1.1.0/24 is directly connected, FastEthernet0/1
O E2     10.48.66.0/23 [110/20] via 10.1.1.2, 03:06:08, FastEthernet0/1
```

Dopo che Cisco 7204VXR-2 diventa il router attivo durante il failover HSRP, il traffico VPN tra Cisco 7204VXR-2 e Cisco VPN 7200 richiama le associazioni di protezione ISAKMP e IPSec.

Di seguito viene riportato l'output dei comandi **show crypto isakmp sa** e **show crypto ipsec sa** sul

router VPN 7200:

```
7204VXR-2#show crypto isakmp sa detail
Codes: C - IKE configuration mode, D - Dead Peer Detection
K - Keepalives, N - NAT-traversal
X - IKE Extended Authentication
psk - Preshared key, rsig - RSA signature
renc - RSA encryption

C-id Local        Remote      I-VRF Encr Hash Auth DH Lifetime Cap.
1   172.16.172.53  172.16.172.69        des  md5   psk  1  23:53:47 K
Connection-id:Engine-id = 1:1(software)


7204VXR-2#show crypto ipsec sa

interface: FastEthernet0/0
Crypto map tag: vpn, local addr. 172.16.172.53


protected vrf:
local ident (addr/mask/prot/port): (99.99.99.99/255.255.255.255/0/0)
remote ident (addr/mask/prot/port): (20.1.1.0/255.255.255.0/0/0)
current_peer: 172.16.172.69:500
PERMIT, flags={origin_is_acl,}
#pkts encaps: 9, #pkts encrypt: 9, #pkts digest: 9
#pkts decaps: 9, #pkts decrypt: 9, #pkts verify: 9
#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.: 172.16.172.53, remote crypto endpt.: 172.16.172.69
path mtu 1500, media mtu 1500
current outbound spi: 83827275

inbound esp sas:
spi: 0x8D70E8A3(2372987043)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2000, flow_id: 1, crypto map: vpn
crypto engine type: Software, engine_id: 1
sa timing: remaining key lifetime (k/sec): (4453897/3162)
ike_cookies: 95074F89 3FF73F2B F70FEDF6 5998090C
IV size: 8 bytes
replay detection support: Y

inbound ah sas:

inbound pcp sas:

outbound esp sas:
spi: 0x83827275(2206364277)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2001, flow_id: 2, crypto map: vpn
crypto engine type: Software, engine_id: 1
sa timing: remaining key lifetime (k/sec): (4453898/3162)
ike_cookies: 95074F89 3FF73F2B F70FEDF6 5998090C
IV size: 8 bytes
replay detection support: Y
```

```
outbound ah sas:

outbound pcp sas: vpn7200#show crypto isa sa
dst src state conn-id slot
172.16.172.53   172.16.172.69   QM_IDLE 1       0

vpn7200#show crypto ipsec sa

interface: FastEthernet0/1
Crypto map tag: vpn, local addr. 172.16.172.69


local ident (addr/mask/prot/port): (20.1.1.0/255.255.255.0/0/0)
remote ident (addr/mask/prot/port): (99.99.99.99/255.255.255.255/0/0)
current_peer: 172.16.172.53
PERMIT, flags={origin_is_acl,}
#pkts encaps: 19, #pkts encrypt: 19, #pkts digest 19
#pkts decaps: 19, #pkts decrypt: 19, #pkts verify 19
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0, #pkts decompress failed: 0
#send errors 6, #recv errors 0

local crypto endpt.: 172.16.172.69, remote crypto endpt.: 172.16.172.53
path mtu 1500, ip mtu 1500
current outbound spi: 8D70E8A3

inbound esp sas:
spi: 0x83827275(2206364277)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2029, flow_id: 1, crypto map: vpn
sa timing: remaining key lifetime (k/sec): (4607997/3070)
IV size: 8 bytes
replay detection support: Y

inbound ah sas:

inbound pcp sas:

outbound esp sas:
spi: 0x8D70E8A3(2372987043)
transform: esp-des esp-md5-hmac ,
in use settings ={Tunnel, }
slot: 0, conn id: 2030, flow_id: 2, crypto map: vpn
sa timing: remaining key lifetime (k/sec): (4607998/3070)
IV size: 8 bytes
replay detection support: Y

outbound ah sas:

outbound pcp sas:
```

Dopo il ripristino del router primario originale HSRP da un'interruzione

Dopo il ripristino del servizio sul router primario originale HSRP Cisco 7204VXR-1, il dispositivo riprende la posizione di router attivo perché ha una priorità più alta e perché è configurata la priorità HSRP.

L'output dei comandi **show** e **debug** restituito da diversi router mostra un altro passaggio di HSRP e IPSec. Le associazioni di protezione ISAKMP e IPSec vengono ristabilite automaticamente e le informazioni di routing vengono aggiornate in modo dinamico.

In questo output di esempio viene mostrato che lo stato del router 7204VXR-1 viene modificato in "Attivo".

```
HSRP: Fa0/0 API 172.16.172.52 is not an HSRP address
HSRP: Fa0/0 API MAC address update
HSRP: Fa0/0 API Software interface coming up
%LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
HSRP: API Hardware state change
HSRP: Fa0/0 API Software interface coming up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
   changed state to up
HSRP: Fa0/0 Interface up
HSRP: Fa0/0 Starting minimum interface delay (1 secs)
HSRP: Fa0/0 Interface min delay expired
HSRP: Fa0/0 Grp 1 Init: a/HSRP enabled
HSRP: Fa0/0 Grp 1 Init -> Listen
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Init -> Backup
HSRP: Fa0/0 Grp 1 Listen: c/Active timer expired (unknown)
HSRP: Fa0/0 Grp 1 Listen -> Speak
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Backup -> Speak
HSRP: Fa0/0 Grp 1 Speak: d/Standby timer expired (unknown)
HSRP: Fa0/0 Grp 1 Standby router is local
HSRP: Fa0/0 Grp 1 Speak -> Standby
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Speak -> Standby
HSRP: Fa0/0 Grp 1 Redundancy enquiry for VPNHA succeeded
HSRP: Fa0/0 Grp 1 Standby: c/Active timer expired (unknown)
HSRP: Fa0/0 Grp 1 Active router is local
HSRP: Fa0/0 Grp 1 Standby router is unknown, was local
HSRP: Fa0/0 Grp 1 Standby -> Active
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Standby -> Active
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Standby -> Active
HSRP: Fa0/0 Grp 1 Active: i/Resign rcvd (100/172.16.172.54)
HSRP: Fa0/0 Grp 1 Redundancy group VPNHA state Active -> Active
HSRP: Fa0/0 Grp 1 Redundancy group VPNHA state Active -> Active
HSRP: Fa0/0 Grp 1 Standby router is 172.16.172.54
```

Lo stato del router 7204VXR-2 viene modificato in "Standby". La route VPN viene rimossa dalla tabella di routing.

```
HSRP: Fa0/0 Grp 1 Standby router is 172.16.172.52
HSRP: Fa0/0 Grp 1 Hello in 172.16.172.52 Active pri 200 vIP 172.16.172.53
hel 3000 hol 10000 id 0000.0c07.ac01
HSRP: Fa0/0 Grp 1 Active router is 172.16.172.52, was local
HSRP: Fa0/0 Grp 1 Standby router is unknown, was 172.16.172.52
HSRP: Fa0/0 Grp 1 Active: g/Hello rcvd from
   higher pri Active router (200/172.16.172.52)
HSRP: Fa0/0 Grp 1 Active -> Speak (active 1->0, passive 0->1)
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Active -> Speak
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Active -> Speak
HSRP: Fa0/0 Grp 1 Speak: d/Standby timer expired (unknown)
HSRP: Fa0/0 Grp 1 Standby router is local
HSRP: Fa0/0 Grp 1 Speak -> Standby (active 0, passive 1)
HSRP: Fa0/0 Grp 1 Redundancy "VPNHA" state Speak -> Standby
HSRP: Fa0/0 Grp 1 Redundancy enquiry for VPNHA succeeded
addr 172.16.172.53 name VPNHA state Speak
active 172.16.172.52 standby 172.16.172.54
 !--- The VPN route is removed. IPSEC(rte_mgr): VPN Route Removed 20.1.1.0 255.255.255.0 via
172.16.172.69 in IP DEFAULT TABLE
```

Informazioni correlate

- Pagina di supporto per la negoziazione IPSec/i protocolli IKE
- Documentazione e supporto tecnico – Cisco Systems