Configurando recursos de alta disponibilidade para VPNs de IPSec site para site

Contents

Introduction

Este documento descreve os novos recursos de alta disponibilidade para redes IPSec VPN de site a site. O Hot Standby Router Protocol (HSRP) é usado frequentemente para acompanhar o status da interface dos roteadores para executar o failover entre roteadores. Entretanto, como não existe nenhuma correlação interna entre o IPsec e o HSRP, o HSRP não acompanha o estado das associações de segurança (SA) do IPSec e o IPsec exige esquemas para sincronizar com o failover do HSRP, quando ele ocorre. Estes são alguns destaques dos esquemas usados para obtenção de uma melhor integração entre o IPsec e o HSRP:

- A manutenção de atividade IKE (Internet Key Exchange) é utilizada para permitir que o IPSec detecte o failover de HSRP a tempo.
- O cripto mapa aplicado em uma interface de roteador específica está vinculado ao grupo de HSRP já configurado nessa interface para que o IPSec tome conhecimento da configuração de HSRP. Isso também permite que o IPSec utilize o endereço IP virtual de HSRP como a identidade de protocolo ISAKMP (protocolo de gerenciamento de chave e associação de segurança) dos roteadores HSRP.
- O Reverse Route Injection (RRI) é usado para permitir atualizações de informações de roteamento dinâmico durante failover de HSRP e IPSec.

Observação: este documento descreve como usar o Hot Standby Router Protocol (HSRP) com VPN. O HSRP também é usado para rastrear links ISP com falha. Para configurar links ISP redundantes em roteadores, consulte Analisando Níveis de Serviço IP Usando a Operação de Eco ICMP. Aqui o dispositivo de origem é o roteador e o dispositivo de destino é o dispositivo ISP.

Prerequisites

Requirements

Não existem requisitos específicos para este documento.

Componentes Utilizados

As informações neste documento são baseadas nestas versões de software e hardware:

- Cisco 7200 Series Routers
- Software Cisco IOS® versão 12.3(7)T1, c7200-a3jk9s-mz.123-7.T1

As informações neste documento foram criadas a partir de dispositivos em um ambiente de laboratório específico. All of the devices used in this document started with a cleared (default) configuration. Se você estiver trabalhando em uma rede ativa, certifique-se de que entende o impacto potencial de qualquer comando antes de utilizá-lo.

Conventions

Consulte as Convenções de Dicas Técnicas da Cisco para obter mais informações sobre convenções de documentos.

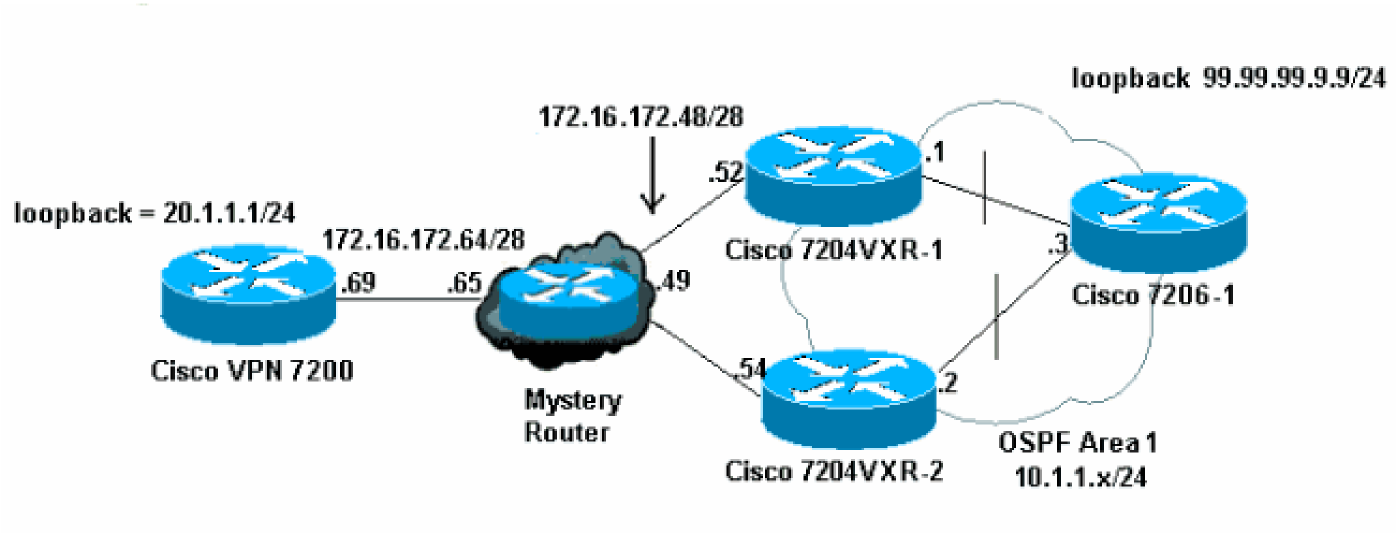
Configurar

Nesta seção, você encontrará informações para configurar os recursos descritos neste documento.

Nota: Use a Command Lookup Tool (somente clientes registrados) para obter mais informações sobre os comandos usados nesta seção.

Diagrama de Rede

Este documento utiliza a seguinte configuração de rede:



Configurações

Este documento utiliza as seguintes configurações:

- Configuração do Cisco VPN 7200
- Configuração do Cisco 7204VXR-1
- Configuração do Cisco 7204VXR-2
- Configuração do Cisco 7206-1

Configuração do 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
```

Configuração do 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
```

Configuração do 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
```

Configuração do 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
```

Como isso funciona?

Este exemplo demonstra como o failover de HSRP e IPSec funcionam juntos usando a configuração e a configuração acima. Três aspectos são destacados neste estudo de caso:

- Failover de HSRP devido à falha da interface.
- Como ocorre o failover de IPSec após o failover de HSRP. Como pode ser visto, o failover de IPSec aqui será um failover "stateless".
- Como as alterações nas informações de roteamento causadas pelo failover são atualizadas dinamicamente e propagadas para redes internas.

Observação: o tráfego de teste aqui são pacotes ICMP (Internet Control Message Protocol) entre o endereço IP de loopback do Cisco 7206-1 (99.99.99.99) e o endereço IP de loopback do Cisco VPN 7200 (20.1.1.1) e simula o tráfego de VPN entre os dois sites.

Circunstância normal (antes do failover)

Antes do failover, o Cisco 7204VXR-1 é o roteador HSRP principal e o Cisco VPN 7200 tem SAs IPSec com o Cisco 7204VXR-1.

Quando o mapa de criptografia é configurado na interface, o recurso RRI injeta uma rota VPN para corresponder à lista de controle de acesso (ACL) IPSec configurada e à instrução de comando **set peer** no mapa de criptografia. Essa rota é adicionada à tabela de roteamento do roteador HSRP primário 7204VXR-1.

A saída do comando **debug crypto ipsec** indica a adição da rota VPN 20.1.1/24 à Base de Informações de Roteamento (RIB).

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

A tabela de roteamento no roteador HSRP principal produz uma rota estática para 20.1.1/24, que é redistribuída pelo OSPF (Open Shortest Path First) para o roteador HSRP secundário, 7204VXR-2, e para o roteador interno, 7206-1.

O próximo salto para a rota VPN 20.1.1/24 injetada como uma rota estática no RIB do roteador 7204VXR-1 é o endereço IP do peer de criptografia remoto. Nesse caso, o próximo salto para a rota VPN 20.1.1/24 é 172.16.172.69. O endereço IP do próximo salto da rota VPN é resolvido por meio de uma pesquisa de rota recursiva, como mostrado nesta tabela do Cisco Express Forwarding:

```
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
```

O roteador HSRP secundário e o roteador interno 7206-1 aprendem essa rota VPN via OSPF/. Os administradores de rede não precisam inserir a rota estática manualmente. Mais importante, as alterações de roteamento causadas pelo failover são atualizadas dinamicamente.

```
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
```

O roteador 7204VXR-1 é o roteador HSRP principal que rastreia a interface 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)
```

Você pode usar o comando **show track** para ver uma lista de todos os objetos rastreados pelo 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
```

O roteador 7204VXR-2 é o roteador HSRP em standby. Em condições operacionais normais, esse dispositivo rastreia a interface 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)
```

Esses comandos **show** relacionados ao IPSec produzem saída no roteador Cisco VPN 7200 que demonstra as SAs ISAKMP e IPSec entre o Cisco VPN 7200 e o roteador principal HSRP, o 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:
```

Após failover de HSRP e IPSec

O failover foi acionado ao desligar Fa0/0 no Cisco 7204VXR-1. Você verá um comportamento semelhante se a outra interface, Fa0/1, estiver inativa porque o HSRP também rastreia o status dessa interface.

Quando o Cisco VPN 7200 não recebe resposta para pacotes de manutenção de atividade IKE enviados para o roteador principal HSRP, o roteador derruba as SAs IPSec.

Esta saída do comando **debug crypto isakmp** mostra como o keepalive de IKE detecta a interrupção do roteador principal:

```
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 ocorre failover no roteador HSRP primário Cisco 7204VXR-1, o dispositivo se torna um roteador em standby. As SAs ISAKMP e IPSec existentes são desligadas. O roteador HSRP secundário Cisco 7204VXR-2 torna-se ativo e estabelece novas SAs IPSec com o Cisco VPN 7200.

A saída do comando **debug standby events** mostra eventos relacionados ao 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
```

Como a interface está desligada, o estado do HSRP é alterado para "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)
```

O Cisco 7204VXR-2 torna-se o roteador HSRP ativo e altera seu estado para "Ativo".

```
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)
```

Com o RRI ativado, as rotas VPN são atualizadas dinamicamente durante o failover. A rota estática 20.1.1.0/24 é removida e o roteador Cisco 7204VXR-1 aprende a rota do roteador Cisco 7204VXR-2.

A saída do comando **show ip route** demonstra essa atualização dinâmica.

```
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
```

A rota de VPN estática é injetada na tabela de roteamento no roteador 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
```

O roteador interno 7206-1 aprende a rota 20.1.1/24 para o peer VPN remoto do roteador vizinho OSPF, 7204VXR-2. Essas alterações de roteamento ocorrem dinamicamente através da combinação de 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
```

Depois que o Cisco 7204VXR-2 se torna o roteador ativo durante o failover do HSRP, o tráfego VPN entre o roteador Cisco 7204VXR-2 e o roteador Cisco VPN 7200 ativa SAs ISAKMP e IPSec.

A saída dos comandos **show crypto isakmp sa** e **show crypto ipsec sa** no roteador VPN 7200 é mostrada aqui:

```
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:
```

Após a recuperação do roteador principal de HSRP original de uma interrupção

Depois que o serviço se recuperar no roteador principal HSRP original do Cisco 7204VXR-1, o dispositivo retoma a posição como roteador ativo porque tem uma prioridade mais alta e porque o preempt do HSRP está configurado.

A saída do comando **show** e **debug** de roteadores diferentes mostra outro switchover de HSRP e IPSec. As SAs ISAKMP e IPSec são restabelecidas automaticamente e as alterações nas informações de roteamento são atualizadas dinamicamente.

Este exemplo de saída mostra que o roteador 7204VXR-1 altera seu estado para "Ativo".

```
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
```

O roteador 7204VXR-2 altera seu estado para "Standby". A rota VPN é removida da tabela de roteamento.

```
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
```

Informações Relacionadas

- Página de Suporte de Negociação IPSec/Protocolos IKE
- Suporte Técnico e Documentação - Cisco Systems