# 使用帶有OSPF、NAT和Cisco IOS防火牆的GRE Over IPsec配置動態多點VPN

## 目錄

## 簡介

本檔案將提供動態多點VPN(DMVPN)的範例組態，使用具有開放最短路徑優先(OSPF)、網路位址轉譯(NAT)和Cisco IOS®防火牆的IPsec通用路由封裝(GRE)。

## 必要條件

### 需求

在可以建立多點GRE(mGRE)和IPsec隧道之前，必須使用**crypto isakmp policy**命令定義網際網路金鑰交換(IKE)策略。

**註：**使用Command Lookup Tool(僅供已註冊客戶使用)可獲取本節中使用的命令的詳細資訊。

### 採用元件

本文中的資訊係根據以下軟體和硬體版本：

- 中心路由器上的Cisco IOS®軟體版本12.2(15)T1和分支路由器上的Cisco IOS軟體版本12.3(1.6)
- Cisco 3620作為中心路由器、2台Cisco 1720路由器和1台Cisco 3620路由器作為分支路由器

本文中的資訊是根據特定實驗室環境內的裝置所建立。文中使用到的所有裝置皆從已清除（預設）的組態來啟動。如果您的網路正在作用，請確保您已瞭解任何指令可能造成的影響。

## 慣例

請參閱思科技術提示慣例以瞭解更多有關文件慣例的資訊。

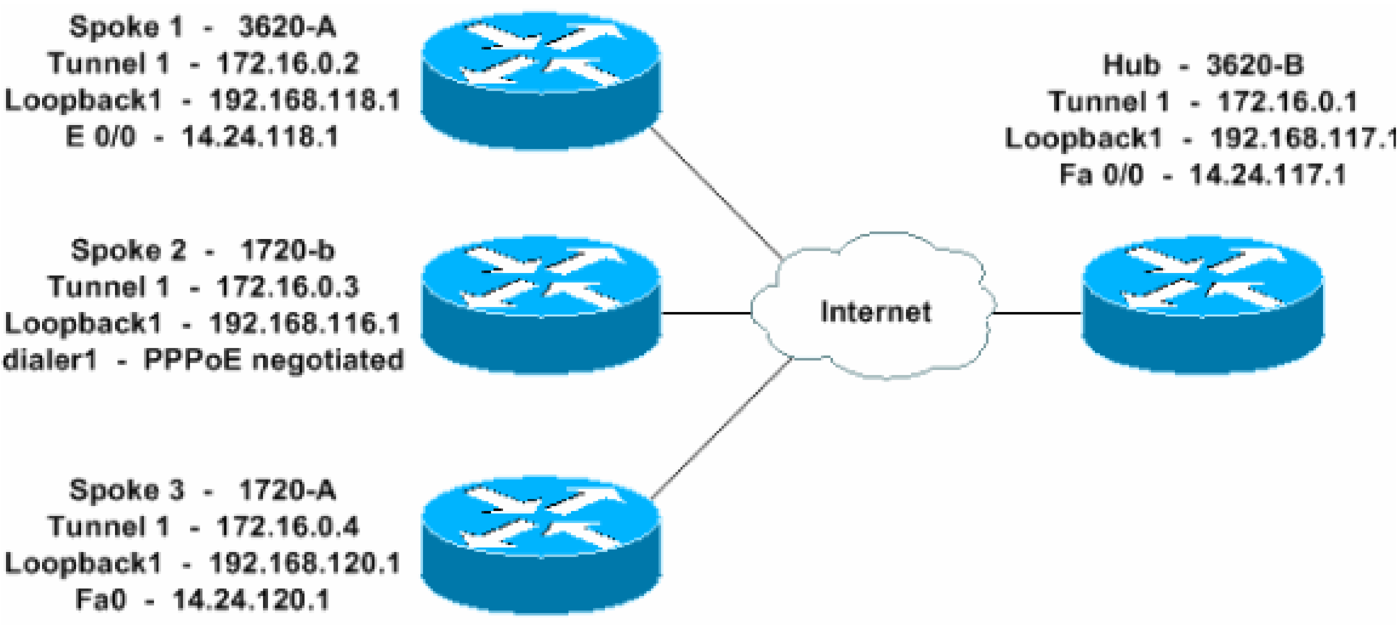
# 設定

本節提供用於設定本文件中所述功能的資訊。

**註：使**用Command Lookup Tool(僅供已註冊客戶使用)可獲取本節中使用的命令的詳細資訊。

## 網路圖表

本檔案會使用此網路設定。



## 組態

本檔案會使用這些設定。

- 集線器 — 3620-B
- 輻條1 - 3620-A
- 分支2 - 1720-b
- 輻條3 - 1720-A

**集線器 — 3620-B**

```
W2N-6.16-3620-B#write terminal
Building configuration...

Current configuration : 2613 bytes
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
```

```
!
hostname W2N-6.16-3620-B
!
logging queue-limit 100
!
memory-size iomem 10
ip subnet-zero
!
!
ip cef
no ip domain lookup
!
!--- This is the Cisco IOS Firewall configuration and
what to inspect. !--- This is applied outbound on the
external interface. ip inspect name in2out rcmd ip
inspect name in2out ftp ip inspect name in2out tftp ip
inspect name in2out tcp timeout 43200 ip inspect name
in2out http ip inspect name in2out udp ip audit po max-
events 100 ! ! ! !--- Create an Internet Security
Association and Key Management !--- Protocol (ISAKMP)
policy for Phase 1 negotiations. crypto isakmp policy 5
authentication pre-share group 2 !--- Add dynamic pre-
shared key. crypto isakmp key dmvpnkey address 0.0.0.0
0.0.0.0 crypto isakmp nat keepalive 20 ! ! !--- Create
the Phase 2 policy for actual data encryption. crypto
ipsec transform-set dmvpnset esp-3des esp-sha-hmac ! !--
- Create an IPsec profile to be applied dynamically !---
to the GRE over IPsec tunnels. crypto ipsec profile
dmvpnprof set transform-set dmvpnset ! ! ! ! ! ! ! ! ! !
! no voice hpi capture buffer no voice hpi capture
destination ! ! mta receive maximum-recipients 0 ! ! !
!--- This is the inbound interface. interface Loopback1
ip address 192.168.117.1 255.255.255.0 ip nat inside !
!--- Create a GRE tunnel template to be applied !--- to
all the dynamically created GRE tunnels. interface
Tunnel1 description MULTI-POINT GRE TUNNEL for BRANCHES
bandwidth 1000 ip address 172.16.0.1 255.255.255.0 no ip
redirects ip mtu 1416 ip nhrp authentication dmvpn ip
nhrp map multicast dynamic ip nhrp network-id 99 ip nhrp
holdtime 300 no ip route-cache ip ospf network broadcast
no ip mroute-cache delay 1000 tunnel source
FastEthernet0/0 tunnel mode gre multipoint tunnel key
100000 tunnel protection ipsec profile dmvpnprof ! !---
This is the outbound interface. interface
FastEthernet0/0 ip address 14.24.117.1 255.255.0.0 ip
nat outside ip access-group 100 in ip inspect in2out out
no ip mroute-cache duplex auto speed auto ! interface
Serial0/0 no ip address shutdown clockrate 2000000 no
fair-queue ! interface FastEthernet0/1 no ip address no
ip mroute-cache duplex auto speed auto ! !--- Enable a
routing protocol to send/receive dynamic !--- updates
about the private networks. router ospf 1 log-adjacency-
changes network 172.16.0.0 0.0.0.255 area 0 network
192.168.117.0 0.0.0.255 area 0 ! !--- Except the private
network traffic from the NAT process. ip nat inside
source route-map nonat interface FastEthernet0/0
overload ip http server no ip http secure-server ip
classless ip route 0.0.0.0 0.0.0.0 14.24.1.1 ip route
2.0.0.0 255.0.0.0 14.24.121.1 ! ! ! !--- Allow ISAKMP,
ESP, and GRE traffic inbound. !--- Cisco IOS Firewall
opens other inbound access as needed. access-list 100
permit udp any host 14.24.117.1 eq 500 access-list 100
premit esp any host 14.24.117.1 access-list 100 permit
gre any host 14.24.117.1 access-list 100 deny ip any any
```

```
!--- Except the private network traffic from the NAT
process. access-list 110 deny ip 192.168.117.0 0.0.0.255
192.168.118.0 0.0.0.255 access-list 110 deny ip
192.168.117.0 0.0.0.255 192.168.116.0 0.0.0.255 access-
list 110 deny ip 192.168.117.0 0.0.0.255 192.168.120.0
0.0.0.255 access-list 110 permit ip 192.168.117.0
0.0.0.255 any ! !--- Except the private network traffic
from the NAT process. route-map nonat permit 10 match ip
address 110 ! call rsvp-sync ! ! mgcp profile default !
dial-peer cor custom ! ! ! ! ! line con 0 exec-timeout 0
0 line aux 0 line vty 0 4 login ! ! end W2N-6.16-3620-B#
```

## 輻條1 - 3620-A

```

W2N-6.16-3620-A#write terminal
Building configuration...

Current configuration : 2678 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname W2N-6.16-3620-A
!
boot system flash slot0:c3620-ik9o3s7-mz.122-15.T1.bin
logging queue-limit 100
!
memory-size iomem 15
ip subnet-zero
!
!
ip cef
no ip domain lookup
!
!--- This is the Cisco IOS Firewall configuration and
what to inspect. !--- This is applied outbound on the
external interface. ip inspect name in2out rcmd ip
inspect name in2out tftp ip inspect name in2out udp ip
inspect name in2out tcp timeout 43200 ip inspect name
in2out realaudio ip inspect name in2out vdolive ip
inspect name in2out netshow ip audit po max-events 100 !
! ! !--- Create an ISAKMP policy for !--- Phase 1
negotiations. crypto isakmp policy 5 authentication pre-
share group 2 !--- Add dynamic pre-shared key. crypto
isakmp key dmvpnkey address 0.0.0.0 0.0.0.0 ! ! !---
Create the Phase 2 policy for actual data encryption.
crypto ipsec transform-set dmvpnset esp-3des esp-sha-
hmac ! !--- Create an IPsec profile to be applied
dynamically !--- to the GRE over IPsec tunnels. crypto
ipsec profile dmvpnprof set transform-set dmvpnset ! ! !
! ! ! ! ! ! ! ! no voice hpi capture buffer no voice hpi
capture destination ! ! mta receive maximum-recipients 0
! ! ! !--- This is the inbound interface. interface
Loopback1 ip address 192.168.118.1 255.255.255.0 ip nat
inside ! !--- Create a GRE tunnel template to be applied
to !--- all the dynamically created GRE tunnels.
interface Tunnel1 description HOST DYNAMIC TUNNEL
bandwidth 1000 ip address 172.16.0.2 255.255.255.0 no ip
redirects ip mtu 1416 ip nhrp authentication dmvpn ip
nhrp map multicast dynamic ip nhrp map 172.16.0.1
14.24.117.1 ip nhrp map multicast 14.24.117.1 ip nhrp
```

```
network-id 99 ip nhrp holdtime 300 ip nhrp nhs
172.16.0.1 no ip route-cache ip ospf network broadcast
no ip mroute-cache delay 1000 tunnel source Ethernet0/0
tunnel mode gre multipoint tunnel key 100000 tunnel
protection ipsec profile dmvpnprof ! !--- This is the
outbound interface. interface Ethernet0/0 ip address
14.24.118.1 255.255.0.0 ip nat outside ip access-group
100 in ip inspect in2out out no ip mroute-cache half-
duplex ! interface Ethernet0/1 no ip address half-duplex
! interface Ethernet0/2 no ip address shutdown half-
duplex ! interface Ethernet0/3 no ip address shutdown
half-duplex ! !--- Enable a routing protocol to
send/receive dynamic !--- updates about the private
networks. router ospf 1 log-adjacency-changes
redistribute connected network 172.16.0.0 0.0.0.255 area
0 network 192.168.118.0 0.0.0.255 area 0 ! !--- Except
the private network traffic from the NAT process. ip nat
inside source route-map nonat interface Ethernet0/0
overload ip http server no ip http secure-server ip
classless ip route 0.0.0.0 0.0.0.0 14.24.1.1 ip route
2.0.0.0 255.0.0.0 14.24.121.1 ! ! ! !--- Allow ISAKMP,
ESP, and GRE traffic inbound. !--- Cisco IOS Firewall
opens inbound access as needed. access-list 100 permit
udp any host 14.24.118.1 eq 500 access-list 100 premit
esp any host 14.24.118.1 access-list 100 permit gre any
host 14.24.118.1 access-list 100 deny ip any any !---
Except the private network traffic from the NAT process.
access-list 110 deny ip 192.168.118.0 0.0.0.255
192.168.117.0 0.0.0.255 access-list 110 deny ip
192.168.118.0 0.0.0.255 192.168.116.0 0.0.0.255 access-
list 110 deny ip 192.168.118.0 0.0.0.255 192.168.120.0
0.0.0.255 access-list 110 permit ip 192.168.118.0
0.0.0.255 any ! !--- Except the private network traffic
from the NAT process. route-map nonat permit 10 match ip
address 110 ! call rsvp-sync ! ! mgcp profile default !
dial-peer cor custom ! ! ! ! ! line con 0 exec-timeout 0
0 line aux 0 line vty 0 4 login ! ! end W2N-6.16-3620-A#
```

## 分支2 - 1720-b

```
1720-b#write terminal
Building configuration...

Current configuration : 2623 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 1720-b
!
logging queue-limit 100
enable password cisco
!
username 7206-B password 0 cisco
ip subnet-zero
!
!
no ip domain lookup
!
ip cef
!--- This is the Cisco IOS Firewall configuration and
```

```
what to inspect. !--- This is applied outbound on the
external interface. ip inspect name in2out rcmd ip
inspect name in2out tftp ip inspect name in2out udp ip
inspect name in2out tcp timeout 43200 ip inspect name
in2out realaudio ip inspect name in2out vdolive ip
inspect name in2out netshow ip audit po max-events 100
vpdn-group 1 request-dialin protocol pppoe ! ! ! ! ! !--
- Create an ISAKMP policy for !--- Phase 1 negotiations.
crypto isakmp policy 5 authentication pre-share group 2
!--- Add dynamic pre-shared key. crypto isakmp key
dmvpnkey address 0.0.0.0 0.0.0.0 ! ! !--- Create the
Phase 2 policy for actual data encryption. crypto ipsec
transform-set dmvpnset esp-3des esp-sha-hmac ! !---
Create an IPsec profile to be applied dynamically !---
to the GRE over IPsec tunnels. crypto ipsec profile
dmvpnprof set transform-set dmvpnset ! ! ! ! ! !--- This
is the inbound interface. interface Loopback1 ip address
192.168.116.1 255.255.255.0 ip nat inside ! !--- Create
a GRE tunnel template to be applied to !--- all the
dynamically created GRE tunnels. interface Tunnel1
description HOST DYNAMIC TUNNEL bandwidth 1000 ip
address 172.16.0.3 255.255.255.0 no ip redirects ip mtu
1416 ip nhrp authentication dmvpn ip nhrp map multicast
dynamic ip nhrp map 172.16.0.1 14.24.117.1 ip nhrp map
multicast 14.24.117.1 ip nhrp network-id 99 ip nhrp
holdtime 300 ip nhrp nhs 172.16.0.1 no ip route-cache ip
ospf network broadcast no ip mroute-cache delay 1000
tunnel source Dialer1 tunnel mode gre multipoint tunnel
key 100000 tunnel protection ipsec profile dmvpnprof !
interface Ethernet0 no ip address half-duplex !
interface FastEthernet0 no ip address no ip mroute-cache
speed auto pppoe enable pppoe-client dial-pool-number 1
! !--- This is the outbound interface. interface Dialer1
ip address 2.2.2.10 255.255.255.0 ip inspect in2out out
ip access-group 100 in encapsulation ppp dialer pool 1
dialer-group 1 ppp authentication pap chap callin ! !---
Enable a routing protocol to send/receive dynamic !---
updates about the private networks. router ospf 1 log-
adjacency-changes redistribute connected network
172.16.0.0 0.0.0.255 area 0 network 192.168.116.0
0.0.0.255 area 0 ! !--- Except the private network
traffic from the NAT process. ip nat inside source
route-map nonat interface Dialer1 overload ip classless
ip route 0.0.0.0 0.0.0.0 14.24.1.1 ip route 0.0.0.0
0.0.0.0 Dialer1 no ip http server no ip http secure-
server ! ! ! !--- Allow ISAKMP, ESP, and GRE traffic
inbound. !--- Cisco IOS Firewall opens inbound access as
needed. access-list 100 permit udp any host 14.24.116.1
eq 500 access-list 100 premit esp any host 14.24.116.1
access-list 100 permit gre any host 14.24.116.1 access-
list 100 deny ip any any !--- Except the private network
traffic from the NAT process. access-list 110 deny ip
192.168.116.0 0.0.0.255 192.168.117.0 0.0.0.255 access-
list 110 deny ip 192.168.116.0 0.0.0.255 192.168.118.0
0.0.0.255 access-list 110 deny ip 192.168.116.0
0.0.0.255 192.168.120.0 0.0.0.255 access-list 110 permit
ip 192.168.116.0 0.0.0.255 any dialer-list 1 protocol ip
permit ! !--- Except the private network traffic from
the NAT process. route-map nonat permit 10 match ip
address 110 ! ! line con 0 exec-timeout 0 0 line aux 0
line vty 0 4 login ! no scheduler allocate end 1720-b#
```

**輻條3 - 1720-A**

```
W2N-6.16-1720-A#write terminal
Building configuration...

Current configuration : 2303 bytes
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname W2N-6.16-1720-A
!
logging queue-limit 100
!
memory-size iomem 25
ip subnet-zero
!
!
no ip domain lookup
!
ip cef
!--- This is the Cisco IOS Firewall configuration and
what to inspect. !--- This is applied outbound on the
external interface. ip inspect name in2out rcmd ip
inspect name in2out tftp ip inspect name in2out udp ip
inspect name in2out tcp timeout 43200 ip inspect name
in2out realaudio ip inspect name in2out vdolive ip
inspect name in2out netshow ip audit notify log ip audit
po max-events 100 ! ! ! ! !--- Create an ISAKMP policy
for !--- Phase 1 negotiations. crypto isakmp policy 5
authentication pre-share group 2 !--- Add dynamic pre-
shared key. crypto isakmp key dmvpnkey address 0.0.0.0
0.0.0.0 ! ! !--- Create the Phase 2 policy for actual
data encryption. crypto ipsec transform-set dmvpnset
esp-3des esp-sha-hmac ! !--- Create an IPsec profile to
be applied dynamically !--- to the GRE over IPsec
tunnels. crypto ipsec profile dmvpnprof set transform-
set dmvpnset ! ! ! ! ! !--- This is the inbound
interface. interface Loopback1 ip address 192.168.120.1
255.255.255.0 ip nat inside ! !--- Create a GRE tunnel
template to be applied to !--- all the dynamically
created GRE tunnels. interface Tunnel1 description HOST
DYNAMIC TUNNEL bandwidth 1000 ip address 172.16.0.4
255.255.255.0 no ip redirects ip mtu 1416 ip nhrp
authentication dmvpn ip nhrp map multicast dynamic ip
nhrp map 172.16.0.1 14.24.117.1 ip nhrp map multicast
14.24.117.1 ip nhrp network-id 99 ip nhrp holdtime 300
ip nhrp nhs 172.16.0.1 ip ospf network broadcast no ip
mroute-cache delay 1000 tunnel source FastEthernet0
tunnel mode gre multipoint tunnel key 100000 tunnel
protection ipsec profile dmvpnprof ! interface Ethernet0
no ip address no ip mroute-cache half-duplex ! !--- This
is the outbound interface. interface FastEthernet0 ip
address 14.24.120.1 255.255.0.0 ip nat outside ip
inspect in2out out ip access-group 100 in no ip mroute-
cache speed auto ! !--- Enable a routing protocol to
send/receive dynamic !--- updates about the private
networks. router ospf 1 log-adjacency-changes
redistribute connected network 172.16.0.0 0.0.0.255 area
0 network 192.168.120.0 0.0.0.255 area 0 ! !--- Except
the private network traffic from the NAT process. ip nat
inside source route-map nonat interface FastEthernet0
```

```
overload ip classless ip route 0.0.0.0 0.0.0.0 14.24.1.1
ip route 2.0.0.0 255.0.0.0 14.24.121.1 no ip http server
no ip http secure-server ! ! ! !--- Allow ISAKMP, ESP,
and GRE traffic inbound. !--- Cisco IOS Firewall opens
inbound access as needed. access-list 100 permit udp any
host 14.24.116.1 eq 500 access-list 100 premit esp any
host 14.24.116.1 access-list 100 permit gre any host
14.24.116.1 access-list 100 deny ip any any access-list
110 permit ip 192.168.120.0 0.0.0.255 any !--- Except
the private network traffic from the NAT process.
access-list 110 deny ip 192.168.120.0 0.0.0.255
192.168.116.0 0.0.0.255 access-list 110 deny ip
192.168.120.0 0.0.0.255 192.168.117.0 0.0.0.255 access-
list 110 deny ip 192.168.120.0 0.0.0.255 192.168.118.0
0.0.0.255 access-list 110 permit ip 192.168.120.0
0.0.0.255 any ! !--- Except the private network traffic
from the NAT process. route-map nonat permit 10 match ip
address 110 ! ! line con 0 exec-timeout 0 0 line aux 0
line vty 0 4 login ! end W2N-6.16-1720-A#
```

# 驗證

使用本節內容，確認您的組態是否正常運作。

輸出直譯器工具(僅供已註冊客戶使用)(OIT)支援某些**show**命令。使用OIT檢視**show**命令輸出的分析。

- **show crypto isakmp sa** — 顯示ISAKMP安全關聯(SA)的狀態。
- **show crypto engine connections active** — 顯示每個SA的加密/解密總數。
- **show crypto ipsec sa** — 顯示活動隧道的統計資訊。
- **show ip route** — 顯示路由表。
- **show ip ospf neighbor** — 按介面顯示OSPF鄰居資訊。
- **show ip nhrp** — 顯示IP下一跳解析協定(NHRP)快取，可選擇僅限於特定介面的動態或靜態快取條目。

# 疑難排解

本節提供的資訊可用於對組態進行疑難排解。

## 疑難排解指令

**註：發出**debug指令之前，請先參閱有關Debug指令的**重要**資訊。

- **debug crypto ipsec** — 顯示IPsec事件。
- **debug crypto isakmp** — 顯示有關IKE事件的消息。
- **debug crypto engine** — 顯示來自加密引擎的資訊。

有關IPsec故障排除的其他資訊，請參閱IP安全故障排除 — 瞭解和使用debug命令。

# 相關資訊

- **Cisco IOS防火牆配置故障排除**

- DMVPN和Cisco IOS概述
- IPSec 協商/IKE 通訊協定
- 技術支援與文件 - Cisco Systems