

使用ISIS遠端LFA的MPLS L3VPN配置示例

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簡介

本文說明如何使用ISIS遠端無回圈替代(LFA)功能設定多重協定標籤交換(MPLS)第3層Vpn。文中提供一個範例網路情境及其組態和輸出，以便更好瞭解。

必要條件

需求

本文檔沒有具體要求，但是對MPLS的基本瞭解和ISIS協定的工作知識無疑會有所幫助。

採用元件

本文件所述內容不限於特定軟體和硬體版本。

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。

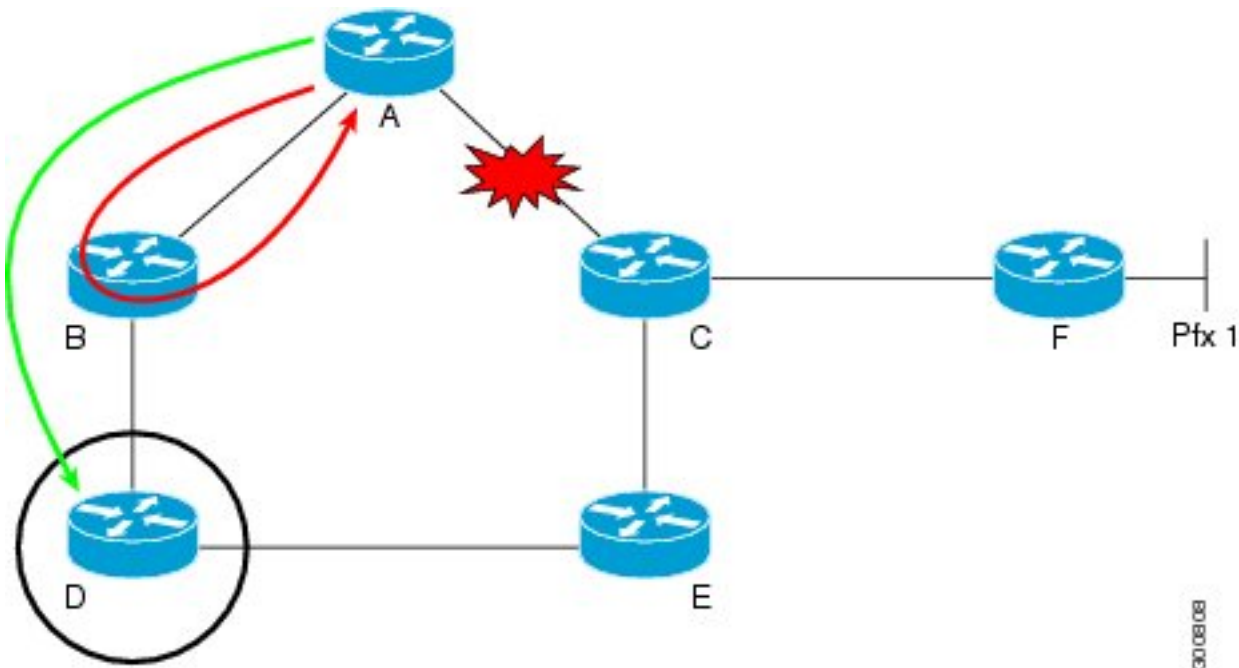
背景資訊

ISIS在全球的ISP中廣泛部署，MPLS第3層Vpn是ISP提供的最常見解決方案。在ISP核心基礎設施內部，鏈路故障直接影響效能，因此非常希望亞秒級收斂。MPLS隧道鏈路保護和節點保護等功能可以解決這些問題，但需要手動配置。

ISIS遠端LFA利用了以下概念：對於給定的區域，所有ISIS路由器將具有相同的鏈路狀態資料庫。如果路由器A需要通過路由器B選擇到目標X的備份路徑，則路由器A可以選擇路由器B作為備份下一跳，前提是路由器B不使用路由器A作為目標X的下一跳。這可以實現，因為所有路由器都有相同的資料庫。這是LFA功能的基本思想。現在，此備份路徑直接程式設計到思科快速轉發(CEF)條目中，在主路由發生故障後立即使用。這樣，路由協定就可以按照傳統計時器收斂。

ISIS遠端LFA

要更好地瞭解遠端LFA的工作方式，請考慮以下圖表：



流量從路由器A流向採用路徑A—C—F的F。如果路由器A和C之間的鏈路斷開。路由器A隨後可以將目的地為F的資料包立即傳送到路由器B，但這不會解決問題。因為鏈路剛剛斷開，而ISIS拓撲沒有意識到變化。如果資料包到達路由器B，則路由器B仍舊有路由資訊，並且仍具有通過A路由到F的條目。因此，資料包會在B和A之間循環，直到點拓撲收斂。

要解決此問題，請將資料包從路由器A隧道傳送到路由器D。路由器D從未使用通過路由器A的路徑來轉到F。現在，當路由器A和C之間的鏈路發生故障時，在不收斂的情況下立即通過隧道將發往路由器F的流量傳送到路由器D。現在，路由器D在從路由器A獲得發往路由器F的隧道流量時，不會察覺到拓撲的任何變化，而是通過其正常路由邏輯轉發資料包。因此，流量不受影響，同時拓撲可以重新收斂。

設定

網路圖表

帶遠端LFA的MPLS第3層Vpn的拓撲：

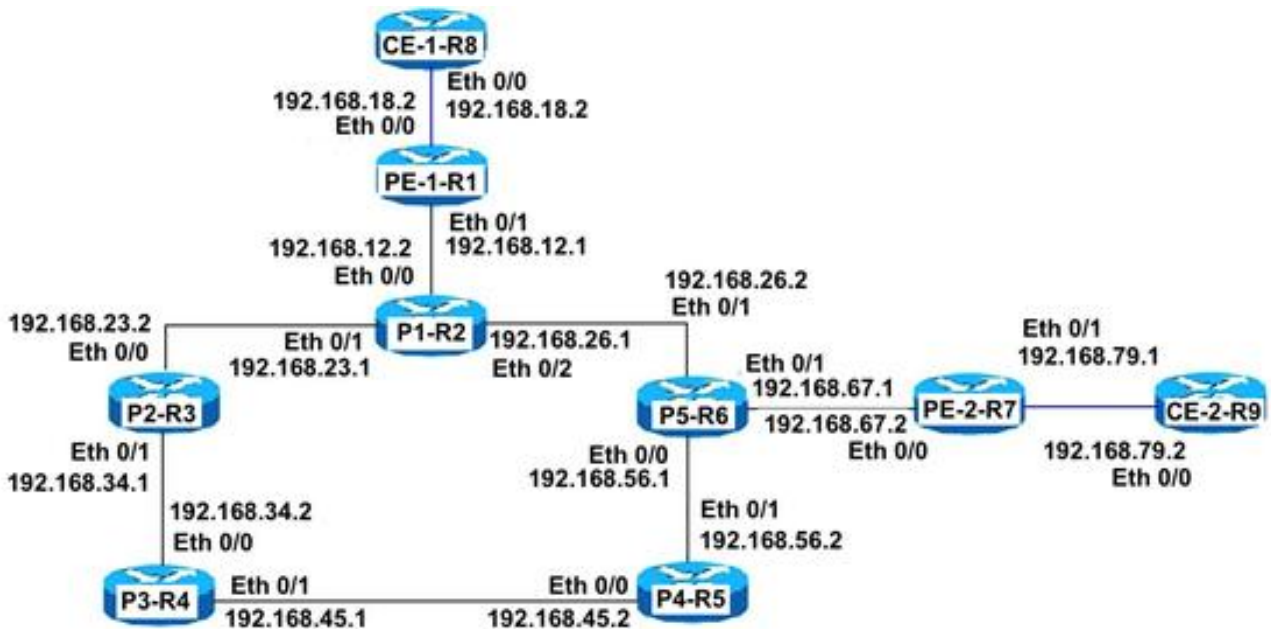
縮寫

CE = 客戶邊緣路由器

PE = 提供商邊緣路由器

P = 提供商路由器

使用的環回是192.168.255.X，其中X路由器號。例如，如果考慮R1，則環回是192.168.255.1。



組態

CPE-1-R8

#Basic用預設路由配置CE:

```
interface Ethernet0/0
ip address 192.168.18.8 255.255.255.0
!
!
ip route 0.0.0.0 0.0.0.0 192.168.18.1
!
!
```

CPE-2-R8

#Basic用預設路由配置CE。

```
interface Ethernet0/0
ip address 192.168.79.9 255.255.255.0
!
!
ip route 0.0.0.0 0.0.0.0 192.168.79.7
!
!
```

PE-1-R1

PE配置數量

```
interface Loopback1
ip address 192.168.255.1 255.255.255.255
ip router isis TAC
!
interface Ethernet0/0
vrf forwarding A
ip address 192.168.18.1 255.255.255.0
!
```

ISIS介面必須為點對點

```
interface Ethernet0/1
ip address 192.168.12.1 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
!
```

#配置ISIS遠端LFA

```
router isis TAC
net 49.0000.0000.0001.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
mpls ldp autoconfig level-2
!
```

BGP Vpvn4與PE-2-R7對等

```
router bgp 65000
bgp log-neighbor-changes
no bgp default ipv4-unicast
neighbor 192.168.255.7 remote-as 65000
neighbor 192.168.255.7 update-source Loopback1
!
address-family ipv4
exit-address-family
!
```

```
address-family vpnv4
neighbor 192.168.255.7 activate
neighbor 192.168.255.7 send-community both
exit-address-family
!
address-family ipv4 vrf A
redistribute connected
exit-address-family
!
```

P1-R2

P配置

```
interface Loopback1
ip address 192.168.255.2 255.255.255.255
ip router isis TAC
!
```

ISIS介面必須為點對點

```
interface Ethernet0/0
ip address 192.168.12.2 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/1
ip address 192.168.23.2 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/2
ip address 192.168.26.2 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
!
```

#配置ISIS遠端LFA

```
router isis TAC
net 49.0000.0000.0002.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
!
```

P2-R3

P配置

```
interface Loopback1
ip address 192.168.255.3 255.255.255.255
ip router isis TAC
!
```

ISIS介面必須為點對點

```
interface Ethernet0/0
ip address 192.168.23.3 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/1
ip address 192.168.34.3 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
!
```

#配置ISIS遠端LFA

```
router isis TAC
net 49.0000.0000.0003.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
!
```

P3-R4

P配置

```
interface Loopback1
ip address 192.168.255.4 255.255.255.255
ip router isis TAC
!
```

ISIS介面必須為點對點

```
interface Ethernet0/0
ip address 192.168.34.4 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/1
ip address 192.168.45.4 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
```

```
isis network point-to-point
```

```
!
```

```
!
```

#配置ISIS遠端LFA

```
router isis TAC
net 49.0000.0000.0004.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
```

P4-R5

P配置

```
interface Loopback1
ip address 192.168.255.5 255.255.255.255
ip router isis TAC
```

```
!
```

ISIS介面必須為點對點

```
interface Ethernet0/0
ip address 192.168.45.5 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
```

```
!
```

```
interface Ethernet0/1
ip address 192.168.56.5 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
```

```
!
```

```
!
```

#配置ISIS遠端LFA

```
router isis TAC
net 49.0000.0000.0005.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
```

P5-R6

P配置

```
interface Loopback1
ip address 192.168.255.6 255.255.255.255
ip router isis TAC
```

```
!
```

ISIS介面必須為點對點

```
interface Ethernet0/0
ip address 192.168.56.6 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/1
ip address 192.168.26.6 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/2
ip address 192.168.67.6 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
```

#配置ISIS遠端LFA

```
router isis TAC
net 49.0000.0000.0006.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
!
```

PE-2-R7

PE配置數量

```
interface Loopback1
ip address 192.168.255.7 255.255.255.255
ip router isis TAC
!
```

ISIS介面必須為點對點

```
interface Ethernet0/0
ip address 192.168.67.7 255.255.255.0
ip router isis TAC
mpls ip
isis circuit-type level-2-only
isis network point-to-point
!
interface Ethernet0/1
vrf forwarding A
ip address 192.168.79.7 255.255.255.0
!
```

#配置ISIS遠端LFA


```
router isis TAC
net 49.0000.0000.0007.00
is-type level-2-only
metric-style wide
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-2 mpls-ldp
!
```

BGP Vpnv4與PE-1-R1對等

```
router bgp 65000
bgp log-neighbor-changes
no bgp default ipv4-unicast
neighbor 192.168.255.1 remote-as 65000
neighbor 192.168.255.1 update-source Loopback1
!
address-family ipv4
exit-address-family
!
address-family vpnv4
neighbor 192.168.255.1 activate
neighbor 192.168.255.1 send-community both
exit-address-family
!
address-family ipv4 vrf A
redistribute connected
exit-address-family
!
```

驗證

使用本節內容，確認您的組態是否正常運作。

P1-R2

show isis fast-reroute remote-lfa tunnels命令顯示路由器上構建的遠端LFA隧道：

```
P1-R2#show isis fast-reroute remote-lfa tunnels
Tag TAC - Fast-Reroute Remote-LFA Tunnels: MPLS-Remote-Lfa1: use Et0/2, nexthop 192.168.26.6,
end point 192.168.255.5
MPLS-Remote-Lfa2: use Et0/1, nexthop 192.168.23.3, end point 192.168.255.4
```

P2-R3

```
P2-R3#show isis fast-reroute remote-lfa tunnels
Tag TAC - Fast-Reroute Remote-LFA Tunnels: MPLS-Remote-Lfa1: use Et0/1, nexthop 192.168.34.4,
end point 192.168.255.5
MPLS-Remote-Lfa2: use Et0/0, nexthop 192.168.23.2, end point 192.168.255.6
```

P3-R4

```
P3-R4#show isis fast-reroute remote-lfa tunnels
Tag TAC - Fast-Reroute Remote-LFA Tunnels: MPLS-Remote-Lfa1: use Et0/1, nexthop 192.168.45.5,
end point 192.168.255.6
```

```
MPLS-Remote-Lfa2: use Et0/0, nexthop 192.168.34.3, end point 192.168.255.2
```

P4-R5

```
P4-R5#show isis fast-reroute remote-lfa tunnels
```

```
Tag TAC - Fast-Reroute Remote-LFA Tunnels: MPLS-Remote-Lfa1: use Et0/0, nexthop 192.168.45.4,  
end point 192.168.255.3
```

```
MPLS-Remote-Lfa2: use Et0/1, nexthop 192.168.56.6, end point 192.168.255.2
```

P5-R6

```
P5-R6#show isis fast-reroute remote-lfa tunnels
```

```
Tag TAC - Fast-Reroute Remote-LFA Tunnels: MPLS-Remote-Lfa1: use Et0/0, nexthop 192.168.56.5,  
end point 192.168.255.4
```

```
MPLS-Remote-Lfa2: use Et0/1, nexthop 192.168.26.2, end point 192.168.255.3
```

核心方案中的故障，配置LFA時核心中的流量。

在導致鏈路故障之前，如果您檢查P-1-R2，您會看到在P-1-R2和P-5-R4之間已經形成了目標LDP會話，作為RLFA的備用路徑。沒有RLFA，路由協定必須檢測故障，並需要重新收斂。

```
P-1-R2#show ip route repair-paths 192.168.255.7
```

```
Routing entry for 192.168.255.7/32
```

```
Known via "isis", distance 115, metric 30, type level-c
```

```
Redistributing via isis TAC
```

```
Last update from 192.168.26.6 on Ethernet0/2, 02:23:31 ago
```

```
Routing Descriptor Blocks:
```

```
* 192.168.26.6, from 192.168.255.7, 02:23:31 ago, via Ethernet0/2
```

```
Route metric is 30, traffic share count is 1
```

```
Repair Path: 192.168.255.4, via MPLS-Remote-Lfa6
```

```
[RPR]192.168.255.4, from 192.168.255.7, 02:23:31 ago, via MPLS-Remote-Lfa6
```

```
Route metric is 20, traffic share count is 1
```

```
P-1-R2#show mpls ldp neighbor 192.168.255.4
```

```
Peer LDP Ident: 192.168.255.4:0; Local LDP Ident 192.168.255.2:0
```

```
TCP connection: 192.168.255.4.32391 - 192.168.255.2.646
```

```
State: Oper; Msgs sent/rcvd: 184/183; Downstream
```

```
Up time: 02:26:09
```

```
LDP discovery sources:
```

```
Targeted Hello 192.168.255.2 -> 192.168.255.4, active, passive
```

```
Addresses bound to peer LDP Ident:
```

```
192.168.255.4 192.168.34.4 192.168.45.4
```

此處可以觀察到，路由表中到PE2-R7的修復路徑是通過192.168.255.4(P3-R4)。作為遠端LFA邏輯的一部分，隧道預先構建到P3-R4。因此，每當主鏈路發生故障時，資料包都會立即通過隧道傳輸到P3-R4，而此情況線上路卡級別發生，因為條目是預先構建的。因此，沒有流量中斷，並且轉發是無縫的。然後，ISIS協定可以根據其配置的計時器進行收斂。

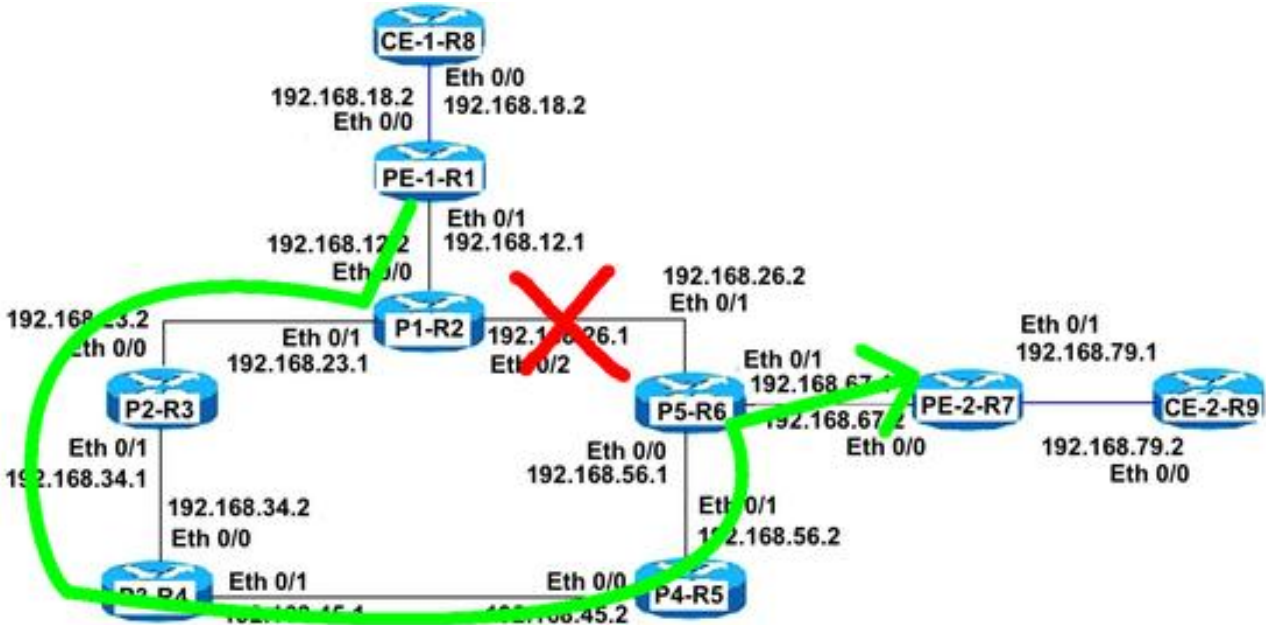
P1-R2路由器不需要查詢備份路徑，因為在出現故障之前，已經有一個CEF條目通過P2-R3形成。

```
P1-R2#show ip cef 192.168.255.7
```

```
nexthop 192.168.26.6 Ethernet0/2 label [25|26]
```

repair: attached-next-hop 192.168.255.4 MPLS-Remote-Lfa6

此圖顯示先前說明的確切行為：



P1-R2

為了進行驗證，在通過關閉P1-R2和P5-R6之間的核心鏈路(Eth 0/2)重新建立故障場景後，從CE-1-R8連續向CE-2-R9執行ping操作，即使在測試環境中也未觀察到一次丟棄。

```
CE-1-R8#ping 192.168.79.9
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.79.9, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! <Ouput Snipped>
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!

Success rate is 100 percent (149320/149320), round-trip min/avg/max = 1/1/18 ms
```

疑難排解

目前尚無適用於此組態的具體疑難排解資訊。