案例研究：ACI交換矩陣中的第3層組播

目錄

簡介

從2.0版本開始的ACI交換矩陣支援第3層組播路由，並且需要EX交換機(即N9K-C93180YC-EX)。在版本2.0之前，ACI僅支援網橋域內的第2層組播。　在2.0中這仍是一個有效的選項，可用於非EX交換機。

在ACI版本2.0中，支援的組播路由功能包括：PIM ASM、PIM SSM、靜態RP、PIM自動RP和PIM BSR。

在本文檔中，我們介紹一個經驗證的解決方案，用於在ACI交換矩陣上進行L3組播路由的實際客戶部署方案。選定的ACI版本為2.1(1h)。 此版本不支援交換矩陣上的RP，因此PIM ASM需要外部RP。

設計要求

客戶需要端到端解決方案，以便在交換矩陣內外進行L3組播路由。部署方案具有以下要求：

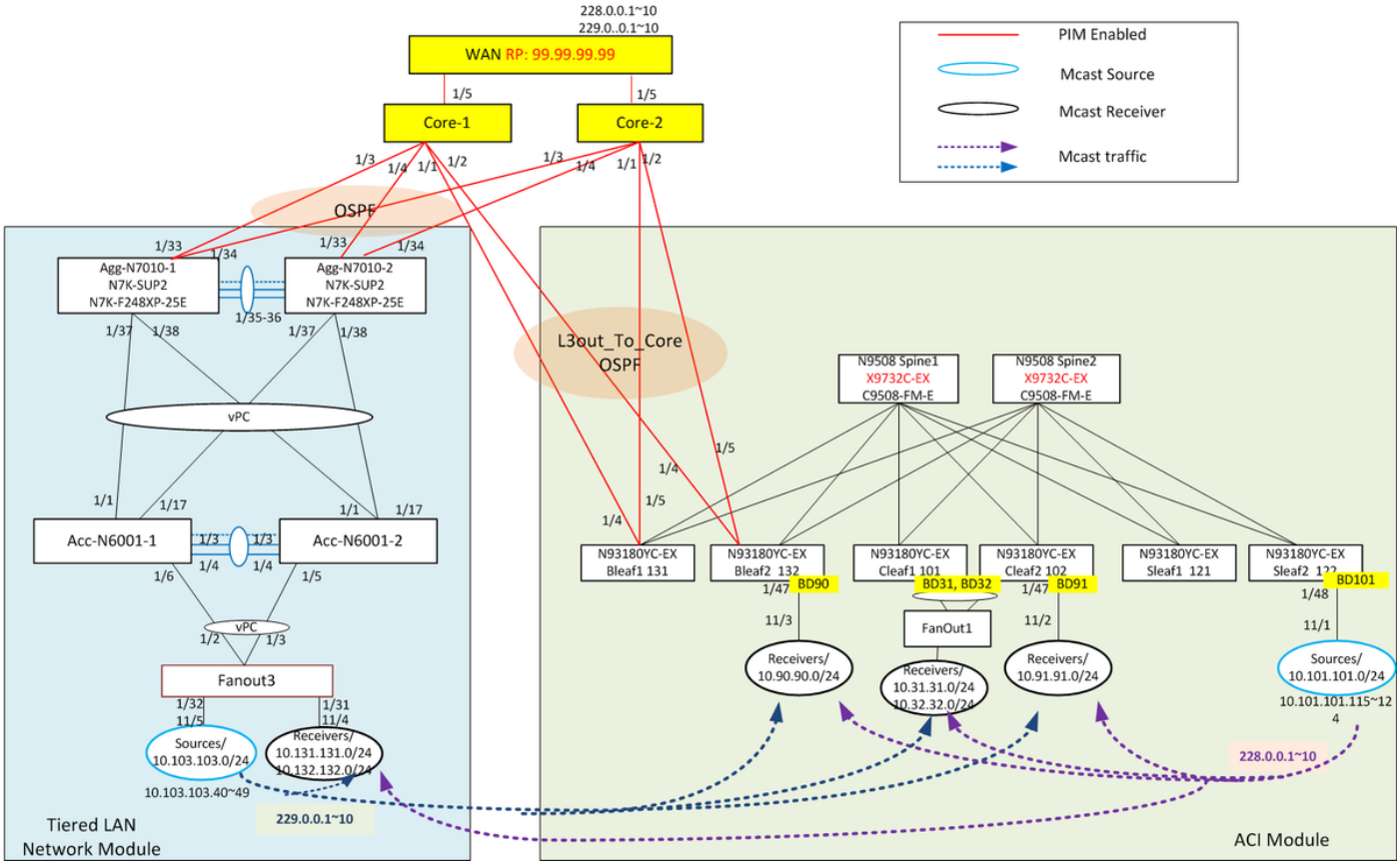
- 為所有租戶部署一個VRF。

附註：組播需要每個VRF的專用L3out。如果交換矩陣中有多個VRF，則組播路由不支援共用L3out。

- 帶有外部源的織物中的接收器
- 帶有外部接收器的交換矩陣中的源
- 結構中的源和接收器
- 靜態RP或自動RP

解決方案

拓撲檢查



在拓撲中，有兩個主要元件：aci模組和分層LAN網路模組。兩個模組通過運行OSPF和PIM的點對點L3鏈路連線到核心裝置。在ACI模組中，外部路由網路稱為與VRF common:default關聯的L3out-to-Core。它包括從兩個邊界枝葉到核心裝置的四個鏈路。分層LAN網路模組（稱為交換矩陣外部）由傳統的接入層和使用vPC的匯聚層組成。

第3層組播流通過核心層在ACI交換矩陣和傳統LAN網路上運行。對於靜態RP方案，RP部署在WAN邊緣裝置上。

我們使用Spirent流量生成器(STC)來模擬內部和外部的源和接收器。Spirent埠連線到ACI模組和分層區域網網路模組中的不同位置。接收器傳送IGMP v2成員資格加入消息。

連線到Sleaf2的內部源：源IP地址為10.101.101.115~124，傳送到組地址：228.0.0.1~10

連線到Bleaf1、Cleaf1和Cleaf2的內部接收器：支援組播的BD是BD90、BD91、BD31、BD32，感興趣的組：228.0.0.1~10和229.0.0.1~10。

連線到LAN網路中接入層的外部源：源IP地址為10.103.103.40~49，傳送到組地址：229.0.0.1~10。

連線到LAN網路中接入層的外部接收器：vlan131、vlan132，感興趣的組：228.0.0.1~10。

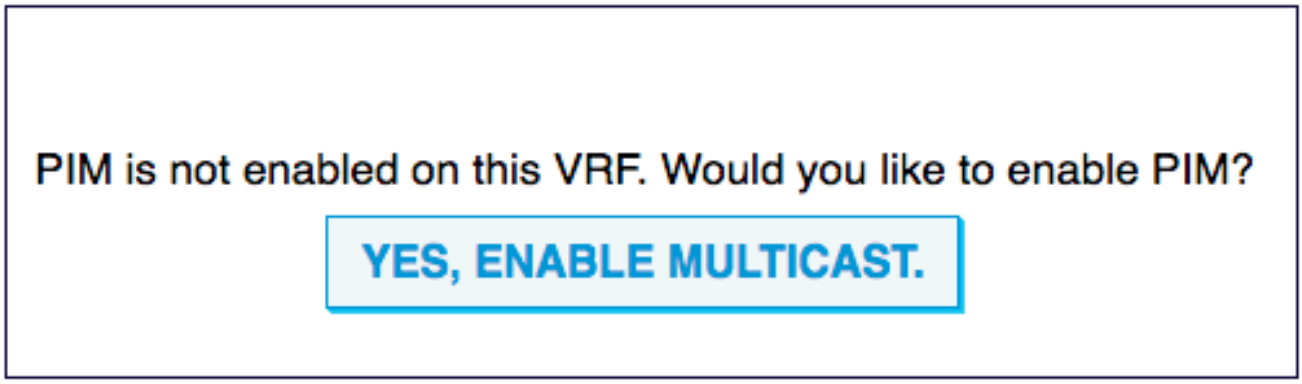
組態

第0步: 在連線到核心的模擬WAN裝置上設定RP，在分層LAN網路裝置上啟用PIM稀疏模式。

```
!!!!! RP configuration

ip pim rp-address 99.99.99.99 group-list 224.0.0.0/4
```

```
ip pim ssm range 232.0.0.0/8

interface loopback99
  ip address 99.99.99.99/32
  ip router ospf 65017 area 0.0.0.0
  ip pim sparse-mode

interface Ethernet2/1
  ip pim sparse-mode

interface Ethernet2/2
  ip pim sparse-mode
```

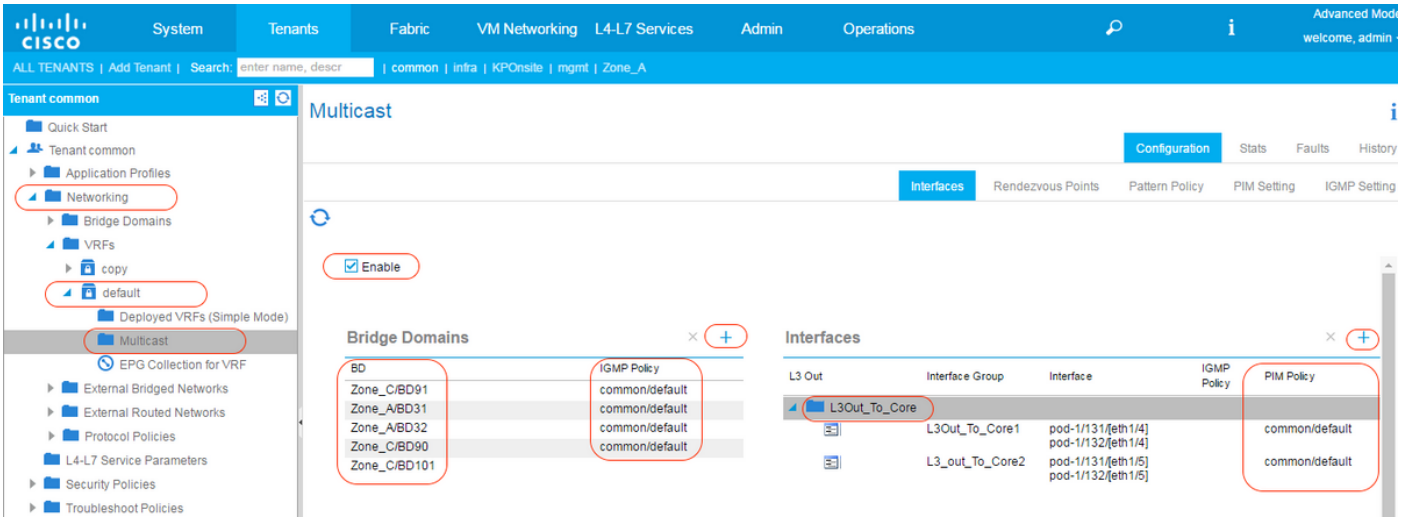
第1步：在VRF上啟用組播。在租戶空間中，導航到Networking > VRFs > Multicast，在工作面板上按一下黃油以啟用組播。



第2步：在BD和L3out級別啟用組播，為接收方BD啟用IGMP。導航到Networking > VRFs > VRF name > Multicast，在工作面板上，選擇Configuration > Interface頁籤，按一下「+」以新增需要組播流量的網橋域。為啟用組播的BD啟用IMGP策略。

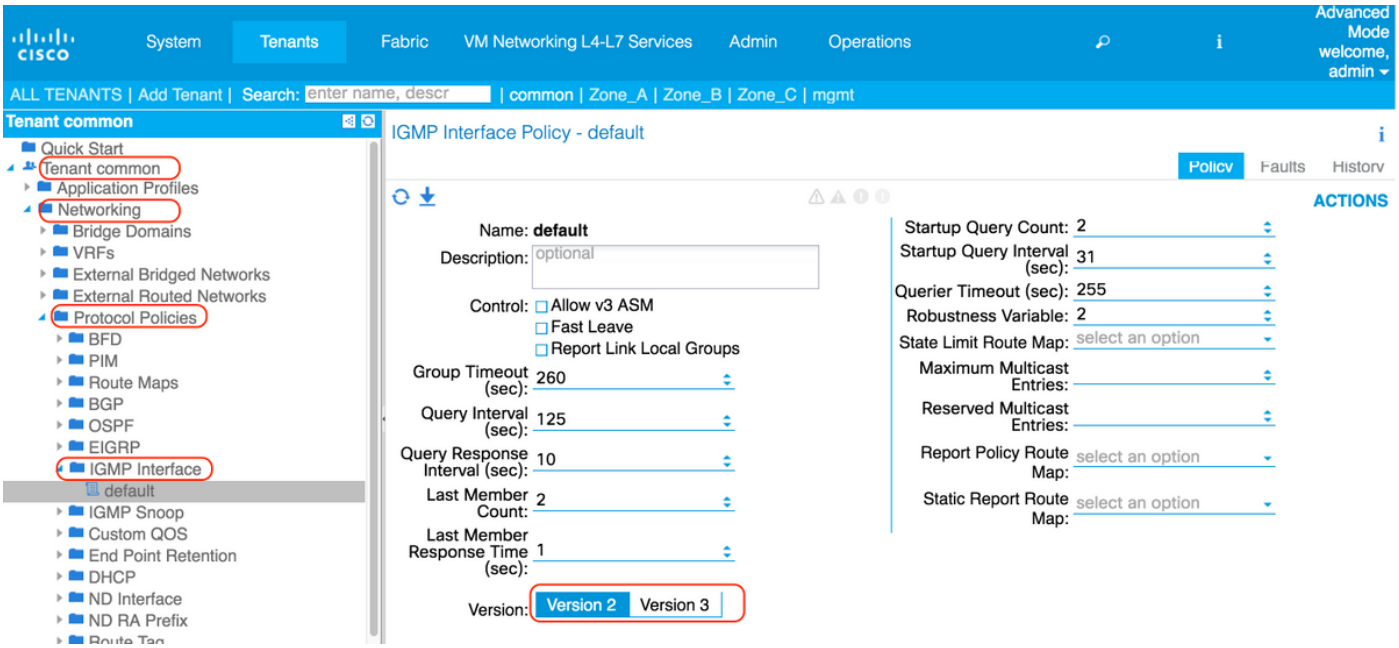
然後按一下「+」新增此VRF的L3out。為L3out啟用組播時，它將在L3out下的所有介面上啟用PIM，並且該L3out的所有邊界保留均通過組播路由啟用。為L3out介面組選擇PIM策略。

這裡假設BD和L3out已調配。



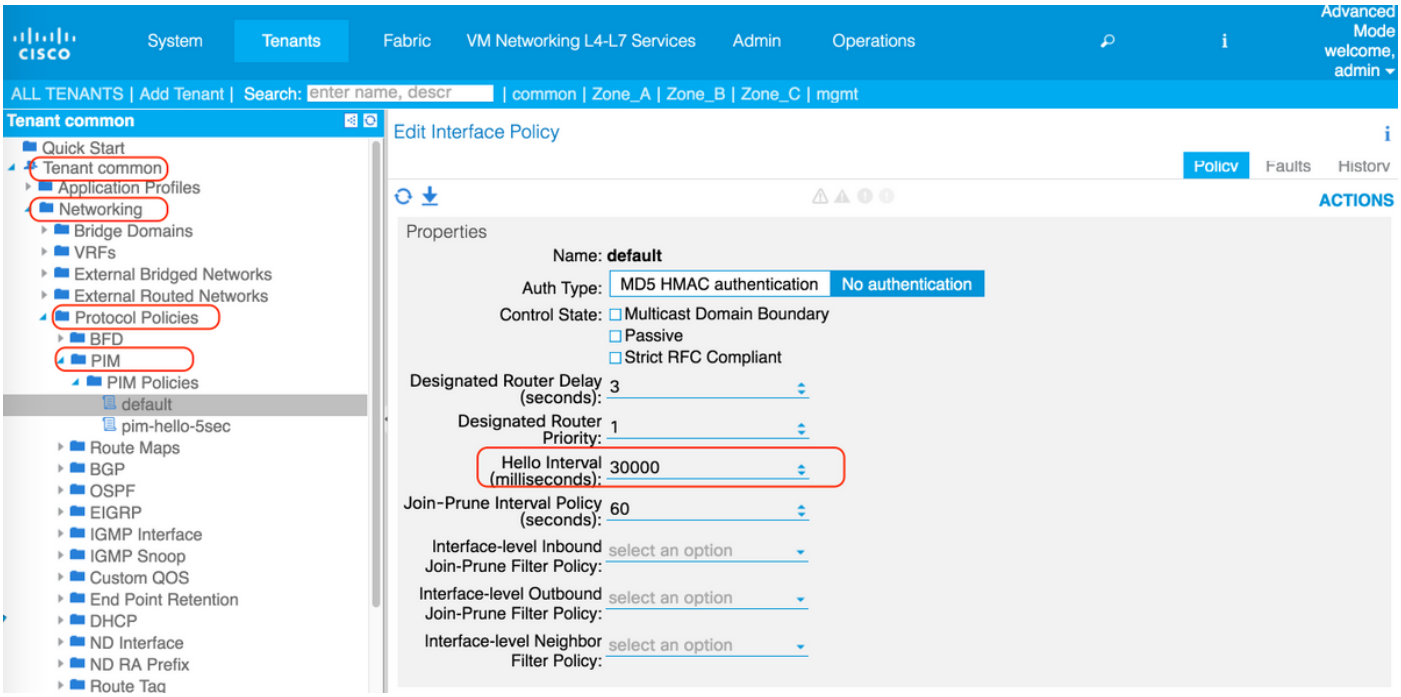
將IGMP策略附加到BD使其也成為IGMP查詢器。IGMP策略在Tenant > Networking > Protocol Policies > IGMP Interface下配置。預設IGMP策略具有以下引數，您可以在其中定義查詢間隔。如

果未指定任何策略，介面將使用預設策略。

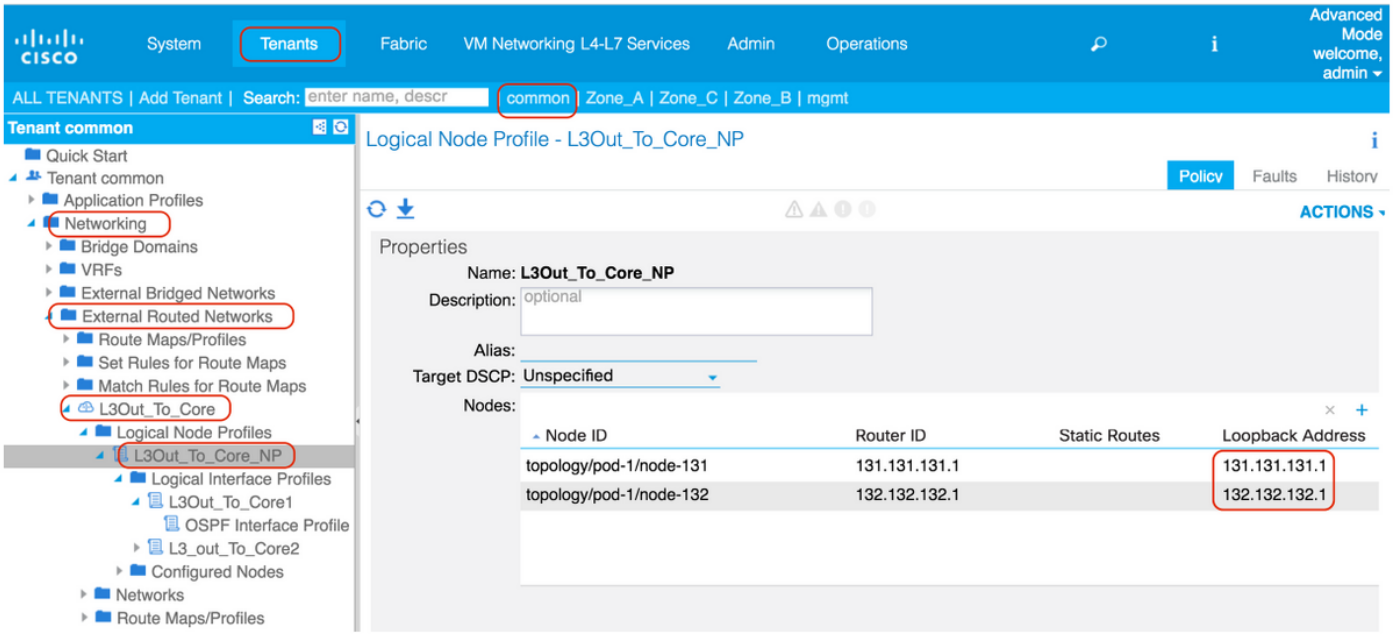


PIM策略也配置在Tenant > Networking > Protocol Policies > PIM下。

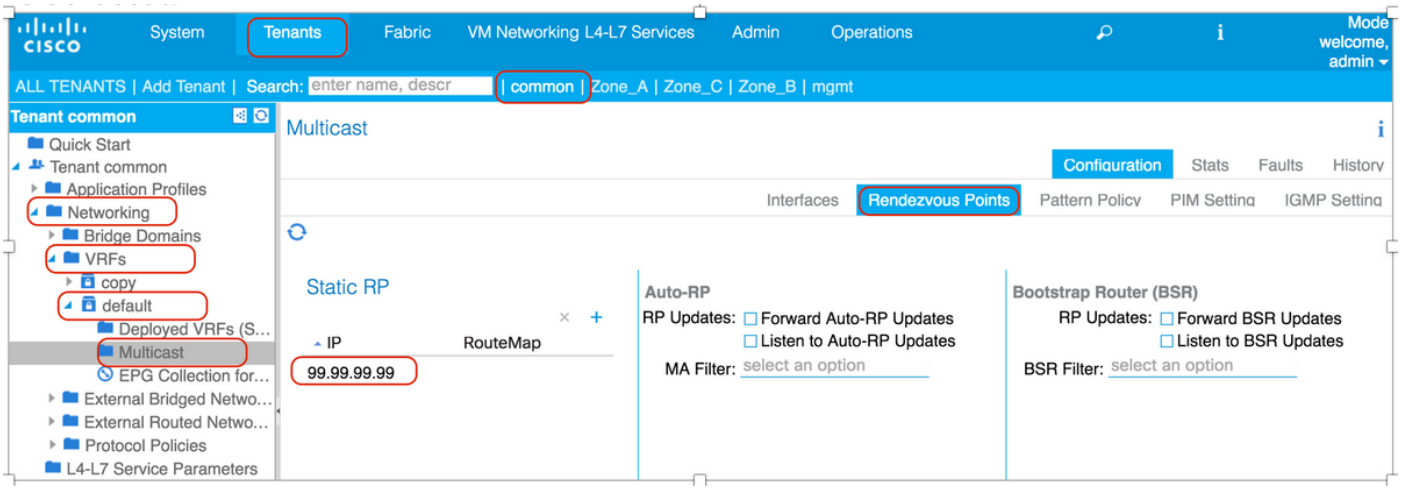
預設PIM策略具有以下引數，您可以在其中定義hello間隔。



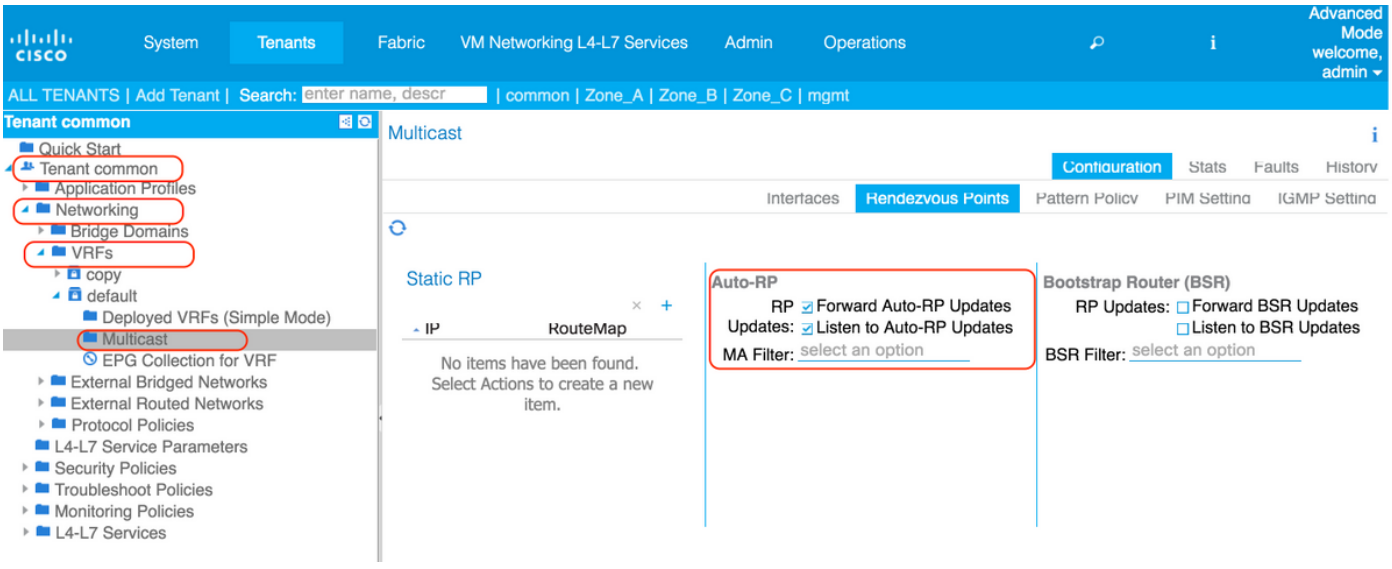
邊界枝葉上的L3Outs必須配置為在節點配置檔案中啟用環回地址。



步驟3:為PIM ASM配置RP。導航到Tenant > VRF > Multicast，在工作面板中選擇Configuration > Rendezvous Points。在此示例中，選擇靜態RP。按一下「+」新增RP。



對於自動RP配置，請選中「集結點」頁面上的「轉發自動RP更新」和「偵聽自動RP更新」覈取方塊。



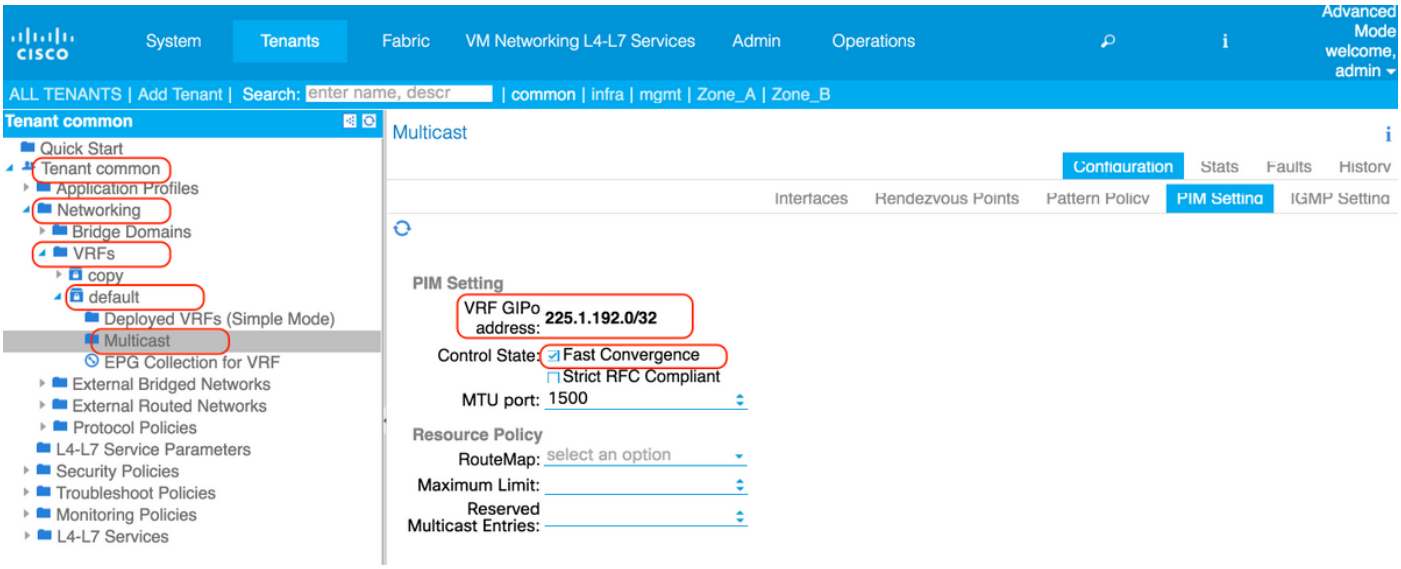
在ACI交換矩陣之外，NX-OS平台上的自動RP配置保持不變。

```
!!! On RP candidate

ip pim send-rp-announce loopback99 group-list 224.0.0.0/4
ip pim send-rp-discovery loopback99 scope 32

!!! On RP listeners:
ip pim auto-rp listen forward
```

第4步：配置必要的PIM設定。導航到Tenant >VRF -> Multicast，在工作面板中選擇Configuration > PIM settings，注意VRF GIPo地址225.1.192.0/32，該地址由APIC從組播組地址池分配。對於啟用了PIM的BD，VRF GIPo將用作組播流量的外部組IP地址。

啟用**快速收斂**模式後（預設情況下為禁用），所有啟用了PIM的邊界枝葉都將向外部網路傳送連線，但只有一個邊界枝葉會將流量轉發到交換矩陣以防止重複。轉發組流量的邊界枝葉是組**的指定**轉發器。當由於邊界枝葉關閉而出現條帶優勝者更改時，啟用快速收斂有助於縮短包含外部源和內部接收器的組播流的丟包持續時間。從新的條帶優勝者加入PIM樹不會產生延遲。這將犧牲非條帶優勝者的外部鏈路上的額外頻寬使用量，因為所有邊界都會從外部源抽取流量。

About the Stripe Winner — 當前ACI使用BSR(Bootstrap Router)雜湊計算BL條帶贏家。 使用枝葉的S、G和環回IP計算雜湊。 從ACI 3.0(1)開始，無法影響使用者的條帶獲勝者選擇。



第5步：建立所需的合約以允許組播流量：

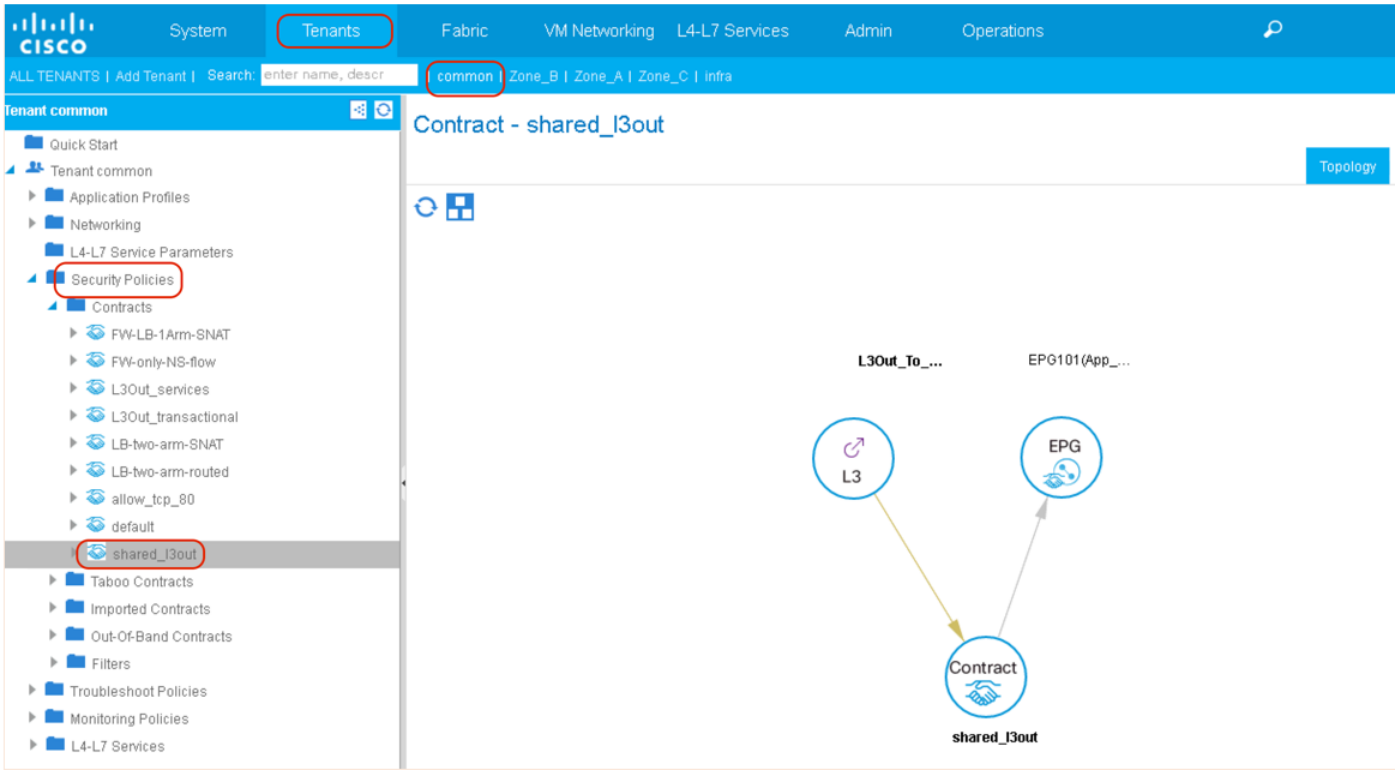
— 交換矩陣內的源和接收器（無需合約）

— 交換矩陣內的接收器，外部源（不需要合約）

— 來源內部交換矩陣，外部接收器（需要合約）*

*如果BD部署在邊界枝葉上，則不需要合約

在本例中，我們在交換矩陣之外有接收器，應用L3out_to_Core與EPG101中組播源之間的合約。



驗證

PIM驗證

當為組播路由啟用VRF時，將為交換矩陣內的組播路由建立交換矩陣介面(通道)。PIM控制平面資料包通過交換矩陣內的交換矩陣介面傳送。隧道目標將是VRF GiPo組播地址。在邊界枝葉交換機上，隧道源將是邊界枝葉上的環回介面。在非邊界枝葉交換機上，隧道源將是環回地址(127.0.0.100)。

邊界枝葉在交換矩陣介面上傳送PIM hello。L3Out介面在正常模式下運行PIM，包括傳送和接收hello、選擇DR等。非邊界枝葉在交換矩陣介面上以被動模式運行；他們偵聽來自邊界葉的PIM hello，但不傳送PIM hello。非邊界枝葉不會顯示在「show ip pim neighbor」的輸出中。

```
!!!!! Border Leaf Node bleaf1 !!!!!
bleaf1# show ip pim neighbor

PIM Neighbor information for Dom:common:default
Neighbor              Interface            Uptime               Expires              DRPriority
Bidir      BFDState
132.132.132.1/32      tunnel16             06:20:40             00:01:21             1
no         n/a
10.1.20.25/32         eth1/5               06:23:12             00:01:35             1
yes        n/a
10.1.20.1/32          eth1/4               06:23:12             00:01:24             1
yes        n/a

bleaf1# show interface tunnel 16
Tunnel16 is up
    MTU 9000 bytes, BW 0 Kbit
    Transport protocol is in VRF "common:default"
    Tunnel protocol/transport is ivxlan
    Tunnel source 131.131.131.1
    Tunnel destination 225.1.192.0/32
    Last clearing of "show interface" counters never
```

```
    Tx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec

bleaf1#
```

!!!!! Border Leaf Node bleaf2 !!!!!

```
bleaf2# show ip pim neighbor

PIM Neighbor information for Dom:common:default
Neighbor             Interface            Uptime               Expires              DRPriority
Bidir      BFDState
131.131.131.1/32     tunnel16             06:23:26             00:01:30             1
no         n/a
10.1.20.29/32        eth1/5               06:38:26             00:01:43             1
yes        n/a
10.1.20.5/32         eth1/4               06:38:27             00:01:20             1
yes        n/a

bleaf2# show interface tunnel 16
Tunnel16 is up
    MTU 9000 bytes, BW 0 Kbit
    Transport protocol is in VRF "common:default"
    Tunnel protocol/transport is ivxlan
    Tunnel source 132.132.132.1
    Tunnel destination 225.1.192.0/32
    Last clearing of "show interface" counters never
    Tx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec

bleaf2#
```

!!!!! RP !!!!!

```
bleaf1# show ip pim rp vrf all

PIM RP Status Information for VRF:"common:default"
BSR: Not Operational
Auto-RP RPA: 192.168.1.2/32
RP: 99.99.99.99, uptime: 26d21h, expires: 00:02:38,
  priority: 0, RP-source: 192.168.1.2 (A), group-map: None, group ranges:
    224.0.0.0/4
bleaf1#

bleaf2# show ip pim rp vrf all

PIM RP Status Information for VRF:"common:default"
BSR: Not Operational
Auto-RP RPA: 192.168.1.2/32
RP: 99.99.99.99, uptime: 26d21h, expires: 00:02:38,
  priority: 0, RP-source: 192.168.1.2 (A), group-map: None, group ranges:
    224.0.0.0/4
bleaf2#
```

!!!!! Non border leaf Node !!!!!

```
cleaf1# show ip pim neighbor

PIM Neighbor information for Dom:common:default
Neighbor             Interface            Uptime               Expires              DRPriority
Bidir      BFDState
```

```
132.132.132.1/32      tunnel16             06:32:43             00:01:37             1
no         n/a
131.131.131.1/32      tunnel16             06:32:43             00:01:17             1
no         n/a

cleaf1# show interface tunnel 16
Tunnel16 is up
    MTU 9000 bytes, BW 0 Kbit
    Transport protocol is in VRF "common:default"
    Tunnel protocol/transport is ivxlan
    Tunnel source 127.0.0.100/32
    Tunnel destination 225.1.192.0/32
    Last clearing of "show interface" counters never
    Tx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec

cleaf1#

cleaf2# show ip pim neighbor vrf all

PIM Neighbor information for Dom:common:default
Neighbor              Interface            Uptime               Expires              DRPriority
Bidir      BFDState
132.132.132.1/32      tunnel16             06:33:17             00:01:33             1
no         n/a
131.131.131.1/32      tunnel16             06:33:17             00:01:41             1
no         n/a

cleaf2# show interface tunnel 16 Tunnel16 is up MTU 9000 bytes, BW 0 Kbit Transport protocol is
in VRF "common:default" Tunnel protocol/transport is ivxlan  Tunnel source 127.0.0.100/32
    Tunnel destination 225.1.192.0/32
    Last clearing of "show interface" counters never
    Tx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec

cleaf2#

!!!!!! Core Router !!!!!
N7K-core-1# show ip pim neighbor
PIM Neighbor Status for VRF "default"
Neighbor        Interface            Uptime    Expires   DR       Bidir-  BFD
                                                         Priority Capable State
10.1.20.2       Ethernet1/1          3d22h     00:01:43  1        no     n/a
10.1.20.6       Ethernet1/2          3d22h     00:01:36  1        no     n/a
10.1.20.10      Ethernet1/3          2w6d      00:01:30  1        yes     n/a
10.1.20.14      Ethernet1/4          2w6d      00:01:18  1        yes     n/a
10.1.20.42      Ethernet1/5          2w6d      00:01:28  1        yes     n/a
N7K-core-1#

N7K-core-2# sh ip pim neighbor
PIM Neighbor Status for VRF "default"
Neighbor        Interface            Uptime    Expires   DR       Bidir-  BFD
                                                         Priority Capable State
10.1.20.26      Ethernet1/1          3d22h     00:01:23  1        no     n/a
10.1.20.30      Ethernet1/2          3d22h     00:01:17  1        no     n/a
10.1.20.18      Ethernet1/3          2w6d      00:01:38  1        yes     n/a
10.1.20.22      Ethernet1/4          2w6d      00:01:41  1        yes     n/a
10.1.20.46      Ethernet1/5          2w6d      00:01:17  1        yes     n/a
N7K-core-2#
```

活動邊界枝葉驗證

如果通過組播路由啟用多個邊界枝葉，APIC會為所有活動邊界枝葉上的每個組地址選擇一個條帶勝者。作為組條帶優勝者的邊界枝葉負責代表交換矩陣傳送PIM加入並將組播流量轉發到交換矩陣。

組內的條帶優勝者決定指定轉發者。如果條帶優勝者能夠到達根，則條帶優勝者也是DF。如果條帶獲取者沒有到根的外部連線，則BL通過交換矩陣介面傳送PIM連線來選擇DF。

```
!!!!! Enter into vsh mode to execute the command !!!!!
bleaf2# vsh
Cisco iNX-OS Debug Shell
This shell should only be used for internal commands and exists
for legacy reasons. User should use ibash infrastructure as this
will be deprecated.
bleaf2# show ip pim internal stripe-winner 228.0.0.1 vrf common:default
PIM Stripe Winner info for VRF "common:default" (BL count: 2)
(*, 228.0.0.1)
BLs: 132.132.132.1  hash: 2081913316 (local)
      131.131.131.1  hash: 1024236260
Winner: 132.132.132.1 best_hash: 2081913316
bleaf2#
bleaf2#
bleaf2# show ip pim internal stripe-winner 229.0.0.1 vrf common:default
PIM Stripe Winner info for VRF "common:default" (BL count: 2)
(*, 229.0.0.1)
BLs: 132.132.132.1  hash: 1595374052 (local)
      131.131.131.1  hash: 2047646436
Winner: 131.131.131.1 best_hash: 2047646436
bleaf2#
```

快速收斂驗證

```
!!! Verify if fast convergence is enabled
bleaf1# show fabric multicast vrf common:default
Fabric Multicast Enabled VRFs
VRF Name              VRF      Vprime        VN-Seg     VRF    Conv   Tunnel
                      ID       If            ID         Role   Mode   IP
common:default        4        Tunnel16      2162688    BL     Fast   131.131.131.1
bleaf1#

!!! None-border leaf

cleaf1# show fabric multicast vrf common:default
Fabric Multicast Enabled VRFs
VRF Name              VRF      Vprime        VN-Seg     VRF    Conv   Tunnel
                      ID       If            ID         Role   Mode   IP
common:default        4        Tunnel16      2162688    Leaf   Fast   127.0.0.100
cleaf1#
```

IGMP驗證

```
!!!!! Bleaf2 receiving IGMP membership join !!!!!
bleaf2# show ip igmp groups vrf common:default
Type: S - Static, D - Dynamic, L - Local, T - SSM Translated
Displaying Groups for vrf:common:default
```

```
Group Address        Type   Interface    Uptime              Expires             Last Reporter
228.0.0.1            D      vlan25       25d23h              00:02:20            10.90.90.71
229.0.0.1            D      vlan25       25d23h              00:02:24            10.90.90.71
228.0.0.2            D      vlan25       25d23h              00:02:27            10.90.90.72
229.0.0.2            D      vlan25       25d23h              00:02:20            10.90.90.72
228.0.0.3            D      vlan25       25d23h              00:02:25            10.90.90.73
229.0.0.3            D      vlan25       25d23h              00:02:25            10.90.90.73
228.0.0.4            D      vlan25       25d23h              00:02:26            10.90.90.74
229.0.0.4            D      vlan25       25d23h              00:02:25            10.90.90.74
228.0.0.5            D      vlan25       25d23h              00:02:28            10.90.90.75
229.0.0.5            D      vlan25       25d23h              00:02:20            10.90.90.75
228.0.0.6            D      vlan25       25d23h              00:02:22            10.90.90.76
229.0.0.6            D      vlan25       25d23h              00:02:26            10.90.90.76
228.0.0.7            D      vlan25       25d23h              00:02:25            10.90.90.77
229.0.0.7            D      vlan25       25d23h              00:02:19            10.90.90.77
228.0.0.8            D      vlan25       25d23h              00:02:22            10.90.90.78
229.0.0.8            D      vlan25       25d23h              00:02:25            10.90.90.78
228.0.0.9            D      vlan25       25d23h              00:02:27            10.90.90.79
229.0.0.9            D      vlan25       25d23h              00:02:20            10.90.90.79
228.0.0.10           D      vlan25       25d23h              00:02:20            10.90.90.80
229.0.0.10           D      vlan25       25d23h              00:02:21            10.90.90.80
bleaf2#

bleaf2# show ip igmp snooping groups vlan 25
Type: S - Static, D - Dynamic, R - Router port, F - Fabricpath core port

Vlan  Group Address      Ver  Type  Port list
25    */*                -    R     Vlan25
25    228.0.0.1          v2   D     Eth1/47
25    228.0.0.2          v2   D     Eth1/47
25    228.0.0.3          v2   D     Eth1/47
25    228.0.0.4          v2   D     Eth1/47
25    228.0.0.5          v2   D     Eth1/47
25    228.0.0.6          v2   D     Eth1/47
25    228.0.0.7          v2   D     Eth1/47
25    228.0.0.8          v2   D     Eth1/47
25    228.0.0.9          v2   D     Eth1/47
25    228.0.0.10         v2   D     Eth1/47
25    229.0.0.1          v2   D     Eth1/47
25    229.0.0.2          v2   D     Eth1/47
25    229.0.0.3          v2   D     Eth1/47
25    229.0.0.4          v2   D     Eth1/47
25    229.0.0.5          v2   D     Eth1/47
25    229.0.0.6          v2   D     Eth1/47
25    229.0.0.7          v2   D     Eth1/47
25    229.0.0.8          v2   D     Eth1/47
25    229.0.0.9          v2   D     Eth1/47
25    229.0.0.10         v2   D     Eth1/47
bleaf2#

!!!!! cleaf2 receivng IGMP membership join !!!!!
cleaf2# show ip igmp groups vrf common:default
Type: S - Static, D - Dynamic, L - Local, T - SSM Translated
Displaying Groups for vrf:common:default
Group Address        Type   Interface    Uptime              Expires             Last Reporter
228.0.0.1            D      vlan9        25d23h              00:03:37            10.32.32.120
228.0.0.1            D      vlan30       25d23h              00:04:17            10.91.91.71
228.0.0.1            D      vlan3        11d23h              00:03:18            10.31.31.123
229.0.0.1            D      vlan9        25d23h              00:03:41            10.32.32.121
229.0.0.1            D      vlan30       25d23h              00:02:22            10.91.91.71
229.0.0.1            D      vlan3        11d23h              00:03:16            10.31.31.120
228.0.0.2            D      vlan9        25d23h              00:03:38            10.32.32.123
228.0.0.2            D      vlan30       25d23h              00:02:15            10.91.91.72
228.0.0.2            D      vlan3        11d23h              00:03:16            10.31.31.122
```

```
229.0.0.2            D      vlan9        25d23h              00:03:37            10.32.32.123
229.0.0.2            D      vlan30       25d23h              00:02:16            10.91.91.72
229.0.0.2            D      vlan3        11d23h              00:03:16            10.31.31.124
228.0.0.3            D      vlan9        25d23h              00:03:41            10.32.32.120
228.0.0.3            D      vlan30       25d23h              00:04:18            10.91.91.73
228.0.0.3            D      vlan3        11d23h              00:03:18            10.31.31.120
229.0.0.3            D      vlan9        25d23h              00:03:38            10.32.32.121
229.0.0.3            D      vlan30       25d23h              00:04:17            10.91.91.73
229.0.0.3            D      vlan3        11d23h              00:03:18            10.31.31.122
<......>

cleaf2#
cleaf2# show ip igmp snooping vlan 3
IGMP Snooping information for vlan 3
  IGMP snooping enabled
  Lookup mode: IP
  Optimised Multicast Flood (OMF) enabled
  IGMP querier present, address: 10.31.31.1, version: 2, i/f Vlan3
  Switch-querier disabled
  IGMPv3 Explicit tracking enabled
  IGMPv2 Fast leave disabled
  IGMPv1/v2 Report suppression enabled
  IGMPv3 Report suppression enabled
  Link Local Groups suppression enabled
  Router port detection using PIM Hellos, IGMP Queries
  Number of router-ports: 1
  Number of groups: 20
  VLAN vPC function enabled
  Active ports:
    Eth1/2      Eth1/3      Po3         Po4
cleaf2# show ip igmp snooping groups vlan 3
Type: S - Static, D - Dynamic, R - Router port, F - Fabricpath core port

Vlan  Group Address      Ver  Type  Port list
3     */*                -    R     Vlan3
3     228.0.0.1          v2   D     Po4
3     228.0.0.2          v2   D     Po4
3     228.0.0.3          v2   D     Po4
3     228.0.0.4          v2   D     Po4
3     228.0.0.5          v2   D     Po4
3     228.0.0.6          v2   D     Po4
3     228.0.0.7          v2   D     Po4
3     228.0.0.8          v2   D     Po4
3     228.0.0.9          v2   D     Po4
3     228.0.0.10         v2   D     Po4
3     229.0.0.1          v2   D     Po4
3     229.0.0.2          v2   D     Po4
3     229.0.0.3          v2   D     Po4
3     229.0.0.4          v2   D     Po4
3     229.0.0.5          v2   D     Po4
3     229.0.0.6          v2   D     Po4
3     229.0.0.7          v2   D     Po4
3     229.0.0.8          v2   D     Po4
3     229.0.0.9          v2   D     Po4
3     229.0.0.10         v2   D     Po4
cleaf2#
```

MRIB驗證

作為FHR的枝葉節點sleaf2具有直接連線的組播源。其RPF鄰居是spine1上的10.0.176.64。傳入介面是通過PIM與邊界枝葉對等的結構介面（隧道16）。

為簡單起見，顯示的輸出是針對每個組範圍的一個組播IP地址：228.0.0.1用於內部源，229.0.0.1用於外部源。

```
!!!!! FHR of mcast sources in fabric
sleaf2# show ip mroute vrf common:default
IP Multicast Routing Table for VRF "common:default"

(10.101.101.115/32, 228.0.0.1/32), uptime: 00:17:54, ip pim
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 0)

(10.101.101.116/32, 228.0.0.1/32), uptime: 00:17:54, ip pim
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 0)

(10.101.101.117/32, 228.0.0.1/32), uptime: 00:17:54, ip pim
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 0)

(……)

(*, 232.0.0.0/8), uptime: 4d00h, pim ip
  Incoming interface: Null, RPF nbr: 0.0.0.0
  Outgoing interface list: (count: 0)

sleaf2# show ip pim neighbor vrf common:default

PIM Neighbor information for Dom:common:default
Neighbor             Interface            Uptime               Expires              DRPriority
Bidir      BFDState
131.131.131.1/32     tunnel16             04:01:06             00:01:23             1
no         n/a
132.132.132.1/32     tunnel16             04:01:06             00:01:32             1
no         n/a
sleaf2#

sleaf2# show interface tunnel 16
Tunnel16 is up
    MTU 9000 bytes, BW 0 Kbit
    Transport protocol is in VRF "common:default"
    Tunnel protocol/transport is ivxlan
    Tunnel source 127.0.0.100/32
    Tunnel destination 225.1.192.0/32
    Last clearing of "show interface" counters never
    Tx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec

sleaf2#
```

用於228.0.0.1的接收器連線到bleaf2（節點132）、cleaf1（節點101）和cleaf2（節點102）。Bleaf2通過隧道16將組播轉發到組228.0.0.1，將外部接收器通過L3out轉發到核心裝置。

```
!!!!!! Bleaf2 !!!!!
bleaf2# show ip mroute 228.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(*, 228.0.0.1/32), uptime: 3w5d, ngmvpn ip pim igmp
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.5
```

```
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, igmp
    Tunnel16, uptime: 3w5d, ngmvpn

(10.101.101.115/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.116/32, 228.0.0.1/32), uptime: 3w5d, ip mrib pim ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 3) (Fabric OIF)
    Ethernet1/5, uptime: 00:04:36, pim
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.117/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.118/32, 228.0.0.1/32), uptime: 3w5d, ip mrib pim ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 3) (Fabric OIF)
    Ethernet1/5, uptime: 00:04:36, pim
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.119/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.120/32, 228.0.0.1/32), uptime: 3w5d, mrib ip pim ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.121/32, 228.0.0.1/32), uptime: 3w5d, mrib ip pim ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.122/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 2) (Fabric OIF)
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.123/32, 228.0.0.1/32), uptime: 3w5d, ip mrib pim ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 3) (Fabric OIF)
    Ethernet1/5, uptime: 00:04:36, pim
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

(10.101.101.124/32, 228.0.0.1/32), uptime: 3w5d, ip mrib pim ngmvpn
  Incoming interface: Tunnel16, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 3) (Fabric OIF)
```

```
    Ethernet1/5, uptime: 1d00h, pim
    Vlan25, uptime: 3w5d, mrib
    Tunnel16, uptime: 3w5d, mrib, ngmvpn, (RPF)

bleaf2#
bleaf2# show interface vlan25
Vlan25 is up, line protocol is up
  Hardware EtherSVI, address is  0000.0c07.ac5a
  Internet Address is 10.90.90.1/24
  MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
   reliability 255/255, txload 1/255, rxload 1/255
  Carrier delay is 10 sec
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  ARP type: ARPA
  Last clearing of "show interface" counters never
  30 seconds input rate 0 bits/sec, 0 packets/sec
  30 seconds output rate 0 bits/sec, 0 packets/sec
  Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
  L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
  L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
  L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

bleaf2#
```

Bleaf1通過L3out介面將組228.0.0.1轉發到外部，但它不會通過交換矩陣介面轉發到交換矩陣，因為它不是228.0.0.1的條帶贏家

```
!!!!! Bleaf1 !!!!!
!!!!!
bleaf1# show ip mroute 228.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(10.101.101.115/32, 228.0.0.1/32), uptime: 3w4d, mrib ip pim
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/5, uptime: 1d01h, pim

(10.101.101.116/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 1d01h, pim

(10.101.101.117/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/5, uptime: 1d01h, pim

(10.101.101.118/32, 228.0.0.1/32), uptime: 3w5d, mrib ip pim
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 1d01h, pim

(10.101.101.119/32, 228.0.0.1/32), uptime: 3w5d, mrib ip pim
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/5, uptime: 1d01h, pim
```

```
(10.101.101.120/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 1d01h, pim

(10.101.101.121/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 1d01h, pim

(10.101.101.122/32, 228.0.0.1/32), uptime: 1d01h, ip mrib pim
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/5, uptime: 1d01h, pim

(10.101.101.123/32, 228.0.0.1/32), uptime: 3w5d, pim mrib ip
  Incoming interface: Tunnel14, RPF nbr: 10.0.176.64 (pervasive)
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 1d01h, pim


bleaf1#
```

Bleaf1是組229.0.0.1的活動邊界枝葉/條帶纏繞器。 bleaf1通過外部核心裝置接收到組229.0.0.1的組播，然後轉發到BD90、BD91、BD31、BD32中的內部接收器。（注意，VLAN ID僅是枝葉節點的內部接收器，作為普適的GW）。

```
!!!!! bleaf1 !!!!!
bleaf1# show ip mroute 229.0.0.1 vrf common:default IP Multicast Routing Table for VRF
"common:default" (*, 229.0.0.1/32), uptime: 3w5d, ngmvpn ip pim Incoming interface: Ethernet1/5,
RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) (Fabric OIF) Tunnel14, uptime: 3w5d,
ngmvpn (10.103.103.40/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.41/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/4, RPF nbr: 10.1.20.1 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.42/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.43/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.44/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.45/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.46/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.25 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.47/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/4, RPF nbr: 10.1.20.1 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.48/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/4, RPF nbr: 10.1.20.1 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib (10.103.103.49/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/4, RPF nbr: 10.1.20.1 Outgoing interface list: (count: 1) Tunnel14, uptime: 1d01h,
mrib bleaf1#

!!!!! bleaf2 !!!!!
bleaf2# show ip mroute 229.0.0.1 vrf common:default IP Multicast Routing Table for VRF
"common:default" (*, 229.0.0.1/32), uptime: 3w5d, ip pim igmp Incoming interface: Ethernet1/4,
RPF nbr: 10.1.20.5 Outgoing interface list: (count: 1) Vlan25, uptime: 3w5d, igmp
(10.103.103.40/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface: Ethernet1/4,
RPF nbr: 10.1.20.5 Outgoing interface list: (count: 1) (Fabric Forwarding Loser) Vlan25, uptime:
```

```
1d01h, mrib (10.103.103.41/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/4, RPF nbr: 10.1.20.5 Outgoing interface list: (count: 1) (Fabric Forwarding Loser)
Vlan25, uptime: 1d01h, mrib (10.103.103.42/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim
Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.29 Outgoing interface list: (count: 1) (Fabric
Forwarding Loser) Vlan25, uptime: 1d01h, mrib (10.103.103.43/32, 229.0.0.1/32), uptime: 1d01h,
ip mrib pim Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.29 Outgoing interface list:
(count: 1) (Fabric Forwarding Loser) Vlan25, uptime: 1d01h, mrib (10.103.103.44/32,
229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.29
Outgoing interface list: (count: 1) (Fabric Forwarding Loser) Vlan25, uptime: 1d01h, mrib
(10.103.103.45/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface: Ethernet1/4,
RPF nbr: 10.1.20.5 Outgoing interface list: (count: 1) (Fabric Forwarding Loser) Vlan25, uptime:
1d01h, mrib (10.103.103.46/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface:
Ethernet1/5, RPF nbr: 10.1.20.29 Outgoing interface list: (count: 1) (Fabric Forwarding Loser)
Vlan25, uptime: 1d01h, mrib (10.103.103.47/32, 229.0.0.1/32), uptime: 1d01h, ip mrib pim
Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.5 Outgoing interface list: (count: 1) (Fabric
Forwarding Loser) Vlan25, uptime: 1d01h, mrib (10.103.103.48/32, 229.0.0.1/32), uptime: 1d01h,
ip mrib pim Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.29 Outgoing interface list:
(count: 1) (Fabric Forwarding Loser) Vlan25, uptime: 1d01h, mrib (10.103.103.49/32,
229.0.0.1/32), uptime: 1d01h, ip mrib pim Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.5
Outgoing interface list: (count: 1) (Fabric Forwarding Loser) Vlan25, uptime: 1d01h, mrib
bleaf2#
```

非邊界枝葉Cleaf1和Cleaf2在BD31、BD32和BD91中連線了接收器。僅支援非邊界枝葉節點安裝(*, G)、(S ， G)。

```
cleaf1# show ip mroute 228.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim
  Incoming interface: Tunnel14, RPF nbr: 10.0.80.91
  Outgoing interface list: (count: 2)
    Vlan4, uptime: 1w5d, igmp
    Vlan7, uptime: 3w5d, igmp

cleaf1# show ip mroute 229.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim
  Incoming interface: Tunnel14, RPF nbr: 10.0.80.91
  Outgoing interface list: (count: 2)
    Vlan4, uptime: 1w5d, igmp
    Vlan7, uptime: 3w5d, igmp


cleaf1#


cleaf1# show interface vlan 4
Vlan4 is up, line protocol is up
  Hardware EtherSVI, address is  0000.0c07.ac1f
  Internet Address is 10.31.31.1/24
  MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
   reliability 255/255, txload 1/255, rxload 1/255
  Carrier delay is 10 sec
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  ARP type: ARPA
  Last clearing of "show interface" counters never
  30 seconds input rate 0 bits/sec, 0 packets/sec
  30 seconds output rate 0 bits/sec, 0 packets/sec
  Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
  L3 Switched:
```

```
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
  L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
  L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf1# show interface vlan 7
Vlan7 is up, line protocol is up
  Hardware EtherSVI, address is  0000.0c07.ac20
  Internet Address is 10.32.32.1/24
  MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
   reliability 255/255, txload 1/255, rxload 1/255
  Carrier delay is 10 sec
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  ARP type: ARPA
  Last clearing of "show interface" counters never
  30 seconds input rate 0 bits/sec, 0 packets/sec
  30 seconds output rate 0 bits/sec, 0 packets/sec
  Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
  L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
  L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
  L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf1#


!!!! Non-border leaf node has (*, G) only, (S,G) is not supported.
cleaf2# show ip mroute 228.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim
  Incoming interface: Tunnel16, RPF nbr: 10.0.80.91
  Outgoing interface list: (count: 3)
    Vlan3, uptime: 1w5d, igmp
    Vlan30, uptime: 3w5d, igmp
    Vlan9, uptime: 3w5d, igmp


cleaf2# show ip mroute 229.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim
  Incoming interface: Tunnel16, RPF nbr: 10.0.80.91
  Outgoing interface list: (count: 3)
    Vlan3, uptime: 1w5d, igmp
    Vlan30, uptime: 3w5d, igmp
    Vlan9, uptime: 3w5d, igmp


cleaf2#
cleaf2# show interface vlan 3
Vlan3 is up, line protocol is up
  Hardware EtherSVI, address is  0000.0c07.ac1f
  Internet Address is 10.31.31.1/24
  MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
   reliability 255/255, txload 1/255, rxload 1/255
  Carrier delay is 10 sec
  Encapsulation ARPA, loopback not set
  Keepalive not supported
```

```
  ARP type: ARPA
  Last clearing of "show interface" counters never
  30 seconds input rate 0 bits/sec, 0 packets/sec
  30 seconds output rate 0 bits/sec, 0 packets/sec
  Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
  L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
  L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
  L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf2# show interface vlan 30
Vlan30 is up, line protocol is up
  Hardware EtherSVI, address is  0000.0c07.ac5b
  Internet Address is 10.91.91.1/24
  MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
   reliability 255/255, txload 1/255, rxload 1/255
  Carrier delay is 10 sec
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  ARP type: ARPA
  Last clearing of "show interface" counters never
  30 seconds input rate 0 bits/sec, 0 packets/sec
  30 seconds output rate 0 bits/sec, 0 packets/sec
  Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
  L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
  L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
  L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf2# show interface vlan 9
Vlan9 is up, line protocol is up
  Hardware EtherSVI, address is  0000.0c07.ac20
  Internet Address is 10.32.32.1/24
  MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
   reliability 255/255, txload 1/255, rxload 1/255
  Carrier delay is 10 sec
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  ARP type: ARPA
  Last clearing of "show interface" counters never
  30 seconds input rate 0 bits/sec, 0 packets/sec
  30 seconds output rate 0 bits/sec, 0 packets/sec
  Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
  L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
  L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
  L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf2#
```

在核心路由器上，N7K-core-1和N7K-core-2為源自LAN網路的組播流進行負載共用，如果未啟用快速收斂，則只有一個邊界枝葉(bleaf1)向源傳送加入。

```
!!!!! Sources in LAN network !!!!!

!!!!! N7K-core-1 !!!!!
N7K-core-1# show ip mroute 229.0.0.1
IP Multicast Routing Table for VRF "default"

(10.103.103.41/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.10
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.42/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
  Outgoing interface list: (count: 0)

(10.103.103.43/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
  Outgoing interface list: (count: 0)

(10.103.103.44/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
  Outgoing interface list: (count: 0)

(10.103.103.46/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
  Outgoing interface list: (count: 0)

(10.103.103.47/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.14
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.48/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.10
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.49/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.10
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

N7K-core-1#

!!!!! N7K-core-2 !!!!!
N7K-core-2# show ip mroute 229.0.0.1
IP Multicast Routing Table for VRF "default"

(*, 229.0.0.1/32), uptime: 3w5d, pim ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.46
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 3w5d, pim

(10.103.103.40/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.18
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.41/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.22
  Outgoing interface list: (count: 0)
```

```
(10.103.103.42/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.18
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.43/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.22
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.44/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.18
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.45/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.22
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.46/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/3, RPF nbr: 10.1.20.18
  Outgoing interface list: (count: 1)
    Ethernet1/1, uptime: 1d01h, pim

(10.103.103.47/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.22
  Outgoing interface list: (count: 0)

(10.103.103.48/32, 229.0.0.1/32), uptime: 00:53:01, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.46
  Outgoing interface list: (count: 0)

(10.103.103.49/32, 229.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/4, RPF nbr: 10.1.20.22
  Outgoing interface list: (count: 0)

N7K-core-2#



!!!!!! Sources in ACI !!!!!

!!!!! N7K-core-1 !!!!!
N7K-core-1# show ip mroute 228.0.0.1
IP Multicast Routing Table for VRF "default"

(*, 228.0.0.1/32), uptime: 3w5d, pim ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
  Outgoing interface list: (count: 2)
    Ethernet1/3, uptime: 3w5d, pim
    Ethernet1/2, uptime: 3w5d, pim

(10.101.101.115/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.6
  Outgoing interface list: (count: 0)

(10.101.101.116/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.2
  Outgoing interface list: (count: 1)
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.117/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
```

```
  Outgoing interface list: (count: 0)

(10.101.101.118/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.2
  Outgoing interface list: (count: 1)
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.119/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.6
  Outgoing interface list: (count: 0)

(10.101.101.120/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.2
  Outgoing interface list: (count: 1)
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.121/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.2
  Outgoing interface list: (count: 1)
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.122/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.6
  Outgoing interface list: (count: 0)

(10.101.101.123/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.2
  Outgoing interface list: (count: 1)
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.124/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.42
  Outgoing interface list: (count: 0)

N7K-core-1#
N7K-core-1#

!!!!! N7K-core-2 !!!!!
N7K-core-2# show ip mroute 228.0.0.1
IP Multicast Routing Table for VRF "default"

(*, 228.0.0.1/32), uptime: 3w5d, pim ip
  Incoming interface: Ethernet1/5, RPF nbr: 10.1.20.46
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 3w5d, pim

(10.101.101.115/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.26
  Outgoing interface list: (count: 2)
    Ethernet1/4, uptime: 00:02:03, pim
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.116/32, 228.0.0.1/32), uptime: 00:01:28, pim mrib ip
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.30
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 00:00:57, pim

(10.101.101.117/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.26
  Outgoing interface list: (count: 2)
    Ethernet1/4, uptime: 00:02:03, pim
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.118/32, 228.0.0.1/32), uptime: 00:01:28, pim mrib ip
```

```
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.30
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 00:00:57, pim

(10.101.101.119/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.26
  Outgoing interface list: (count: 2)
    Ethernet1/4, uptime: 00:02:03, pim
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.122/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/1, RPF nbr: 10.1.20.26
  Outgoing interface list: (count: 2)
    Ethernet1/4, uptime: 00:02:03, pim
    Ethernet1/3, uptime: 1d01h, pim

(10.101.101.123/32, 228.0.0.1/32), uptime: 00:01:28, pim mrib ip
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.30
  Outgoing interface list: (count: 1)
    Ethernet1/4, uptime: 00:00:57, pim

(10.101.101.124/32, 228.0.0.1/32), uptime: 1d01h, pim mrib ip
  Incoming interface: Ethernet1/2, RPF nbr: 10.1.20.30
  Outgoing interface list: (count: 2)
    Ethernet1/3, uptime: 1d01h, pim
    Ethernet1/4, uptime: 1d01h, pim

N7K-core-2#
```

參考資料

[ACI 2.0多點傳送路由]