Case Study: L3 multicast in de ACI-fabric

Inhoud

Inleiding

Layer 3 Multicast-routing wordt ondersteund in de ACI-fabric vanaf release 2.0 en vereist EX-switches (d.w.z. N9K-C93180YC-EX). Vóór release 2.0 ondersteunt ACI alleen L2 multicast binnen het bridge-domein. Dit is nog steeds een geldige optie in 2.0 en kan worden gebruikt voor niet-EX-switches.

In ACI release 2.0 omvat de ondersteunde multicast routing functies: PIM ASM, PIM SSM, Static RP, PIM Auto-RP en PIM BSR.

In dit document beschrijven we een gevalideerde oplossing voor een echt klant implementatiescenario voor L3 multicast routing op ACI-fabric. De geselecteerde ACI release is 2.1(1). Deze release ondersteunt RP niet op de stof, zodat er een externe RP nodig is voor PIM ASM.

Ontwerpvereisten

De klant heeft een end-to-end oplossing nodig voor L3 multicast routing binnen en buiten de fabric. Het inzetscenario heeft de volgende vereisten:

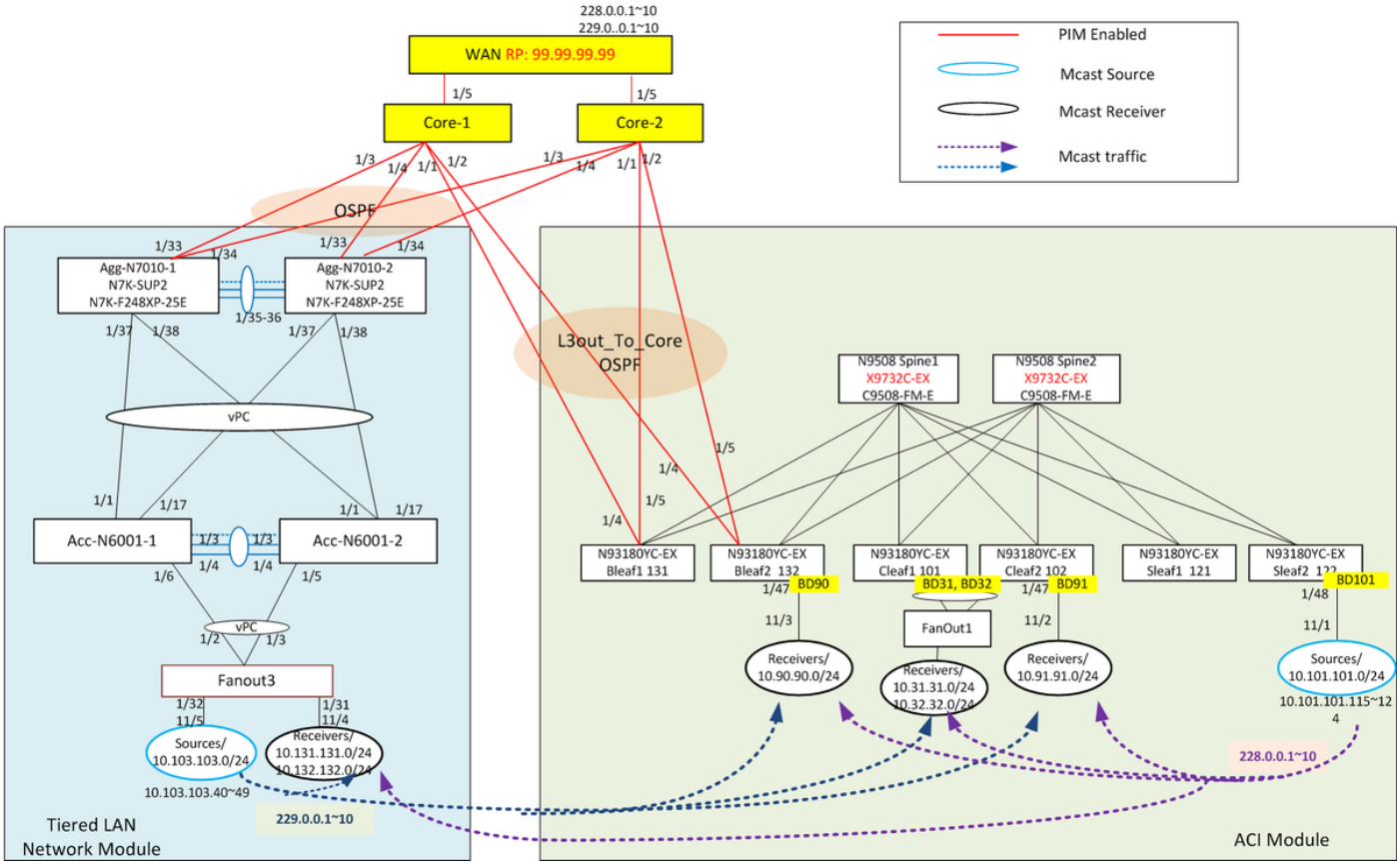
- Eén VRF wordt voor alle huurders ingezet.

Opmerking: Multicast vereist specifieke L3out voor elke VRF. Als er meerdere VRFs in de stof zijn, wordt gedeeld L3out niet ondersteund voor multicast routing.

- Ontvangers in weefsel met externe bronnen
- Bronnen in weefsel met externe ontvangers
- Bronnen en ontvangers in stof
- Static RP of Auto-RP

Oplossing

Overzicht van topologie



In de topologie zijn er twee belangrijke componenten: de ACI-module en de gelaagde LAN-netwerkmodule. Beide modules worden aangesloten op kernapparaten via point-to-point L3 links die OSPF en PIM uitvoeren. In ACI module, wordt het externe routed Network genoemd L3out-to-Core verbonden met de VRF common:default. Het omvat de vier verbindingen van de twee grensbladeren naar de kernelementen. De gelaagde LAN netwerkmodule, die niet op de stof aangesloten is, bestaat uit traditionele toegangslaag en aggregatielaag met vPC.

L3 multicast stromen via de ACI-structuur en het bestaande LAN-netwerk door de Core-laag. Voor Static RP-scenario wordt RP op het WAN Edge-apparaat ingezet.

We gebruiken spirituele verkeersgeneratoren (STC) om de interne en externe bronnen en ontvangers te simuleren. De vorige poorten worden aangesloten op verschillende locaties in de ACI-module en de gelaagde LAN-netwerkmodule. Ontvangers sturen IGMP v2 lidmaatschap bij berichten.

Interne bronnen gekoppeld aan Sleaf2: IP-bronnen zijn 10.101.101.115~124 en verzenden naar groepsadressen: 228.0.0,1-10

Interne ontvangers verbonden aan Bleaf1, Cleaf1 en Cleaf2: multicast enabled-BD's zijn BD90, BD91, BD31, BD32, geïnteresseerde groepen: 228.0.0.1~10 en 29.0.0.1~10.

Externe bronnen aan de toegangslaag in LAN-netwerk bevestigd: IP-bronnen zijn 10.103.103.40~49 en verzenden naar groepsadressen: 229.0.0.1~10.

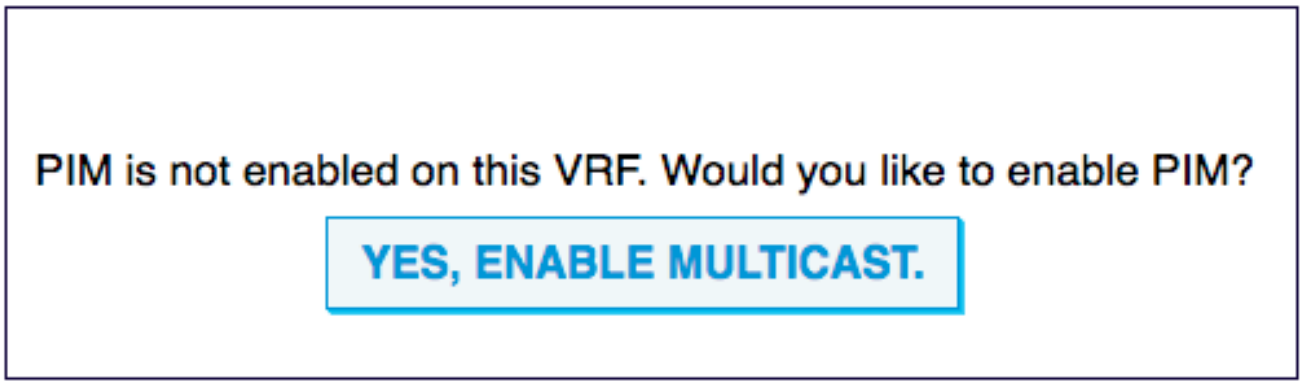
Externe ontvangers aangesloten op de toegangslaag in LAN-netwerk: vlan131 , vlan132 , geïnteresseerde groepen : 228.0.0.1~10.

Configuratie

Stap 0: Stel RP in op het gesimuleerde WAN-apparaat dat aan de kern is gekoppeld, en zet PIM in op de dunne modus van de gelaagde LAN-netwerkapparaten.

```
!!!!! 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
```

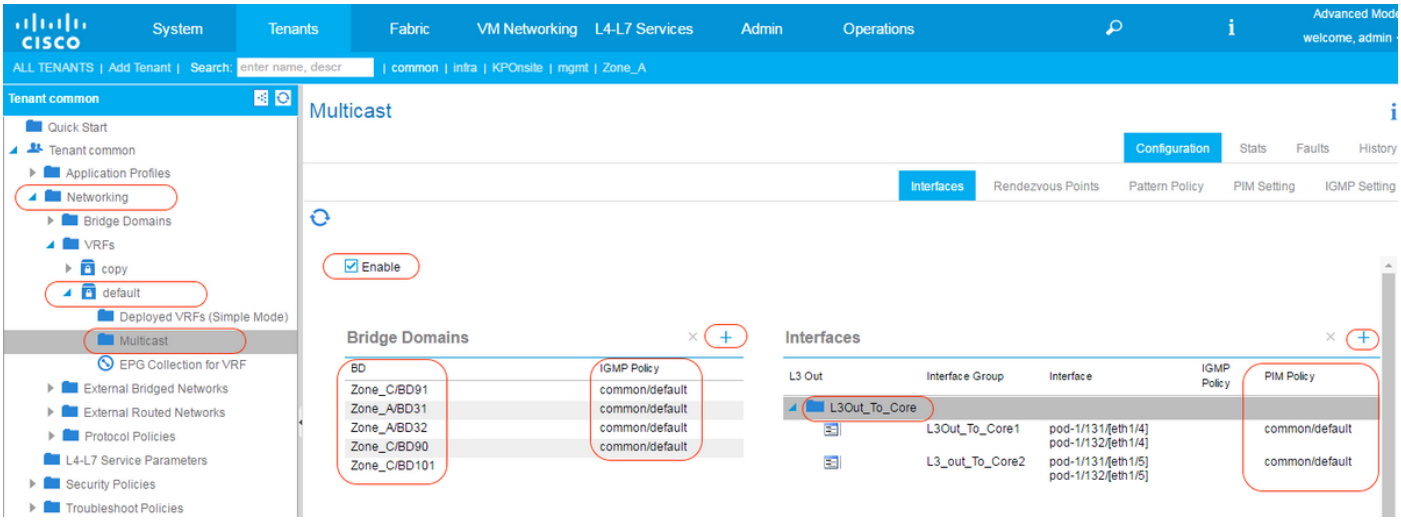
Stap 1: Multicast bij VRF inschakelen. In vaste ruimte kunt u navigeren naar netwerken > VRF's > Multicast op het werkpaneel en op de boter klikken om Multicast mogelijk te maken.



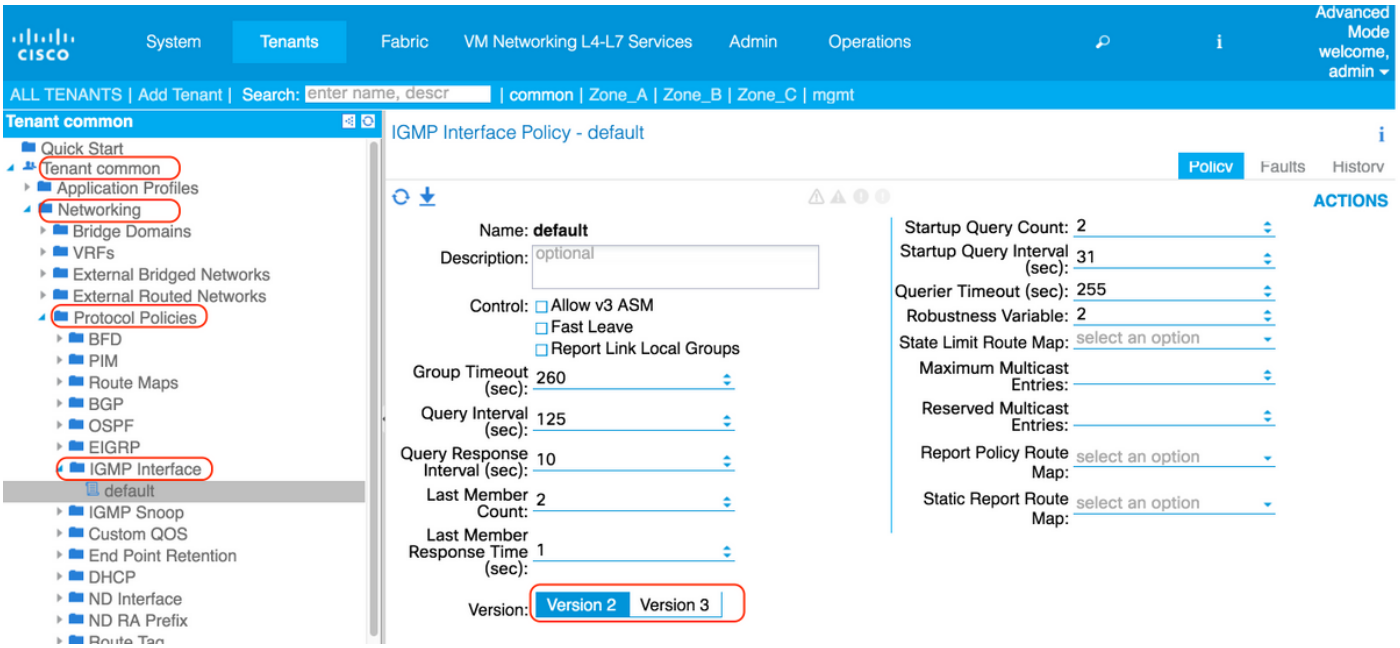
Stap 2: Schakel Multicast op BD- en L3out-niveaus in en schakelt IGMP voor ontvanger-BD's in. Navigeren in naar netwerken > VRF's > VRF-naam > Multicast, selecteer in het werkpaneel Configuration > Interface tab, klik "+" om de Bridge Domeinen toe te voegen waar verkeer van meerdere deelnemers wordt verwacht. IMGP-beleid voor multicast enabled-BD inschakelen.

Klik vervolgens op "+" om L3out toe te voegen voor deze VRF. Wanneer multicast voor een L3out is ingeschakeld, zal het PIM op alle interfaces onder L3out inschakelen en zullen alle grensblaadjes voor dat L3out zijn ingeschakeld met multicast routing. Selecteer het PIM beleid voor L3out interfacegroepen.

Hier wordt aangenomen dat de BD's en L3out al zijn voorzien.

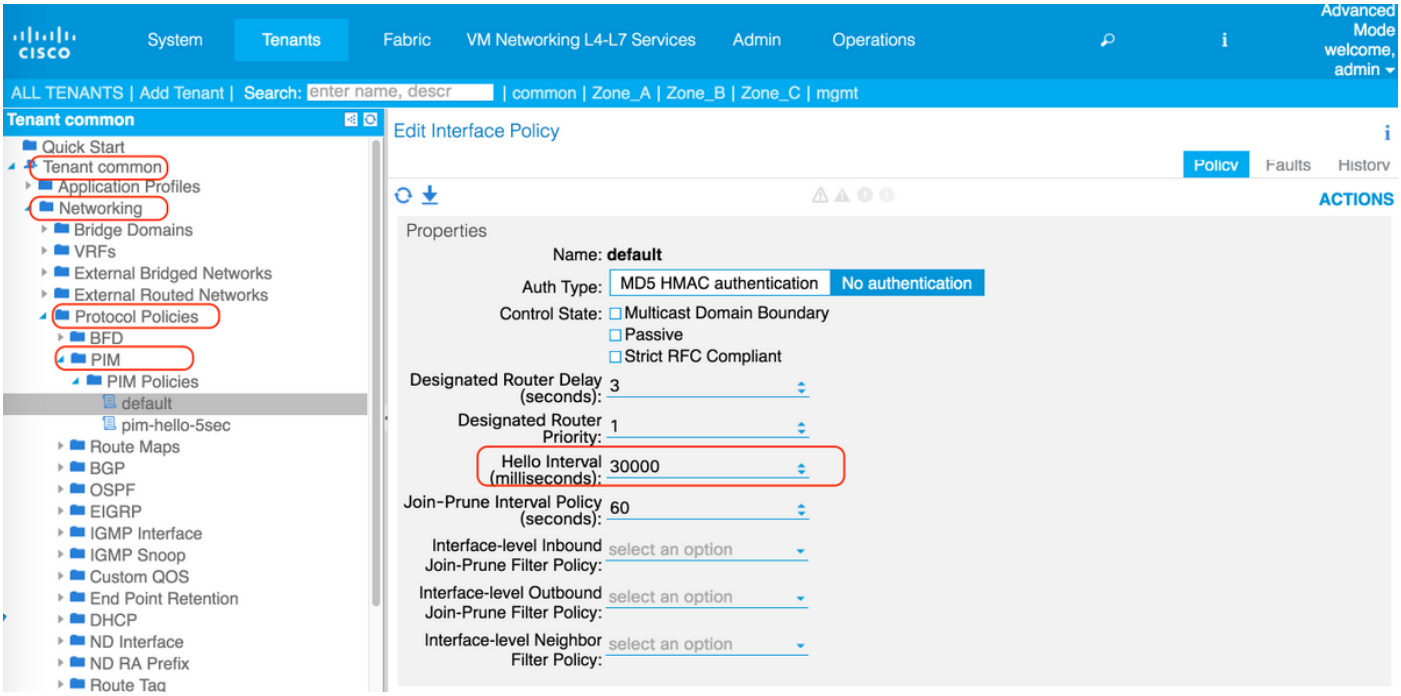


Door het IGMP-beleid aan de BD's te hechten is het ook een IGMP-instelling. IGMP-beleid wordt ingesteld onder Verkennend > Netwerk > Protocollen > IGMP-interface. Het standaard IGMP-beleid heeft de volgende parameters waar u query-intervallen kunt definiëren. Als er geen beleid wordt opgegeven, wordt de interface gebruikt als standaardbeleid.

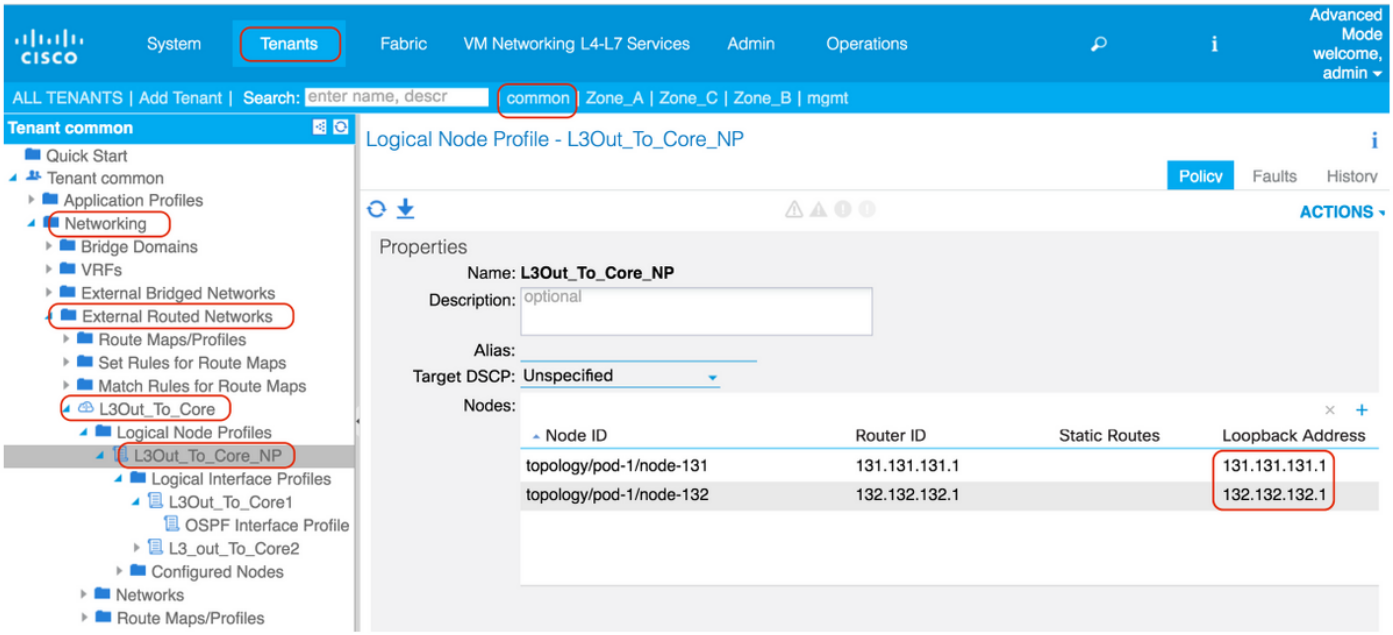


PIM-beleid wordt ook ingesteld bij Spanning > Netwerk > Protocol-beleid > PIM.

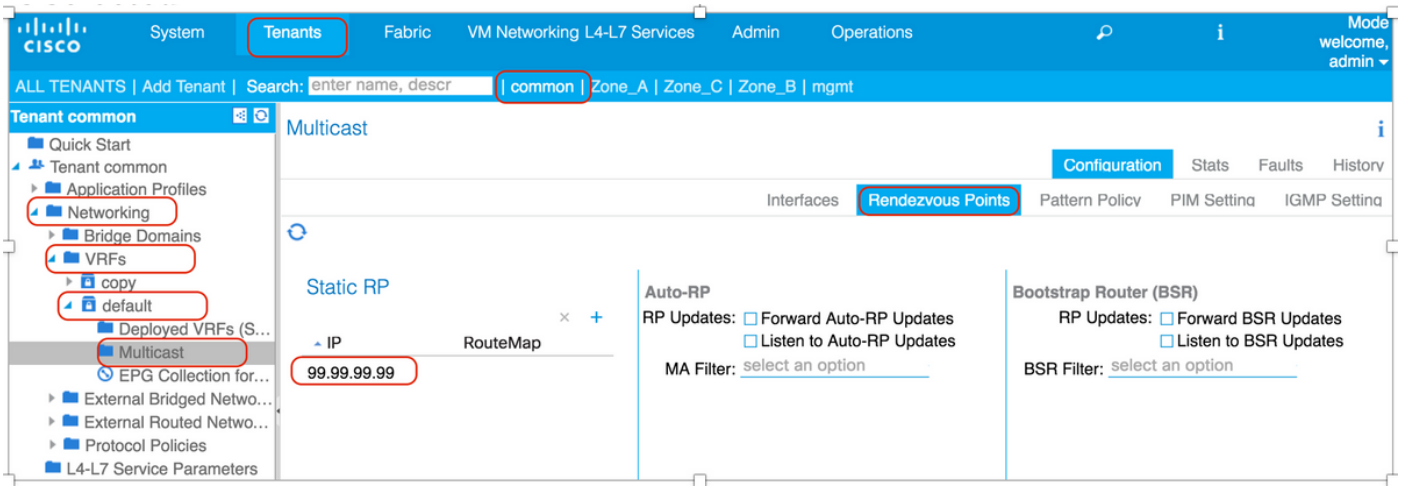
Het standaard PIM beleid heeft de volgende parameters waar u hallo intervallen kunt definiëren.



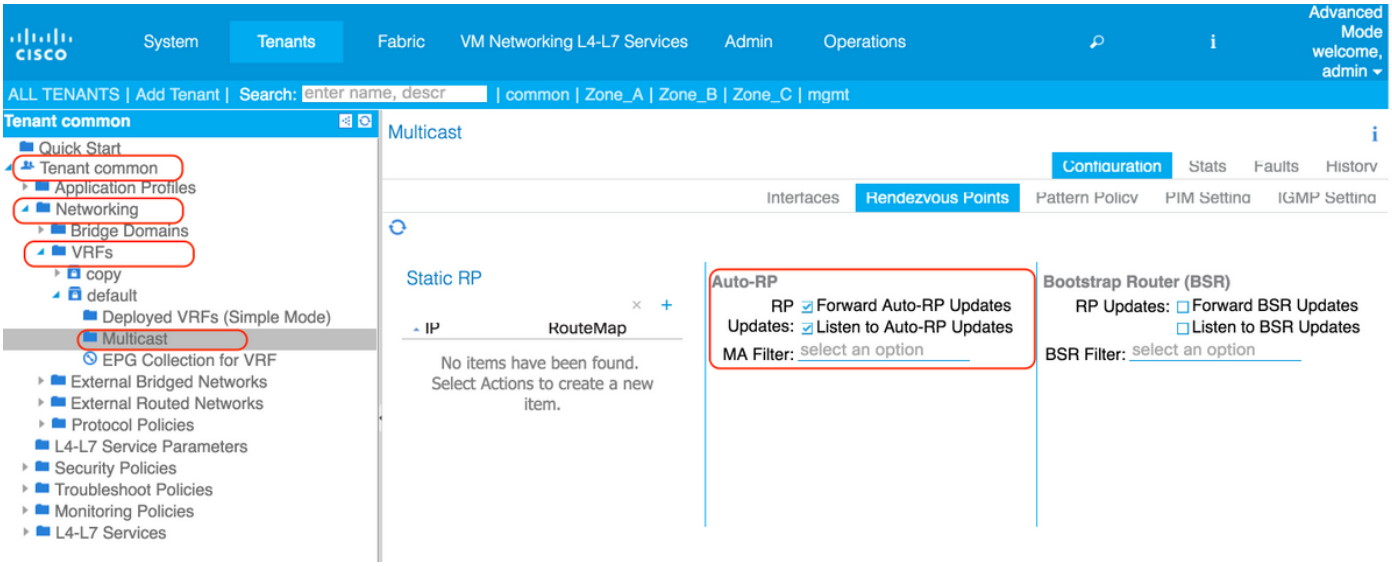
L3Outs op grensblad moet worden geconfigureerd met loopback-adressen die in het Node-profiel zijn ingeschakeld.



Stap 3: Configureer RP voor PIM ASM. Navigeer aan Aanhoudster > VRF > Multicast, in het werkpaneel selecteer Configuratie > Aanpassingspunten. In dit voorbeeld wordt Static RP geselecteerd. Klik op '+' om de RP toe te voegen.



Voor Auto-RP-configuratie, controleer de vakjes voor "Voorwaarts Auto-RP-updates" en "Luister naar Auto-RP-updates" op de pagina "Aanpassingspunten".



Buiten de ACI-structuur blijven de AUTO-RP-configuraties op NX-OS-platforms hetzelfde.

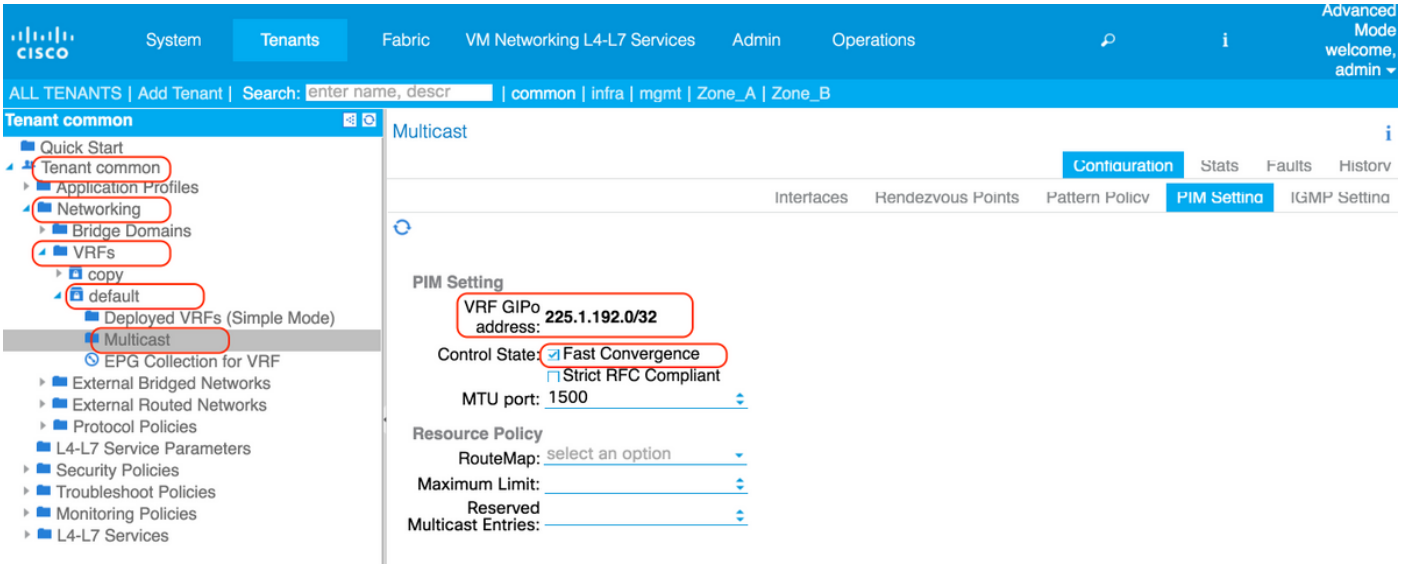
```
!!! On RP candidate

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
```

Stap 4: Configureer de benodigde PIM-instellingen. Navigeer naar Tant >VRF -> Multicast, in het werkpaneel, selecteer Configuratie > PIM instellingen, noteer VRF GIPo adres 225.1.192.0/32 dat door APIC van de multicast groepadrespool wordt toegewezen. Het VRF GIPo zal als het externe IP-adres van de groep voor multicast verkeer voor BDs met PIM worden gebruikt.

Als de modus **Snel converteren** is ingeschakeld (standaard uitgeschakeld), zullen alle rand-bladeren die met PIM zijn geactiveerd, verbindingen naar het externe netwerk verzenden, maar slechts één grensblad zal verkeer naar het weefsel doorsturen om duplicaten te voorkomen. Het grensblad dat het verkeer voor de groep doorgeeft, is de **aangewezen expediteur** voor de groep. Door Fast Convergence in te schakelen kunt u de duur van de pakketvertraging verminderen voor multicast-stromen met externe bronnen en binnenontvangers, wanneer er een streep-winnaar-

verandering is vanwege het omlaag gaan met het grensblad. Er wordt geen latentie opgelopen door de PIM-boom van de nieuwe streep-winnaar bij te sluiten. Dit komt ten koste van het extra bandbreedtegebruik op de externe links van de niet-streepjeswinnaars aangezien alle grensbladeren het verkeer van de externe bron trekken.

Over de Stripe Winners - Op dit moment gebruikt ACI een SR (Bootstrap Router) hash om de BL strepe winnaar te berekenen. De hash wordt berekend met behulp van de S,G en Loopback IP van de Leaf. Vanaf ACI 3.0(1) is er geen enkele manier om de verkiezing van de streepjeswinnaar voor de gebruiker te beïnvloeden.



Stap 5: Maak nodig contract om multicast verkeer toe te staan:

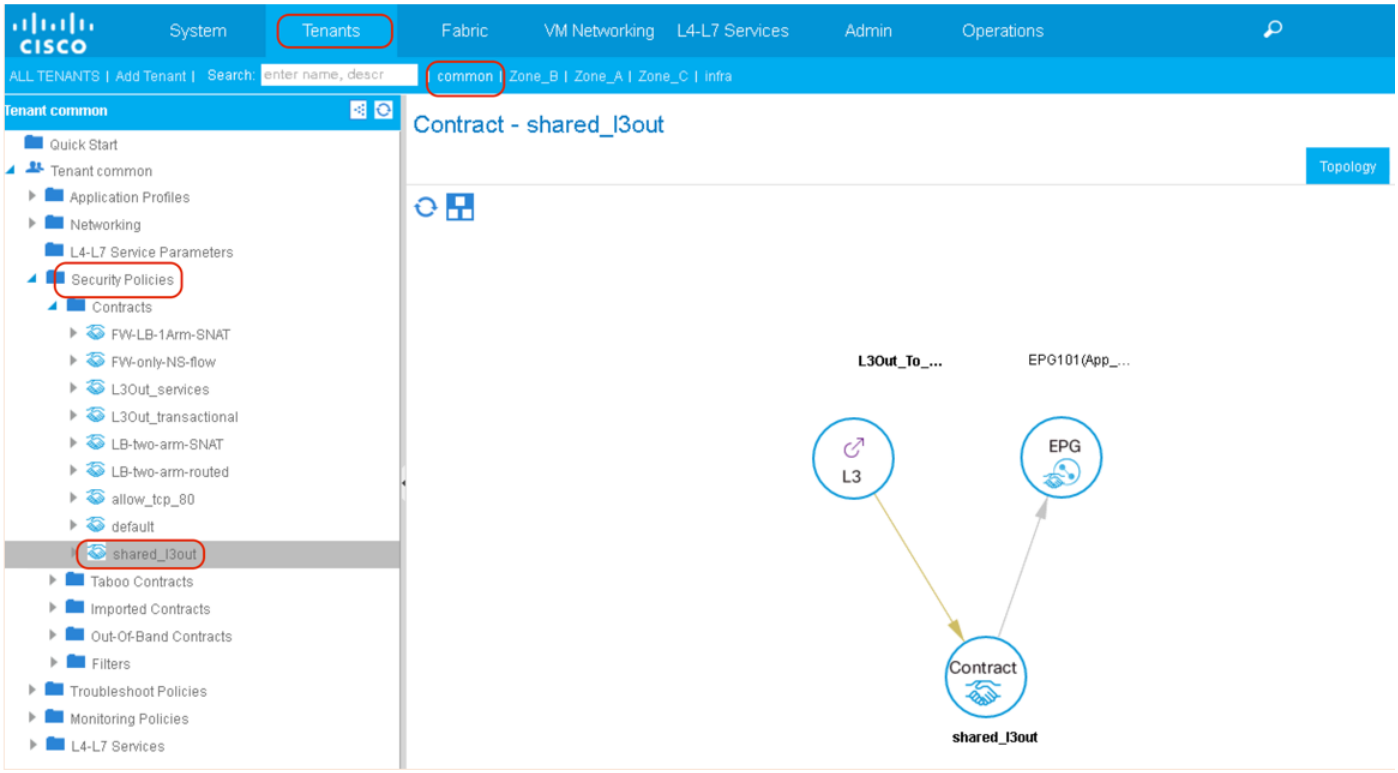
- Bron en ontvanger in stof (contract niet nodig)

- Ontvanger in weefsel, externe bron (contract niet nodig)

- Bron in stof, externe ontvanger (verplicht contract)*

*Het contract is niet vereist als de BD op het randblad wordt ingezet.

In ons geval hebben we ontvangers buiten het weefsel, passen contract toe tussen L3out_to_Core en mcast bron in EPG101.



Verifiëren

PIM-verificatie

Wanneer de VRF voor multicast routing is ingeschakeld, wordt een fabric-interface (tunnel) gecreëerd voor multicast routing binnen de stof. De PIM-besturingsplannen worden verzonden via de fabric-interfaces binnen de stof. De tunnelbestemming is het multicast adres van VRF GiPo. Op de veranderingen van het grensblad zal de tunnelbron de loopback interface op het grensblad zijn. Op niet-grensoverschrijdende bladwissels zal de tunnelbron een achteruitwijkadres zijn (127.0.0.100).

Rand-bladeren sturen PIM-hellos op de interface van het weefsel.L3Oout-interfaces draaien PIM in de normale modus, inclusief het verzenden en ontvangen van hellos, het selecteren van DR, enz. Niet-grensbladeren lopen in passieve modus op de interface van het weefsel. ze luisteren naar PIM hellos van de grenzen, maar sturen geen PIM hellos. Niet-grensoverschrijdende bladeren zullen niet in uitvoer verschijnen om "de ip-pop-buurman" te tonen.

```
!!!!! 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#
```

Controle van actief grensgebied

Als er meer dan één grensblad met multicast routing is ingeschakeld, kiest APIC één streep-winnaar voor elk groepsadres dat alle actieve grensbladeren overschrijdt. Het grensblad dat de streepjeswinnaar voor een groep is, is verantwoordelijk voor het verzenden van PIM-verbindingen namens de stof en voor het doorsturen van multicast-verkeer naar de stof.

De stakingswinnaar voor de groep beslist over de aangewezen Forwarder. Als de streep winnaar bereikbaar is voor de wortel, dan is de streep winnaar ook de DF. Als de streepjeswinnaar geen externe connectiviteit op de wortel heeft, kiest BL een DF door een PIM te verzenden om zich bij de weefsel-interface aan te sluiten.

```
!!!!! 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#
```

Snelle conversie-verificatie

```
!!! 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-verificatie

```
!!!!! 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-verificatie

Het bladknooppunt sleaf2, dat de FHR is, is rechtstreeks gekoppeld aan multicast bronnen. Zijn RPF-buurman is 10.0.176.64 op wervelkolom1. De inkomende interface is de fabric-interface (tunnel16) die met het grensblad werkt via PIM.

Voor eenvoud, is de output die wordt getoond voor één multicast IP adres van elk groepsbereik: 228.0.0.1 voor binnenbronnen en 229.0.0.1 voor buitenbronnen.

```
!!!!! 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#
```

Ontvangers voor 228.0.0.1 zijn bevestigd aan bleaf2 (knooppunt 132), cleaf1 (knooppunt 101) en

cleaf2 (knooppunt 102). Bleaf2 zendt de mcast naar groep 228.0.0.1 door naar interne ontvangers via tunnel 16 en naar externe ontvangers via L3out naar de kernapparaten.

```
!!!!!! 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 forwards group of 228.0.0.1 naar buiten via L3out interface, maar zendt niet via de fabric-interfaces naar de stof, omdat deze niet de streep-winnaar is voor 228.0.0.1

```
!!!!! 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 is de actieve winnaar van de grens voor groep 229.0.0.1. bleaf1 ontvangt de multicast naar groep 229.0.0.1 via het externe kernapparaat, en stuurt dan door naar interne ontvangers in BD90, BD91, BD31, BD32. (let wel: het vlan-ID is alleen. inwendig tot bladknooppunt (als de wijdverspreide 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#
```

Niet-grensblaadjes Cleaf1 en Cleaf2 hebben ontvangers bevestigd in BD31, BD32, BD91. Alleen het installeren (*, G) van bladknooppunten zonder grenzen (S,G) wordt niet ondersteund.

```
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#
```

Op de kernrouters, N7K-core-1 en N7K-core-2 zijn load-sharing voor multicast stromen die in LAN-netwerk zijn gesourcet, indien snelle convergentie niet is ingeschakeld, stuurt slechts één grensblad (bleaf1) een verbinding naar de bron.

```
!!!!! 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#
```

Referenties

[ACI 2000 multicast routing]