

Controleer Native multicast in SD-Access fabric

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Inleiding

Dit document beschrijft hoe Native Multicast in SD-Access (SDA)-fabric moet worden geverifieerd.

Voorwaarden

Vereisten

Cisco raadt kennis van de volgende onderwerpen aan:

- Doorsturen van Internet Protocol (IP)
- Locator-id/scheidingsprotocol (LISP)
- Protocolafhankelijke multicast (PIM) in beperkte modus

Gebruikte componenten

- C900v op Cisco IOS® XE 17.10.1
- Cisco Catalyst Center versie 2.3.5.3

De informatie in dit document is gebaseerd op de apparaten in een specifieke laboratoriumomgeving. Alle apparaten die in dit document worden beschreven, hadden een opgeschoonde (standaard)configuratie. Als uw netwerk live is, moet u zorgen dat u de potentiële impact van elke opdracht begrijpt.

Dit document kan ook worden gebruikt voor de volgende hardware- en softwareversies:

- C9200
- C9300
- C9400
- C9500
- C9600
- Cisco IOS® XE 16.12 en hoger

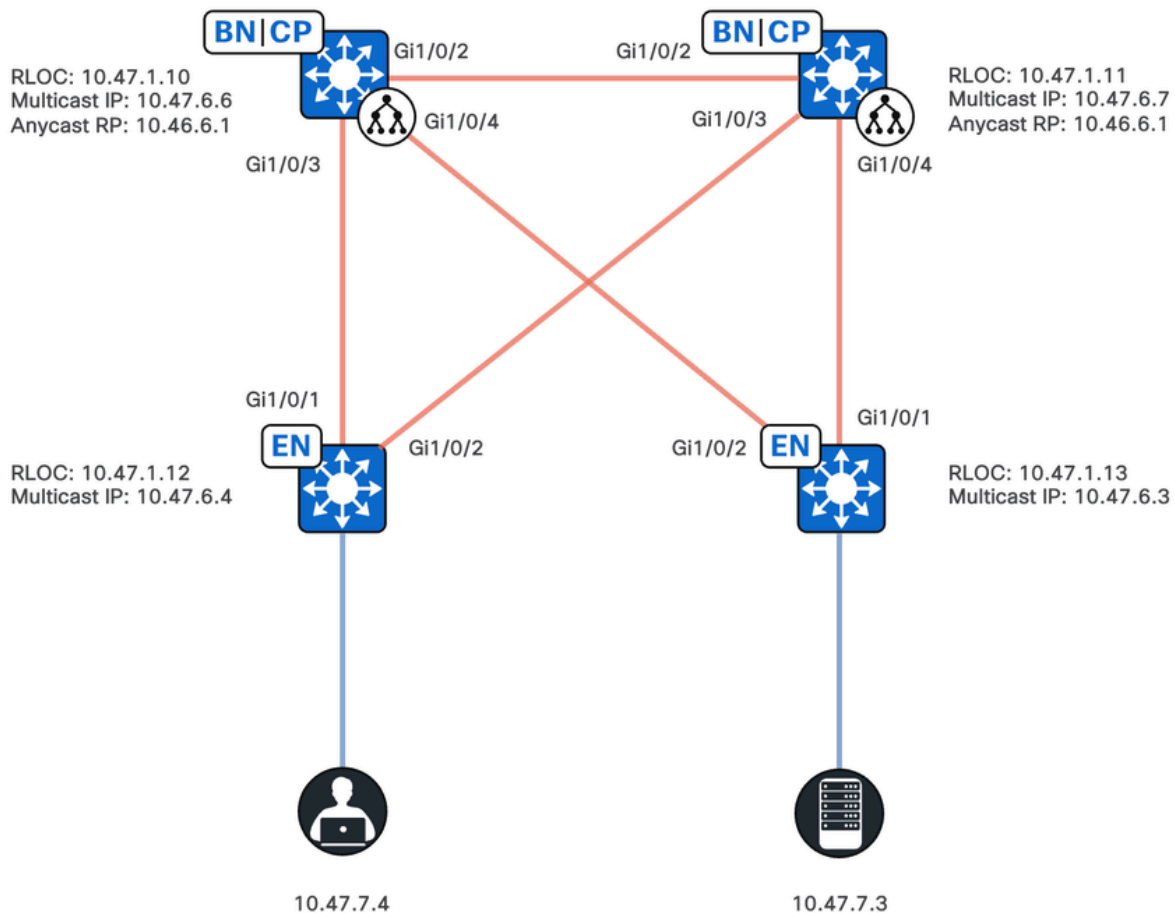
Achtergrondinformatie

SDA Native Multicast is een vorm van overlay multicast, die wordt gebruikt om multicast verkeer tussen fabric-apparaten te transporteren en multicast verkeer in een andere multicast groep in te kapselen. Native multicast kan multicast verkeer leiden tussen bronnen en ontvangers die in hetzelfde VLAN of anders VLAN zijn (multicast met hetzelfde VLAN kan worden gerouteerd). Multicastverkeer tussen bronnen en ontvangers op dezelfde Fabric Edge (FE) wordt niet doorgestuurd met behulp van overlay multicast (VXLAN-insluiting), maar wordt lokaal door de FE gerouteerd. Native multicast kan multicast verkeer niet routeren voor groepen die 224.0.0.0/24 of een Time To Live (TTL) =1 matchen, deze worden verwerkt via Layer 2 (L2) Flooding. Native multicast kan worden geconfigureerd om elke Source Multicast (ASM), Source Specific Multicast (SSM) of een combinatie van beide door te sturen. Native multicast is afhankelijk van onderliggende multicast.



Opmerking: Opdrachten voor het platform (fed) kunnen variëren. De opdracht kan zijn "show platform fed <active|standby>" versus "show platform fed switch <active|standby>". Als de syntaxis die in de voorbeelden is genoteerd, niet wordt geparseerd, probeer dan de variant.

Topologie



Netwerktopologie

In deze topologie:

- Remote Locator ID (RLOC) 10.47.1.10 en 10.47.1.11 worden overal met elkaar geplaatst en fungeren ook als Anycast Rendez Point (RP) met Multicast Source Discovery Protocol (MSDP) tussen de twee in het Virtual Network (VN) of Virtual Routing and Forwarding (VRF).
- 10.47.1.12 en 10.47.1.13 zijn FE-knooppunten
- 10.47.7.4 is de multicast-ontvanger
- 10.47.7.3 is de multicastbron
- 239.0.0.5 is het multicast doeladres van de groep (GDA)

Configuratie

Er wordt aangenomen dat Cisco Catalyst Center wordt gebruikt om de SDA-stof met deze instellingen te provisioneren:

- Implementatie van replicatiemodus is Native Multicast
- Multicastmodus is Any Source Multicast (ASM)
- Anycast Rendezvous Point (RP) met Multicast Source Detectie Protocol (MSDP) geconfigureerd op de samengestelde willekeurige randen

- Underlay Multicast is handmatig geconfigureerd of geconfigureerd als deel van de eerste LAN-automatisering, Native Multicast vertrouwt op Underlay Multicast om goed te functioneren.

Configuratie van Fabric Edge (10.47.1.12)

```

ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISPO.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan1025
ip pim passive
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.4 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
router lisp
service ipv4
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id-range 8188 , 8190 , 8192 , 8193 override
remote-rloc-probe on-route-change
service ethernet
eid-table vlan 1025 , 1026 , 1028 , 2727
database-mapping mac locator-set rloc_222e1707-175d-4019-a783-060404f8bc2f
instance-id 4099
service ipv4
sgt
instance-id 4100
service ipv4
sgt
database-mapping 10.47.6.4/32 locator-set rloc_222e1707-175d-4019-a783-060404f8bc2f
instance-id 8188
service ethernet
eid-table vlan 1025
dynamic-eid detection multiple-addr bridged-vm
instance-id 8190
service ethernet
eid-table vlan 1026
dynamic-eid detection multiple-addr bridged-vm
instance-id 8192
service ethernet
eid-table vlan 1028
dynamic-eid detection multiple-addr bridged-vm
ip domain lookup source-interface Loopback0
ip domain lookup

```

```
ip multicast vrf blue_vn multipath
```

Configuratie van Fabric Edge (10.47.1.13)

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan1025
ip pim passive
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.3 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
router lisp
service ipv4
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id-range 8188 , 8190 , 8192 , 8193 override
remote-rloc-probe on-route-change
service ethernet
eid-table vlan 1025 , 1026 , 1028 , 2727
database-mapping mac locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51
instance-id 4099
service ipv4
sgt
instance-id 4100
service ipv4
sgt
database-mapping 10.47.6.3/32 locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51
instance-id 8188
service ethernet
eid-table vlan 1025
dynamic-eid detection multiple-addr bridged-vm
instance-id 8190
service ethernet
eid-table vlan 1026
dynamic-eid detection multiple-addr bridged-vm
instance-id 8192
service ethernet
eid-table vlan 1028
dynamic-eid detection multiple-addr bridged-vm
ip domain lookup source-interface Loopback0
```

```
ip domain lookup
ip multicast vrf blue_vn multipath
```

Configuratie Collocation Anywhere Border/Anycast RP (10.47.1.10)

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan3001
ip pim sparse-mode
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp originator-id Loopback4600
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
network 10.47.6.1 mask 255.255.255.255
router lisp
service ipv4
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id 4099
service ipv4
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-red_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e1
distance site-registrations 250
map-cache site-registration
instance-id 4100
service ipv4
map-cache 10.47.6.7/32 10.47.1.11 priority 1 weight 100
sgt
route-export site-registrations
```

```
route-import database bgp 69420 route-map DENY-blue_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
distance site-registrations 250
map-cache site-registration
database-mapping 10.47.6.6/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
database-mapping 10.47.6.1/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
site site_uci
authentication-key *****
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
```

Configuratie Collocation Anywhere Border/Anycast RP (10.47.1.10)

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan3001
ip pim sparse-mode
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp originator-id Loopback4600
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
network 10.47.6.1 mask 255.255.255.255
router lisp
service ipv4
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id 4099
service ipv4
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-red_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
distance site-registrations 250
```



```

map-cache site-registration
instance-id 4100
service ipv4
map-cache 10.47.6.7/32 10.47.1.11 priority 1 weight 100
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-blue_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
distance site-registrations 250
map-cache site-registration
database-mapping 10.47.6.6/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
database-mapping 10.47.6.1/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
site site_uci
authentication-key *****
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics

```

Verificatie van besturingsplane

Verificatie van de Protocol Independent Multicast (PIM) vindt in deze sectie plaats, vanaf de validatie van (S,G) de aanmaak op de First Hop Router (FHR)

FHR (S,G) Creatie

De multicastbron, 10.47.7.3, verstuurt UDP-multicastpakketten naar 239.0.0.5. Controleer IP Device-Tracking (IPDT), Cisco Express Forwarding (CEF) en Reverse Path Forwarding (RPF), en wijst correct naar de multicast-bron. Zorg er bovendien voor dat de Anycast Gateway SVI de PIM Designated Router (DR) voor dit segment is.

Gebruik de opdracht "show device-tracking database address <ip address>" om er zeker van te zijn dat er een geldige IPDT-ingang is

```
<#root>
```

```
Edge-2#
```

```
show device-tracking database address 10.47.7.3
```

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DHCP
Preflevel flags (prlvl):
```

```
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
```

```
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
```

```
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
```

```

Network Layer Address Link Layer Address Interface vlan prlvl age state Time left
DH4 10.47.7.3 5254.0012.521d Gi1/0/4 1025 0024 166s

```

```
REACHABLE
```

```
81 s try 0(2276 s)
```

Gebruik de opdracht "toon ip cef vrf <VN Name> <ip address>" en zorg ervoor dat de multicast-

bron rechtstreeks is verbonden

```
<#root>
```

```
Edge-2#
```

```
show ip cef vrf blue_vn 10.47.7.3
```

```
10.47.7.3/32
```

```
nexthop 10.47.7.3 Vlan1025
```

Gebruik vervolgens de opdracht "toon ip rpf vrf <VN> <ip address>" om ervoor te zorgen dat de RPF-interface het VLAN is waarin de bron zich bevindt, en niet LISP.

```
<#root>
```

```
Edge-1#
```

```
show ip rpf vrf blue_vn 10.47.7.3
```

```
RPF information for (10.47.7.2)
```

```
RPF interface: Vlan1025
```

```
RPF neighbor: ? (
```

```
10.47.7.3
```

```
) - directly connected
```

```
RPF route/mask: 10.47.7.3/32
```

```
RPF type:
```

```
unicast (lisp)
```

```
Doing distance-preferred lookups across tables
```

```
Multicast Multipath enabled.
```

```
RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

Gebruik de opdracht "toon ip pim vrf <VN name> interface VLAN <vlan> detail | omvat DR|enabled" om te valideren dat de FE-knooppunt de PIM DR voor het segment is en de FHR is.

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn interface vlan 1025 detail | include DR|enabled
```

```
PIM: enabled
```

```
PIM DR: 10.47.7.1 (this system)
```

```
PIM State-Refresh processing: enabled
```

```
PIM Non-DR-Join: FALSE
```

Gebruik de opdracht "toon ip mroute vrf <VN name> <multicast group address>" om (S,G) te valideren. (S,G) gaat een Null Outgoing Interface List (OIL) hebben omdat er geen geïnteresseerde ontvanger of PIM-router is geweest die zich bij de FHR heeft aangesloten.

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

```
Z - Multicast Tunnel, z - MDT-data group sender,
```

```
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
```

```
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
```

```
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
```

```
V - RD & Vector, v - Vector, p - PIM Joins on route,
```

```
x - VxLAN group, c - PFP-SA cache created entry,
```

```
* - determined by Assert, # - iif-starg configured on rpf intf,
```

```
e - encaps-helper tunnel flag, l - LISP decap ref count contributor
```

```
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
```

```
t - LISP transit group
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(* , 239.0.0.5), 00:00:10/stopped, RP 10.47.6.1, flags: SPF1
```

```
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10
```

```
Outgoing interface list: Null
```

```
(
```

```
10.47.7.3
```

```
,
```

```
239.0.0.5
```

```
), 00:00:10/00:02:50, flags: PFT
```

```
Incoming interface: Vlan1025, RPF nbr 0.0.0.0
```

```
Outgoing interface list:
```

```
Null
```

FHR (S,G)-registratie

De FHR registreert de unicastbron naar de Anycast RP, met behulp van de interface geconfigureerd als "geregistreerde bron" PIM Register Berichten.

- Kop voor buitengebruik, RLOC naar RLOC (10.47.1.13 t/m 10.47.1.10)
- Kop binnen, loopback naar loopback (10.47.6.3 t/m 10.47.6.1)

- Real-multicast

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn tunnel
```

```
Tunnel1
```

```
Type : PIM Encap
```

```
RP : 10.47.6.1
```

```
Source : 10.47.6.3
```

```
State : UP
```

```
Last event : Created (00:42:43)
```

```
Edge-2#
```

```
show ip cef vrf blue_vn 10.47.6.1
```

```
10.47.6.1/32
```

```
nexthop
```

```
10.47.1.10
```

```
LISP0.4100
```

```
<-- FHR happened to register to this RP
```

```
nexthop 10.47.1.11 LISP0.4100
```

LHR IGMP-lidmaatschapsrapport

De multicast-ontvanger verstuurt een IGMP-lidmaatschapsrapport/samenvoeging om aan te geven dat er belangstelling is voor ontvangst van multicast verkeer, waarmee IGMP-controle en IGMP-groepsvermeldingen op de laatste hop router (LHR) worden gemaakt. Gebruik de opdracht "toon ip igmp snooping groups vlan <vlan id> <group target address>" en "toon ip igmp vrf <VN Name> groepen <group>"

```
<#root>
```

```
Edge-1#
```

```
show ip igmp snooping groups vlan 1025 239.0.0.5
```

```
Vlan Group      Type Version Port List
```

```
-----  
1025 239.0.0.5 igmp v2      Gi1/0/5
```

```
Edge-1#
```

```
show ip igmp vrf blue_vn groups 239.0.0.5
```

```
IGMP Connected Group Membership
Group Address Interface Uptime Expires Last Reporter Group Accounted
239.0.0.5 Vlan1025 00:02:01 00:02:58 10.47.7.4
```

Daarna, zorg ervoor dat LHR eigenlijk PIM DR voor dit segment is, gebruik het bevel "toon ip pim vrf <VN name> interface vlan <vlan> detail | omvat DR|enabled"

```
<#root>
```

```
Edge-1#
```

```
show ip pim vrf blue_vn interface vlan 1025 detail | include DR|enabled
```

```
PIM: enabled
```

```
PIM DR: 10.47.7.1 (this system)
```

```
PIM State-Refresh processing: enabled
```

```
PIM Non-DR-Join: FALSE
```

LHR (*,G) maken overlay

Aangezien LHR het IGMP-lidmaatschapsrapport ontvangt, maakt het ook PIM-status aan, specifiek (*,G) kunt u de opdracht "toon ip route vrf <VN Name><overlay group> breedsprakig" gebruiken om de (*,G) status te zien

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5 verbose
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

```
Z - Multicast Tunnel, z - MDT-data group sender,
```

```
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
```

```
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
```

```
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
```

```
V - RD & Vector, v - Vector, p - PIM Joins on route,
```

```
x - VxLAN group, c - PFP-SA cache created entry,
```

```
* - determined by Assert, # - iif-starg configured on rpf intf,
```

```
e - encap-helper tunnel flag, l - LISP decap ref count contributor
```

```
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
```

```
t - LISP transit group
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(* , 239.0.0.5), 1w3d/stopped, RP
```

```
10.47.6.1
```

```
, flags: SJC1
```

```
<-- Anycast RP IP address
```

```
Incoming interface: LISP0.4100,
```

```
RPF nbr 10.47.1.10
```

```
, LISP: [
```

```
10.47.1.10
```

```
,
```

```
232.0.2.245
```

```
]
```

```
<-- RPF neighbor to reach the Anycast RP, Overlay Group 239.0.0.5 is mapped to Underlay Group 232.0.2.245
```

```
Outgoing interface list:
```

```
Vlan1025
```

```
, Forward/Sparse-Dense, 1w3d/00:02:31, Pkts:0, flags:
```

```
<-- IGMP Membership Report/PIM Join received in VLAN 1025, multicast traffic is sent into VLAN 1025
```

Toewijzing LHR (*,G) in SSM-groep onderaan

Uit de (*,G) wordt het onderliggend SSM (S,G) afgeleid. De bron is RP RPF en Group is de Overlay Mapping.

```
<#root>
```

```
Edge-1#
```

```
show ip mroute 232.0.2.245 10.47.1.10
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

```
Z - Multicast Tunnel, z - MDT-data group sender,
```

```
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
```

```
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
```

```
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
```

```
V - RD & Vector, v - Vector, p - PIM Joins on route,
```

```
x - VxLAN group, c - PFP-SA cache created entry,
```

```
* - determined by Assert, # - iif-starg configured on rpf intf,
```

e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.10, 232.0.2.245

), 2d01h/00:02:28, flags: sT

<-- 10.47.1.10 in this example is the RPF IP/neighbor to get to the RP, 232.0.2.245 is the Underlay Group

Incoming interface:

GigabitEthernet1/0/1

, RPF nbr 10.47.1.0

<-- RPF interface to reach 10.47.1.10

Outgoing interface list:

Null0

, Forward/Dense, 2d01h/stopped, flags:

<-- The Outgoing Interface List (OIL) is Null0, and in Native Multicast, this is treated as a De-Encapsu

Rand/RP maakt (*,G) in Overlay en (S,G) in Onderlay

Met de LHR wordt een PIM (*,G) verzonden in de Overlay. U kunt deze opdracht gebruiken om ip route vrf <VN-naam> <overlay group> breedbose" te tonen om het (*,G) binnen de Overlay te bekijken

<#root>

Border-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(  
*, 239.0.0.5  
) , 2d01h/00:03:05, RP 10.47.6.1, flags: Sp  
Incoming interface:  
Null  
,  
RPF nbr 0.0.0.0
```

```
Outgoing interface list:  
LISP0.4100, (  
10.47.1.10, 232.0.2.245  
) , Forward/Sparse, 2d01h/stopped, Pkts:0, flags: p  
10.47.1.12  
, 2d01h/00:03:05  
<-- This is the RLOC of Edge-1, which is the LHR
```

In de Underlay, kunt u de opdracht "toon ip route <underlay group address> <RP RLOC>" gebruiken

<#root>

Border-1#

```
show ip mroute 232.0.2.245 10.47.1.10
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode


```

(
10.47.1.10
,
232.0.2.245
), 2d01h/00:03:13, flags: sT
Incoming interface:
Null0
,
RPF nbr 0.0.0.0

Outgoing interface list:
GigabitEthernet1/0/3
, Forward/Sparse, 2d01h/00:03:13, flags:
<-- Interface that connects to Edge-1, which is the LHR, a PIM Join was received off this interface

```

Border-1 maakt (S,G) van MSDP SA-Cache

De FHR registreerde de multicastbron naar Border-2. Border-2 adverteert met de multicastbron naar Border-1 via MSDP. U kunt de opdracht "show ip msdp vrf <VN Name> overview" gebruiken om de MSDP-status te bekijken.

```
<#root>
```

```
Border-1#
```

```
show ip msdp vrf blue_vn summary
```

```

MSDP Peer Status Summary
Peer Address AS      State Uptime/  Reset SA   Peer Name
                Downtime Count Count
10.47.6.7      23456 Up    2d02h   1         1

```

Gebruik de opdracht "toon ip msdp vrf <VN Name> peer <peer Address> Accepted-SAs" om de SA's te zien die worden geaccepteerd van de peer

```
<#root>
```

```
Border-1#
```

```
show ip msdp vrf blue_vn peer 10.47.6.7 accepted-SAs
```

```
MSDP SA accepted from peer 10.47.6.7 (?)
```

239.0.0.5

10.47.7.3

(?) RP:

10.47.6.7 <-- 239.0.0.5 is the Overlay Group, 10.47.7.3 is the multicast source, 10.47.6.7 is the IP address

Gebruik de opdracht "toon ip mroute vrf <VN Name> <group target address> verbose" om de (S,G) te zien

<#root>

Border-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encaps-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.0.0.5), 2d02h/00:03:27, RP 10.47.6.1, flags: Sp

Incoming interface: Null, RPF nbr 0.0.0.0

Outgoing interface list:

LISP0.4100, (10.47.1.10, 232.0.2.245), Forward/Sparse, 2d02h/stopped, Pkts:0, flags: p

10.47.1.12, 2d02h/00:03:27

(

10.47.7.3

,

239.0.0.5

), 00:18:26/00:02:50, flags: PTA

<-- True multicast source

Incoming interface: LISP0.4100, RPF nbr 10.47.1.13, LISP: [

10.47.1.13

```

,
232.0.2.245
]
<-- RLOC of Edge-2, which is FHR, and 232.0.2.245 is the Underlay multicast group

Outgoing interface list:
10.47.1.12, 00:00:05/00:03:24
<-- RLOC of Edge-1

```

border-overlay (S,G) maakt onderlay (S,G)

Border-1 maakt de Underlay (S, G) als resultaat van de Overlay (S, G) u kunt de opdracht "toon ip route <group destination address>" gebruiken om extra informatie te zien.

Er zijn twee (S, G)'s, voor de FHR, en voor zichzelf. De Null0 OIL voor 10.47.1.13, 232.0.2.245 geeft decapsatie aan, de Null0 als een IIF voor 10.47.1.10 geeft inkapseling aan.

<#root>

Border-1#

```
show ip mroute 232.0.2.245
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```

(
10.47.1.13
,
232.0.2.245
), 00:02:34/00:00:25, flags: sPT

```

```
<-- RLOC of the FHR, underlay multicast group IP
```

```
Incoming interface: GigabitEthernet1/0/4, RPF nbr 10.47.1.3 <-- RPF interface towards the FHR
```

```
Outgoing interface list: Null <-- Indicates decapsulation
```

```
(  
10.47.1.10  
,  
232.0.2.245  
) , 2d02h/00:02:41, flags: sT
```

```
<-- RLOC of Border-1, underlay multicast group IP
```

```
Incoming interface: Null0, RPF nbr 0.0.0.0 <-- Indicates encapsulation
```

```
Outgoing interface list:
```

```
GigabitEthernet1/0/3, Forward/Sparse, 2d02h/00:02:41, flags: <-- where multicast traffic is sent
```

FHR-ontvangers (S,G) worden samengevoegd in Overlay en Underlay

De grens/RP stuurt PIM (S, G) toe aan de FHR, u kunt de "show ip mroute" opdracht gebruiken om informatie te krijgen. Gebruik in de Overlay "toon ip route vrf <VN Name> <overlay group address"

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SPF1
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10
Outgoing interface list: Null

(
10.47.7.3
,
239.0.0.5
) , 1w3d/00:01:23, flags: FT
<-- Multicast source, true multicast group

Incoming interface: Vlan1025, RPF nbr 0.0.0.0

Outgoing interface list:

LISPO.4100, (

10.47.1.13

,
232.0.2.245

), Forward/Sparse, 19:12:56/stopped, flags:

<-- FHR RLOC, underlay group IP

10.47.1.10, 00:00:09/00:03:19 <-- Border/RP RLOC

Gebruik in de Onderlay "toon ip route <underlay group address>"

<#root>

Edge-2#

show ip mroute 232.0.2.245

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encaps-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(  
10.47.1.13  
,  
232.0.2.245  
) , 1w3d/00:03:01, flags: sT  
<-- RLOC of the FHR, Underlay multicast group  
  
Incoming interface: Null0, RPF nbr 0.0.0.0 <-- Indicates encapsulation
```

Outgoing interface list:

```
GigabitEthernet1/0/1  
, Forward/Sparse, 00:01:42/00:03:01, flags:  
<-- Where the multicast traffic is forwarded
```

LHR ontvangt multicastverkeer langs de gedeelde structuur

Nadat de LHR het ingekapselde multicastverkeer langs de gedeelde boom van de RP ontvangt, decapsuleert het het multicastverkeer aangezien de OLIE in de Onderlaag (S,G) Null0 is, en creëert dan een (S,G) ingang in de Overlay. U kunt de opdracht "toon ip route <underlay group address>" en "toon ip mroute vrf <VN Name> <overlay group address>"

```
<#root>
```

```
Edge-1#
```

```
show ip mroute 232.0.2.245
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(  
10.47.1.10  
,  
232.0.2.245  
) , 2d03h/00:00:36, flags: sT  
<-- RLOC of the RP, Underlay group
```

Incoming interface:

```
GigabitEthernet1/0/1, RPF nbr 10.47.1.0 <-- RPF interface towards the RP
```

Outgoing interface list:

```
Null0, Forward/Dense, 2d03h/stopped, flags: <-- Indicates Decapsulation
```

In de Overlay "toon ip mroute vrf <VN Name> <overlay group address>"

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(* , 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SJC1
```

```
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:03, flags:
```

```
(
10.47.7.3, 239.0.0.5
), 00:01:21/00:01:38, flags: JT1
<-- Multicast Source, Overlay Group
```

```
Incoming interface: LISP0.4100, RPF nbr 10.47.1.13, LISP:
[
10.47.1.13, 232.0.2.245
]
<-- RLOC of the FHR, Underlay Group
```

```
Outgoing interface list:
Vlan1025
, Forward/Sparse-Dense, 00:01:21/00:02:03, flags:
<-- Multicast traffic is forwarded into VLAN 1025
```

Nu, de LHR sluit zich aan bij de Kortste Pad Boom (SPT) en snoei de Gedeelde Boom, via PIM (S, G) sluit zich aan bij de Overlay en de Onderlay. Nadat de LHR de gedeelde boom heeft gesnoeid, omvat de RP OIL voor de (S,G) niet langer de LHR. Ga naar de RP en gebruik de opdracht "toon ip mroute vrf <VN Name> <overlay group address>"

```
<#root>
```

```
Border-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
```


Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.0.0.5), 2d04h/00:03:10, RP 10.47.6.1, flags: S

Incoming interface: Null, RPF nbr 0.0.0.0

Outgoing interface list:

LISPO.4100, (10.47.1.10, 232.0.2.245), Forward/Sparse, 2d04h/stopped, flags:

(10.47.7.3, 239.0.0.5), 00:14:17/00:02:42, flags: PT

Incoming interface: LISPO.4100, RPF nbr 10.47.1.13

Outgoing interface list: Null

Aangezien de (S,G) structuur geen onderladafbeelding meer heeft, zelfs als het verkeer naar 239.0.0.5 via de onderlaag wordt ontvangen, herkapselt de RP het niet tot een LHR, die de gedeelde boom snoeit. De (S,G) structuur voor zowel de bronstructuur als de gedeelde structuur bestaat echter nog steeds. Ga naar de RP en controleer de Underlay-groep met de opdracht "toon ip route <underlay group address>"

<#root>

Border-1#

show ip mroute 232.0.2.245

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(10.47.1.13, 232.0.2.245), 00:01:07/00:01:52, flags: sPT

Incoming interface: GigabitEthernet1/0/4, RPF nbr 10.47.1.3

Outgoing interface list: Null

(10.47.1.10, 232.0.2.245), 2d04h/00:03:23, flags: sT

Incoming interface: Null0, RPF nbr 0.0.0.0

Outgoing interface list:

GigabitEthernet1/0/3, Forward/Sparse, 2d04h/00:03:23, flags:

Als de RP al zijn OIL(s) heeft verwijderd, snoeit het zich ook uit de FHR OIL, en de FHR OIL

alleen LHR(s) Ga naar de FHR en gebruik de opdracht "toon ip mroute vrf <VN Name> <overlay group address>"

<#root>

Edge-2#

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(* , 239.0.0.5), 1w4d/stopped, RP 10.47.6.1, flags: SPF1  
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10  
Outgoing interface list: Null
```

```
(  
10.47.7.3  
,  
239.0.0.5  
) , 1w3d/00:01:25, flags: FT  
<-- Multicast Source, Overlay Group
```

```
Incoming interface: Vlan1025, RPF nbr 0.0.0.0  
Outgoing interface list:  
LISPO.4100, (  
10.47.1.13, 232.0.2.245  
) , Forward/Sparse, 20:16:48/stopped, flags:  
<-- RLOC of the LHR, Underlay Group
```

Verificatie van dataplane (platformonafhankelijk)

Er kunnen verschillende problemen zijn die kunnen voorkomen dat de multicast bron of multicast ontvanger het verkeer verzendt/ontvangt. Deze sectie concentreert zich op de validatie van kwesties die zowel de multicast bron als multicast ontvanger kunnen beïnvloeden, met nadruk op kwesties die niet met hardware programmering verwant zijn.

FHR (S,G) maken

Om ervoor te zorgen dat de FHR (S,G) controleert dat SISF, LISP, CEF en RPF allemaal geldig en correct zijn, gebruik de opdracht "toon apparaat-tracking database adres <IPv4 adres>"

```
<#root>
```

```
Edge-2#
```

```
show device-tracking database address 10.47.7.3
```

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DHCP
Preflevel flags (prlvl):
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
   Network Layer Address Link Layer Address Interface vlan prlvl age state      Time left
DH4 10.47.7.3           5254.0012.521d   Gi1/0/4   1025 0024 16s REACHABLE 232 s try 0(84662 s)
```

SISF is leveraged by LISP, gebruik de opdracht "toon lisp instantie-id <L3 LISP Instance ID> ipv4 database <IP/32>"

```
<#root>
```

```
Edge-2#
```

```
show lisp instance-id 4100 ipv4 database 10.47.7.3/32
```

```
LISP ETR IPv4 Mapping Database for LISP 0 EID-table vrf blue_vn (IID 4100), LSBs: 0x1
Entries total 1, no-route 0, inactive 0, do-not-register 1
```

```
10.47.7.3/32
```

```
, dynamic-eid blue-IPV4, inherited from default locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51
Uptime: 5w0d, Last-change: 5w0d
Domain-ID: local
Service-Insertion: N/A
Locator Pri/Wgt Source State
10.47.1.13 10/10 cfg-intf site-self, reachable
Map-server Uptime ACK Domain-ID
10.47.1.10 2d04h Yes 0
10.47.1.11 2d15h Yes 0
```

```
Edge-2#
```

```
show ip lisp instance-id 4100 forwarding eid local 10.47.7.3
```

```
Prefix
```

10.47.7.3/32

LISP-programma's CEF, gebruik de opdracht "toon ip cef vrf <VN Name> <ip address>" en zorg ervoor dat het een next-hop in het VLAN is die niet naar LISP wijst.

<#root>

Edge-2#

```
show ip cef vrf blue_vn 10.47.7.3
```

10.47.7.3/32

```
nexthop 10.47.7.3 Vlan1025
```

Zorg er ten slotte voor dat RPF correct wijst en zegt dat hij direct verbonden is.

<#root>

Edge-2#

```
show ip rpf vrf blue_vn 10.47.7.3
```

```
RPF information for (10.47.7.3)
```

```
RPF interface: Vlan1025
```

```
RPF neighbor: ?
```

```
(10.47.7.3) - directly connected
```

```
RPF route/mask: 10.47.7.3/32
```

```
RPF type: unicast (lisp)
```

```
Doing distance-preferred lookups across tables
```

```
Multicast Multipath enabled.
```

```
RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

Als er geen geldige ingang in SISF/IPDT is, resulteert dit in geen LISP database mapping op de FHR, wat ertoe leidt dat CEF en RPF naar de grens(en) wijzen. Als de multicast-bron verkeer verstuurt, wijst RPF naar de onjuiste interface, wat resulteert in een RPF-fout, (S,G) wordt niet gevormd.

<#root>

Edge-2#

```
show device-tracking database address 10.47.7.3
```

Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DHCP - IPv4 DHCP
Preflevel flags (prlvl):

```
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
Network Layer Address Link Layer Address Interface vlan prlv1 age state Time left
```

Edge-2#

```
show lisp instance-id 4100 ipv4 database 10.47.7.3/32
```

```
% No database-mapping entry for 10.47.7.3/32.
```

Edge-2#

```
show ip cef vrf blue_vn 10.47.7.3
```

```
10.47.7.0/24
nexthop 10.47.1.10
```

```
LISP0.4100 <-- Result of a LISP Negative Map-Reply, so the LISP interface is now the RPF interface
```

```
nexthop 10.47.1.11
```

```
LISP0.4100 <-- Result of a LISP Negative Map-Reply, so the LISP interface is now the RPF interface
```

Edge-2#

```
show ip rpf vrf blue_vn 10.47.7.3
```

```
RPF information for (10.47.7.3)
RPF interface:
```

```
LISP0.4100
```

```
RPF neighbor: ? (
```

```
10.47.1.11
```

```
)
```

```
RPF route/mask: 10.47.7.3/32
```

```
RPF type: unicast ()
```

```
Doing distance-preferred lookups across tables
```

```
Multicast Multipath enabled.
```

```
RPF topology: ipv4 multicast base
```

Om dit te voorkomen, behandel de multicast bron als een stille host, waar IP Directed Broadcast, Flooding, Statische SISF/IPDT bindingen dit probleem kunnen overwinnen.

Bronregistratie

PIM-registratie is een unicast-pakketstroom die LISP/VXLAN gebruikt zoals elk ander unicast-pakket. Er zijn verschillende vereiste controles om te valideren dat de FHR de multicast bron naar de Anycast RP goed kan registreren.

Zorg er eerst voor dat de Anycast RP correct is geconfigureerd voor de GDA.

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn rp 239.0.0.5
```

```
Group: 239.0.0.5, RP: 10.47.6.1, uptime 1w4d, expires never
```

Zorg ervoor dat de PIM Register-tunnel is gevormd.

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn tunnel
```

```
Tunnel1
```

```
Type : PIM Encap
```

```
RP : 10.47.6.1 <-- This is from "ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1"
```

```
Source : 10.47.6.3 <-- This is from ip pim vrf blue_vn register-source Loopback4100
```

```
State : UP
```

```
Last event : Created (1w4d)
```

Zorg ervoor dat de Anycast RP bereikbaar is via IP

```
<#root>
```

```
Edge-2#
```

```
show ip cef vrf blue_vn 10.47.6.1
```

```
10.47.6.1/32
```

```
nexthop
```

```
10.47.1.10
```

```
LISPO.4100
```

```
<-- RLOC of Border-1
```

```
nexthop
```

```
10.47.1.11
```

```
LISPO.4100
```

```
<-- RLOC of Border-2
```

```
Edge-2#
```

```
ping vrf blue_vn 10.47.6.1 source lo4100
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 10.47.6.1, timeout is 2 seconds:
```

```
Packet sent with a source address of 10.47.6.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/3 ms
```

Verificatie aan ontvangerzijde

- Zorg ervoor dat de multicast ontvanger een IGMP MR verzendt.
- Zorg ervoor dat IGMP-controle is ingeschakeld. L2 alleen VPN's zijn het enige type VPN dat geen IGMP-snooping heeft ingeschakeld
- Zorg ervoor dat er geen Port ACL, VLAN ACL, Routed Port ACL is geconfigureerd die de IGMP MR zou laten vallen.
- Valideer de versie van IGMP MR, standaard is het IGMPv2, als de multicast-ontvanger IGMPv3 is, dat "ip igmp versie 3" vereist
- Zorg ervoor dat "ip option drop" niet is geconfigureerd

Verificatie LHR PIM (*,G)

- Zorg ervoor dat de LHR de PIM DR is voor het ontvangersubnet/segment
- Zorg ervoor dat er geen "ip multicast groep-bereik" is geconfigureerd
- Zorg ervoor dat er geen Port ACL, VLAN ACL, Routed Port ACL is geconfigureerd die de IGMP MR zou laten vallen.
- Zorg ervoor dat er geen hoge CPU of Control-Plane Policing (CoPP) is die de IGMP MR laat vallen.

LHR PIM gedeelde boomverificatie

Zorg ervoor dat er een RP is geconfigureerd voor de groep

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.0.0.5), 1w3d/stopped, RP

10.47.6.1

, flags: SJC1

<-- Anycast RP address

Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:36, flags:

Zorg ervoor dat RPF naar de Anycast RP juist is

<#root>

Edge-1#

show ip cef vrf blue_vn 10.47.6.1

10.47.6.1/32

nexthop 10.47.1.10 LISP0.4100

nexthop 10.47.1.11 LISP0.4100

Edge-1#

show ip rpf vrf blue_vn 10.47.6.1

RPF information for (10.47.6.1)

RPF interface: LISP0.4100

RPF neighbor: ? (10.47.1.10)

RPF route/mask: 10.47.6.1/32

RPF type: unicast ()

Doing distance-preferred lookups across tables

Multicast Multipath enabled.

RPF topology: ipv4 multicast base

MFIB-doorsturen - Native Multicast (Overlay) - verificatie van bronzijde

U kunt de opdracht "toon ip mfib vrf <VN Name> <overlay group address> <unicast source>

verbose" gebruiken om extra informatie over pakketdoorsturen te krijgen.

<#root>

Edge-2#

```
show ip mfib vrf blue_vn 239.0.0.5 10.47.7.3 verbose
```

```
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
(10.47.7.3,239.0.0.5) Flags: K HW DDE
0x530 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 352467143981268992/0/19/0, Other: 0/0/0
Vlan1025 Flags: RA A MA
LISPO.4100, (
10.47.1.13
,
232.0.2.245
) Flags: RF F NS
<-- RLOC of FHR, Underlay Group IP address

CEF: Adjacency with MAC:
4500000000004000001184BC0A2F010DE80002F5000012B500000000084000000100400BA25CDF4AD38BA25CDF4AD380000

Pkts: 0/0/0 Rate: 0 pps
```

MFIB Forwarding - Native Multicast (Underlay) - verificatie van bronzijde

Gebruik "toon ip mroute <underlay group address> <RLOC of FHR>" om de Underlay-groep te bekijken

<#root>

Edge-2#

```
show ip mroute 232.0.2.245 10.47.1.13
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encaps-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(
```

```
10.47.1.13
```

```
,
```

```
232.0.2.245
```

```
), 1w4d/00:03:17, flags: sT
```

```
<-- RLOC of the FHR, Underlay Group
```

Incoming interface:

```
Null0
```

```
, RPF nbr 0.0.0.0
```

```
<-- Indicates Encapsulation
```

Outgoing interface list:

```
GigabitEthernet1/0/1, Forward/Sparse, 00:00:26/00:03:17, flags <-- Where the multicast traffic is forwarded
```

```
Edge-2#
```

```
show ip mfib 232.0.2.245 10.47.1.13 verbo
```

```
se
```

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,

RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
Default
(

10.47.1.13,232.0.2.245

) Flags: K HW
0x348 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding:

5268151634814304256

/0/1/0, Other: 0/0/0

Null0

Flags: RA A MA
GigabitEthernet1/0/1 Flags: RF F NS
CEF: Adjacency with MAC: 01005E0002F552540017FE730800
Pkts: 0/0/0 Rate: 0 pps

MFIB-doorsturen - native multicast (na decapulatie)

Wanneer multicast verkeer bij LHR wordt ingekapseld met een bron-IP van 10.47.1.13 en een bestemmingsadres van 232.0.2.245, wordt het naar de uitgaande interface Null0 verstuurd. Deze actie brengt decapsulation van het pakket op gang.

<#root>

Edge-1#

```
show ip mroute 232.0.2.245 10.47.1.13
```

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```

(
10.47.1.13
,
232.0.2.245
), 00:38:22/00:00:37, flags: sT
Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.47.1.4
Outgoing interface list:
Null0
, Forward/Dense, 00:01:12/stopped, flags:
Edge-1#
show ip mfib 232.0.2.245 10.47.1.13 verbose

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
Default
(
10.47.1.13,232.0.2.245
) Flags: K HW
0x77 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 0/0/0/0, Other: 0/0/0

GigabitEthernet1/0/2

Flags: RA A MA

Null0, LISPv4 Decap Flags: RF F NS

CEF: OCE (lisp decap)

Pkts: 0/0/0 Rate: 0 pps

```

Na decapulatie, identificeert de LHR dat het echte bestemmingsIP adres als 239.0.0.5 binnen VNI 4100, uit met een bron IP van 10.47.7.3

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.0.0.5

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SJC1
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:01, flags:

(

10.47.7.3

,

239.0.0.5

), 00:01:29/00:01:30, flags: JT1
Incoming interface: LISPO.4100, RPF nbr 10.47.1.13
Outgoing interface list:

vlan1025

, Forward/Sparse-Dense, 00:01:29/00:02:01, flags:

Edge-1#

show ip mfib vrf blue_vn 239.0.0.5 10.47.7.3

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup

```
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
(
```

```
10.47.7.3,239.0.0.5
```

```
) Flags: HW
```

```
<-- Unicast Source and Overlay Group
```

```
SW Forwarding: 0/0/0/0, Other: 2/1/1
```

```
HW Forwarding: 0/0/0/0, Other: 0/0/0
```

```
LISP0.4100 Flags: A <-- Incoming Interface
```

```
Vlan1025 Flags: F NS <-- Outgoing Interface
```

```
Pkts: 0/0/0 Rate: 0 pps
```

Gebruik de opdracht "toon ip igmp snooping groups vlan <VLAN>" om te zien welke poorten multicast verkeer zullen ontvangen.

```
<#root>
```

```
Edge-1#
```

```
show ip igmp snooping groups vlan 1025
```

```
Vlan Group      Type Version Port List
```

```
-----  
1025 239.0.0.5 igmp v2      Gi1/0/5
```

Verificatie van dataplane (afhankelijk van platform)

Mroute Hardware Programming - IOS mroute

Hardware programmeren maakt gebruik van deze keten: IOS, dan FMAN RP, FMAN FP, en dan FED. Controleer IOS eerst, met de opdracht "toon ip route vrf <VN Name> <overlay group address> breedbase" en "toon ip route <underlay group address> breedbase"

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5 verbose
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

```
(  
*, 239.0.0.5  
) , 1w3d/stopped, RP 10.47.6.1, flags: SJC1  
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10, LISP: [10.47.1.10, 232.0.2.245]  
Outgoing interface list:  
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:58, Pkts:0, flags:  
  
(  
10.47.7.3, 239.0.0.5  
) , 00:02:19/00:00:40, flags: JT1  
Incoming interface: LISPO.4100, RPF nbr 10.47.1.13, LISP: [10.47.1.13, 232.0.2.245]  
Outgoing interface list:  
Vlan1025, Forward/Sparse-Dense, 00:02:19/00:02:58, Pkts:0, flags:
```

In de ondergrond

<#root>

Edge-1#

```
show ip mroute 232.0.2.245 verbose
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.13, 232.0.2.245

), 01:18:55/00:02:04, flags: sT

Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.47.1.4

LISP EID ref count: 1, Underlay ref timer: 00:05:13

Outgoing interface list:

Null0, Forward/Dense, 00:01:46/stopped, Pkts:0, flags:

(

10.47.1.10, 232.0.2.245

), 2d06h/00:02:59, flags: sT

Incoming interface: GigabitEthernet1/0/1, RPF nbr 10.47.1.0

LISP EID ref count: 1, Underlay ref timer: 00:05:12

Outgoing interface list:

Null0, Forward/Dense, 2d06h/stopped, Pkts:0, flags:

Virtuele hardwareprogramming - IOS MFIB

Controleer de Overlay en Underlay MFIB met de opdracht "toon ip mfib vrf <VN Name> <overlay group address> verbose" en "toon ip route <underlay group address> verbose"

In de Overlay

<#root>

Edge-1#

```
show ip mfib vrf blue_vn 239.0.0.5 verbose
```

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn

(

*,239.0.0.5


```
) Flags: C K HW
0x6D OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 16218869633044709376/0/0/0, Other: 0/0/0
LISPO.4100 Flags: RA A MA NS
Vlan1025 Flags: RF F NS
CEF: Adjacency with MAC: 01005E00000500000C9FFB870800
Pkts: 0/0/0 Rate: 0 pps
(
```

10.47.7.3,239.0.0.5

```
) Flags: K HW DDE
0x7B OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 2/0/2
HW Forwarding: 0/0/0/0, Other: 0/0/0
LISPO.4100 Flags: RA A MA
Vlan1025 Flags: RF F NS
CEF: Adjacency with MAC: 01005E00000500000C9FFB870800
Pkts: 0/0/0 Rate: 0 pps
```

In de ondergrond

<#root>

Edge-1#

```
show ip mfib 232.0.2.245 verbose
```

```
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
Default
(
```

10.47.1.10,232.0.2.245

```
) Flags: K HW
0x18 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 8384858081233731584/0/0/0, Other: 0/0/0
GigabitEthernet1/0/1 Flags: RA A MA
Null0, LISPV4 Decap Flags: RF F NS
CEF: OCE (lisp decap)
Pkts: 0/0/0 Rate: 0 pps
(
```

10.47.1.13,232.0.2.245

```
) Flags: K HW
0x77 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 0/0/0/0, Other: 0/0/0
GigabitEthernet1/0/2 Flags: RA A MA
Null0, LISPv4 Decap Flags: RF F NS
CEF: OCE (lisp decap)
Pkts: 0/0/0 Rate: 0 pps
```

Mroute Hardware Programming - FMAN RP

Om FMAN RP te valideren, moet eerst de VRF-id worden vastgelegd.

```
<#root>
```

```
Edge-1#
```

```
show vrf detail blue_vn | include Id
```

```
VRF blue_vn (
```

```
VRF Id = 2
```

```
); default RD <not set>; default VPNID <not set>
```

Gebruik vervolgens de VRF-indexwaarde voor de volgende opdrachten. Om de Overlay te valideren (*,G) gebruik de opdracht "toon platform software ip switch active r0 mfib vrf index <VRF Index> groep <overlay group address>/32"

```
<#root>
```

```
Edge-1#
```

```
show platform software ip switch active r0 mfib vrf index 2 group 239.0.0.5/32
```

```
Route flags:
```

```
S - Signal; C - Directly connected;
```

```
IA - Inherit A Flag; L - Local;
```

```
BR - Bidir route
```

```
*, 239.0.0.5/32 --> OBJ_INTF_LIST (0x6d)
```

```
Obj id: 0x6d, Flags: C
```

```
OM handle: 0x348030b738
```

Om de Overlay te valideren (S,G) gebruik de opdracht "toon platform software ip switch active r0 mfib vrf index 2 groepsadres <overlay group address> <unicast source>"

```
<#root>
```

Edge-1#

```
show platform software ip switch active r0 mfib vrf index 2 group address 239.0.0.5 10.47.7.3
```

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

239.0.0.5, 10.47.7.3/64 --> OBJ_INTF_LIST (0x7f)

Obj id: 0x7f, Flags: unknown

OM handle: 0x34803a3800

Om de Underlay (S,G) voor de Overlay (*,G) te valideren, gebruikt u de opdracht "toon platform software ip switch actief r0 mfib groepsadres <underlay group address> <RP adres>"

<#root>

Edge-1#

```
show platform software ip switch active r0 mfib group address 232.0.2.245 10.47.1.10
```

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

232.0.2.245, 10.47.1.10/64 --> OBJ_INTF_LIST (0x18)

Obj id: 0x18, Flags: unknown

OM handle: 0x34803b9be8

Om de Underlay (S,G) voor de Overlay te valideren (S,G) gebruik de opdracht "toon platform software ip switch actief r0 mfib groepsadres <underlay group address> <RLOC of FHR>"

<#root>

Edge-1#

```
show platform software ip switch active r0 mfib group address 232.0.2.245 10.47.1.13
```

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

232.0.2.245, 10.47.1.13/64 --> OBJ_INTF_LIST (0x77)

Obj id: 0x77, Flags: unknown

OM handle: 0x348026b988

Mroute Hardware Programming - FMAN FP

Voor het valideren van de Overlay (*,G) gebruikt u de opdracht "toon platformsoftware ip switch

```
switch active f0 mfib vrf index <VRF ID> groep <overlay group address>"
```

```
<#root>
```

```
Edge-1#
```

```
show platform software ip switch active f0 mfib vrf index 2 group 239.0.0.5/32
```

```
Route flags:
```

```
S - Signal; C - Directly connected;
```

```
IA - Inherit A Flag; L - Local;
```

```
BR - Bidir route
```

```
*, 239.0.0.5/32 --> OBJ_INTF_LIST (0x6d)
```

```
Obj id: 0x6d, Flags: C
```

```
aom id:
```

```
100880
```

```
, HW handle: (nil) (created)
```

Om de Overlay te valideren (S,G) gebruik de opdracht "toon platformsoftware ip switch switch active f0 mfib vrf index <VRF ID> groepsadres <overlay group address> <unicast source>"

```
<#root>
```

```
Edge-1#
```

```
show platform software ip switch active f0 mfib vrf index 2 group address 239.0.0.5 10.47.7.3
```

```
Route flags:
```

```
S - Signal; C - Directly connected;
```

```
IA - Inherit A Flag; L - Local;
```

```
BR - Bidir route
```

```
239.0.0.5, 10.47.7.3/64 --> OBJ_INTF_LIST (0x8f)
```

```
Obj id: 0x8f, Flags: unknown
```

```
aom id:
```

```
161855
```

```
, HW handle: (nil) (created)
```

Om de Underlay (S,G) voor de Overlay (*,G) te valideren, gebruikt u de opdracht "toon platform software ip switch actief f0 mfib groepsadres <underlay group address> <RP adres>"

```
<#root>
```

```
Edge-1#
```

```
show platform ip switch active f0 mfib group address 232.0.2.245 10.47.1.10
```

```
Route flags:
```

```
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
232.0.2.245, 10.47.1.10/64 --> OBJ_INTF_LIST (0x18)
Obj id: 0x18, Flags: unknown
aom id:

138716

, HW handle: (nil) (created)
```

Om de Underlay (S, G) voor de Overlay (S, G) te valideren, gebruikt u de opdracht "toon platform software ip switch actief f0 mfib groepsadres <underlay group address> <RLOC of FHR>"

```
<#root>
```

```
Edge-1#
```

```
show platform software ip switch active f0 mfib group address 232.0.2.245 10.47.1.13
```

```
Route flags:
```

```
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
232.0.2.245, 10.47.1.13/64 --> OBJ_INTF_LIST (0x5)
Obj id: 0x5, Flags: unknown
aom id:

161559

, HW handle: (nil) (created)
```

Mroute Hardware Programming - FMAN FP Database

Om FMAN FP object te valideren, gebruikt u de opdracht "show platform software object-manager switch active f0 object <object ID> parent"

Bijvoorbeeld: de Overlay valideren (*,G)

```
<#root>
```

```
Edge-1#
```

```
show platform software object-manager switch active f0 object 100880 parents
```

```
Object identifier: 100605
Description: ipv4_mcast table 2 (
blue_vn
), vrf id 2
Status: Done
Object identifier: 100878
```

Description:

```
mlist 109
```

Status: Done

De overlay valideren (S,G)

```
<#root>
```

```
Edge-1#
```

```
show platform software object-manager switch active f0 object 161855 parents
```

Object identifier: 100605

Description: ipv4_mcast table 2 (blue_vn), vrf id 2

Status: Done

Object identifier: 161854

Description:

```
mlist 143
```

Status: Done

De mlist is een combinatie van de inkomende interface (IIF) en de uitgaande interfacelijst (OIL), gescheiden van de route in een ander object. Om de mlist te valideren, gebruik de opdracht "show platform software mlist switch active f0 index <index>"

```
<#root>
```

```
Edge-1#
```

```
show platform software mlist switch active f0 index 109
```

Multicast List entries

OCE Flags:

NS - Negate Signalling; IC - Internal copy;

A - Accept; F - Forward;

OCE Type OCE Flags Interface

```
-----  
0xf8000171 OBJ_ADJACENCY NS, A LISP0.4100
```

```
<-- Incoming Interface for (*,G)
```

```
0xf80001f1 OBJ_ADJACENCY NS, F Vlan1025
```

```
<-- Outgoing Interface for (S,G)
```

```
<#root>
```

Edge-1#

```
show platform software mlist switch active f0 index 143
```

Multicast List entries

OCE Flags:

NS - Negate Signalling; IC - Internal copy;

A - Accept; F - Forward;

OCE Type OCE Flags Interface

0xf8000171 OBJ_ADJACENCY A LISP0.4100

<-- Outgoing Interface for (S,G)

0xf80001f1 OBJ_ADJACENCY NS, F Vlan1025

<-- Incoming Interface for (S,G)

Mroute Hardware Programming - FED

Om de Overlay te valideren (S,G) gebruik de opdracht "toon platform software gevoed switch actieve ip mfib vrf <VN Name> <overlay group address> <Unicast Source>"

<#root>

Edge-1#

```
show platform software fed switch active ip mfib vrf blue_vn 239.0.0.5 10.47.7.3
```

Multicast (S,G) Information

VRF : 2

Source Address : 10.47.7.3

HTM Handler : 0x7f0efe53a638

SI Handler : 0x7f0efe50ec68

DI Handler :

0x7f0efe530768

REP RI handler : 0x7f0efe5387e8

Flags :

Packet count : 0

State : 4

RPF :

LISP0.4100 A

OIF :

Vlan1025 F NS

LISP0.4100 A

(Adj: 0xf8000171)

Om de Underlay te valideren (S,G) gebruik de opdracht "toon platform software gevoed switch actieve ip mfib <underlay group address> <RLOC of FHR>"

<#root>

Edge-1#

```
show platform software fed switch active ip mfib 232.0.2.245 10.47.1.13
```

```
Multicast (S,G) Information
VRF : 0
Source Address : 10.47.1.13
HTM Handler : 0x7f0efe512408
SI Handler : 0x7f0efe5158f8
DI Handler :

0x7f0efe525538
```

```
REP RI handler : 0x7f0efe52ca18
Flags :
Packet count : 0
State : 4
RPF :
GigabitEthernet1/0/2 A
OIF :
LISP0 LISP Decap F NS
GigabitEthernet1/0/2 A
```

Vervolgens wordt de Bestemmingsindex (DI) gevalideerd voor zowel Overlay als Underlay (S, G), u kunt de opdracht "platform hardwarefeed switch active fwd-asic abstraction print-resource-handle <DI Handler> 1 gebruiken"

Voor de Overlay (S,G)

<#root>

Edge-1#

```
show platform hardware fed switch active fwd-asic abs print-resource-handle 0x7f0efe512408 1
```

```
Handle:0x7f0efe530768 Res-Type:ASIC_RSC_DI Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_L3_MULTICA
priv_ri/priv_si Handle: (nil)Hardware Indices/Handles: index0:0x5279 mtu_index/13u_ri_index0:0x0 index1
Cookie length: 56
```

```
00 00 00 00 00 00 00 00 02 00 00 00 03 07 2f 0a 05 00 00 ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

```
Detailed Resource Information (ASIC_INSTANCE# 0)
```

```
-----
```

```
Destination index = 0x5279
```

```
pmap = 0x00000000 0x00000010
```

```
pmap_intf : [GigabitEthernet1/0/5] <-- From IGMP Snooping
```

```
cmi = 0x0
```

```
rcp_pmap = 0x0
```

```
al_rsc_cmi
```

```
CPU Map Index (CMI) [0]
```

```
ctiLo0 = 0
```

```
ctiLo1 = 0
```

```
ctiLo2 = 0
```

```
cpuQNum0 = 0
```

```
cpuQNum1 = 0
```



```
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
Detailed Resource Information (ASIC_INSTANCE# 1)
-----
Destination index = 0x5279
pmap = 0x00000000 0x00000000
cmi = 0x0
rcp_pmap = 0x0
al_rsc_cmi
CPU Map Index (CMI) [0]
ctiLo0 = 0
ctiLo1 = 0
ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
=====
```

Voor de onderlaag (S,G)

<#root>

Edge-1#

```
show platform hardware fed switch active fwd-asic abs print-resource-handle 0x7f0efe525538 1
```

```
Handle:0x7f0efe525538 Res-Type:ASIC_RSC_DI Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_L3_MULTICA
00 00 00 00 00 00 00 00 00 00 00 00 00 0d 01 2f 0a f5 02 00 e8 00 00 00 00 00 00 00 00 00 00 00 00 00
```

```
Detailed Resource Information (ASIC_INSTANCE# 0)
```

```
-----
```

```
Destination index = 0x5284
```

```
pmap = 0x00000000 0x00000000 <-- Expected since this is the Underlay, and recirculation is required to s
```

```
cmi = 0x0
```

```
rcp_pmap = 0x1 <-- Indicates recirculation is required
```

```
al_rsc_cmi
```

```
CPU Map Index (CMI) [0]
```

```
ctiLo0 = 0
```

```
ctiLo1 = 0
```

```
ctiLo2 = 0
```

```
cpuQNum0 = 0
```

```
cpuQNum1 = 0
```

```
cpuQNum2 = 0
```

```
npuIndex = 0
```

```
stripSeg = 0
```

```
copySeg = 0
```

```
Detailed Resource Information (ASIC_INSTANCE# 1)
```

```
-----
```

```
Destination index = 0x5284
```

```
pmap = 0x00000000 0x00000000
cmi = 0x0
rcp_pmap = 0x0
al_rsc_cmi
CPU Map Index (CMI) [0]
ctiLo0 = 0
ctiLo1 = 0
ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
```

```
=====
```

Over deze vertaling

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