

Verifieer head-end replicatie in SD-Access Fabric

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Inleiding

In dit document wordt beschreven hoe u HeadEnd-replicatie in SD-Access (SDA)-fabric kunt

oplossen.

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

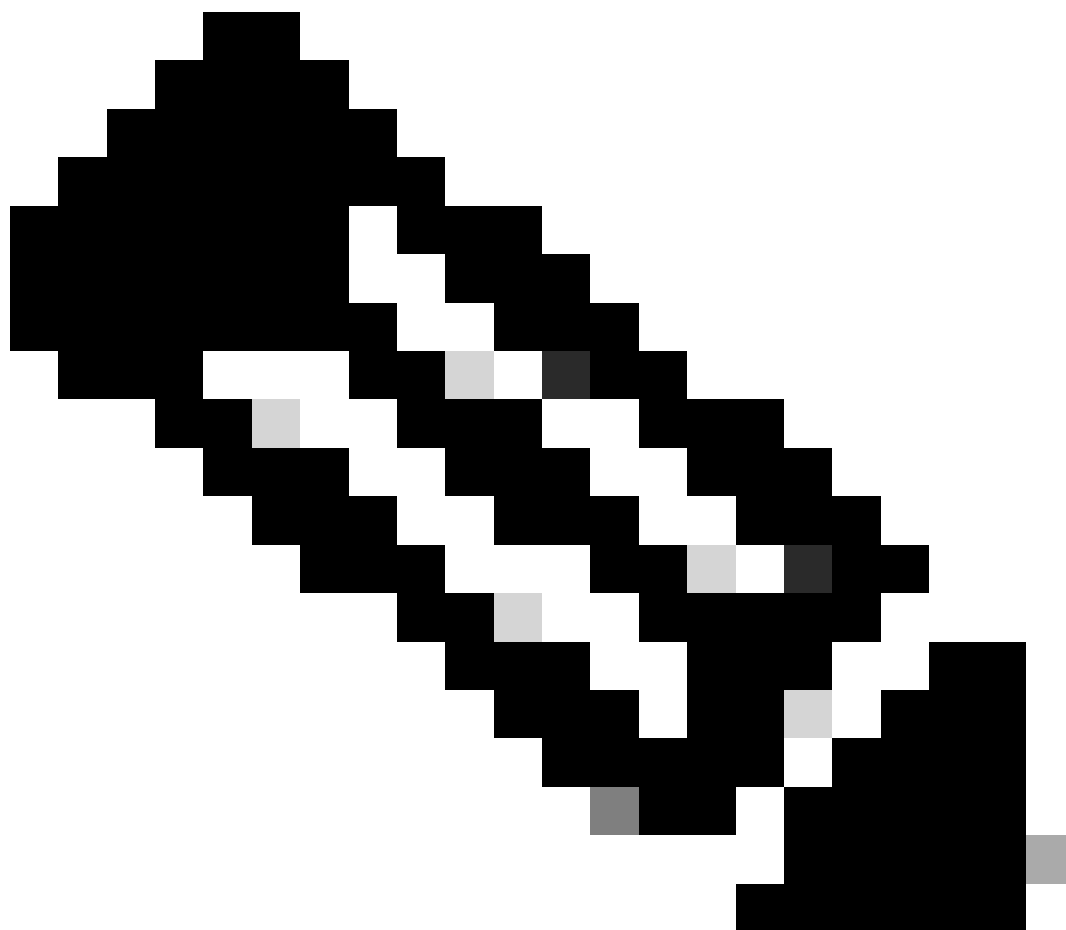
SDA Head-end replicatie is een vorm van overlay-multicast, die wordt gebruikt om multicast verkeer tussen fabric-apparaten te dragen, waarbij multicast verkeer wordt ingekapseld in een unicast IP-header. Head-end replicatie kan multicast verkeer tussen bron(nen) en ontvanger(s) routeren in hetzelfde VLAN of verschillend VLAN (dezelfde VLAN-multicast kan worden gerouteerd).

Multicastverkeer tussen bronnen en ontvangers op dezelfde Fabric Edge wordt niet doorgestuurd met behulp van overlay multicast (VXLAN-insluiting), maar wordt lokaal doorgestuurd door de Fabric Edge.

Elke vorm van overlay multicast (head-end of native) kan multicast verkeer voor groepen in het 224.0.0.0/24-bereik niet routeren, of met TTL=1, wordt dit behandeld via Layer 2 Flooding

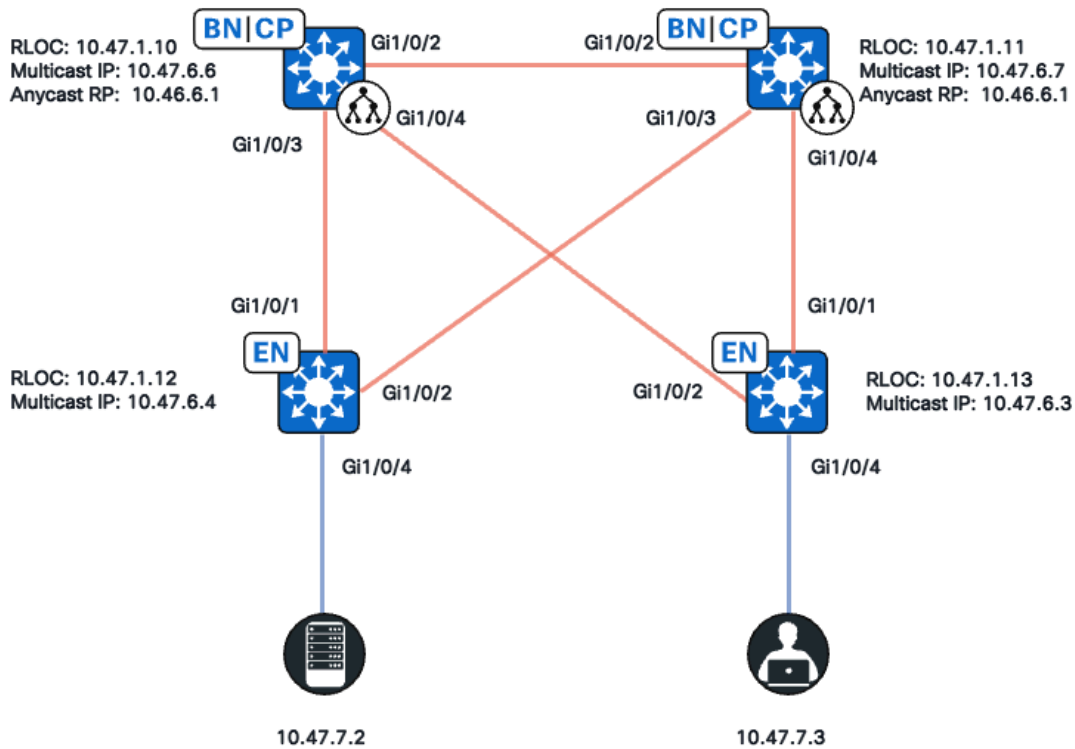
Opmerking: betekent dat de lezer er notitie van neemt. De opmerkingen bevatten nuttige

suggesties of verwijzingen naar materiaal dat niet in het document is opgenomen.



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:

- 10.47.10 en 10.47.1.11 zijn op elkaar geplaatste randen die ook als Anycast Rendezvous Point (RP) functioneren met Multicast Source Discovery Protocol (MSDP) tussen de twee in het Virtual Network (VN)/VRF.
- 10.47.1.12 en 10.47.1.13 zijn Fabric Edge-knooppunten
- 10.47.7.2 is de multicastbron
- 10.47.7.3 is de multicast-ontvanger
- 239.1.1.1 is het multicast doeladres van de groep (GDA)

Configuratie

Er wordt aangenomen dat Cisco Catalyst Center wordt gebruikt om de SDA-stof te voorzien van de standaardinstellingen:

- Implementatie van replicatie is head-end replicatie
- Anycast RP met MSDP voor een Any Source Multicast (ASM)-multicast op de gecodeerde randen

Na een succesvolle configuratie vanuit Catalyst Center bevat de relevante configuratie per apparaat verschillende secties:

Configuratie van Fabric Edge (10.47.1.12)

```
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISP0.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.4 255.255.255.255
ip pim sparse-mode
end
!
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
!
interface Vlan1025
description Configured from Cisco DNA-Center
mac-address 0000.0c9f.fb87
vrf forwarding blue_vn
ip address 10.47.7.1 255.255.255.0
ip helper-address 10.47.9.9
no ip redirects
ip pim passive
ip route-cache same-interface
ip igmp version 3
ip igmp explicit-tracking
no lisp mobility liveness test
lisp mobility blue-IPV4
end
!
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
```

Configuratie van Fabric Edge (10.47.1.13)

```
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISP0.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.4 255.255.255.255
ip pim sparse-mode
end
!
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
!
interface Vlan1025
```

```
description Configured from Cisco DNA-Center
mac-address 0000.0c9f.fb87
vrf forwarding blue_vn
ip address 10.47.7.1 255.255.255.0
ip helper-address 10.47.9.9
no ip redirects
ip pim passive
ip route-cache same-interface
ip igmp version 3
ip igmp explicit-tracking
no lisp mobility liveness test
lisp mobility blue-IPV4
end
!
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
```

Configuratie Rand/Anycast RP (10.47.1.10) op locatie

```
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
!
router lisp
site site_uci
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
!
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISP0.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
end
!
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
end
!
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 access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
!
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
```

Configuratie Rand/Anycast RP (10.47.1.11) op locatie

```
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
!
router lisp
site site_uci
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
!
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISPO.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
end
!
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.7 255.255.255.255
ip pim sparse-mode
end
!
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 access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
!
ip msdp vrf blue_vn peer 10.47.6.6 connect-source Loopback4600
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
```

Verificatie van besturingsplane

Controleer vervolgens het Internet Group Membership Protocol (IGMP) en PIM.

Multicast-ontvanger verzendt IGMP-lidmaatschapsrapport

De multicastontvanger (10.47.7.3) stuurt een IGMP-lidmaatschapsrapport (MR) of IGMP-verbinding om aan te geven dat er belangstelling is voor het ontvangen van multicastverkeer. U kunt een ingesloten pakketopname (EPC) configureren om te bevestigen dat er een IGMP MR ontvangen is:

<#root>

Edge-2#

```
monitor capture 1 interface GigabitEthernet1/0/5 IN
```

Edge-2#

```
monitor capture 1 match any
```

Edge-2#

```
monitor capture 1 buffer size 10
```

Edge-2#

```
monitor capture 1 start
```

Edge-2#

```
monitor capture 1 stop
```

Edge-1#

```
show monitor capture 1 buff display-filter igmp brief
```

```
Starting the packet display ..... Press Ctrl + Shift + 6 to exit  
145 63.730527 10.47.7.4 -> 239.1.1.1 IGMPv2 60 Membership Report group 239.1.1.1
```

Zorg er vervolgens voor dat de Fabric Edge de PIM Designated Router (DR) voor het VLAN is waarin de multicast-ontvanger zich bevindt. Dit wordt ook de Last Hop Router (LHR) genoemd. U kunt de opdracht "toon ip pim vrf <VN Name> interface VLAN <vlan> detail gebruiken | PIM DR."

<#root>

Edge-2#

```
show ip pim vrf blue_vn interface vlan 1025 detail | i PIM DR
```

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

Controleer of IGMP Snooping de IGMP MR heeft opgepikt met de opdracht "toon ip igmp vrf <VN Name> snooping group"

<#root>

Edge-1#

```
show ip igmp vrf blue_vn snooping groups
```

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

```
-----  
1025 239.255.255.254 igmp v2      Gi1/0/5
```

Creatie van gedeelde boomstructuur in PIM Sparse-Mode

Edge-2, de DR op dat segment stuurt een (*,G) PIM Join naar de Anycast RP. Als het Anycast RP-adres niet wordt opgelost in de LISP Map-Cache, is het LISP EID Watch-proces verantwoordelijk voor het activeren van LISP Map-Verzoeken. U kunt de opdracht "show lisp instance-id <LISP L3 ID> ipv4/ipv6 e-watch" gebruiken | OPSTARTEN VAN LOC"

<#root>

Edge-2#

```
show lisp instance-id 4100 ipv4 eid-watch | begin RLOC
```

```
LISP IPv4 EID Watches for Table (RLOC mapping in vrf blue_vn IPv4) IID (4100), 1 watch entries  
Watch entries for prefix 10.47.6.1/32
```

```
10.47.6.1
```

```
,
```

```
multicast
```

Edge-2#

```
show lisp instance-id 4100 ipv4 map-cache 10.47.6.1
```

```
LISP IPv4 Mapping Cache for LISP 0 EID-table vrf blue_vn (IID 4100), 1 entries
```

```
10.47.6.1/32, uptime: 9w1d, expires: 20:19:57, via map-reply, complete
```

```
Sources: map-reply
```

```
State: complete, last modified: 9w1d, map-source: 10.47.1.10
```

```
Active, Packets out: 577721(21849998 bytes), counters are not accurate (~ 00:00:12 ago)
```

```
Locator Uptime State Pri/Wgt Encap-IID
```

```
10.47.1.10
```

```
9w1d up 10/10 -
```

```
Last up-down state change: 1w1d, state change count: 3
```

```
Last route reachability change: 9w1d, state change count: 1
```

```
Last priority / weight change: never/never
```

```
RLOC-probing loc-status algorithm:
```

```
Last RLOC-probe sent: 1w1d (rtt 272ms)
```

```
10.47.1.11
```

```
9w1d up 10/10 -
Last up-down state change: 9w1d, state change count: 1
Last route reachability change: 9w1d, state change count: 1
Last priority / weight change: never/never
RLOC-probing loc-status algorithm:
Last RLOC-probe sent: 1w1d (rtt 602ms)
```

```
Edge-2#
```

```
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
```

Valideer de (*,G) vermelding op Edge-2 met de opdracht "toon ip mroute vrf <VN-naam> <multicast group>"

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
(*, 239.1.1.1), 4d05h/00:02:12, RP

10.47.6.1
, flags: SC

<-- Anycast RP IP address 10.47.6.1
```

Incoming interface: LISP0.4100, RPF nbr

10.47.1.10 <-- Reverse Path Forwarding (RPF) neighbor to get to the Anycast RP IP

Outgoing interface list:

Vlan1025

, Forward/Sparse-Dense, 4d05h/00:02:12, flags:

<-- Outgoing interface list (OIL) is populated via PIM Join or IGMP Membership Report

PIM-buren in de overlay

Zodra de RPF-buur die wordt weergegeven door zijn Routing Locator (RLOC) en bereikbaar is via de LISP-interface, wordt deze toegevoegd als een PIM-buur in de VRF/VN.

Enkele zaken om bewust te zijn van:

- RPF-controle, die wordt gebruikt om de PIM (*,G) te verzenden, activeert de aanmaak van de PIM-buur met een verlooptimer van twee minuten. Als er 2 minuten lang geen PIM Join-berichten worden verstuurd, wordt de buurtijd uitgezonden.
- PIM moet expliciet een buurstructuur maken voor de corresponderende RLOC, aangezien PIM Hello-berichten niet worden verzonden in de SDA Overlay

<#root>

Edge-2#

```
show ip pim vrf blue_vn neighbor
```

PIM Neighbor Table

Mode: B - Bidir Capable, DR - Designated Router, N - Default DR Priority,

P - Proxy Capable, S - State Refresh Capable, G - GenID Capable,

L - DR Load-balancing Capable

Neighbor	Interface	Uptime/Expires	Ver	DR
----------	-----------	----------------	-----	----

Address				Prio/Mode
---------	--	--	--	-----------

10.47.1.10	LISP0.4100	4d23h/00:01:37	v2	0 /
------------	------------	----------------	----	-----

Anycast RP creëert (*,G)

Gebaseerd op de PIM (*,G) Join ontvangen van Edge-2, maakt Border-1 (*,G) met de OIL naar Edge-2's RLOC

<#root>

Border-1#

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
(*, 239.1.1.1), 4d23h/00:02:48, RP 10.47.6.1, flags: S
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:
```

```
LISP0.4100
```

```
,
```

```
10.47.1.13
```

```
, Forward/Sparse, 4d23h/00:02:33, flags:
```

```
<-- RLOC of Edge-2
```

Multicastbronregistratie

Multicastbron 10.47.7.2 verzendt multicast verkeer, dat Edge-1 inschakelt. Edge-1 prikt het pakket naar de CPU om de status (S,G) te maken en Edge-1 registreert de bron naar de Anycast RP.

```
<#root>
```

```
Edge-1#
```

```
monitor capture 1 interface GigabitEthernet1/0/4 IN
```

```
Edge-1#
```

```
monitor capture 1 match any
```

```
Edge-1#
```

```
monitor capture 1 buffer size 10
```

Edge-1#

monitor capture 1 start

Edge-1#

monitor capture 1 stop

Edge-1#

show monitor capture 1 buffer brief

Starting the packet display Press Ctrl + Shift + 6 to exit

```
1 0.000000 10.47.7.2 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=107/27392, ttl=5
2 0.355071 10.47.7.3 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=107/27392, ttl=5
3 1.096757 10.47.7.3 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=108/27648, ttl=5
4 1.102425 10.47.7.3 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=108/27648, ttl=5
```

Zodra grens-1 het multicast pakket via PIM-registratie ontvangt, heeft grens-1 (S, G) en adverteert dit aan grens-2 via MSDP

<#root>

Border-1#

show ip mroute vrf blue_vn 239.1.1.1 10.47.7.2

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

(10.47.7.2, 239.1.1.1), 00:02:26/00:00:34, flags: T

A <-- A flag indicates that this is a candidate for MSDP advertisement

Incoming interface: LISP0.4100, RPF nbr 10.47.1.12

Outgoing interface list:

LISP0.4100, 10.47.1.13, Forward/Sparse, 00:02:26/00:02:36, flags:

MSDP-bronadvertenties

Gebruik de opdracht "toon ip msdp vrf <VN name> sa-cache" om de Source Active Cache te bekijken. U kunt de opdracht "toon ip msdp vrf <VN name> samenvatting" gebruiken om de MSDP peer te zien

<#root>

Border-1#

```
show ip msdp vrf blue_vn sa-cache
```

MSDP Source-Active Cache - 1 entries

(10.47.7.2, 239.1.1.1), RP 10.47.6.7, BGP/AS 23456, 00:00:34/00:05:25, Peer 10.47.6.7

Border-1#

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

MSDP Peer Status Summary

Peer Address	AS	State	Uptime/ Downtime	Reset SA Count	Peer Name
--------------	----	-------	---------------------	-------------------	-----------

10.47.6.7

23456

Up

1w1d	0	1			
------	---	---	--	--	--

Border-2 ontvangt (S,G) informatie van Border-1 via MSDP-aankondiging. Als Border-2 een PIM (*,G) heeft ontvangen van Edge-2, maakt Border-2 een (S,G)-ingang en erft de LISP OIL van de (*,G) die naar Edge-2's RLOC wijst. De vuistregel is dat MSDP SA-vermeldingen alleen in de multicast Routing Information Base (MRIB) worden geïnstalleerd als een (*,G) bestaat.

<#root>

Border-2#

```
show ip msdp vrf blue_vn sa-cache
```

MSDP Source-Active Cache - 1 entries

(10.47.7.2, 239.1.1.1), RP 10.47.6.6, BGP/AS 23456, 00:13:59/00:03:28, Peer 10.47.6.6

Border-2#

```
show ip mroute vrf blue_vn 239.1.1.1
```

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
(* , 239.1.1.1), 00:21:04/00:00:06, RP 10.47.6.1, flags: SP
Incoming interface: Null, RPF nbr 0.0.0.0

Outgoing interface list: Null <-- Indicates no PIM (*,G) Join received, if there was an OIL, then

Border-1 stuurt een PIM (S,G) Join naar de bron 10.47.7.2 om het multicast verkeer native aan te trekken, waardoor Edge-1 de (S,G) OIL kan updaten

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.1.1.1 10.47.7.3

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
(10.47.7.2, 239.1.1.1), 01:19:57/00:02:29, flags: FT
Incoming interface:

```
vlan1025
, RPF nbr 0.0.0.0
<-- Multicast source 10.47.7.2 is in VLAN 1025
```

```
Outgoing interface list:
LISPO.4100,
10.47.1.10
, Forward/Sparse, 01:19:55/00:02:30, flags:
<-- RLOC of Border-1
```

Multicastverkeer van 10.47.7.2 tot 239.1.1.1 wordt doorgestuurd vanuit 10.47.6.6 (border-1) via Unicast VLAN-insluiting. Border-1 de-kapselt het VXLAN-verkeer in en kapselt dit opnieuw in op Edge-2 (10.47.1.13)

```
<#root>
```

```
Border-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
```

```
(* , 239.1.1.1), 5d01h/00:03:14, RP 10.47.6.1, flags: S
```

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

```
Outgoing interface list:
```

```
LISPO.4100, 10.47.1.13, Forward/Sparse, 5d01h/00:02:54, flags:
```

```
(
```

```
10.47.7.2
```

```
, 239.1.1.1), 00:02:28/00:00:30, flags: MT
```

```
<-- Unicast Source
```

```
Incoming interface: LISPO.4100, RPF nbr
10.47.1.12
<-- RPF neighbor to get to the source (Edge-1)
```

```
Outgoing interface list:
LISPO.4100,
10.47.1.13
, Forward/Sparse, 00:02:28/00:03:14, flags:
<-- RLOC of Edge-2
```

Kortste snijpad boom (SPT) cutover

Zodra de Last Hop Router (LHR) Edge-2, het multicast pakket langs de (*,G) boom ontvangt, probeert het om SPT cutover te doen en een PIM (S,G) te verzenden toetreden tot Edge-1.

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
(*, 239.1.1.1), 4d23h/stopped, RP 10.47.6.1, flags: SJC
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10
Outgoing interface list:
```

```
vlan1025
```

```
, Forward/Sparse-Dense, 4d23h/00:02:40, flags:
```

```
<-- LHR creates the OIL because of receipt of an IGMP MR
```

```
(
```

```
10.47.7.2
```

```
, 239.1.1.1), 00:00:02/00:02:57, flags: JT
```

```
<-- Unicast Source
```

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

```
10.47.1.12
```

```
<-- RPF neighbor to get to 10.47.7.2, which is Edge-1 RLOC
```

```
Outgoing interface list:
```

```
Vlan1025
```

```
, Forward/Sparse-Dense, 00:00:02/00:02:57, flags:
```

```
<-- Multicast traffic is forwarded into VLAN 1025, where 10.47.7.3 is
```

De FHR (Edge-1) heeft (S,G) direct naar de RLOC van Edge-2 gericht

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
```

```
(*, 239.1.1.1), 5d01h/stopped, RP 10.47.6.1, flags: SCF
```

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

```
Outgoing interface list:
```

Vlan1025, Forward/Sparse-Dense, 5d01h/00:01:40, flags:

(

10.47.7.2

, 239.1.1.1), 01:53:06/00:02:42, flags: FT

<-- Unicast Source

Incoming interface: Vlan1025, RPF nbr 0.0.0.0

Outgoing interface list:

LISP0.4100,

10.47.1.13

, Forward/Sparse, 00:14:22/00:03:07, flags:

<-- Edge-2's RLOC

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.

Verificatie aan de bronzijde

Om de multicast bron en de capaciteit van FHR te bevestigen om (S, G) te creëren, Switch Integrated Security Feature (SISF), LISP, Cisco Express Forwarding (CEF), en toen RPF te bevestigen.

De multicast bron moet in SISF/IP Device-Tracking (IPDT) zijn die de rest van LISP, CEF en uiteindelijk RPF stuurt.

U kunt de opdracht "show device-tracking database address <IP address>" gebruiken om er zeker van te zijn dat de multicast bron een geldige IPDT-ingang heeft.

<#root>

Edge-1#

show device-tracking database address 10.47.7.2

Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - I

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	10.47.7.2	5254.0012.521d	Gi1/0/4	1025	0024	163s	REACHABLE	81 s try 0(8428
-----	-----------	----------------	---------	------	------	------	-----------	-----------------

Zorg er vervolgens voor dat de LISP-database op de FHR een ingang heeft voor de multicast bron. Gebruik de opdracht "show lisp instance-id <LISP L3 ID> ipv4 database ip address/32"

<#root>

Edge-1#

```
show lisp instance-id 4100 ipv4 database 10.47.7.2/32
```

```
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-b
Uptime: 1w2d, Last-change: 1w2d
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 1w2d Yes 0
10.47.1.11 1w2d Yes 0
```

Edge-1#

```
show ip lisp instance-id 4100 forwarding eid local 10.47.7.2
```

Prefix

```
10.47.7.2/32
```

CEF maakt een vermelding op basis van LISP, CEF verwijst naar een /32-hostvermelding, niet naar LISP.

<#root>

Edge-1#

```
show ip cef vrf blue_vn 10.47.7.2
```

```
10.47.7.2/32
nexthop 10.47.7.2 Vlan1025
```

Vervolgens wordt RPF afgeleid van CEF

<#root>

Edge-1#

```
show ip rpf vrf blue_vn 10.47.7.2
```

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

```
RPF interface: Vlan1025
```

```
RPF neighbor: ? (
```

```
10.47.7.2
```

```
) - directly connected
```

```
RPF route/mask: 10.47.7.2/32
```

```
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, die in geen LISP- gegevensbestandafbeelding op FHR resulteert, die in CEF en RPF die naar de Grenzen richten resulteert. Als de multicast bron verkeers-RPF-punten naar de onjuiste interface stuurt, wat resulteert in RPF-fout, (S,G) wordt niet gevormd.

<#root>

Edge-1#

```
show device-tracking database address 10.47.7.2
```

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DHCP - 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
```

Edge-1#

```
show lisp instance-id 4100 ipv4 database 10.47.7.2/32
```

```
% No database-mapping entry for 10.47.7.2/32.
```

Edge-1#

```
show ip cef vrf blue_vn 10.47.7.2
```

```
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 interfac
```

```
Edge-1#
```

```
show ip rpf vrf blue_vn 10.47.7.2
```

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

```
RPF interface:
```

```
LISP0.4100
```

```
RPF neighbor: ? (
```

```
10.47.1.11
```

```
)
```

```
RPF route/mask: 10.47.7.2/32
```

```
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, Static 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 noodzakelijke 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-1#
```

```
show ip pim vrf blue_vn rp 239.1.1.1
```

```
Group: 239.1.1.1, RP: 10.47.6.1, uptime 5d22h, expires never
```

Zorg ervoor dat de PIM Register-tunnel is gevormd.

```
<#root>
```

Edge-1#

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 :

10.47.6.4 <-- This is from "ip pim vrf blue_vn register-source Loopback4100"

State : UP

Last event : Created (1w2d)

Zorg voor IP bereikbaarheid naar de Anycast RP

<#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

<-- RLOC of Border-1

nexthop

10.47.1.11

LISP0.4100

<-- RLOC of Border-2

Edge-1#

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 10.47.6.4

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 257/275/294 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 group-range" 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 de RP is geconfigureerd voor de multicast groep

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
```

```
(*, 239.1.1.1), 6d01h/stopped,
```

RP 10.47.6.1

, flags: SCF
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 6d01h/00:01:34, flags:

Zorg ervoor dat RPF naar de Anycast RP juist is

<#root>

Edge-2#

```
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-2#

```
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 - verificatie vanaf de bronzijde

U kunt de opdracht "toon ip mfib vrf <VN Name> <multicast group> <unicast source> breedsprakig" gebruiken om extra informatie te verkrijgen over het doorsturen van pakketten

<#root>

Edge-1#

```
show ip mfib vrf blue_vn 239.1.1.1 10.47.7.2 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
(10.47.7.2,239.1.1.1) Flags: K HW DDE
0x42 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 272/272/0
HW Forwarding: 7431223059161284608/0/0/0, Other: 0/0/0
Vlan1025 Flags: RA A MA NS
LISP0.4100,

10.47.1.13

Flags: RF F NS

<-- RLOC of Edge-2

CEF: Adjacency with MAC: 4500000000004000001164770A2F010D0A2F010C000012B5000000000840000000100400

Pkts: 0/0/0 Rate: 0 pps

Edge-1#

show adjacency lisp0.4100

Protocol Interface Address
IP LISP0.4100 10.47.1.10(23)
IP LISP0.4100 10.47.1.11(27)
IP LISP0.4100

10.47.1.13

(8)

Edge-2#

show adjacency lisp0.4100 10.47.1.13 detail

Protocol Interface Address
IP LISP0.4100

10.47.1.13

(8)

0 packets, 0 bytes
epoch 0
sourced in sev-epoch 14
Encap length 50
4500000000004000001164770A2F010D
0A2F010C000012B50000000008400000
00100400BA25CDF4AD3852540017FE73
0000

```
L2 destination address byte offset 0
L2 destination address byte length 0
Link-type after encap: ip
LISP
Next chain element:

IP adj out of GigabitEthernet1/0/1
, addr 10.47.1.6
```

Een EPC kan worden gebruikt om VXLAN-insluiting van het multicast pakket te valideren

```
<#root>
```

```
Edge-1#monitor capture 1 interface GigabitEthernet1/0/4 IN
Edge-1#monitor capture 1 interface GigabitEthernet1/0/1 OUT
Edge-1#monitor capture 1 match any
Edge-1#monitor capture 1 buffer size 10
Edge-1#monitor capture 1 limit pps 1000
Edge-1#monitor capture 1 start
Edge-1#monitor capture 1 stop
```

```
Edge-1#
```

```
show monitor capture 1 buffer brief
```

```
Starting the packet display ..... Press Ctrl + Shift + 6 to exit
```

```
1 0.000000 10.47.7.2 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0008, seq=28213/13678,
ttl=5 <-- Packet as it ingresses the FHR, TTL is 5
```

```
2 0.014254 10.47.7.2 -> 239.1.1.1 ICMP 148 Echo (ping) request id=0x0008, seq=28213/13678,
ttl=4 <-- Packet as it leaves the FHR, TTL is 4 as is it decremented
```

MFIB-doorsturen - verificatie ontvangerzijde

Het onderliggende netwerk routeert dit pakket van Edge-1 naar Edge-2 met behulp van unicast-routing.

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.1.1.1 10.47.7.2
```

```
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
(

10.47.7.2

,

239.1.1.1

), 00:01:39/00:01:20, flags: JT
Incoming interface: LISPO.4100, RPF nbr

10.47.1.12

Outgoing interface list:

Vlan1025

, Forward/Sparse-Dense, 00:01:39/00:02:45, flags:

Met de opdracht "toon ip mfib vrf <VN Name> <group address> <unicast source>-tellers"
kunt u ervoor zorgen dat de tellers voor het doorsturen van hardware toenemen

<#root>

Edge-2#

show ip mfib vrf blue_vn 239.1.1.1 counters

Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second
Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)
VRF blue_vn
12 routes, 7 (*,G)s, 4 (*,G/m)s
Group: 239.1.1.1
RP-tree,
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 0/0/2/0, Other: 0/0/0
Source: 10.47.7.2,
SW Forwarding: 0/0/0/0, Other: 2/1/1
HW Forwarding:

6118996613340856320

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

Totals - Source count: 1, Packet count:

6118996613340856320

Edge-2#

```
show ip igmp snooping groups vlan 1025 239.1.1.1
```

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

```
-----  
1025 239.1.1.1 igmp v2      Gi1/0/4
```

U kunt uitgaande multicast tellers gebruiken om te bevestigen of het multicast verkeer LHR, naar de multicast ontvanger heeft verlaten. Gebruik de opdracht "toon controllers Ethernet-controller <interface> | Inclusief multicast|Verzenden"

<#root>

Edge-2#

```
show controllers ethernet-controller g1/0/4 | include Multicast|Transmit  
Transmit
```

GigabitEthernet1/0/5

Receive

426729240 Total bytes

100803109 Total bytes

5732 Unicast frames

949355 Unicast frames

5732 Unicast bytes

93563018 Unicast bytes

4388433

Multicast frames

32346 Multicast frames

4388433

Multicast bytes

7236178 Multicast bytes

<snip>

Edge-2#

```
show controllers ethernet-controller g1/0/5 | include |Multicast|Transmit
```

```
Transmit
```

GigabitEthernet1/0/5	Receive
426742895 Total bytes	100813570 Total bytes
5733 Unicast frames	949456 Unicast frames
5733 Unicast bytes	93573016 Unicast bytes
 4388569	
Multicast frames	32348 Multicast frames
 4388569	
Multicast bytes	7236641 Multicast bytes

Een andere manier om multicast verkeer te valideren dat de LHR verlaat, is door een EPC te doen naar de multicast-ontvanger.

<#root>

Edge-2#

show monitor capture 1 buffer brief

Starting the packet display Press Ctrl + Shift + 6 to exit

```
1 0.168401 10.47.7.2 -> 239.1.1.1 ICMP 106 Echo (ping) request id=0x0008, seq=35903/16268, ttl=3
2 0.969138 10.47.7.2 -> 239.1.1.1 ICMP 106 Echo (ping) request id=0x0008, seq=35904/16524, ttl=3
```

Verificatie van dataplane (afhankelijk van platform)

(S,G) Aanmaken - CPU puntpad

Opdat de FHR (S,G) status kan creëren, worden een paar van de multicast pakketten die vanuit de multicast bron worden verstuurd naar de CPU die door het MFIB moet worden verwerkt. De multicastpakketten worden naar de FED-wachtrij "CPU_Q_MCAST_DATA" gestuurd

<#root>

Edge-1#

show platform software fed switch active punt cpuq 30

Punt CPU Q Statistics

=====

CPU Q Id : 30

CPU Q Name : CPU_Q_MCAST_DATA

Packets received from ASIC : 27124

Send to IOSd total attempts : 27124

Send to IOSd failed count : 0
RX suspend count : 0
RX unsuspend count : 0
RX unsuspend send count : 0
RX unsuspend send failed count : 0
RX consumed count : 0
RX dropped count : 0
RX non-active dropped count : 0
RX conversion failure dropped : 0
RX INTACK count : 0
RX packets dq'd after intack : 0
Active RxQ event : 0
RX spurious interrupt : 0
RX phy_idb fetch failed: 0
RX table_id fetch failed: 0
RX invalid punt cause: 0

Replenish Stats for all rxq:

Number of replenish : 0
Number of replenish suspend : 0
Number of replenish un-suspend : 0

Bovendien mag de CoPP-wachtrij voor MCAST Data geen verlies lijden. Gebruik de opdracht "toon platform hardware gevoed actieve qos wachtrij stats interne cpu policer | MCAST Data|QId" opnemen

<#root>

Edge-1#

```
show platform hardware fed active qos queue stats internal cpu policer | include MCAST Data|QId
```

QId	PlcIdx	Queue	Name	Enabled	Rate	Rate
30	9	MCAST	Data	No	500	400

Als het verkeer afkomstig is van een direct aangesloten bron, wordt het verwerkt door de Linux Shared Memory Punt Interface (LSMPI) wachtrij voor "direct verbonden bron" als het afkomstig is van een (S, G) Join, is het "Mcast PIM Signaling"

Gebruik de opdracht "Toon platform software infrastructuur lsmapi punt | Oorzaak |Drogen" opnemen

<#root>

Edge-1#

```
show platform software infrastructure lsmapi punt | include Cause|Mcast
```

Cause	Total	Total	Length	Dot1q encap	Other
Mcast Directly Connected Source					
0					
27038					
0	0	0	0		
Mcast IPv4 Options data packet	0	0	0	0	0
Mcast Internal Copy	0	0	0	0	0
Mcast IGMP Unroutable	0	0	0	0	0
Mcast PIM signaling					
0	0	0	0	0	
Mcast punt to RP	0	0	0	0	0
Mcast UDLR	0	0	0	0	0

Vervolgens kan een FED Punject-pakketopname worden uitgevoerd om multicast-pakketten te zien van de bron en de groep op de CPU, wat de inkomende interface en de CPU-wachtrij bevestigt.

```
<#root>
```

```
Edge-1#
```

```
debug platform software fed switch active punt packet-capture set-filter "ip.addr==239.1.1.1"
```

```
Edge-1#
```

```
debug platform software fed switch active punt packet-capture start
```

```
Edge-1#
```

```
debug platform software fed switch active punt packet-capture stop
```

```
Punt packet capturing stopped. Captured 2 packet(s)
```

```
Edge-1#
```

```
show platform software fed switch active punt packet-capture brief
```

```
Punt packet capturing: disabled. Buffer wrapping: disabled
```

```
Total captured so far: 2 packets. Capture capacity : 4096 packets
```

```
Capture filter : "ip.addr==239.255.255.254"
```

```
----- Punt Packet Number: 1, Timestamp: 2024/08/26 15:38:27.341 -----
```

```
interface : physical:
```

```
GigabitEthernet1/0/4
```

```
[if-id: 0x0000000c], pa1:
```

```
vlan1025
```

```
[if-id: 0x0000001d]
```

metadata : cause: 12 [

Mcast Directly Connected Source

], sub-cause: 0, q-no: 30, linktype: MCP_LINK_TYPE_IP [1]
ether hdr : dest mac: 0100.5e7f.ffffe, src mac: 5254.0012.521d
ether hdr : ethertype: 0x0800 (IPv4)
ipv4 hdr : dest ip:

239.1.1.1,

src ip: 10.47.7.2
ipv4 hdr : packet len: 84, ttl: 5, protocol: 1 (ICMP)
icmp hdr : icmp type: 8, code: 0

Mroute Hardware Programming - IOS Mroute

Hardware programmering van de (S, G) gebruikt dezelfde structuur als elk ander programmeerpad: IOS naar FMAN RP naar FMAN FP, naar FED.

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.1.1.1

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

(* , 239.255.255.254), 00:08:29/stopped, RP

10.47.6.1

, flags: SCF

<-- Anycast RP address

Incoming interface: LISP0.4100, RPF nbr

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

```
Outgoing interface list:
```

```
Vlan1025, Forward/Sparse-Dense, 00:08:29/00:00:30, flags:
```

```
(
```

```
10.47.7.2
```

```
,
```

```
239.1.1.1
```

```
), 00:08:28/00:02:54, flags: FT
```

```
<-- Unicast source
```

```
Incoming interface:
```

```
vlan1025
```

```
, RPF nbr 0.0.0.0
```

```
<-- Multicast source is in VLAN 1025
```

```
Outgoing interface list:
```

```
LISP0.4100
```

```
,
```

```
10.47.1.13
```

```
, Forward/Sparse, 00:08:23/00:03:07, flags:
```

```
<-- Forwarding to Edge-2
```

Virtuele hardwareprogramming - IOS MFIB

Multicastroutes worden vervolgens toegevoegd aan de Multicast Forwarding Information Base (MFIB), die vergelijkbaar is met hoe de Routing Information Base (RIB) wordt toegevoegd aan Cisco Express Forwarding (CEF), het multicast-equivalent is de MFIB.

```
<#root>
```

```
Edge-1#
```

```
show ip mfib vrf blue_vn 239.1.1.1 10.47.7.2 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
(
10.47.7.2,239.1.1.1
) Flags: K HW DDE
<-- Multicast source and GDA
```

```
0x21 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 2/2/0
HW Forwarding: 0/0/0/0, Other: 0/0/0
Vlan1025 Flags: RA A MA NS
```

```
LISP0.4100, 10.47.1.13
```

```
Flags: RF F NS
```

```
<-- RLOC of Edge-2 and the RPF interface to reach 10.47.1.13
```

```
CEF: Adjacency with MAC: 4500000000004000001164770A2F010D0A2F010C000012B5000000000840000000100400
Pkts: 0/0/0 Rate: 0 pps
```

Mroute Hardware Programming - RP MFIB

Gebruik de opdracht "toon platform software ip switch active r0 mfib vrf index <VRF index> groep <GDA/32>"

```
<#root>
```

```
Edge-1#
```

```
show vrf detail blue_vn | inc Id
```

```
VRF blue_vn (
```

```
VRF Id = 2
```

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

```
Edge-1#
```

```
show platform software ip switch active r0 mfib vrf index 2 group 239.1.1.1/32
```

```
Route flags:
```

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

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

```
BR - Bidir route
```

```
*,
239.1.1.1/32
--> OBJ_INTF_LIST (0x6b)
Obj id:
0x6b
, Flags: C
OM handle: 0x34803c47f0
Edge-2#
show platform software ip switch active r0 mfib vrf index 2 group address 239.1.1.1 10.47.7.2
```

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
```

```
239.1.1.1, 10.47.7.2/64
--> OBJ_INTF_LIST (0x21)
Obj id:
0x21
, Flags: unknown
OM handle: 0x34803c4088
```

Mroute Hardware Programming - FP MFIB

De FMAN RP-vermelding voor dezelfde routes bevat een Asynchronous Object Manager (AOM) ID, deze AOM ID wordt gebruikt om verdere programmering te valideren.

Gebruik de opdracht "show platform software ip switch active f0 mfib vrf index <VRF Index> group <GDA/32>"

```
<#root>
```

```
Edge-1#
show platform software ip switch active f0 mfib vrf index 2 group 239.1.1.1/32
```

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
```

```
*,
239.1.1.1/32
--> OBJ_INTF_LIST (0x6b)
Obj id:
0x6b
```

```
, Flags: C
aom id:

29154

, HW handle: (nil) (created)

Edge-1#

show platform software ip switch active f0 mfib vrf index 2 group address 239.1.1.1 10.47.7.2

Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route

239.1.1.1., 10.47.7.2/64

--> OBJ_INTF_LIST (0x21)
Obj id:

0x21

, Flags: unknown
aom id:

36933

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

Mroute Hardware Programming - Mroute Objects

Controleer met de AOM-id's het object en de ouderobjecten op zowel (*,G) als (S,G) met de opdrachten object-manager. U kunt de opdracht "show platform software object-manager switch active f0 object <AOM ID>" of "show platform software object-manager switch active f0 object <AOM ID> parent gebruiken"

Elke route heeft twee ouderobjecten. Een van de objecten verwijst naar de ipv4_mcast tabel, de andere is een mlist, die gebruikt wordt in volgende opdrachten.

<#root>

Edge-1#

```
show platform software object-manager switch active f0 object 29154
```

Object identifier: 29154

Description:

```
PREFIX 0.0.0.0 , 239.1.1.1/32
```

(Table id 2)

Obj type id: 72

Obj type:

```
mroute-pfx
```

Status:

Done

, Epoch: 0, Client data: 0xa3e23c48

Edge-1#

show platform software object-manager switch active f0 object 29154 parents

Object identifier: 26509

Description:

ipv4_mcast table 2 (blue_vn

), vrf id 2

Status: Done

Object identifier: 29153

Description:

mlist 107

Status:

Done

Edge-1#

show platform software object-manager switch active f0 object 36933

Object identifier: 36933

Description:

PREFIX 10.47.7.2 , 239.1.1.164

(Table id 2)

Obj type id: 72

Obj type:

mroute-pfx

Status:

Done

, Epoch: 0, Client data: 0xa413c928

Edge-1#

show platform software object-manager switch active f0 object 36933 parents

Object identifier: 26509

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

Status:

Done

Object identifier: 47695

Description:

```
mlist 33
```

```
Status:
```

```
Done
```

Mroute Hardware Programming - Mlist Objects

De MLIST-objecten zijn een combinatie van zowel inkomende interfaces als uitgaande interfacelijsten. U kunt de opdracht "show platform software mlist switch active f0 index <index>" gebruiken

```
<#root>
```

```
This is for (*,G)
```

```
Edge-1#
```

```
show platform software mlist switch active f0 index 107
```

```
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
```

```
<-- A Flag indicates an Incoming interface for (*,G)
```

```
0xf80001d1 OBJ_ADJACENCY      NS,
```

```
  F
```

```
      Vlan1025
```

```
<-- F Flag indicates an Outgoing interface for (*,G)
```

```
This is for (S,G)
```

```
Edge-1#
```

```
show platform software mlist switch active f0 index 33
```

```
Multicast List entries
```

```
OCE Flags:
```

```
NS - Negate Signalling; IC - Internal copy;
```

A - Accept; F - Forward;

OCE	Type	OCE Flags	Interface
-----	------	-----------	-----------

0x5c	OBJ_ADJACENCY	NS,	
------	---------------	-----	--

F

LISP0.4100

<-- F Flag indicates an Outgoing interface(s), for (S,G)

0xf80001d1 OBJ_ADJACENCY

A

Vlan1025

<-- A Flag indicates an Incoming interface, for (S,G)

Mroute Hardware Programming - FED Mroute

Om de FED-programmering te valideren, gebruikt u de opdracht "toon platform software fed switch active ip mfib vrf <VN Name> <GDA> <unicast source>"

<#root>

Edge-1#

```
show platform software fed switch active ip mfib vrf blue_vn 239.1.1.1 10.47.7.2
```

Multicast (S,G) Information

VRF : 2

Source Address : 10.47.7.2

HTM Handler : 0x7f45d98c7728

SI Handler : 0x7f45d9a44a28

DI Handler : 0x7f45d9bcb2d8

REP RI handler : 0x7f45d97e7188

Flags :

Packet count : 0

State : 4

RPF :

Vlan1025 A

OIF :

Vlan1025 A

LISP0.4100 F NS

(Adj: 0x5c)

De Rewrite Index verstrekt informatie over inkapseling van het multicast verkeer, dat is wat de hefboomwerkingen van de Koppelingsreplicatie van het Hoofd. U kunt de opdracht

ASIC#:0

RI:50

Rewrite_type:AL_RRM_REWRITE_IPV4_VXLAN_INNER_IPV4_ENCAP(110) Mapped_rii:LVX_L3_ENCAP_L2_PAYLOAD
Dst Mac: MAC Addr: ba:25:cd:f4:ad:38,

Src IP: 10.47.1.12 <-- RLOC of Edge-1

Dst IP: 10.47.1.13 <--

RLOC of Edge-2

IPv4 TTL: 0

LISP INSTANCEID: 0

L3IF LE Index: 49

ASIC#:1

RI:50

Rewrite_type:AL_RRM_REWRITE_IPV4_VXLAN_INNER_IPV4_ENCAP(110) Mapped_rii:LVX_L3_ENCAP_L2_PAYLOAD
Dst Mac: MAC Addr: ba:25:cd:f4:ad:38,

Src IP: 10.47.1.12 <-- RLOC of Edge-1

Dst IP: 10.47.1.13 <-- RLOC of Edge-2

IPv4 TTL: 0

LISP INSTANCEID: 0

L3IF LE Index: 49

Neem vervolgens de RI van de vorige opdracht voor verdere verificatie. Gebruik de opdracht "show platform software fed switch active ip mfib vrf <VN Name> <GDA> <source>"

<#root>

Edge-1#

show platform software fed switch active ip mfib vrf blue_vn 239.1.1.1 10.47.7.2

Multicast (S,G) Information

VRF : 2

Source Address : 10.47.7.2

HTM Handler : 0x7f45d98c7728

SI Handler : 0x7f45d9a44a28

DI Handler : 0x7f45d9bcb2d8

REP RI handler : 0x7f45d97e7188

Flags :

Packet count : 0

State : 4

RPF :

```
Vlan1025 A
OIF :
Vlan1025 A
LISP0.4100 F NS

(Adj: 0x5c )
```

Gebruik de opdracht "toon platform software fed switch actieve ip adj | <destroom>" opnemen

```
<#root>
```

```
Edge-1#
```

```
show platform software fed switch active ip adj 10.47.1.12
```

```
IPV4 Adj entries
```

dest	if_name	dst_mac	si_hdl	ri_hdl	pd_flags	adj_id	Last-modified
10.47.1.12	LISP0.4100	4500.0000.0000	0x7f45d9a4a5e8	0x7f45d9a4a798	0x60		

```
0x5c
```

```
2024/08/21 16:18:58.948
```

```
<-- 0x5c matches the Adj in the previous command
```

Op de LHR kunt u de doelindex valideren om te zien waar het multicast pakket naar wordt doorgestuurd, wat de multicast ontvanger(s) is. U kunt de opdracht "show platform software fed switch active ip mfib vrf <VN Name> <GDA> <source> gebruiken"

```
<#root>
```

```
Edge-2#
```

```
show platform software fed switch active ip mfib vrf blue_vn 239.1.1.1 10.47.7.2
```

```
Multicast (S,G) Information
```

```
VRF : 2
```

```
Source Address : 10.47.7.2
```

```
HTM Handler : 0x7f0efdad33a8
```

```
SI Handler : 0x7f0efdad2648
```

```
DI Handler : 0x7f0efdad7668
```

```
REP RI handler : 0x7f0efdad4858
```

```
Flags :
```

```
Packet count : 0
```

```
State : 4
```

```
RPF :
```

```
LISP0.4100 A
```

```
OIF :
```

stripSeg = 0
copySeg = 0

=====

Over deze vertaling

Cisco heeft dit document vertaald via een combinatie van machine- en menselijke technologie om onze gebruikers wereldwijd ondersteuningscontent te bieden in hun eigen taal. Houd er rekening mee dat zelfs de beste machinevertaling niet net zo nauwkeurig is als die van een professionele vertaler. Cisco Systems, Inc. is niet aansprakelijk voor de nauwkeurigheid van deze vertalingen en raadt aan altijd het oorspronkelijke Engelstalige document ([link](#)) te raadplegen.