Überprüfung von nativem Multicast in SD-Access-Fabric

Inhalt

Einleitung

In diesem Dokument wird beschrieben, wie Sie Native Multicast in der SD-Access (SDA) Fabric überprüfen.

Voraussetzungen

Anforderungen

Cisco empfiehlt, dass Sie über Kenntnisse in folgenden Bereichen verfügen:

- Internet Protocol (IP)-Weiterleitung
- Locator ID/Separation Protocol (LISP)
- Protocol Independent Multicast (PIM) Sparse-Mode

Verwendete Komponenten

- C9000v auf Cisco IOS® XE 17.10.1
- Cisco Catalyst Center Version 2.3.5.3

Die Informationen in diesem Dokument beziehen sich auf Geräte in einer speziell eingerichteten Testumgebung. Alle Geräte, die in diesem Dokument benutzt wurden, begannen mit einer gelöschten (Nichterfüllungs) Konfiguration. Wenn Ihr Netzwerk in Betrieb ist, stellen Sie sicher, dass Sie die möglichen Auswirkungen aller Befehle kennen.

Dieses Dokument kann auch mit folgenden Hardware- und Softwareversionen verwendet werden:

- C9200
- C9300
- C9400
- C9500
- C9600
- Cisco IOS® XE 16.12 und höher

Hintergrundinformationen

SDA Native Multicast ist eine Form von Overlay-Multicast, das zur Übertragung von Multicast-Verkehr zwischen Fabric-Geräten verwendet wird und den Multicast-Verkehr in eine andere Multicast-Gruppe kapselt. Natives Multicast kann Multicast-Datenverkehr zwischen Quellen und Empfängern routen, die sich entweder im selben VLAN oder in einem anderen VLAN befinden (Multicast im selben VLAN kann geroutet werden). Multicast-Datenverkehr zwischen Quellen und Empfängern am selben Fabric Edge (FE) wird nicht mithilfe von Overlay-Multicast (VXLAN-Kapselung) weitergeleitet, sondern lokal von der FE geroutet. Natives Multicast kann Multicast-Datenverkehr nicht für Gruppen weiterleiten, die 224.0.0.0/24 oder einer Time To Live (TTL) =1 entsprechen. Diese werden durch Layer-2-Flooding (L2-Flooding) verarbeitet. Natives Multicast kann für die Weiterleitung von Any Source Multicast (ASM), Source Specific Multicast (SSM) oder

einer Kombination aus beiden konfiguriert werden. Natives Multicast basiert auf Underlay-Multicast.
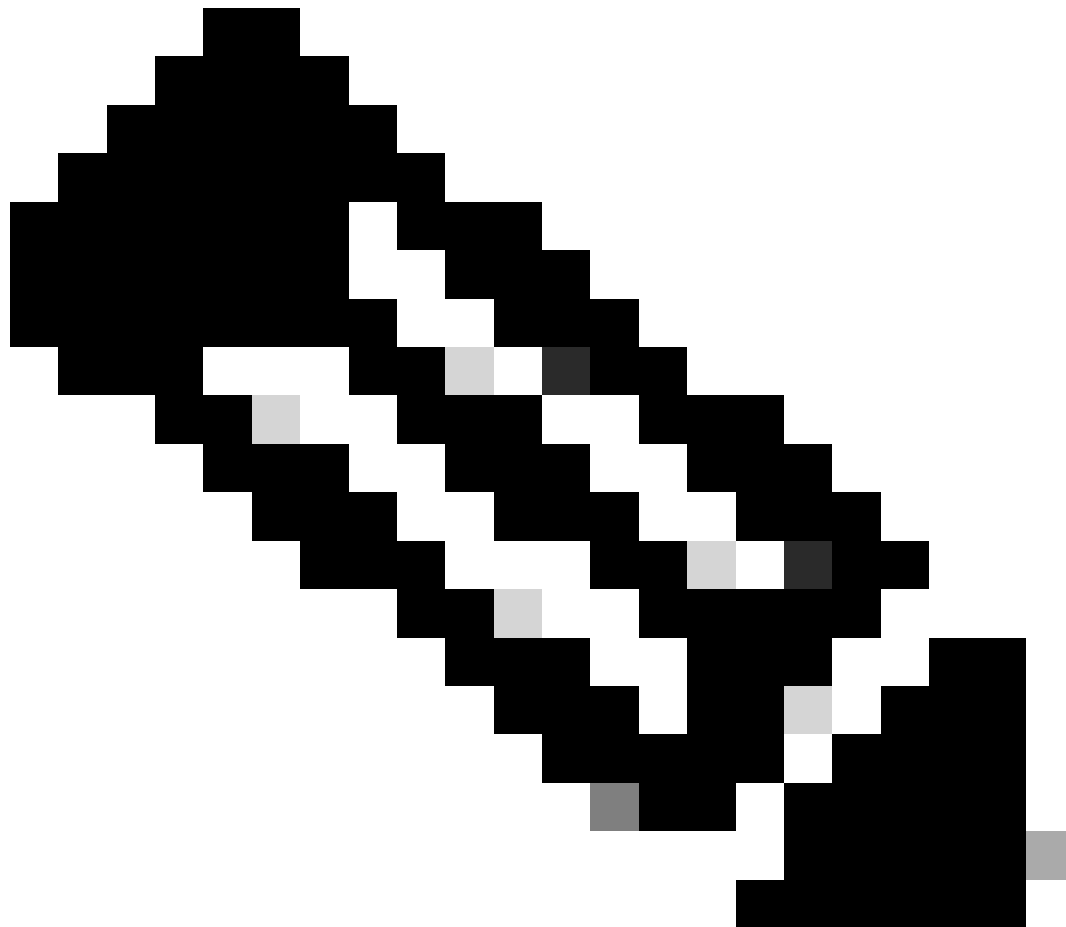
Hinweis: Plattformbefehle (Eingabe) können variieren. Der Befehl kann "show platform fed <active|standby>" oder "show platform fed switch <active|standby>" sein.". Wenn die in den Beispielen angegebene Syntax nicht analysiert wird, versuchen Sie es mit der Variante.

Topologie
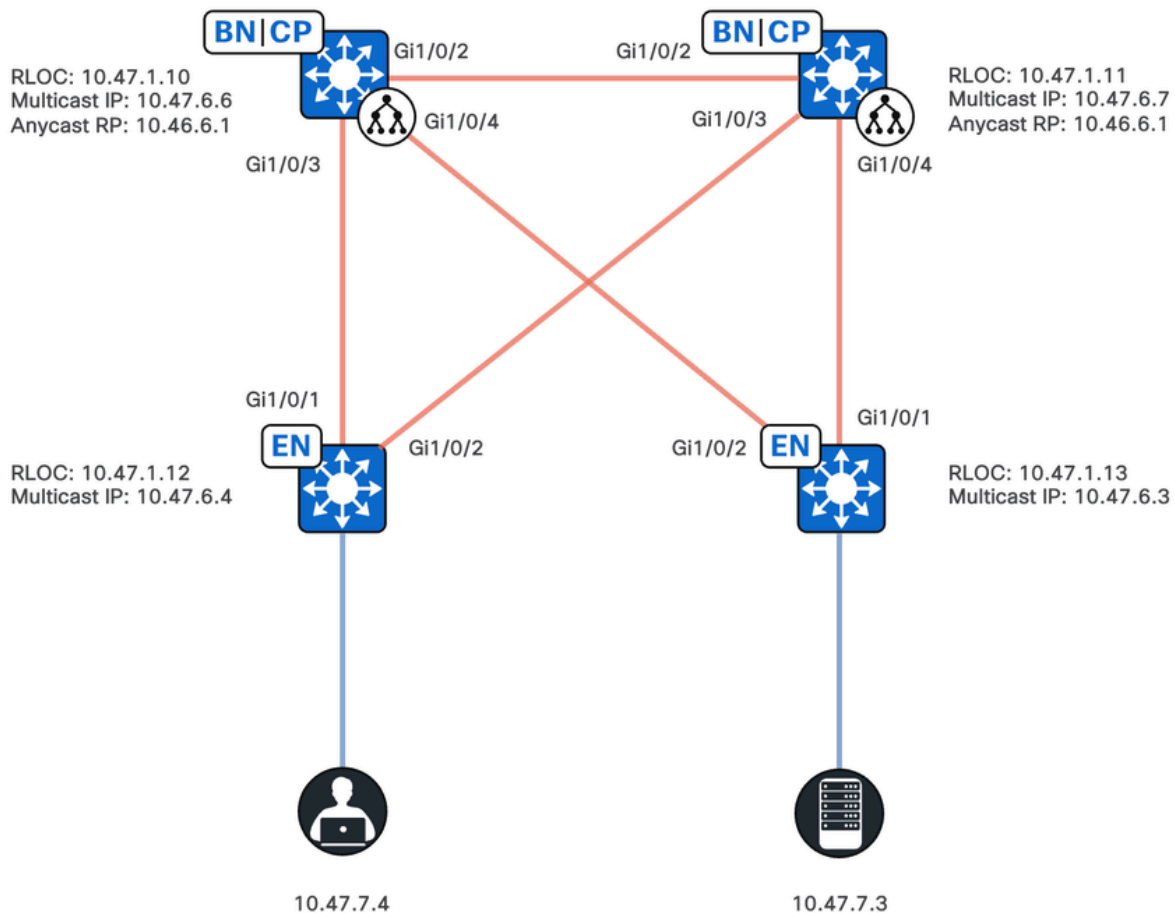
Netzwerktopologie

In dieser Topologie gilt Folgendes:

- Remote Locator ID (RLOC) 10.47.1.10 und 10.47.1.10 sind standortunabhängige Grenzen und fungieren als Anycast Rendezvous Point (RP) mit Multicast Source Discovery Protocol (MSDP) zwischen den beiden im Virtual Network (VN) oder Virtual Routing and Forwarding (VRF).
- 10.47.1.12 und 10.47.1.3 sind FE-Knoten
- 10.47.7.4 ist der Multicast-Empfänger.
- 10.47.7.3 ist die Multicast-Quelle.
- 239.0.0.5 ist die Multicast-Gruppen-Zieladresse (GDA).

Konfiguration

Es wird davon ausgegangen, dass Cisco Catalyst Center verwendet wird, um die SDA-Fabric mit den folgenden Einstellungen bereitzustellen:

- Implementierung des Replikationsmodus ist natives Multicast
- Der Multicast-Modus ist Any Source Multicast (ASM).
- Anycast Rendezvous Point (RP) mit Multicast Source Discovery Protocol (MSDP), das an

den ortsunabhängigen Grenzen konfiguriert ist

- Underlay Multicast wurde entweder manuell konfiguriert oder als Teil der anfänglichen LAN-Automatisierung konfiguriert. Natives Multicast benötigt Underlay Multicast, um ordnungsgemäß zu funktionieren.

Fabric Edge-Konfiguration (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 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 10.47.6.4 255.255.255.255
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
```

Fabric Edge-Konfiguration (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
```

Standortunabhängiger Rand/Anycast RP (10.47.1.10) - Konfiguration

```
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-9f46-28eda0e
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
```

Standortunabhängiger Rand/Anycast RP (10.47.1.10) - Konfiguration

```
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-9f46-28eda0e
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
```

Überprüfung der Kontrollebene

In diesem Abschnitt wird das Protocol Independent Multicast (PIM) verifiziert. Dies beginnt mit der Validierung der (S,G)-Erstellung auf dem First Hop Router (FHR).

FHR (S,G) Erstellung

Die Multicast-Quelle 10.47.7.3 sendet UDP-Multicast-Pakete an 239.0.0.5. Überprüfen Sie, ob IP Device-Tracking (IPDT), Cisco Express Forwarding (CEF) und Reverse Path Forwarding (RPF) korrekt auf die Multicast-Quelle zeigen. Stellen Sie außerdem sicher, dass die Anycast Gateway SVI der PIM Designated Router (DR) für dieses Segment ist.

Verwenden Sie den Befehl "show device-tracking database address <IP-Adresse>", um sicherzustellen, dass ein gültiger IPDT-Eintrag vorhanden ist.

```
<#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 DH
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)
```

Verwenden Sie den Befehl "show ip cef vrf <VN-Name> <IP-Adresse>", und stellen Sie sicher, dass die Multicast-Quelle direkt verbunden ist.

<#root>

Edge-2#

show ip cef vrf blue_vn 10.47.7.3

10.47.7.3/32
nexthop 10.47.7.3 Vlan1025

Verwenden Sie anschließend den Befehl "show ip rpf vrf <VN> <ip address>", um sicherzustellen, dass die RPF-Schnittstelle das VLAN ist, in dem sich die Quelle befindet, nicht 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

Verwenden Sie den Befehl "show ip pim vrf <VN name> interface vlan <vlan> detail | include DR|enabled", um zu überprüfen, ob der FE-Knoten der PIM DR für das Segment und der FHR ist.

<#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

Verwenden Sie den Befehl "show ip mroute vrf <VN-Name> <Multicast-Gruppenadresse>", um die Erstellung (S,G) zu validieren. (S,G) verfügt über eine Null-OIL (Outgoing Interface List), da kein interessierter Empfänger oder PIM-Router dem FHR beigetreten ist.

<#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), 00:00:10/stopped, RP 10.47.6.1, flags: SPFl
Incoming interface: LISP0.4100, 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) Registrierung

Der FHR registriert die Unicast-Quelle beim Anycast RP und verwendet dabei die als "registered-source" konfigurierte Schnittstelle für PIM-Registrierungsnachrichten.

- Äußere Kopfzeile, RLOC zu RLOC (10.47.1.13 bis 10.47.1.10)

- Innerer Header, Loopback an Loopback (10.47.6.3 bis 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-Mitgliedschaftsbericht

Der Multicast-Empfänger sendet einen IGMP Membership Report/Join, um das Interesse am Empfang von Multicast-Datenverkehr anzugeben. Dadurch werden IGMP-Snooping- und IGMP-Gruppeneinträge auf dem Last Hop Router (LHR) erstellt. Verwenden Sie den Befehl "show ip igmp snooping groups vlan <VLAN-ID> <Gruppenzieladresse>" sowie den Befehl "show ip igmp vrf <VN-Name> groups <Gruppe>"

<#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
```

Stellen Sie anschließend sicher, dass der LHR tatsächlich der PIM DR für dieses Segment ist. Verwenden Sie den Befehl "show ip pim vrf <VN name> interface vlan <vlan> detail | DR|aktiviert einschließen"

<#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) Overlay-Erstellung

Wenn der LHR den IGMP-Mitgliedschaftsbericht empfängt, erstellt er auch den PIM-Status. Mit (*,G) können Sie den Befehl "show ip mroute vrf <VN-Name><overlay group> verbose" verwenden, um den Status (*,G) anzuzeigen.

<#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: SJCl

<-- 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 232.0.2.24

```
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

LHR (*,G)-Zuordnung in Underlay SSM Group

Aus dem (*,G) wird das Underlay SSM (S,G) abgeleitet. Die Quelle ist RP RPF, und die Gruppe ist die Overlay-Zuordnung.

<#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 Grou

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

Rahmen/RP erstellt (*,G) in Overlay und (S,G) in Underlay

Der LHR sendet eine PIM-Join-Nachricht (*,G) in das Overlay. Mit dem Befehl "show ip mroute vrf
<VN name> <overlay group> verbose" können Sie das (*,G) in dem Overlay anzeigen.

<#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

Im Underlay können Sie den Befehl "show ip mroute <Underlay-Gruppenadresse> <RP RLOC>"
verwenden.

<#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 erstellt (S,G) aus MSDP-SA-Cache

Der FHR hat die Multicast-Quelle zufällig für Border-2 registriert. Border-2 informiert Border-1 über MSDP über die Multicast-Quelle. Mit dem Befehl "show ip msdp vrf <VN Name> summary" können Sie den MSDP-Status anzeigen.

<#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
```

Verwenden Sie den Befehl "show ip msdp vrf <VN-Name> peer <Peer-Adresse> accepted-SAs", um die vom Peer akzeptierten SAs anzuzeigen.

<#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 add

Verwenden Sie den Befehl "show ip mroute vrf <VN-Name> <Gruppenzieladresse> verbose", um
die (S,G)

<#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), 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) erzeugt Underlay (S,G)

Border-1 erzeugt das Underlay (S,G) als Ergebnis des Overlays (S,G) können Sie mit dem Befehl "show ip mroute <Gruppenzieladresse>" weitere Informationen anzeigen.

Es gibt zwei (S,G), für die FHR und für sich selbst. Null0 OIL für 10.47.1.13, 232.0.2.245 steht für Entkapselung, Null0 als IIF für 10.47.1.10 steht für Kapselung.

<#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 empfängt (S,G) Join in Overlay und Underlay

Der Border/RP sendet PIM-Joins (S,G) an den FHR. Sie können den Befehl "show ip mroute" verwenden, um Informationen abzurufen. Verwenden Sie im Overlay "show 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), 1w3d/stopped, RP 10.47.6.1, flags: SPFl
Incoming interface: LISP0.4100, 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:
LISP0.4100, (
```

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

Verwenden Sie im Underlay "show ip mroute <Underlay-Gruppenadresse>"

<#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 - 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

), 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 empfängt Multicast-Datenverkehr entlang des Shared Tree

Nachdem der LHR den gekapselten Multicast-Datenverkehr entlang des Shared Tree vom RP empfängt, entkapselt er den Multicast-Datenverkehr, da das OIL im Underlay (S,G) Null ist, und erstellt dann einen (S,G)-Eintrag im Overlay. Sie können den Befehl "show ip mroute <underlay group address>" und den Befehl "show 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

Im Overlay wird "show ip mroute vrf <VN-Name> <Adresse der Overlay-Gruppe>" angezeigt.

<#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: SJCl
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: JTl
```

<-- 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 fowarded into VLAN 1025

Jetzt fügt sich der LHR in den Shortest Path Tree (SPT) ein und schneidet den Shared Tree über PIM (S,G) Joins in the Overlay and Underlay ab. Nachdem die LHR den Shared Tree bereinigt hat, enthält das RP OIL für (S,G) die LHR nicht mehr. Rufen Sie den RP auf, und verwenden Sie den Befehl "show 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:
LISP0.4100, (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: LISP0.4100, RPF nbr 10.47.1.13

Outgoing interface list: Null
```

Da die (S,G)-Struktur keine Underlay-Zuordnung mehr aufweist, selbst wenn der Datenverkehr zu 239.0.0.5 über die Underlay-Struktur empfangen wird, kapselt der RP diese nicht erneut in einen LHR ein, wodurch der Shared-Tree bereinigt wird. Die (S,G)-Struktur für den Quellbaum und den freigegebenen Baum ist jedoch weiterhin vorhanden. Rufen Sie den RP auf, und überprüfen Sie die Underlay-Gruppe mit dem Befehl "show ip mroute <Underlay-Gruppenadresse>"

```
<#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:
```

Wenn der RP alle seine Öle entfernt hat, entfernt er sich auch selbst aus dem FHR-ÖL, und das FHR-ÖL enthält nur LHR(s) Gehen Sie zum FHR und verwenden Sie den Befehl "show 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: SPFl
Incoming interface: LISP0.4100, 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:
LISP0.4100, (
```

10.47.1.13, 232.0.2.245

), Forward/Sparse, 20:16:48/stopped, flags:

<-- RLOC of the LHR, Underlay Group

Datenebenenverifizierung (plattformunabhängig)

Es kann verschiedene Probleme geben, die verhindern können, dass die Multicast-Quelle oder der Multicast-Empfänger den Datenverkehr senden/empfangen. Dieser Abschnitt konzentriert sich auf die Validierung von Problemen, die sich sowohl auf die Multicast-Quelle als auch auf den Multicast-Empfänger auswirken können. Der Schwerpunkt liegt dabei auf Problemen, die nicht mit der Hardwareprogrammierung zusammenhängen.

Erstellung von FHR (S,G)

Damit die FHR (S,G) sicherstellen kann, dass alle SISF, LISP, CEF und RPF gültig und korrekt sind, verwenden Sie den Befehl "show device-tracking database address <IPv4 address>"

<#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 DH
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 wird von LISP genutzt. Verwenden Sie den Befehl "show lisp instance-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 programmiert CEF, verwenden Sie den Befehl "show ip cef vrf <VN Name> <IP-Adresse>", und stellen Sie sicher, dass es sich um einen Next-Hop im VLAN handelt, der nicht auf LISP verweist.

<#root>

```
Edge-2#
```

show ip cef vrf blue_vn 10.47.7.3

```
10.47.7.3/32
nexthop 10.47.7.3 Vlan1025
```

Stellen Sie abschließend sicher, dass der RPF richtig zeigt und direkt verbunden ist.

<#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
```

Wenn es keinen gültigen Eintrag in SISF/IPDT gibt, führt dies zu keiner LISP-Datenbankzuordnung auf dem FHR, was dazu führt, dass CEF und RPF auf die Grenze(en) verweisen. Wenn die Multicast-Quelle Datenverkehr sendet, verweist RPF auf die falsche Schnittstelle, was zu einem RPF-Fehler führt. (S,G) wird nicht gebildet.

<#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 DH(
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-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
```

Um dies zu verhindern, behandeln Sie die Multicast-Quelle als einen unbeaufsichtigten Host, bei dem dieses Problem durch IP-Directed Broadcast, Flooding und statische SISF/IPDT-Bindungen behoben werden kann.

Quellregistrierung

Die PIM-Registrierung ist ein Unicast-Paketfluss, der LISP/VXLAN wie jedes andere Unicast-Paket verwendet. Es gibt mehrere erforderliche Prüfungen, um sicherzustellen, dass die FHR die Multicast-Quelle ordnungsgemäß beim Anycast RP registrieren kann.

Stellen Sie zunächst sicher, dass der Anycast RP für den GDA richtig konfiguriert ist.

```
<#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
```

Stellen Sie sicher, dass der PIM-Registrierungstunnel gebildet ist.

```
<#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)
```

Sicherstellen, dass der Anycast RP über eine IP erreichbar ist

```
<#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
```

```
<-- RLOC of Border-1


nexthop

10.47.1.11

 LISP0.4100

<-- 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
```

Empfängerseitige Verifizierung

- Stellen Sie sicher, dass der Multicast-Empfänger einen IGMP-MR sendet.
- Stellen Sie sicher, dass IGMP-Snooping aktiviert ist. Nur L2-VNs sind die einzigen VN-Typen, für die IGMP-Snooping nicht aktiviert ist.
- Stellen Sie sicher, dass keine Port-ACL, VLAN-ACL oder Routed Port ACL konfiguriert ist, die den IGMP MR auslassen würden.
- Validieren Sie die IGMP-MR-Version. Wenn es sich beim Multicast-Empfänger um IGMPv3 handelt, ist es standardmäßig IGMPv2, das "ip igmp version 3" erfordert.
- Stellen Sie sicher, dass "ip option drop" nicht konfiguriert ist.

LHR PIM (*,G)-Verifizierung

- Stellen Sie sicher, dass der LHR der PIM-DR für das Empfängersubnetz/-segment ist.
- Stellen Sie sicher, dass kein "ip multicast group-range" konfiguriert ist.
- Stellen Sie sicher, dass keine Port-ACL, VLAN-ACL oder Routed Port ACL konfiguriert ist, die den IGMP MR auslassen würden.
- Stellen Sie sicher, dass die IGMP MR nicht durch eine hohe CPU oder Control Plane Policing (CoPP) verworfen wird.

LHR PIM Shared Tree-Überprüfung

Stellen Sie sicher, dass ein RP für die Gruppe konfiguriert ist.

```
<#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: SJCl
```

<-- 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:
```

Stellen Sie sicher, dass die RPF für den Anycast RP korrekt ist.

<#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 Forwarding - Native Multicast (Overlay) Source Side Verification

Mit dem Befehl "show ip mfib vrf <VN-Name> <overlay group address> <Unicast-Quelle> verbose" erhalten Sie zusätzliche Informationen zur Paketweiterleitung.

```
<#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
LISP0.4100, (

10.47.1.13

,

232.0.2.245

) Flags: RF F NS

<-- RLOC of FHR, Underlay Group IP address


CEF: Adjacency with MAC:

45000000000004000001184BC0A2F010DE80002F5000012B50000000000840000000100400BA25CDF4AD38BA25CDF4AD380000


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

MFIB Forwarding - Native Multicast (Underlay) Source Side Verification

Verwenden Sie "show ip mroute <Underlay-Gruppenadresse> <RLOC of FHR>", um die

Underlay-Gruppe anzuzeigen.

<#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 - 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

), 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 forwar

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 Forwarding - Natives Multicast (nach der Entkapselung)

Wenn Multicast-Datenverkehr am LHR eingeht, das mit einer Quell-IP-Adresse von 10.47.1.13 und der Zieladresse 232.0.2.245 gekapselt ist, wird er an die ausgehende Null0-Schnittstelle weitergeleitet. Diese Aktion löst die Entkapselung des Pakets aus.

<#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
```

Nach der Entkapselung erkennt der LHR, dass die tatsächliche Ziel-IP-Adresse 239.0.0.5 im VNI 4100 lautet, und zwar ausgehend von der Quell-IP-Adresse 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: SJCl
Incoming interface: LISP0.4100, 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: JTl
Incoming interface: LISP0.4100, 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
```

Verwenden Sie den Befehl "show ip igmp snooping groups vlan <VLAN>", um festzustellen, welche Ports Multicast-Datenverkehr empfangen sollen.

<#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
```

Datenebenenverifizierung (plattformabhängig)

Mroute Hardware-Programmierung - IOS mroute

Bei der Hardwareprogrammierung wird diese Kette verwendet: IOS, dann FMAN RP, zu FMAN FP und dann FED. Überprüfen Sie zuerst IOS mit dem Befehl "show ip mroute vrf <VN-Name> <overlay group address> verbose" und "show ip mroute <underlay group address> verbose"

<#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: SJCl
Incoming interface: LISP0.4100, 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: JTl
Incoming interface: LISP0.4100, 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:

Im Underlay

<#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:
```

Mroute Hardware-Programmierung - IOS MFIB

Überprüfen Sie die Overlay- und Underlay-MFIB mit dem Befehl "show ip mfib vrf <VN Name> <overlay group address> verbose" und "show ip mroute <underlay group address> verbose"

Im 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
LISP0.4100 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
LISP0.4100 Flags: RA A MA
Vlan1025 Flags: RF F NS
CEF: Adjacency with MAC: 01005E00000500000C9FFB870800
Pkts: 0/0/0 Rate: 0 pps
```

Im Underlay

```
<#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: 838485808123373184/0/0/0, 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-Programmierung - FMAN RP

Erfassen Sie zur Validierung des FMAN RP zunächst die VRF-ID.

<#root>

Edge-1#

show vrf detail blue_vn | include Id

VRF blue_vn (

VRF Id = 2

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

Verwenden Sie anschließend den VRF-Indexwert für die nächsten Befehle. Um das Overlay (*,G) zu validieren, verwenden Sie den Befehl "show platform software ip switch active r0 mfib vrf index <VRF-Index> group <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
```

Um das Overlay (S,G) zu validieren, verwenden Sie den Befehl "show platform software ip switch active r0 mfib vrf index 2 group address <overlay group address> <Unicast-Quelle>"

<#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
```

Um das Underlay (S,G) für das Overlay (*,G) zu validieren, verwenden Sie den Befehl "show platform software ip switch active r0 mfib group address <Adresse der Underlay-Gruppe> <RP-Adresse>"

<#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
```

Um das Underlay (S,G) für das Overlay (S,G) zu validieren, verwenden Sie den Befehl "show platform software ip switch active r0 mfib group address <Adresse der Underlay-Gruppe> <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 Programmierung - FMAN FP

Um das Overlay (*,G) zu validieren, verwenden Sie den Befehl "show platform software ip switch active f0 mfib vrf index <VRF-ID> group <overlay group address>"

<#root>

Edge-1#

show platform software 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)
```

Verwenden Sie zum Validieren des Overlays (S,G) den Befehl "show platform software ip switch active f0 mfib vrf index <VRF-ID> group address <overlay group address> <Unicast-Quelle>"

<#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)
```

Um das Underlay (S,G) für das Overlay (*,G) zu validieren, verwenden Sie den Befehl ""show platform software ip switch active f0 mfib group address <Adresse der Underlay-Gruppe> <RP-

Adresse>"

<#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)
```

Um das Underlay (S,G) für das Overlay (S,G) zu validieren, verwenden Sie den Befehl "show platform software ip switch active f0 mfib group address <Adresse der Underlay-Gruppe> <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 Programmierung - FMAN FP Datenbank

Verwenden Sie zum Validieren des FMAN FP-Objekts den Befehl "show platform software object-manager switch active f0 object <object ID> parent".

Zum Beispiel, um das Overlay (*,G) zu validieren

<#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
```

So validieren Sie das Overlay (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
```

Die mlist ist eine Kombination aus eingehender Schnittstelle (IIF) und ausgehender Schnittstellenliste (OIL), die von der mroute in einem anderen Objekt getrennt ist. Verwenden Sie zum Validieren der mlist den Befehl "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 Programmierung - FED

Verwenden Sie zum Validieren des Overlays (S,G) den Befehl "show platform software fed switch active ip mfib vrf <VN Name> <overlay group address> <Unicast-Quelle>"

<#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 )
```

Um das Underlay (S,G) zu validieren, verwenden Sie den Befehl "show platform software fed switch active 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
```

Als Nächstes wird der Zielindex (DI) für Overlay und Underlay (S,G) validiert. Sie können den Befehl "show platform hardware fed switch active fwd-asic abstraction print-resource-handle <DI-Handler> 1" verwenden.

Für das 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/l3u_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
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
==============================================================
```

Für das Underlay (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 0d 01 2f 0a f5 02 00 e8 00 00 00 00 00 00 00 00 00 00 00 00 00 0(
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
===============================================================
```