Présentation d'ASM (Any-Source Multicast) dans l'environnement de fabric de campus SDA

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Introduction

Ce document décrit la vue d'ensemble de la multidiffusion Any-Source (ASM) avec un point de rendez-vous unique (RP) dans l'environnement d'accès défini par logiciel (SD-Access).

Conditions préalables

Exigences

Il est recommandé de connaître le protocole LISP (Locator ID Separation Protocol) et la multidiffusion.

Composants utilisés

Ce document n'est pas limité à des versions de matériel et de logiciel spécifiques.

Les informations de ce document ont été créées à partir de périphériques dans un environnement de travaux pratiques spécifique. Si votre réseau est actif, assurez-vous de comprendre l'impact potentiel de toute commande.GUI

Périphériques utilisés pour cet article

Contrôleur d'architecture de réseau numérique (DNAC) - Version 1.2.1

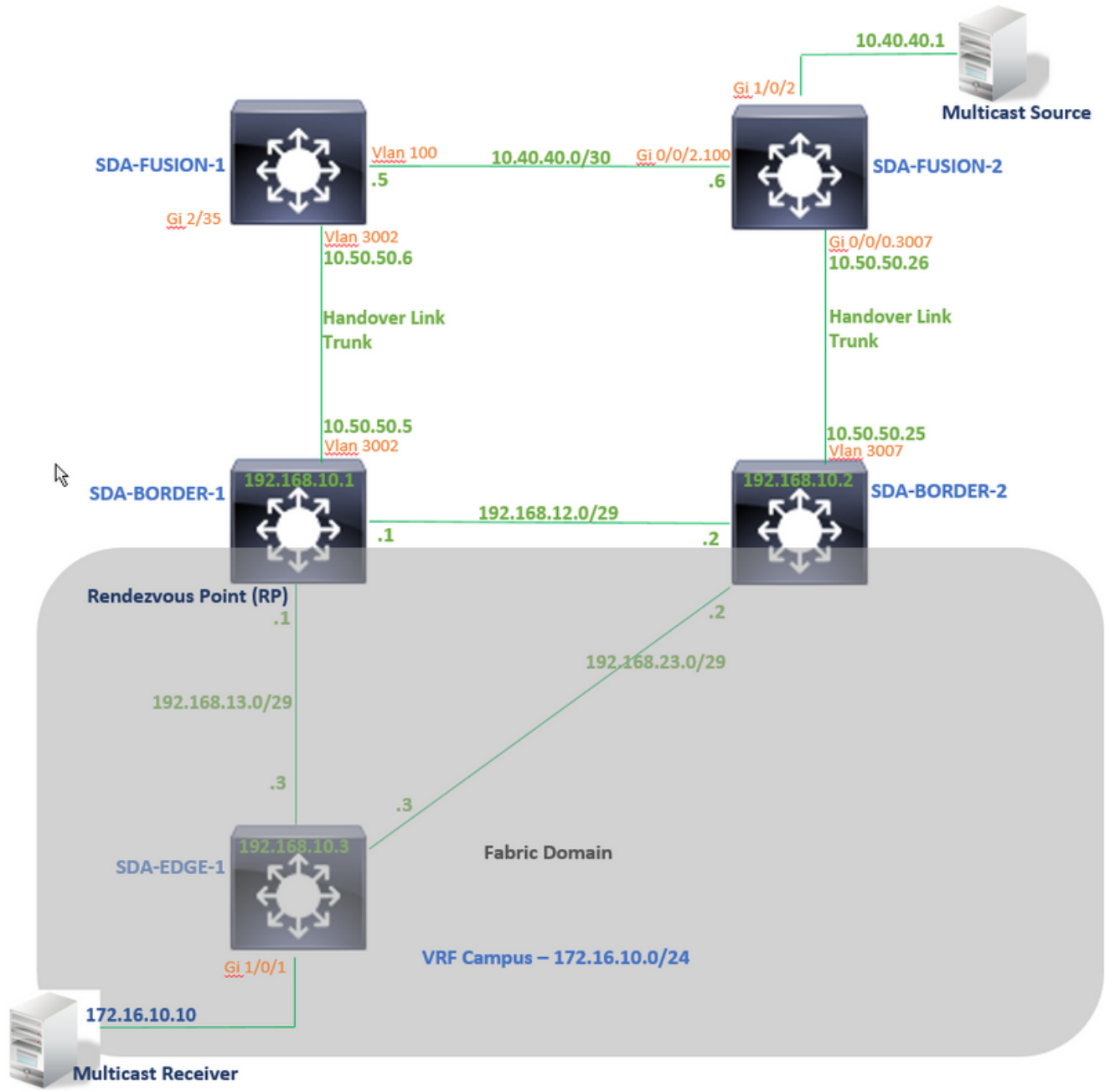
Périphérie et périphérie - Commutateur Cisco Cat3k

Fusion - Routeur Cisco avec prise en charge des fuites inter-VRF (Virtual Route Forwarding)

Configurer

Diagramme du réseau

La topologie utilisée pour cet article se compose de deux routeurs de périphérie configurés comme des frontières externes et de deux routeurs de fusion avec une connexion à chaque routeur de périphérie respectif. Border-1 est configuré comme RP, la source de multidiffusion est connectée à Fusion-2 et le récepteur de multidiffusion est connecté à Edge-1.



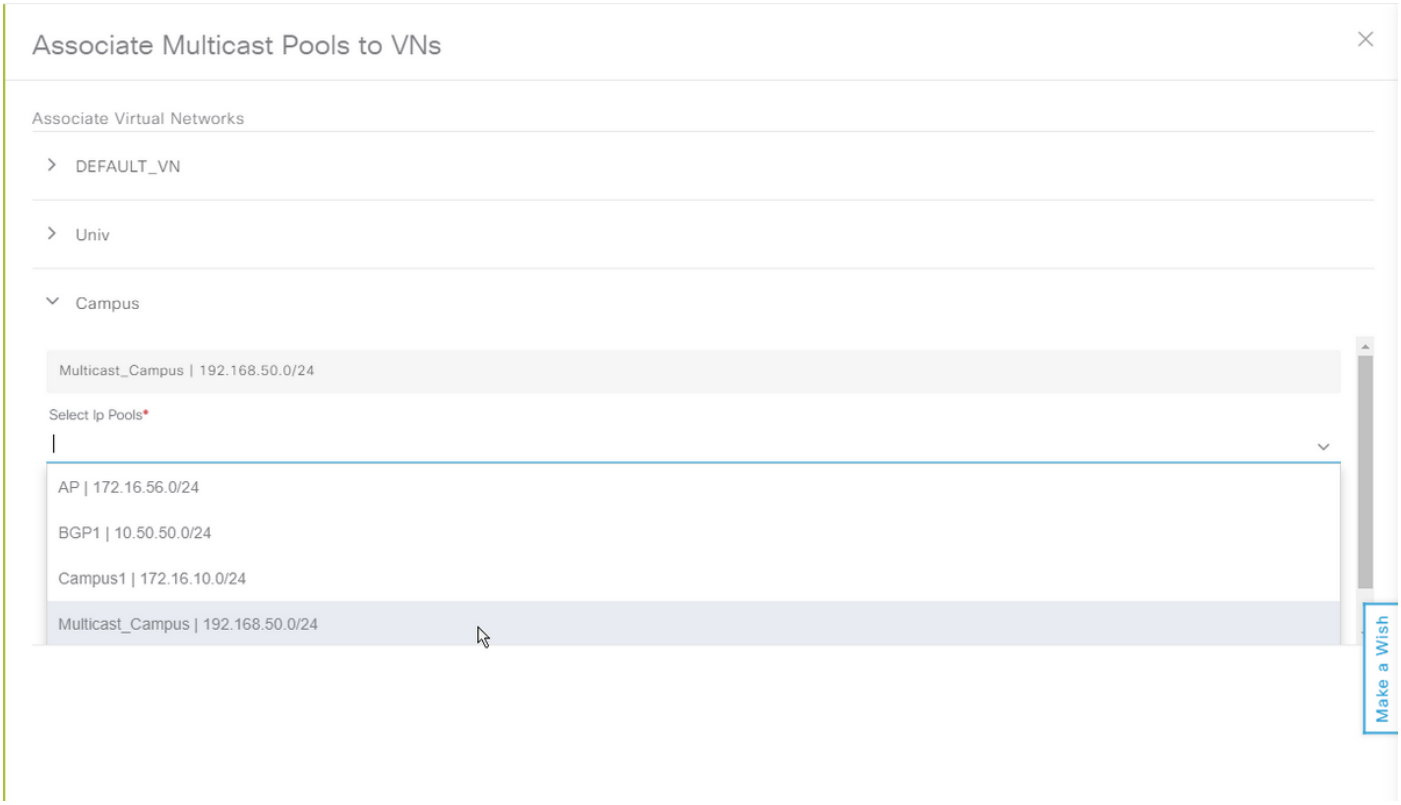
Configurations

Cet article ne couvre pas les étapes de configuration du fabric dans l'environnement SDA (Software-Defined Access) et commence par une explication des étapes de configuration de la multidiffusion dans le domaine de fabric pour un VLAN spécifique.

Étape 1 : Configurer la multidiffusion sur les périphériques de fabric à partir de DNAC

Dans l'interface utilisateur graphique (GUI) DNAC, sous Provisionner -> Workflow de fabric. La multidiffusion est configurée par l'option "Enable Rendezvous point " sur le périphérique SDA-BORDER-1.

Choisissez ensuite un pool de protocole Internet (IP) à utiliser pour la configuration de multidiffusion sous le VLAN spécifique « Campus » dans cet exemple.



Étape2: Vérification de la configuration diffusée sur les périphériques

Cette section traite de la vérification de la configuration de la multidiffusion sur les périphériques de fabric.

SDA-BORDER-1

```
interface Loopback4099                          <<<<<<<<<<<< Loopback Interface is created and assign
 vrf forwarding Campus
 ip address 192.168.50.1 255.255.255.255
 ip pim sparse-mode                             <<<<<<<<<<< PIM is enabled on Interface
end


interface LISP0.4099                            <<<<<<<<<<< PIM is enabled on LISP interface
 ip pim sparse-mode
end

SDA-Border1#sh run | in pim|multicast

ip multicast-routing                           <<<<<<<<<<< Multicast Routing is enabled for Global
ip multicast-routing vrf Campus                <<<<<<<<<<< Multicast Routing is enabled for Campus VN

ip pim ssm default                             <<<<<<<<<<< PIM SSM mode is enabled for Global for defa
ip pim vrf Campus rp-address 192.168.50.1      <<<<<<<<<<< BORDER-1 Loopback4099 is configued as RP
ip pim vrf Campus register-source Loopback4099
ip pim vrf Campus ssm default                  <<<<<<<<<<< PIM SSM mode is enabled for vrf Campus for

SDA-Border1#sh run | s address-family ipv4 vrf Campus
 address-family ipv4 vrf Campus
.....
```

```
 network 192.168.50.1 mask 255.255.255.255       <<<<<<<<<<< RP Address is injected into BGP Table
 aggregate-address 192.168.50.0 255.255.255.0 summary-only <<<<<<<<<<< Aggregate for Multicast Pool is
.....
```

SDA-BORDER-2

```
interface Loopback4099
 vrf forwarding Campus
 ip address 192.168.50.3 255.255.255.255
 ip pim sparse-mode
end

interface LISP0.4099
 ip pim sparse-mode
end


SDA-Border2#sh run | in pim|multicast

ip multicast-routing
ip multicast-routing vrf Campus

ip pim ssm default
ip pim vrf Campus rp-address 192.168.50.1       <<<<<<<<<< BORDER-1 Loopback4099 is configued as RP
ip pim vrf Campus register-source Loopback4099
ip pim vrf Campus ssm default


SDA-Border2#sh run | s address-family ipv4 vrf Campus
 address-family ipv4 vrf Campus
.....
 network 192.168.50.1 mask 255.255.255.255
 aggregate-address 192.168.50.0 255.255.255.0 summary-only
.....
```

SDA-EDGE-1

```
interface Vlan1021
 description Configured from apic-em
 mac-address 0000.0c9f.f45c
 vrf forwarding Campus
 ip address 172.16.10.1 255.255.255.0
 ip helper-address 10.10.10.100
 no ip redirects
 ip local-proxy-arp
 ip pim sparse-mode                              <<<<<<<<<<< PIM is enabled on all SVI-s under Campus VN
 ip route-cache same-interface
 ip igmp version 3
 no lisp mobility liveness test
 lisp mobility 172_16_10_0-Campus
```

```
end


interface Loopback4099
 vrf forwarding Campus
 ip address 192.168.50.2 255.255.255.255
 ip pim sparse-mode
end


interface LISP0.4099
 ip pim sparse-mode
end


SDA-Edge1#sh run | in pim|multicast

ip multicast-routing
ip multicast-routing vrf Campus

ip pim ssm default
ip pim vrf Campus rp-address 192.168.50.1       <<<<<<<<<< BORDER-1 Loopback4099 is configued as RP
ip pim vrf Campus register-source Loopback4099
ip pim vrf Campus ssm default
```

Étape 3 : Configuration manuelle de PIM sur une liaison de transfert

La source de multidiffusion est connectée en dehors du fabric à Fusion-2 dans cet exemple. Pour que le flux de multidiffusion circule, assurez-vous qu'il existe un chemin PIM entre RP et source et entre le récepteur et la source (les chemins peuvent être différents !).

Homologue PIM entre SDA-BORDER-1 et SDA-FUSION-1

<#root>

SDA-BORDER-1

```
------------------------------------------------
interface Vlan3002                              <<<<<<<< Enable PIM on Handover link in Campus VN
 description vrf interface to External router
 vrf forwarding Campus
 ip address 10.50.50.5 255.255.255.252
 no ip redirects
```

ip pim sparse-mode

```
 ip route-cache same-interface
end
```

SDA-FUSION-1

```
------------------------------------------------
ip multicast-routing
```

ip multicast-routing vrf Campus

```
               <<<<<<<<< Enable Multicast Routing in vrf Campus

ip pim vrf Campus rp-address 192.168.50.1

     <<<<<<<<< Configure BORDER-1 Loopback4099 as RP

interface Vlan3002                              <<<<<<<<< Enable PIM on Fusion Interface towards Border
vrf forwarding Campus
ip address 10.50.50.6 255.255.255.252

ip pim sparse-mode


end
```

Homologue PIM entre SDA-BORDER-2 et SDA-FUSION-2

<#root>

SDA-BORDER-2

```
-----------------------------------------------
interface Vlan3007
 description vrf interface to External router
 vrf forwarding Campus
 ip address 10.50.50.25 255.255.255.252
 no ip redirects

 ip pim sparse-mode

 ip route-cache same-interface
end
```

SDA-FUSION-2

```
-----------------------------------------------
ip multicast-routing distributed

ip multicast-routing vrf Campus distributed

ip pim vrf Campus rp-address 192.168.50.1



interface GigabitEthernet0/0/0.3007
 encapsulation dot1Q 3007
 vrf forwarding Campus
 ip address 10.50.50.26 255.255.255.252

 ip pim sparse-mode

 no cdp enable
end
```

Homologation PIM entre SDA-FUSION-1 et SDA-FUSION-2

<#root>

SDA-FUSION-1

```
------------------------------------------------
interface Vlan100
 description Muticast_Campus
 vrf forwarding Campus
 ip address 10.40.40.5 255.255.255.252


ip pim sparse-mode

end
```

SDA-FUSION-2

```
------------------------------------------------
interface GigabitEthernet0/0/2.100
 encapsulation dot1Q 100
 vrf forwarding Campus
 ip address 10.40.40.6 255.255.255.252

 ip pim sparse-mode

end
```

Activer PIM sur l'interface se connectant à la source

<#root>

SDA-FUSION-2

```
------------------------------------------------

interface GigabitEthernet1/0/2
 vrf forwarding Campus
 ip address 10.40.40.2 255.255.255.252

 ip pim sparse-mode

 load-interval 30
 negotiation auto
end
```

Processus du plan de contrôle

À un moment donné, le récepteur multidiffusion envoie une jointure IGMP (Internet Group Management Protocol) au routeur de dernier saut (LHR) afin de recevoir le flux pour un groupe spécifique, et la source multidiffusion (serveur) commence à envoyer le flux multidiffusion au routeur de premier saut (FHR). Dans notre cas, FHR est SDA-FUSION-2 et LHR est SDA-EDGE-

1 et le processus du plan de contrôle est expliqué dans le scénario où le récepteur demande un flux en premier, et la source commence la diffusion en continu pour ce groupe ensuite.

Joindre IGMP sur LHR

Le récepteur multidiffusion envoie un rapport IGMP (Join) à LHR pour le groupe 239.1.1.1. Le récepteur est connecté à Gi1/0/1 (SVI 1021) sur SDA-EDGE-1.

```
<#root>

SDA-Edge1#

debug ip igmp vrf Campus 239.1.1.1

IGMP debugging is on

*Aug 14

23:53:06.445

: IGMP(4):

Received v2 Report on Vlan1021 from 172.16.10.10 for 239.1.1.1

*Aug 14 23:53:06.445: IGMP(4): Received Group record for group 239.1.1.1, mode 2 from 172.16.10.10 for
*Aug 14 23:53:06.445: IGMP(4): MRT Add/Update Vlan1021 for (*,239.1.1.1) by 0

*Aug 14

23:54:07.445

: IGMP(4):

Received v2 Report on Vlan1021 from 172.16.10.10 for 239.1.1.1

<<<<<<< one minute apart


SDA-Edge1#

show ip igmp vrf Campus group


IGMP Connected Group Membership
Group Address    Interface                Uptime    Expires   Last Reporter
239.1.1.1        Vlan1021                 00:49:10  00:02:45  172.16.10.10    <<<<<<< Receiver is prese
SDA-Edge1#
```

Le nouveau service de surveillance de route multidiffusion détermine les informations de redirection de chemin inverse (RPF) vers le RP (pour l'arborescence partagée) et vers la source (pour l'arborescence du chemin le plus court (SPT)). Pour les adresses LISP accessibles, le voisin de tronçon suivant est représenté par l'adresse RLOC (Routing Locator) du site en amont.

```
<#root>

SDA-Edge1#
```

show ip pim vrf Campus rp mapping 239.1.1.1

PIM Group-to-RP Mappings

Group(s): 224.0.0.0/4, Static
    RP: 192.168.50.1 (?)   <<<<<<<<<<< RP is 192.168.50.1
SDA-Edge1#
SDA-Edge1#

SDA-Edge1#

show lisp eid-table vrf Campus ipv4 map 192.168.50.1/32

       <<<<<<<<< check Reachability towards the RP address
LISP IPv4 Mapping Cache for EID-table vrf Campus (IID 4099), 4 entries

192.168.50.1/32, uptime: 2w5d, expires: 23:10:58, via map-reply, complete
  Sources: map-reply
  State: complete, last modified: 2w5d, map-source: 192.168.10.1
  Active, Packets out: 171704(3435172 bytes) (~ 00:00:43 ago)
  Locator   Uptime   State   Pri/Wgt   Encap-IID

192.168.10.1

  2w5d   up   10/10   -   <<<<<<<<<<< RLOC is 192.168.10.1
    Last up-down state change: 2w5d, state change count: 1
    Last route reachability change: 2w5d, state change count: 1
    Last priority / weight change: never/never
    RLOC-probing loc-status algorithm:
      Last RLOC-probe sent: 00:49:02 (rtt 3ms)

SDA-Edge1#

show ip cef vrf Campus 192.168.50.1/32

192.168.50.1/32
  nexthop 192.168.10.1

LISP0.4099

                                  <<<<<<<<<<< RP is reachable via LISP interface

SDA-Edge1#

show ip mroute vrf Campus 239.1.1.1

IP Multicast Routing Table

(*, 239.1.1.1), 00:50:06/00:02:57, RP 192.168.50.1, flags: SJC   <<<<<<<<<<< (*,G) entry is created

Incoming interface: LISP0.4099, RPF nbr 192.168.10.1

             <<<<<<<<<<< Incoming interface is set as LISP interface
  Outgoing interface list:
    Vlan1021, Forward/Sparse, 00:50:06/00:02:57   <<<<<<<<<<< Outgoing Interface is se

Ensuite, le LHR envoie un PIM (*, G) Join Towards the RP (à intervalles d'une minute) - si LHR est DR pour ce segment.

<#root>

```
SDA-Edge1#debug ip pim vrf Campus 239.1.1.1
PIM debugging is on

*Aug 15 00:03:44.592: PIM(4): Building Periodic (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*Aug 15 00:03:44.593: PIM(4):
```

Insert (*,239.1.1.1) join in nbr 192.168.10.1's queue

```
*Aug 15 00:03:44.593: PIM(4): Building Join/Prune packet for nbr 192.168.10.1
*Aug 15 00:03:44.594: PIM(4):  Adding v2 (192.168.50.1/32, 239.1.1.1), WC-bit, RPT-bit, S-bit Join
*Aug 15 00:03:44.594: PIM(4): Adding LISP Unicast transport attribute in join/prune to 192.168.10.1 (LI
*Aug 15
```

00:03:44.594

```
: PIM(4):
```

Send v2 join/prune to 192.168.10.1 (LISP0.4099)

```
         <<<<<<< PIM (*,G) Join is sent towards the RP

*Aug 15 00:04:42.892: PIM(4): Building Periodic (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*Aug 15 00:04:42.892: PIM(4): Insert (*,239.1.1.1) join in nbr 192.168.10.1's queue
*Aug 15 00:04:42.892: PIM(4): Building Join/Prune packet for nbr 192.168.10.1
*Aug 15 00:04:42.892: PIM(4):  Adding v2 (192.168.50.1/32, 239.1.1.1), WC-bit, RPT-bit, S-bit Join
*Aug 15 00:04:42.892: PIM(4): Adding LISP Unicast transport attribute in join/prune to 192.168.10.1 (LI
*Aug 15
```

00:04:42.892

```
: PIM(4):
```

Send v2 join/prune to 192.168.10.1 (LISP0.4099)

```
SDA-Edge1#
```

Création de voisins

Une fois que les informations RPF pointent vers l'interface LISP, PIM doit explicitement créer une structure de voisinage pour le RLOC correspondant. Cela est nécessaire car le routeur de tunnel en amont (xTR) n'envoie pas de messages Hello. Le nouveau bloc voisin expire lorsque aucun message de jointure/élagage n'a été envoyé au voisin après 2 fois l'intervalle standard entre les jointures/élagages.

Dans notre cas, le SDA-EDGE-1 crée un voisin PIM en utilisant l'adresse RLOC en amont/RPF.

<#root>

```
SDA-Edge1#

show ip pim vrf Campus neighbor

PIM Neighbor Table

Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode

192.168.10.1


LISP0.4099

               1w5d/00:01:27     v2    0 /             <<<<<<< RLOC address used for the neighbor


SDA-Edge1#debug ip pim vrf Campus timers    <- chatty!
PIM-TIMERS debugging is on

*Aug 15 00:08:37.992: PIM(4): Building Periodic (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*Aug 15 00:08:37.993: PIM(4)

Twheel Start: Neighbor Timer for Nbr: 192.168.10.1. idb LISP0.4099

. delay: 120000 ms. jitter 0.

...
```

Jointure PIM reçue sur RP

La jonction PIM est reçue sur le RP(SDA-BORDER-1) de LHR(SDA-EDGE-1) via l'interface LISP

<#root>

```
SDA-Border1#

debug ip pim vrf Campus 239.1.1.1

PIM debugging is on

*Aug 18 01:47:14.812: PIM(4): J/P Transport Attribute, Transport Type: Unicast
*Aug 18 01:47:14.813: PIM(4): Join-list: (*, 239.1.1.1), RPT-bit set, WC-bit set, S-bit set
*Aug 18 01:47:14.813: PIM(4): Check RP 192.168.50.1 into the (*, 239.1.1.1) entry
*Aug 18 01:47:14.813: PIM(4): Adding register decap tunnel (Tunnel1) as accepting interface of (*, 239.
*Aug 18 01:47:14.813: PIM(4):

Add LISP0.4099/192.168.10.3 to (*, 239.1.1.1), Forward state, by PIM *G Join

        <<<<<< (*,G) join received from RLOC of LHR over LISP Interface

*Aug 18 01:48:14.267: PIM(4): J/P Transport Attribute, Transport Type: Unicast
*Aug 18 01:48:14.267: PIM(4): Join-list: (*, 239.1.1.1), RPT-bit set, WC-bit set, S-bit set
*Aug 18 01:48:14.267: PIM(4):

Update LISP0.4099/192.168.10.3 to (*, 239.1.1.1), Forward state, by PIM *G Join
```

```
SDA-Border1#
show ip mroute vrf Campus 239.1.1.1
IP Multicast Routing Table
(*, 239.1.1.1), 00:01:38/00:02:51, RP 192.168.50.1, flags: S
  Incoming interface:
 Null, RPF nbr 0.0.0.0
                                <<<<<<<<<<<< RP is myself hence RPF Neighbor is Null
  Outgoing interface list:
LISP0.4099, 192.168.10.3
, Forward/Sparse, 00:01:38/00:02:51          <<<<<<<<<<<< Outgoing Interface is set towards LHR RLOC
```

Le RP(Border1) n'envoie aucune jointure sur l'interface LISP, par conséquent aucun voisin PIM n'est créé sur le RP sur l'interface LISP.

Dans notre cas, le seul voisin PIM est vers Fusion-1 sur une interface non-LISP, et formé à la suite des paquets Hello PIM périodiques reçus.

<#root>

```
SDA-Border1#
debug ip pim vrf Campus hello
PIM-HELLO debugging is on
SDA-Border1#
*Aug 24
00:02:19
.944: PIM(4):
Received v2 hello on Vlan3002 from 10.50.50.6
*Aug 24 00:02:19.944: PIM(4): Neighbor (10.50.50.6) Hello GENID = 1315387214
SDA-Border1#
*Aug 24
00:02:49
.396: PIM(4):
Received v2 hello on Vlan3002 from 10.50.50.6
*Aug 24 00:02:49.397: PIM(4): Neighbor (10.50.50.6) Hello GENID = 1315387214
```

```
SDA-Border1#
show ip pim vrf Campus neigh
PIM Neighbor Table
Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode
10.50.50.6        Vlan3002
                  2w0d/00:01:31     v2    1 / DR S P G
```

Voisin PIM sur les routeurs Fusion

Les voisins PIM sur les routeurs Fusion utilisent des interfaces non-LISP et sont donc également créés en fonction des paquets Hello PIM reçus périodiquement.

<#root>

SDA-FUSION-1

```
SDA-Fusion1#
show ip pim vrf Campus neighbor
PIM Neighbor Table
Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode
10.40.40.6        Vlan100                  5d00h/00:01:41    v2    1 / S P G
10.50.50.5        Vlan3002                 2w4d/00:01:44     v2    1 / S P G
```

SDA-FUSION-2

```
SDA-Fusion2#
show ip pim vrf Campus neighbor
PIM Neighbor Table
Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode
10.50.50.25       Gi0/0/0.3007             2w5d/00:01:36     v2    1 / S P G
10.40.40.5        GigabitEthernet0/0/2.100 5d00h/00:01:23    v2    100/ DR S P G
```

Enregistrement PIM sur RP à partir de FHR

Lorsque la source commence à envoyer du trafic pour le groupe, le FHR (SDA-FUSION-2) enregistre le (S, G) auprès du RP une fois qu'il reçoit le premier paquet multicast de la source - et

si FHR est le DR sur ce segment.

<#root>

```
SDA-Fusion2#

show ip pim vrf Campus rp mapping 239.1.1.1

PIM Group-to-RP Mappings

Group(s): 224.0.0.0/4, Static


 RP: 192.168.50.1

 (?)                              <<<<<<<< RP for the Group

SDA-Fusion2#

show ip cef vrf Campus 192.168.50.1

192.168.50.1/32
  nexthop 10.40.40.5 GigabitEthernet0/0/2.100         <<<<<<<< Next-hop Interface towards RP


SDA-Fusion2#

debug ip mrouting vrf Campus

IP multicast routing debugging is on
SDA-Fusion2#

debug ip pim vrf Campus

PIM debugging is on

*Aug 22 21:59:42.601: PIM(2): Check RP 192.168.50.1 into the (*, 239.1.1.1) entry
*Aug 22 21:59:42.601: MRT(2):

(*,239.1.1.1), RPF change from  /0.0.0.0 to GigabitEthernet0/0/2.100/10.40.40.5

         <<<<<<<< RPF Interface is determined
*Aug 22 21:59:42.601: PIM(2): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*Aug 22 21:59:42.601: MRT(2): Create (*,239.1.1.1), RPF (GigabitEthernet0/0/2.100, 10.40.40.5, 1/0)
*Aug 22 21:59:42.602: MRT(2): (10.40.40.1,239.1.1.1), RPF install from  /0.0.0.0 to GigabitEthernet1/0/
*Aug 22 21:59:42.602: PIM(2):

Adding register encap tunnel (Tunnel0) as forwarding interface of (10.40.40.1, 239.1.1.1).

 <<<<< Register Tunnel is created
*Aug 22 21:59:42.602: MRT(2): Set the F-flag for (*, 239.1.1.1)
*Aug 22 21:59:42.602: MRT(2):

Set the F-flag for (10.40.40.1, 239.1.1.1)

                                            <<<<<<< Register(F) flag is set
*Aug 22 21:59:42.602: MRT(2):

Create (10.40.40.1,239.1.1.1), RPF (GigabitEthernet1/0/2, 0.0.0.0, 0/0)

                 <<<<<<< (S,G) is created
*Aug 22 21:59:42.602: MRT(2):

Set the T-flag for (10.40.40.1, 239.1.1.1)
```

```
                                                <<<<<<< SPT (T) flag is set
*Aug 22 21:59:42.629: PIM(2): Received v2 Join/Prune on GigabitEthernet0/0/2.100 from 10.40.40.5, to us
*Aug 22 21:59:42.629: PIM(2):
```

Join-list: (10.40.40.1/32, 239.1.1.1), S-bit set

```
                                          <<<<<<< (S,G) join is received
*Aug 22 21:59:42.629: MRT(2): WAVL Insert interface: GigabitEthernet0/0/2.100 in (10.40.40.1,239.1.1.1)

*Aug 22 21:59:42.630: MRT(2): set min mtu for (10.40.40.1, 239.1.1.1) 18010->1500
*Aug 22 21:59:42.630: MRT(2):
```

Add GigabitEthernet0/0/2.100/239.1.1.1 to the olist of (10.40.40.1, 239.1.1.1)

```
, Forward state - MAC built
*Aug 22 21:59:42.630: PIM(2): Add GigabitEthernet0/0/2.100/10.40.40.5 to (10.40.40.1, 239.1.1.1), Forwa
*Aug 22 21:59:42.630: MRT(2): Add GigabitEthernet0/0/2.100/239.1.1.1 to the olist of (10.40.40.1, 239.1
*Aug 22 21:59:42.630: MRT(2): Set the PIM interest flag for (10.40.40.1, 239.1.1.1)

SDA-Fusion2#
```

show ip mroute vrf Campus 239.1.1.1

```
IP Multicast Routing Table

(*, 239.1.1.1), 00:01:17/stopped, RP 192.168.50.1, flags: SPF
  Incoming interface: GigabitEthernet0/0/2.100, RPF nbr 10.40.40.5
  Outgoing interface list: Null

(
```

10.40.40.1, 239.1.1.1

```
), 00:01:17/00:02:14, flags: FT
  Incoming interface: GigabitEthernet1/0/2,
```

RPF nbr 0.0.0.0

```
<<<<<<<< RPF neighbor is 0.0.0.0 as the Source is directly connected
```

Outgoing interface list:

Gi0/0/0.3007

```
, Forward/Sparse, 00:01:17/00:03:10

SDA-Fusion2#

SDA-Fusion2#
```

show interface tunnel 0

```
         <<<<<<<< Register Tunnel is created between FHR and RP
Tunnel0 is up, line protocol is up
 Hardware is Tunnel
 Description:
```

Pim Register Tunnel (Encap) for RP 192.168.50.1 on VRF Campus

```
 Interface is unnumbered. Using address of GigabitEthernet0/0/2.100 (10.40.40.6)
 MTU 9972 bytes, BW 100 Kbit/sec, DLY 50000 usec,
 reliability 255/255, txload 1/255, rxload 1/255
 Encapsulation TUNNEL, loopback not set
```

```
 Keepalive not set
 Tunnel linestate evaluation up
 Tunnel source 10.40.40.6 (GigabitEthernet0/0/2.100), destination 192.168.50.1
```

Le RP (BORDER-1) reçoit le registre du FHR, ce qui déclenche une jointure (S, G) à envoyer vers le FHR, et également un Register-Stop vers le FHR - une fois que le flux est reçu nativement sur le RP.

<#root>

```
SDA-Border1#

debug ip mrouting vrf Campus 239.1.1.1

IP multicast routing debugging is on

*Aug 18 02:29:05.186: PIM(4):

Received v2 Register on Vlan3002 from 10.40.40.6

                                          <<<<<<< PIM Register is received from FHR
*Aug 18 02:29:05.186:      for 10.40.40.1, group 239.1.1.1
*Aug 18 02:29:05.187: PIM(4):

Adding register decap tunnel (Tunnel1)

 as accepting interface of (10.40.40.1, 239.1.1.1).  <<<<<<< Register tunnel is created
*Aug 18 02:29:05.187: MRT(4): (10.40.40.1,239.1.1.1), RPF install from  /0.0.0.0 to Vlan3002/10.50.50.6
*Aug 18 02:29:05.188: MRT(4):

Create (10.40.40.1,239.1.1.1), RPF (Vlan3002, 10.50.50.6, 20/0)

                           <<<<<<< (S,G) is created and RPF is resolved
*Aug 18 02:29:05.188: MRT(4): WAVL Insert LISP interface: LISP0.4099 in (10.40.40.1,239.1.1.1) Next-hop
*Aug 18 02:29:05.188: MRT(4): set min mtu for (10.40.40.1, 239.1.1.1) 18010->17892
*Aug 18 02:29:05.189: MRT(4):

Add LISP0.4099/192.168.10.3 to the olist of (10.40.40.1, 239.1.1.1)

, Forward state - MAC not built   <<<<<< LISP OIF is inherited from (*,G)
*Aug 18 02:29:05.189: PIM(4): Insert (10.40.40.1,239.1.1.1) join in nbr 10.50.50.6's queue
*Aug 18 02:29:05.189: PIM(4): Building Join/Prune packet for nbr 10.50.50.6
*Aug 18 02:29:05.189: PIM(4):

Adding v2 (10.40.40.1/32, 239.1.1.1), S-bit Join

*Aug 18 02:29:05.189: PIM(4):

Send v2 join/prune to 10.50.50.6 (Vlan3002)

                                                <<<<<<< (S,G) join is sent towards the Source
*Aug 18 02:29:05.272: PIM(4): J/P Transport Attribute, Transport Type: Unicast
*Aug 18 02:29:05.272: PIM(4): Join-list: (*, 239.1.1.1), RPT-bit set, WC-bit set, S-bit set
*Aug 18 02:29:05.272: PIM(4): Update LISP0.4099/192.168.10.3 to (*, 239.1.1.1), Forward state, by PIM *
*Aug 18 02:29:05.272: MRT(4): Update LISP0.4099/192.168.10.3 in the olist of (*, 239.1.1.1), Forward st
*Aug 18 02:29:05.272: PIM(4): Prune-list: (10.40.40.1/32, 239.1.1.1) RPT-bit set
*Aug 18 02:29:05.273: PIM(4):

Prune LISP0.4099/192.168.10.3 from (10.40.40.1/32, 239.1.1.1)
```

<<<<<<< (S,G) Prune is received from Edge1
*Aug 18 02:29:05.273: MRT(4):

Delete LISP0.4099/192.168.10.3 from the olist of (10.40.40.1, 239.1.1.1)

*Aug 18 02:29:05.273: PIM(4): Insert (10.40.40.1,239.1.1.1) prune in nbr 10.50.50.6's queue - deleted

*Aug 18 02:29:05.273: PIM(4): Building Join/Prune packet for nbr 10.50.50.6
*Aug 18 02:29:05.273: PIM(4):

Adding v2 (10.40.40.1/32, 239.1.1.1), S-bit Prune

*Aug 18 02:29:05.273: PIM(4):

Send v2 join/prune to 10.50.50.6 (Vlan3002

)
*Aug 18 02:29:05.439: PIM(4): J/P Transport Attribute, Transport Type: Unicast

*Aug 18 02:29:07.193: PIM(4): Received v2 Register on Vlan3002 from 10.40.40.6
*Aug 18 02:29:07.193:   for 10.40.40.1, group 239.1.1.1
*Aug 18 02:29:07.194: PIM(4):

Send v2 Register-Stop to 10.40.40.6 for 10.40.40.1, group 239.1.1.1

<<<<<<< Register-Stop is sent towards FHR

SDA-Border1#

show ip mroute vrf Campus 239.1.1.1

IP Multicast Routing Table

(*, 239.1.1.1), 00:51:28/00:02:44, RP 192.168.50.1, flags: S
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:

LISP0.4099, 192.168.10.3

, Forward/Sparse, 00:51:28/00:02:44

(

10.40.40.1, 239.1.1.1

), 00:09:37/00:01:24,

flags: P

                    <<<<<<<<<<<< (S,G) is created but Pruned flag is set

Incoming interface: Vlan3002

, RPF nbr 10.50.50.6   <<<<<<<<<<<< Incoming interface and RPF neighbor

 Outgoing interface list: Null

SDA-Border1#

show ip rpf vrf Campus 10.40.40.1

```
RPF information for ? (10.40.40.1)
  RPF interface: Vlan3002
<<<<<<<<<< RPF interface towards the Source
  RPF neighbor: ? (10.50.50.6)
<<<<<<<<<< RPF neighbor - must be a PIM neighbor
  RPF route/mask: 10.40.40.0/30


 RPF type: unicast (bgp 65005)
<<<<<<<<<< RPF information coming from unicast RIB/BGP
  Doing distance-preferred lookups across tables
  RPF topology: ipv4 multicast base,
originated from ipv4 unicast base


SDA-Border1#
SDA-Border1#
show ip route vrf Campus 10.40.40.1



Routing Table: Campus
Routing entry for 10.40.40.0/30



Known via "bgp 65005"
, distance 20, metric 0
  Tag 65004, type external
  Last update from 10.50.50.6 2w6d ago
  Routing Descriptor Blocks:
  * 10.50.50.6, from 10.50.50.6, 2w6d ago
      Route metric is 0, traffic share count is 1
      AS Hops 1
      Route tag 65004
      MPLS label: none
      MPLS Flags: NSF
SDA-Border1#
```

SPT est élagué par l'Edge-1 - allons voir le LHR pour voir pourquoi.

(S, G) Création sur LHR

Après réception des données de multidiffusion transmises par le RP, une entrée (S, G) est créée sur le LHR.

Ensuite, le LHR bascule sur l'arborescence du plus court chemin (SPT)) en envoyant un (S, G)

Join vers la Source. Ceci est envoyé sur l'interface RPF vers la source.

<#root>

```
SDA-Edge1#
*Aug 18 02:19:53.759: MRT(4):

Create (10.40.40.1,239.1.1.1)

, RPF (unknown, 0.0.0.0, 0/0)                    <<<<<<<<< (S,G) is created on LHR
*Aug 18 02:19:53.759: MRT(4): WAVL Insert interface: Vlan1021 in (10.40.40.1,239.1.1.1) Successful
*Aug 18 02:19:53.759: MRT(4): set min mtu for (10.40.40.1, 239.1.1.1) 18010->1500
*Aug 18 02:19:53.759: MRT(4):

Add Vlan1021/239.1.1.1 to the olist of (10.40.40.1, 239.1.1.1)

, Forward state - MAC not built    <<<<<<< OIL is inherited from (*,G)
*Aug 18 02:19:53.759: MRT(4):

Set the J-flag for (10.40.40.1, 239.1.1.1)

                                    <<<<<<<< SPT Join Flag is set
*Aug 18 02:19:53.762: MRT(4):

(10.40.40.1,239.1.1.1), RPF change from  /0.0.0.0 to LISP0.4099/192.168.10.2

<<<<<<<< RPF interface is resolved
*Aug 18 02:19:53.762: MRT(4): Set the T-flag for (10.40.40.1, 239.1.1.1)
*Aug 18 02:19:53.763: PIM(4): Insert (10.40.40.1,239.1.1.1) join in nbr 192.168.10.2's queue
*Aug 18 02:19:53.763: PIM(4): Building Join/Prune packet for nbr 192.168.10.2
*Aug 18 02:19:53.763: PIM(4):  Adding v2 (10.40.40.1/32, 239.1.1.1), S-bit Join
*Aug 18 02:19:53.763: PIM(4): Adding LISP Unicast transport attribute in join/prune to 192.168.10.2 (LI
*Aug 18 02:19:53.763: PIM(4):

Send v2 join/prune to 192.168.10.2 (LISP0.4099)

                                <<<<<<<< (S,G) Join towards the Source is sent
*Aug 18 02:19:53.826: PIM(4): Building Periodic (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*Aug 18 02:19:53.826: PIM(4): Insert (*,239.1.1.1) join in nbr 192.168.10.1's queue
*Aug 18 02:19:53.826: PIM(4): Insert (10.40.40.1,239.1.1.1) sgr prune in nbr 192.168.10.1's queue
*Aug 18 02:19:53.826: PIM(4):

Building Join/Prune packet for nbr 192.168.10.1

*Aug 18 02:19:53.826: PIM(4):  Adding v2 (192.168.50.1/32, 239.1.1.1), WC-bit, RPT-bit, S-bit Join
*Aug 18 02:19:53.827: PIM(4):

Adding v2 (10.40.40.1/32, 239.1.1.1), RPT-bit, S-bit Prune

*Aug 18 02:19:53.827: PIM(4): Adding LISP Unicast transport attribute in join/prune to 192.168.10.1 (LI
*Aug 18 02:19:53.827: PIM(4):

Send v2 join/prune to 192.168.10.1 (LISP0.4099)

<<<<<<<<< (S,G) Prune towards the RP is sent
*Aug 18 02:20:08.323: MRT(4): Update (*,239.1.1.1), RPF (LISP0.4099, 192.168.10.1, 1/1)
*Aug 18 02:20:08.323: MRT(4): Update Vlan1021/239.1.1.1 in the olist of (*, 239.1.1.1), Forward state -
*Aug 18 02:20:08.323: MRT(4): Update Vlan1021/239.1.1.1 in the olist of (10.40.40.1, 239.1.1.1), Forwar



SDA-Edge1#

show ip mroute vrf Campus 239.1.1.1
```

```
IP Multicast Routing Table

(*, 239.1.1.1), 00:43:35/stopped, RP 192.168.50.1, flags: SJC
  Incoming interface: LISP0.4099,

RPF nbr 192.168.10.1

  Outgoing interface list:
    Vlan1021, Forward/Sparse, 00:43:35/00:02:29

(10.40.40.1, 239.1.1.1), 00:01:45/00:01:14,

flags: JT

                        <<<<<<<<<<<< (S,G) is created
  Incoming interface: LISP0.4099,

RPF nbr 192.168.10.2

                       <<<<<<<<<<<< Border-2 is the RPF neighbor towards the Source
  Outgoing interface list:
    Vlan1021, Forward/Sparse, 00:01:47/00:02:27


SDA-Edge1#

show lisp eid-table vrf Campus ipv4 map 10.40.40.1

                  <<<<<<<< LISP lookup for the Source
LISP IPv4 Mapping Cache for EID-table vrf Campus (IID 4099), 5 entries

0.0.0.0/1, uptime: 2w1d, expires: 18:05:53, via map-reply, forward-native
  Sources: map-reply
  State: forward-native, last modified: 2w1d, map-source: 192.168.10.1
  Active, Packets out: 106458(41136237 bytes) (~ 00:00:38 ago)


Encapsulating to proxy ETR

                                                  <<<<<<<<< No specific entry is known, forwarding to Pro



SDA-Edge1#

show ip cef vrf Campus 10.40.40.1 detail

0.0.0.0/1, epoch 0, flags [subtree context, check lisp eligibility], per-destination sharing
  SC owned,sourced: LISP remote EID - locator status bits 0x00000000
  LISP remote EID: 106468 packets 41140303 bytes fwd action encap
  LISP source path list
    nexthop 192.168.10.1 LISP0.4099                                    <<<<<<<<<< Load balancing t
    nexthop 192.168.10.2 LISP0.4099
  2 IPL sources [no flags]
  nexthop 192.168.10.1 LISP0.4099
  nexthop 192.168.10.2 LISP0.4099


SDA-Edge1#

show ip cef vrf Campus exact-route 192.168.50.2 10.40.40.1

          <<<<<<<<< CEF hashing points towards Border-2
192.168.50.2 -> 10.40.40.1 =>

IP adj out of GigabitEthernet1/0/11, addr 192.168.23.2
```

```
SDA-Edge1#
show ip rpf vrf Campus 10.40.40.1

RPF information for ? (10.40.40.1)

RPF interface: LISP0.4099



RPF neighbor: ? (192.168.10.2)

<<<<<<<<<<< Hence SPT Join is sent towards Border-2
  RPF route/mask: 0.0.0.0/1
  RPF type: unicast ()
  Doing distance-preferred lookups across tables
  RPF topology: ipv4 multicast base
SDA-Edge1#
```

Puisque la jointure (S, G) est envoyée vers la périphérie 2 sur l'interface LISP, un nouveau voisin PIM est créé sur la périphérie 1

<#root>

```
SDA-Edge1#
show ip pim vrf Campus neighbor

PIM Neighbor Table

Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode

192.168.10.2      LISP0.4099

               00:07:32/00:01:22 v2    0 /         <<<<<<<< Neighbor towards Border-2 is created
192.168.10.1      LISP0.4099               2w1d/00:01:58     v2    0 /
```

Comme Border-2 se trouve dans le chemin de données pour le flux de multidiffusion, il doit effectuer un suivi RLOC explicite pour suivre le RLOC des XTR-s en aval pour la réplication monodiffusion des paquets.

<#root>

```
SDA-Border2#
show ip mroute vrf Campus 239.1.1.1

IP Multicast Routing Table
```

```
(*, 239.1.1.1), 00:23:00/stopped, RP 192.168.50.1, flags: SP
  Incoming interface: LISP0.4099, RPF nbr 192.168.10.1
  Outgoing interface list: Null

(10.40.40.1, 239.1.1.1), 00:12:35/00:02:52,
```

flags: T

```
                 <<<<<<< SPT flag is set
  Incoming interface: Vlan3007,
```

RPF nbr 10.50.50.26

```
                  <<<<<<< RPF neighbor is based on RPF towards the Source - must be a PIM neighbor
  Outgoing interface list:
```

LISP0.4099, 192.168.10.3

```
, Forward/Sparse, 00:12:35/00:02:45      <<<<<<< OIL created from (S,G) join received from LHR and conta

SDA-Border2#
```

show ip mfib vrf Campus 239.1.1.1 10.40.40.1

```
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.
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:   FS Pkt Count/PS Pkt Count
VRF Campus
 (10.40.40.1,239.1.1.1) Flags: HW
   SW Forwarding: 0/0/0/0, Other: 0/0/0
```

HW Forwarding: 176/0/122/0

```
, Other: 0/0/0                       <<<<<<< Multicast stream is forwarded in h/w
   Vlan3007 Flags: A
   LISP0.4099, 192.168.10.3 Flags: F NS
     Pkts: 0/0

SDA-Border2#
```

sh ip mfib vrf Campus 239.1.1.1 10.40.40.1 count

```
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 Campus
 6 routes, 2 (*,G)s, 3 (*,G/m)s
Group: 239.1.1.1
```

```
  Source: 10.40.40.1,
   SW Forwarding: 0/0/0/0, Other: 0/0/0


HW Forwarding:   182/0/122/0

, Other: 0/0/0                        <<<<<<<< Counter is incrementing
  Totals - Source count: 1, Packet count: 182

Groups: 1, 1.00 average sources per group
SDA-Border2#
```

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