

Visão geral do Any-Source Multicast (ASM) no ambiente de estrutura de campus SDA

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Introduction

Este documento descreve a Visão Geral do Multicast de Origem Qualquer (ASM) com Ponto de Encontro Único (RP) no Ambiente de Acesso Definido por Software (SD-Access).

Prerequisites

Requirements

É recomendável que você tenha conhecimento do Locator ID Separation Protocol (LISP) e multicast.

Componentes Utilizados

Este documento não se restringe a versões de software e hardware específicas.

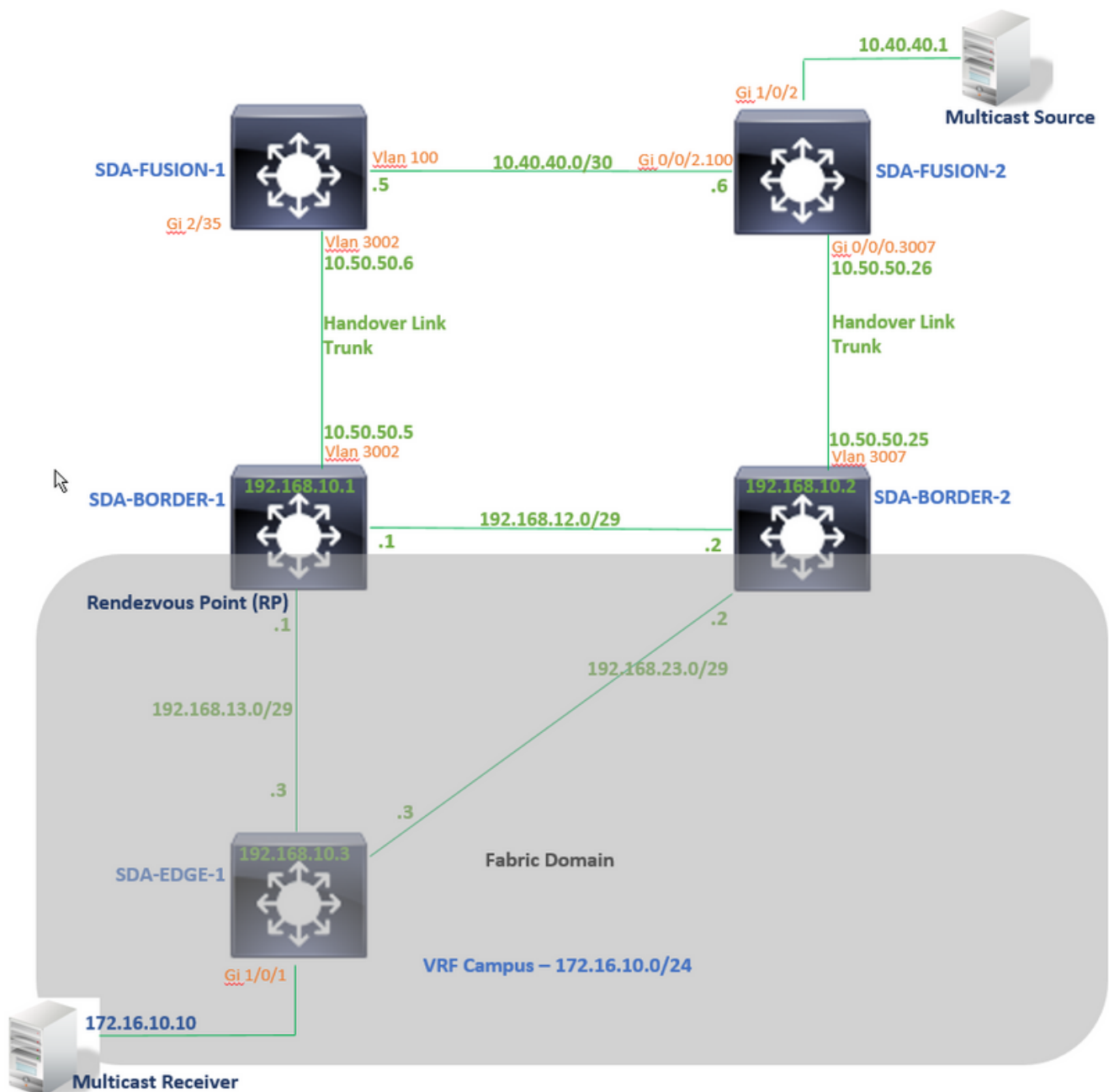
As informações apresentadas neste documento foram criadas a partir de dispositivos em um ambiente de laboratório específico. Se a sua rede estiver ativa, certifique-se de que você entende o impacto potencial de qualquer comando.GUI

Dispositivos usados para este artigo

Configurar

Diagrama de Rede

A topologia usada para este artigo consiste em dois Roteadores de Borda configurados como Fronteiras Externas e dois Roteadores Fusion com uma conexão para cada Roteador de Borda respectivo. A borda 1 é configurada como RP, a origem multicast está conectada ao Fusion-2 e o receptor multicast está conectado à borda 1.



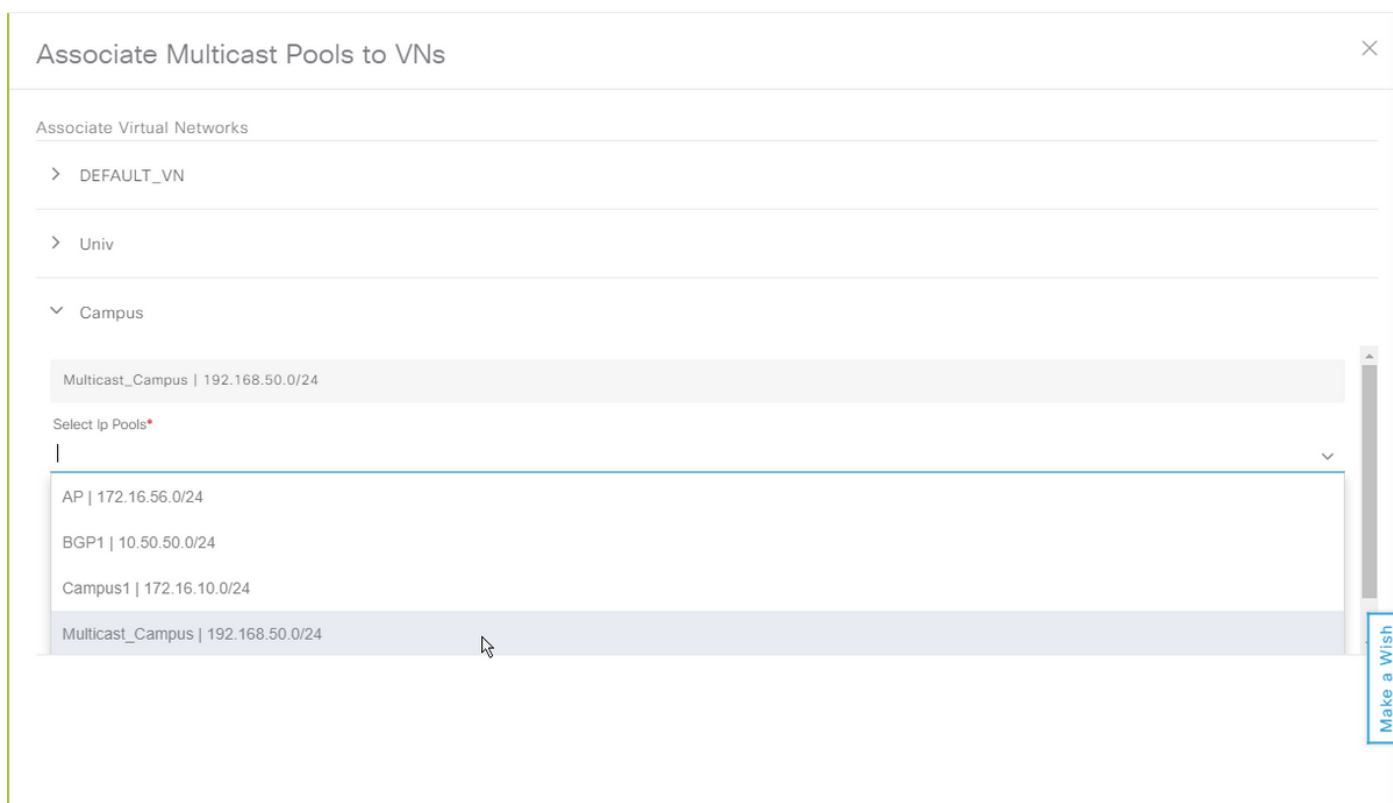
Configurações

Este artigo não aborda as etapas para configurar o Fabric no ambiente de SDA (Software-Defined Access) e começa com uma explicação das etapas para configurar o Multicast no domínio Fabric para uma VN específica.

Etapa 1: Configure o Multicast em Dispositivos de Estrutura a partir do DNAC

Na Interface Gráfica do Usuário (GUI - Graphical User Interface) do DNAC, em Provisioning -> Fabric Workflow. O multicast é configurado pela opção "Enable Rendezvous point" no dispositivo SDA-BORDER-1.

Em seguida, escolha um Pool *Internet Protocol (IP)* a ser usado para a Configuração Multicast em VN específica. "Campus" neste exemplo.



Etapa 2: Verifique a configuração enviada em dispositivos

Esta seção aborda a verificação da configuração de multicast em dispositivos de estrutura.

SDA-BORDER-1

```
interface Loopback4099 <<<<<<<<<<<<<<< Loopback Interface is created and assigned an IP from Pool
selected
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 default address
range 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 default
address range
```

```
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 advertised
.....
```

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-Edgel#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

```

Etapa 3: Configurar manualmente o PIM através do link de transferência

A origem multicast está conectada fora da estrutura para o Fusion-2 neste exemplo. Para que o fluxo do Fluxo Multicast, certifique-se de que haja um caminho PIM do RP para a Origem e do Receptor para a Origem (os caminhos podem ser diferentes!).

Peering PIM entre SDA-BORDER-1 e SDA-FUSION-1

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

```

Peering PIM entre SDA-BORDER-2 e SDA-FUSION-2

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
```

Peering PIM entre SDA-FUSION-1 e SDA-FUSION-2

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
```

Habilitar PIM na interface que se conecta à Origem

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
```

Processo do plano de controle

Em algum momento, o Receptor Multicast envia uma Internet Group Management Protocol (IGMP) Join para o Last Hop Router (LHR) para receber o Fluxo para um grupo específico e a Origem de Multicast (Servidor) começa a enviar o Fluxo Multicast para o First Hop Router (FHR). No nosso caso, o FHR é SDA-FUSION-2 e o LHR é SDA-EDGE-1 e o Processo de Plano de Controle é explicado no cenário em que o Receptor solicita um fluxo primeiro, e a Fonte começa a


```
Neighbor        Interface          Uptime/Expires   Ver  DR
Address                                     Prio/Mode
192.168.10.1   LISP0.4099       1w5d/00:01:27   v2   0 /
address used for the neighbor                <<<<<<<< RLOC
```

```
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.
```

...

PIM Join recebido no RP

A junção PIM é recebida no RP(SDA-BORDER-1) de LHR(SDA-EDGE-1) sobre a Interface LISP

```
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 (Tunnell) as accepting interface of
(*, 239.1.1.1).
*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
```

O RP(Border1) não envia nenhuma união na interface LISP, portanto nenhum vizinho PIM é criado no RP através da interface LISP.

Em nosso caso, o único vizinho PIM é em direção ao Fusion-1 sobre uma interface não LISP e é formado como resultado dos pacotes PIM Hello periódicos recebidos.

```
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 Address	Interface	Uptime/Expires	Ver	DR Prio/Mode
10.50.50.6	Vlan3002	2w0d/00:01:31	v2	1 / DR S P G

Vizinho PIM em roteadores Fusion

Os vizinhos de PIM em roteadores Fusion estão em interfaces não LISP e, portanto, também são criados com base nos PIM Hello-s periódicos recebidos.

SDA-FUSION-1

```

SDA-Fusion1#show ip pim vrf Campus neighbor
PIM Neighbor Table

```

Neighbor Address	Interface	Uptime/Expires	Ver	DR 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 Address	Interface	Uptime/Expires	Ver	DR 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

Registro PIM no RP do FHR

Quando a origem começa a enviar tráfego para o grupo, a FHR (SDA-FUSION-2) registra o (S,G) com o RP depois de receber o primeiro pacote multicast da origem - e se FHR for o DR nesse segmento.

```

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
GigabitEthernet1/0/2/0.0.0.0
*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) Successful

*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), Forward state, by PIM SG Join
*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: 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

RP (BORDER-1) recebe o registro da FHR, que dispara uma (S,G) Join a ser enviada para a FHR, e também uma parada de registro para a FHR - uma vez que o fluxo é recebido nativamente no RP.

```
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 (Tunnell1) 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: 192.168.10.3 Outer-source: 0.0.0.0 Successful
*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 *G Join
*Aug 18 02:29:05.272: MRT(4): Update LISP0.4099/192.168.10.3 in the olist of (*, 239.1.1.1),
Forward state - MAC not built
*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 Edgel
*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#
```

A SPT está sendo podada pela Borda 1 - vamos ao LHR para ver por quê.

(S,G) Criação no LHR

Depois de receber os dados multicast encaminhados pelo RP, a entrada (S,G) é criada no LHR.

Em seguida, o LHR mudará para Shortest Path Tree (SPT) enviando um (S,G) Join para a origem. Isso é enviado na interface RPF em direção à Origem.

```
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
LISPO.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 (LISP0.4099)
*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 (LISP0.4099)
*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 - MAC not built
*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),
Forward state - MAC not built
```

```
SDA-Edgel#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-Edgel#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 Proxy ETR
```

```
SDA-Edgel#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 towards 2 Proxy ETR-s
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#
```

Como o (S,G) Join é enviado para Border-2 na Interface LISP, um novo vizinho PIM é criado na Borda 1

```
SDA-Edge1#show ip pim vrf Campus neighbor
PIM Neighbor Table
```

Neighbor Address	Interface	Uptime/Expires	Ver	DR 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 /	

Como o Border-2 está no Caminho de Dados para o fluxo multicast, ele precisa executar o RLOC Tracking Explícito para rastrear o RLOC de XTR-s de downstream para replicação unicast dos pacotes.

```
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 containing LHR's RLOC info which has to be tracked
```

```
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#