

Overview of Any-Source Multicast (ASM) in SDA Campus Fabric Environment

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Introduction

This document describes Overview of Any-Source Multicast (ASM) with Single Rendezvous point (RP) in Software-Defined Access (SD-Access) Environment.

Prerequisites

Requirements

It is recommended that you have knowledge of Locator ID Separation Protocol (LISP) and multicast.

Components Used

This document is not restricted to specific software and hardware versions.

The information in this document was created from devices in a specific lab environment. If your network is live, make sure that you understand the potential impact of any command.GUI

Devices used for this Article

Digital Network Architecture Controller (DNAC)

- Version 1.2.1

Edge and Border

- Cat3k Cisco Switch

Fusion

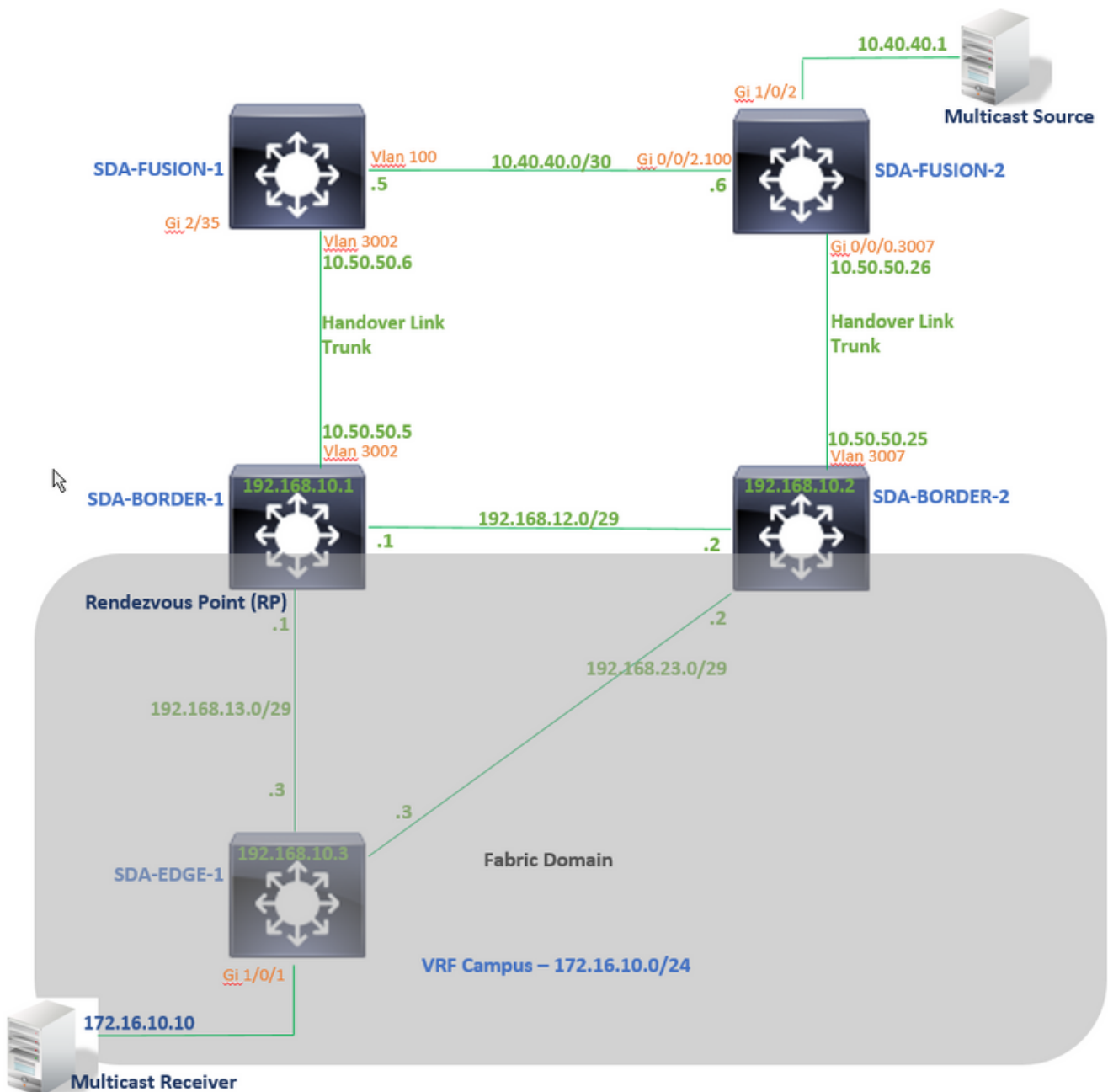
- Cisco Router with Support for

Inter-VRF(Virtual Route Forwarding) leaking

Configure

Network Diagram

Topology used for this article consists of two Border Routers both configured as External Borders, and two Fusion Routers with a connection to each respective Border Router. Border-1 is configured as RP, Multicast Source is connected to Fusion-2 and Multicast Receiver is connected to Edge-1.



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
```


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
```

PIM Peering Between SDA-FUSION-1 and 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
```

Enable PIM on the interface connecting to the Source

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
```

Control Plane Process

At some point Multicast Receiver sends an Internet Group Management Protocol (IGMP) Join to Last Hop Router(LHR) in order to receive the Stream for a specific group, and Multicast Source (Server) starts sending the Multicast Stream to First Hop Router(FHR). In our case FHR is SDA-FUSION-2 and LHR is SDA-EDGE-1 and Control Plane Process is explained in the scenario


```

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

PIM Neighbor on Fusion Routers

PIM Neighbors on Fusion Routers are over non-LISP interfaces and hence are also created based on the periodic PIM Hello-s received.

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

PIM Register on RP from FHR

When the Source starts to send traffic for the group, the FHR (SDA-FUSION-2) registers the (S,G) with the RP once it receives the first multicast packet from the Source - and if FHR is the DR on that segment.

```

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) receives the Register from the FHR, which triggers a (S,G) Join to be sent towards the FHR, and also a Register-Stop towards the FHR - once stream is received natively on the 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 (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: 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
```



```
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#
```

Since the (S,G) Join is sent towards Border-2 over the LISP Interface, a new PIM neighbor is created on Edge-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 /	

As Border-2 is in the Data Path for the multicast stream, it has to perform Explicit RLOC Tracking to track the RLOC of Downstream XTR-s for Unicast Replication of the packets.

```
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#