# **Case Study: L3 Multicast in the ACI Fabric**

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## Introduction

Layer 3 Multicast routing is supported in the ACI fabric starting with release 2.0 onwards and requires EX switches (i.e N9K-C93180YC-EX). Prior to release 2.0, ACI only supported L2 multicast within the bridge domain. This is still a valid option in 2.0 and can be used for non-EX switches.

In ACI release 2.0, supported multicast routing features include: PIM ASM, PIM SSM, Static RP, PIM Auto-RP, and PIM BSR.

In this document, we describe a validated solution for a real customer deployment scenario for L3 multicast routing on ACI fabric. Selected ACI release is 2.1(1h). This release does not support RP on the fabric, thus an external RP is needed for PIM ASM.

## **Design Requirements**

Customer requires an End-to-End solution for L3 multicast routing within and outside the fabric. The deployment scenario has the following requirements:

• One VRF deployed for all tenants.

Note: Multicast requires dedicated L3out for each VRF. If there are multiple VRFs in the fabric, shared L3out is not supported for multicast routing.

- · Receivers in fabric with external sources
- · Sources in fabric with external receivers
- Sources and receivers in fabric
- Static RP or Auto-RP

## Solution

**Topology Review** 



In the topology, there are two major components: the ACI module and the Tiered LAN Network module. Both modules are connected to core devices via point-to-point L3 links running OSPF and PIM. In ACI module, the external routed network is called L3out-to-Core associated with the VRF common:default. It includes the four links from the two border leaves to the core devices. The tiered LAN network module, referred as external to the fabric, consists of traditional access layer and aggregation layer with vPC.

L3 multicast flows run across the ACI fabric and the legacy LAN network through the Core layer. For Static RP scenario, RP is deployed on the WAN edge device.

We use Spirent traffic generators (STC) to simulate the internal and external sources and receivers. The Spirent ports are connected to different locations in the ACI module and the Tiered LAN network module. Receivers send IGMP v2 membership join messages.

Internal Sources attached to Sleaf2: source IPs are 10.101.101.115~124, sending to group addresses: 228.0.0.1~10

Internal Receivers attached to Bleaf1, Cleaf1 and Cleaf2: multicast enabled BDs are BD90, BD91, BD31, BD32, interested groups: 228.0.0.1~10 and 229.0.0.1~10.

External Sources attached to the access layer in LAN network: source IPs are 10.103.103.40~49, sending to group addresses: 229.0.0.1~10.

External Receivers attached to the access layer in LAN network: vlan131, vlan132, interested groups: 228.0.0.1~10.

## Configuration

Step 0: Set up RP on the simulated WAN device attached to core, enable PIM sparse mode on

### the tiered LAN network devices.

```
!!!!! RP configuration
ip pim rp-address 99.99.99 group-list 224.0.0.0/4
ip pim ssm range 232.0.0.0/8
interface loopback99
    ip address 99.99.99.99/32
    ip router ospf 65017 area 0.0.0.0
    ip pim sparse-mode
interface Ethernet2/1
    ip pim sparse-mode
interface Ethernet2/2
    ip pim sparse-mode
Step 1: Enable Multicast at the VRF. In Tenant space, navigate to Networking > VRFs >
Multicast, on the working panel, click the butter to enable Multicast.
```



**Step 2:** Enable Multicast at BD and L3out levels, enable IGMP for receiver BDs. Navigate to Networking > VRFs > VRF name > Multicast, on the working panel, select Configuration > Interface tab, click "+" to add the Bridge Domains where mulcast traffic is expected. Enable IMGP policy for multicast enabled BD.

Then click "+" to add L3out for this VRF. When multicast is enabled for an L3out it will enable PIM on all interfaces under the L3out, and all the border leaves for that L3out is enabled with multicast routing. Select the PIM policy for L3out interface groups.

Here assume the BDs and L3out are provisioned already.

ALL TENANTS   Add Tonget   Sparsh: Million	ants Fabric	VM Networking	L4-L7 Services	Admin	Operations		ρ	i	Advanced Mode
Tenant common	Multicast								
Quick Start  Control Common  Common	O				Interfaces	Rendezvous Points	Configuration Pattern Policy	Stats PIM Se	Faults History
	Enable Bridge Doma	iins	×	+ Inter	iaces				× (+)
EPG Collection for VRF     External Bridged Networks     External Routed Networks	BD Zone_C/BD91 Zone_A/BD31 Zone_A/BD32		IGMP Policy common/default common/default common/default	L3 Out	L3Out_To_Core	Group Interface	IGM Polic [eth 1/4]	, P	IM Policy
Protocol Policies      L4-L7 Service Parameters      Security Policies      Translandated Baliana	Zone_C/BD90 Zone_C/BD101		common/default		E L3_out	pod-1/132/ _To_Core2 pod-1/131/ pod-1/132/	(eth 1/4) (eth 1/5) (eth 1/5)	c	ommon/default

Attaching IGMP policy to the BDs makes it an IGMP querier as well. IGMP policy is configured under Tenant > Networking > Protocol Polices > IGMP Interface. The Default IGMP policy has the following parameters where you can define query intervals. If no policy is specified, the interface will use the default policy.

alialia cisco	System	Tenants	Fabric	VM Netwo	orking L4-L7 Services	Admin	Operatio	ons	Q	i		Mode welcome, admin -
ALL TENANTS	Add Tenant	Search: enter r	name, descr	cor	mmon   Zone_A   Zone_	B   Zone_C	mgmt					
Tenant commo	on	4	IGMP Inte	erface P	olicy - default							
Quick Star	t				uoraan					(De trais		
Tenant cor	nmon									Policv	Faults	History
Application	ing		• <b>±</b>				AOO					ACTIONS
Bridge	Domains			Name:	default			Startup Query C	Count: 2		۵.	
VRFs			Des	scription:	optional			Startup Query In	terval 31		•	
Extern	al Bridged Netv	vorks							(sec): 255		-	
Extern	al Routed Netw	vorks		Control:	Allow v3 ASM			Querier Timeout	(sec): 255		-	
	ol Policies				Fast Leave			Robustness var	lable: 2	option		
	,				Report Link Local Gro	oups		State Limit Houte	Map: <u>select an</u>	option	<u> </u>	
▶ 🖿 Rou	te Maps		Group	Timeout	260	۵		Maximum Mul	iticast		\$	
🕨 🗖 BGF	>		Query	(Sec).				Reserved Mul	lticast			
🕨 🗖 OSF	PF		Query	(sec):	125	\$		Er	ntries:		-	
EIG	RP		Query Re	esponse	10			Report Policy	Route select an	option	-	
e IGM	IP Interface		Interv	al (sec):					Map:			
► IGM	P Snoon		Last	Member Count:	2	\$		Static Report	Route select an	option	-	
Cus	tom QOS		Last	Member					мар:			
🕨 🖿 End	Point Retention	n	Respon	se Time	1	٠						
🕨 🖿 DHO	CP			(sec):		_						
🕨 🖿 ND	Interface			Version	Version 2 Version 3							
ND	RA Prefix											
*	103 10303											

PIM policy is also configured under Tenant > Networking > Protocol Polices > PIM.

The Default PIM policy has the following parameters where you can define hello intervals.

ahaha cisco	System	Tenants	Fabric	VM Networking L4-	L7 Services	Admin	Operations	٩		Advanced Mode welcome, admin <del>-</del>
ALL TENA	NTS   Add Tenant	Search: enter r	name, descr	common   Zo	one_A   Zone_	B   Zone_C	mgmt			
Tenant con	nmon	<ul> <li>Image: A set of the set of the</li></ul>	O Edit Int	erface Policy						
Quick :	Start			criacerolicy					_	1
Tenant	common								Policv	Faults History
Appl	vorking		• <b>±</b>				A O O			ACTIONS
► Br	idge Domains		Prope	rties						
▶ 🖿 VF	RFs		. topo	Name:	default					
🕨 🖿 Ex	ternal Bridged Net	works		Auth Turner	MD5 HMAC	authentication	No authentication			
) = Ex	ternal Routed Netv	vorks		Auth Type:	NIDO TINIAO	. D. I	No autrentication			
4 🔍 Pr	otocol Policies			Control State:	Multicast Do	main Bounda	ry			
	BFD				Strict REC C	Compliant				
			Desig	insted Pouter Delay		Jonipliant				
			Desig	(seconds):	3	\$				
	pim-hello-5sec		•	Designated Router	1					
> <b>m</b>	Route Maps			Priority:	-		_			
> 💼 (	BGP			Hello Interval	30000	\$				
> 🖿 (	OSPF		loin-E	Prune Interval Policy						
> <b>m</b>	EIGRP		J011-P	(seconds):	60	\$				
> <b>•</b>	IGMP Interface		Int	erface-level Inbound	select an onti	00 -				
	IGMP Snoop		Joir	-Prune Filter Policy:	Select all opti	•				
	End Point Potentia	n	Inter	face-level Outbound	select an onti	00				
			Joir	-Prune Filter Policy:	soloot all opti	•				
> <b>m</b>	ND Interface		Inte	rface-level Neighbor	select an opti	on -				
> <b>m</b>	ND RA Prefix			Filter Policy:	ooloot all opti					
► <b>m</b>	Route Tag									

L3Outs on border leaf must be configured with loopback addresses enabled in the Node profile.

CISCO System Tenants	Fabric VM Net	working L4-L7 Services	Admin O	perations	P	i	Advanced Mode welcome, admin <del>~</del>
ALL TENANTS   Add Tenant   Search: enter	name, descr	ommon Zone_A   Zone_(	C   Zone_B   mgm	nt			
Tenant common     Image: Common and Comm	Logical Node Pro	file - L3Out_To_Core	_NP			Policv	Faults History
<ul> <li>Bridge Domains</li> <li>VRFs</li> <li>External Bridged Networks</li> <li>External Routed Networks</li> <li>Route Maps/Profiles</li> <li>Set Rules for Route Maps</li> <li>Match Rules for Route Maps</li> </ul>	Properties Name: Description: Alias: Target DSCP:	L3Out_To_Core_NP optional Unspecified					
BL3Out_To_Core     Logical Node Profiles	Nodes:	<ul> <li>Node ID</li> </ul>		Router ID	Static Routes	Loo	× +
<ul> <li>LSOUL_IO_CONE_INF</li> <li>LSOUL_TO_CORE</li> <li>LSOUL_TO_CORE</li> <li>OSPF Interface Profile</li> <li>L3_out_To_Core2</li> <li>Configured Nodes</li> <li>Networks</li> </ul>		topology/pod-1/node-131 topology/pod-1/node-132		131.131.131.1 132.132.132.1		131 132	.131.131.1 2.132.132.1
Route Maps/Profiles							

**Step 3**: Configure RP for PIM ASM. Navigate to Tenant > VRF > Multicast, in the working panel select Configuration > Rendezvous Points. In this example, Static RP is selected. Click "+" to add the RP.



For Auto-RP configuration, check the boxes for "Forward Auto-RP updates" and "Listen to Auto-RP Updates" on the "Rendezvous Points" page.

cisco System Tenants	Fabric VM	Networking L4-L7 Services	Admin C	Operations	P		Advanced Mode welcome, admin ~
ALL TENANTS   Add Tenant   Search: enter nam	ne, descr	common   Zone_A   Zone_	B   Zone_C   mg	mt			
Tenant common 🛛 🛛 🖾	Multicast						
Quick Start     Tenant common	manoaot				Contiouration	Stats I	Faults History
Application Profiles			Interfaces	s Rendezvous Points	Pattern Policv	PIM Settina	IGMP Settina
<ul> <li>Networking</li> <li>Bridge Domains</li> <li>VRFs</li> <li>Copy</li> <li>default</li> <li>Deployed VRFs (Simple Mode)</li> <li>Multicast</li> <li>EVEG Collection for VRF</li> <li>External Bridged Networks</li> <li>External Routed Networks</li> <li>External Routed Networks</li> <li>External Routed Networks</li> <li>External Routed Networks</li> <li>External Policies</li> <li>L4-L7 Service S</li> <li>Monitoring Policies</li> <li>L4-L7 Services</li> </ul>	C Static RP - IP No iter Select A	× + RouteMap ms have been found. ctions to create a new item.	Auto-RP RP ⊒ Fc Updates: ⊒ Lis MA Filter: <u>sele</u>	orward Auto-RP Updates sten to Auto-RP Updates ct an option	Bootstrap Rout RP Updates BSR Filter: <u>Sele</u>	er (BSR) : Forward Listen to ct an option	BSR Updates BSR Updates

Outside the ACI fabric, the AUTO-RP configurations on NX-OS platforms remain the same.

```
!!! On RP candidate
```

ip pim send-rp-announce loopback99 group-list 224.0.0.0/4
ip pim send-rp-discovery loopback99 scope 32

```
!!! On RP listeners:
ip pim auto-rp listen forward
```

**Step 4:** Configure necessary PIM settings. Navigate to Tenant >VRF -> Multicast, in the working panel, select Configuration > PIM settings, note the VRF GIPo address 225.1.192.0/32 which is assigned by APIC from the multicast group address pool. The VRF GIPo will be used as the outside group IP address for multicast traffic for BDs enabled with PIM.

When **Fast Convergence** mode is enabled (default is disable), all border leaves enabled with PIM will send joins towards the external network, but only one border leaf will forward traffic onto the fabric to prevent duplicates. The border leaf that forwards traffic for the group is the **designated forwarder** for the group. Enabling Fast Convergence helps reduce the packet drop duration for multicast flows with outside sources and inside receivers, when there is a stripe winner change due to the border leaf is down. There is no latency incurred by joining the PIM tree from the new stripe winner. This comes at the cost of the additional bandwidth usage on the non-stripe winners' external links since all of the border leaves pull traffic from the external source.

**About the Stripe Winners** - Currently ACI uses a BSR (Bootstrap Router) hash to calculate the BL stripe winner. The hash is computed using the S,G and Loopback IP of the Leaf. As of ACI 3.0(1) there is no way to influence stripe winner election for the user.

uluilu cisco	System	Tenants	Fabric	VM Networ	rking L4-L7 Service	es Adm	in Op	erations	P			Advanced Mode welcome, admin <del>-</del>
ALL TENANTS	Add Tenant	Search: enter	name, descr		mon   infra   mgmt	Zone_A	Zone_B					
Tenant commo	n	8	Multica:	st								i
<ul> <li>Quick Star</li> <li>Tenant con</li> </ul>	nmon								Contiguration	Stats	Faults	Historv
Application App	on Profiles						Interfaces	Rendezvous Points	Pattern Policv	<b>PIM Setting</b>	IGMF	Settina
	Domains popoed VRFs ( ult control transformed version of Collection for al Bridged Netward Collection for al Bridged Netward of Policies hoot Policies noot Policies policies provices	Simple Mode) or VRF vorks vorks	C PIM S Cc Reso Maxi Multic	VRF GIPo address: ontrol State MTU port: urce Policy RouteMap: Reserved ast Entries:	225.1.192.0/32 ■ Fast Convergen ■ Strict RFC Com 1500 select an option	ce obliant t						

Step 5: Create needed contract to allow multicast traffic:

- Source and Receiver inside fabric (contract not needed)
- Receiver inside fabric, External source (contract not needed)
- Source inside fabric, External receiver (contract required)\*

\*The contract is not required if the BD is deployed on the border leaf

In our case, we have receivers outside the fabric, apply contract between L3out\_to\_Core and mcast source in EPG101.



### Verify

### **PIM Verification**

!!!!! Border Leaf Node bleaf1 !!!!!

When the VRF is enabled for multicast routing, a fabric interface (tunnel) is created for multicast routing within the fabric. The PIM control plane packets are sent via the fabric interfaces within the fabric. The tunnel destination will be the VRF GiPo multicast address. On border leaf switches the tunnel source will be the loopback interface on the border leaf. On non-border leaf switches the tunnel source will be a loopback address (127.0.0.100).

Border leaves send PIM hellos on the fabric interface.L3Oout interfaces run PIM in normal mode including sending and receiving hellos, electing DR, etc. Non-border leaves run in passive mode on the fabric interface; they listen for PIM hellos from the border leaves but do not send PIM hellos. Non-border leaves will not show up in output to "show ip pim neighbor".

bleaf1# show	ip pim neighbor									
PIM Neighbor	information for Dom:com	nmon:default								
Neighbor	Interface	Uptime	Expires	DRPriority						
Bidir BF	DState									
132.132.132.1	/32 tunnel16	06:20:40	00:01:21	1						
no n/	a									
10.1.20.25/32	eth1/5	06:23:12	00:01:35	1						
yes n/	a									
10.1.20.1/32	eth1/4	06:23:12	00:01:24	1						
yes n/	a									
Tunnel16 is u MTU 9000 Transport Tunnel pr Tunnel so Tunnel de Last clea Tx 0 packets Rx 0 packets	<pre>&gt;leaf1# show interface tunnel 16 Cunnel16 is up MTU 9000 bytes, BW 0 Kbit Transport protocol is in VRF "common:default" Tunnel protocol/transport is ivxlan Tunnel source 131.131.131.1 Tunnel destination 225.1.192.0/32 Last clearing of "show interface" counters never Tx 0 packets output, 1 minute output rate 0 packets/sec Rx 0 packets input, 1 minute input rate 0 packets/sec</pre>									
bleaf1#	bleaf1#									
!!!!! Border	Leaf Node bleaf2 !!!!!									

bleaf2# show ip pim neighbor

PIM Neighbor information for Dom:common:default								
Neighbor		Interface	Uptime	Expires	DRPriority			
Bidir	BFDState							
131.131.131	L.1/32	tunnel16	06:23:26	00:01:30	1			
no	n/a							
10.1.20.29/	/32	eth1/5	06:38:26	00:01:43	1			
yes	n/a							
10.1.20.5/3	32	eth1/4	06:38:27	00:01:20	1			
yes	n/a							

bleaf2# show interface tunnel 16
Tunnel16 is up
MTU 9000 bytes, BW 0 Kbit

```
Transport protocol is in VRF "common:default"
    Tunnel protocol/transport is ivxlan
    Tunnel source 132.132.132.1
    Tunnel destination 225.1.192.0/32
   Last clearing of "show interface" counters never
   Τx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec
bleaf2#
!!!!! RP !!!!!
bleaf1# show ip pim rp vrf all
PIM RP Status Information for VRF: "common:default"
BSR: Not Operational
Auto-RP RPA: 192.168.1.2/32
RP: 99.99.99.99, uptime: 26d21h, expires: 00:02:38,
 priority: 0, RP-source: 192.168.1.2 (A), group-map: None, group ranges:
    224.0.0/4
bleaf1#
bleaf2# show ip pim rp vrf all
PIM RP Status Information for VRF: "common:default"
BSR: Not Operational
Auto-RP RPA: 192.168.1.2/32
RP: 99.99.99.99, uptime: 26d21h, expires: 00:02:38,
 priority: 0, RP-source: 192.168.1.2 (A), group-map: None, group ranges:
    224.0.0.0/4
bleaf2#
!!!!! Non border leaf Node !!!!!
cleaf1# show ip pim neighbor
PIM Neighbor information for Dom:common:default
Neighbor
                   Interface Uptime
                                                              Expires
                                                                                   DRPriority
Bidir
         BFDState
132.132.132.1/32
                                        06:32:43
                                                              00:01:37
                   tunnel16
                                                                                   1
          n/a
no
131.131.131.1/32
                                        06:32:43
                                                              00:01:17
                   tunnel16
                                                                                   1
no
          n/a
cleaf1# show interface tunnel 16
Tunnell6 is up
   MTU 9000 bytes, BW 0 Kbit
   Transport protocol is in VRF "common:default"
    Tunnel protocol/transport is ivxlan
    Tunnel source 127.0.0.100/32
    Tunnel destination 225.1.192.0/32
    Last clearing of "show interface" counters never
    Тx
    0 packets output, 1 minute output rate 0 packets/sec
    Rx
    0 packets input, 1 minute input rate 0 packets/sec
cleaf1#
cleaf2# show ip pim neighbor vrf all
```

PIM Neighbor information for Dom:common:default Neighbor Interface Uptime

Bidir	BFDState				
132.132.1	32.1/32	tunnel16	06:33:17	00:01:33	1
no	n/a				
131.131.1	31.1/32	tunnel16	06:33:17	00:01:41	1
no	n/a				
cleaf2# s	how interfa	ice tunnel 16 Tu	nnel16 is up MTU 9000	bytes, BW 0 Kbit Tra	ansport protocol is
in VRF "c	ommon:defau	lt" Tunnel prot	ocol/transport is ivxl	an <b>Tunnel source 12</b>	27.0.0.100/32
Tunne	l destinati	on 225.1.192.0/	32		
Last	clearing of	"show interfac	e" counters never		
Tx					

0 packets output, 1 minute output rate 0 packets/sec Rx

0 packets input, 1 minute input rate 0 packets/sec

cleaf2#

#### !!!!!! Core Router !!!!!

N7K-core-1# show ip pim neighbor											
IM Neighbor Status for VRF "default"											
Neighbor	Interface	Uptime	Expires	DR	Bidir-	BFD					
				Priority	Capable	e State					
10.1.20.2	Ethernet1/1	3d22h	00:01:43	1	no	n/a					
10.1.20.6	Ethernet1/2	3d22h	00:01:36	1	no	n/a					
10.1.20.10	Ethernet1/3	2w6d	00:01:30	1	yes	n/a					
10.1.20.14	Ethernet1/4	2w6d	00:01:18	1	yes	n/a					
10.1.20.42	Ethernet1/5	2w6d	00:01:28	1	yes	n/a					
N7K-core-1#											
N7K-core-2# sh	ip pim neighbor										

	0010 11 2			2 - 2 - 2		
PIM	Neighbor	Status	for	VRF	"default'	I
Neig	ghbor	Inte	erfac	ce		Upti

Neighbor	Interface	Uptime	Expires	DR	Bidir-	BFD
				Priority	Capable	e State
10.1.20.26	Ethernet1/1	3d22h	00:01:23	1	no	n/a
10.1.20.30	Ethernet1/2	3d22h	00:01:17	1	no	n/a
10.1.20.18	Ethernet1/3	2w6d	00:01:38	1	yes	n/a
10.1.20.22	Ethernet1/4	2w6d	00:01:41	1	yes	n/a
10.1.20.46	Ethernet1/5	2w6d	00:01:17	1	yes	n/a
N7K-core-2#						

### **Active Border Leaf Verification**

If there are more than one border leaf is enabled with multicast routing, APIC chooses one stripe winner for each group address across all active border leaves. The border leaf that is the stripe winner for a group is responsible for sending PIM joins on behalf of the fabric and forwarding multicast traffic into the fabric.

The stripe winner for the group decides on the Designated Forwarder. If the stripe winner has reachability to the root, then the stripe winner is the DF also. If the stripe winner does not have external connectivity to the root, then that BL chooses a DF by sending a PIM join over the fabric interface.

!!!!! Enter into vsh mode to execute the command !!!!! bleaf2# vsh Cisco iNX-OS Debug Shell This shell should only be used for internal commands and exists for legacy reasons. User should use ibash infrastructure as this will be deprecated. bleaf2# show ip pim internal stripe-winner 228.0.0.1 vrf common:default PIM Stripe Winner info for VRF "common:default" (BL count: 2) (\*, 228.0.0.1) BLs: 132.132.132.1 hash: 2081913316 (local) 131.131.131.1 hash: 1024236260 Winner: 132.132.132.1 best\_hash: 2081913316 bleaf2# bleaf2# bleaf2# show ip pim internal stripe-winner 229.0.0.1 vrf common:default PIM Stripe Winner info for VRF "common:default" (BL count: 2) (\*, 229.0.0.1) BLs: 132.132.132.1 hash: 1595374052 (local) 131.131.131.1 hash: 2047646436 Winner: 131.131.1 best\_hash: 2047646436

bleaf2#

### **Fast Convergence Verification**

!!! Verify if fast	convergen	nce is enabled				
bleaf1# show fabri	c multicas	st vrf common:d	efault			
Fabric Multicast E	nabled VRF	ſs				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	BL	Fast	131.131.131.1
bleaf1#						
!!! None-border le	af					
cleaf1# show fabri	c multicas	st vrf common:d	efault			
Fabric Multicast E	nabled VRF	ſs				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	Leaf	Fast	127.0.0.100
cleaf1#						
IGMP Verification	ı					
!!! Verify if fast	convergen	nce is enabled				
bleaf1# show fabri	c multicas	st vrf common:d	efault			
Fabric Multicast E	nabled VRF	ſs				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default bleaf1#	4	Tunnel16	2162688	BL	Fast	131.131.131.1
!!! None-border le	af					
cleaf1# show fabri	c multicas	st vrf common:d	efault			
Fabric Multicast E	nabled VRF	ſs				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	Leaf	Fast	127.0.0.100

cleaf1#

### **MRIB** Verification

The leaf node sleaf2 which is the FHR has directly attached multicast sources. Its RPF neighbor is 10.0.176.64 on spine1. The incoming interface is the fabric interface (tunnel16) which is peering with the border leaf via PIM.

For simplicity, the output shown is for one multicast IP address from each group range: 228.0.0.1 for inside sources, and 229.0.0.1 for the outside sources.

!!! Verify if fast convergence is enabled bleafl# show fabric multicast vrf common:default Fabric Multicast Enabled VRFs VRF Name VRF Vprime VN-Seg VRF Conv Tunnel ID If ID Role Mode IP common:default 4 Tunnel16 2162688 BL **Fast** 131.131.131.1 bleaf1#

!!! None-border leaf

cleaf1# show fabric	multicas	t vrf common:d	efault			
Fabric Multicast Ena	abled VRF	S				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	Leaf	Fast	127.0.0.100

cleaf1#

Receivers for 228.0.0.1 are attached to bleaf2 (node 132), cleaf1 (Node 101) and cleaf2 (Node 102). Bleaf2 forwards the mcast to group 228.0.0.1 to internal receivers via tunnel 16, and external receivers via L3out to the core devices.

!!! Verify if fast	convergen	ce is enabled				
bleaf1# show fabric	multicas	t vrf common:d	efault			
Fabric Multicast En	abled VRF	s				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	BL	Fast	131.131.131.1
bleaf1#						
III None handen lee	£					

!!! None-border leaf

cleaf1# show fabr:	ic multicast	t vrf common:d	lefault			
Fabric Multicast N	Enabled VRF:	5				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default cleaf1#	4	Tunnel16	2162688	Leaf	Fast	127.0.0.100

Bleaf1 forwards group of 228.0.0.1 to outside via L3out interface, but it does not forward onto the fabric via the fabric interfaces since it is not the stripe winner for 228.0.0.1

!!! Verify if fast o	convergenc	e is enabled				
bleaf1# show fabric	multicast	vrf common:de	fault			
Fabric Multicast Ena	abled VRFs					
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	BL	Fast	131.131.131.1
bleaf1#						
!!! None-border leaf						
cleaf1# show fabric	multicast	vrf common:de	fault			
Fabric Multicast Ena	abled VRFs					
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	Leaf	Fast	127.0.0.100

cleaf1#

Bleaf1 is the active border leaf/stripe winnder for group 229.0.0.1. bleaf1 receives the multicast to group 229.0.0.1 via the external core device, and then forwards to internal receivers in BD90, BD91, BD31, BD32. (note the vlan ID is only internal to leaf node as the pervasive GW).

<pre>!!! Verify if fast</pre>	convergen	ce is enabled				
bleaf1# show fabric	c multicas	t vrf common:d	efault			
Fabric Multicast En	nabled VRF	S				
VRF Name	VRF	Vprime	VN-Seg	VRF	Conv	Tunnel
	ID	If	ID	Role	Mode	IP
common:default	4	Tunnel16	2162688	BL	Fast	131.131.131.1
bleaf1#						

!!! None-border leaf

cleaf1# show fabric multicast vrf common:default Fabric Multicast Enabled VRFs VRF Name VRF Conv VRF Vprime VN-Seq Tunnel Role Mode ID Τf ID ΙP common:default Tunnel16 2162688 Leaf Fast 4 127.0.0.100 cleaf1#

Non-border leaf Cleaf1 and Cleaf2 has attached receivers in BD31, BD32, BD91. Non-border leaf node install (\*, G) only, (S,G) is not supported.

cleaf1# show ip mroute 228.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

(\*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnell4, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 2) Vlan4, uptime: 1w5d, igmp Vlan7, uptime: 3w5d, igmp

cleaf1# show ip mroute 229.0.0.1 vrf common:default
IP Multicast Routing Table for VRF "common:default"

```
(*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim
Incoming interface: Tunnel14, RPF nbr: 10.0.80.91
Outgoing interface list: (count: 2)
Vlan4, uptime: 1w5d, igmp
Vlan7, uptime: 3w5d, igmp
```

```
cleaf1#
```

```
cleaf1# show interface vlan 4
Vlan4 is up, line protocol is up
 Hardware EtherSVI, address is 0000.0c07.aclf
 Internet Address is 10.31.31.1/24
 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
  reliability 255/255, txload 1/255, rxload 1/255
 Carrier delay is 10 sec
 Encapsulation ARPA, loopback not set
 Keepalive not supported
 ARP type: ARPA
 Last clearing of "show interface" counters never
 30 seconds input rate 0 bits/sec, 0 packets/sec
 30 seconds output rate 0 bits/sec, 0 packets/sec
 Load-Interval #2: 5 minute (300 seconds)
   input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
 L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
 L3 in Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
 L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
cleaf1# show interface vlan 7
Vlan7 is up, line protocol is up
 Hardware EtherSVI, address is 0000.0c07.ac20
 Internet Address is 10.32.32.1/24
 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
  reliability 255/255, txload 1/255, rxload 1/255
 Carrier delay is 10 sec
```

Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf1# !!!! Non-border leaf node has (\*, G) only, (S,G) is not supported. cleaf2# show ip mroute 228.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel16, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 3) Vlan3, uptime: 1w5d, igmp Vlan30, uptime: 3w5d, igmp Vlan9, uptime: 3w5d, igmp cleaf2# show ip mroute 229.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel16, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 3) Vlan3, uptime: 1w5d, igmp Vlan30, uptime: 3w5d, igmp Vlan9, uptime: 3w5d, igmp cleaf2# cleaf2# show interface vlan 3 Vlan3 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.aclf Internet Address is 10.31.31.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf2# show interface vlan 30 Vlan30 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.ac5b Internet Address is 10.91.91.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf2# show interface vlan 9 Vlan9 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.ac20 Internet Address is 10.32.32.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

#### cleaf2#

On the core routers, N7K-core-1 and N7K-core-2 are load sharing for multicast flows sourced in LAN network, if fast convergence is not enabled, only one border leaf (bleaf1) is sending join towards the source.

cleaf1# show ip mroute 228.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel14, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 2) Vlan4, uptime: 1w5d, igmp Vlan7, uptime: 3w5d, igmp cleaf1# show ip mroute 229.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default"

(\*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel14, RPF nbr: 10.0.80.91

```
Outgoing interface list: (count: 2)
   Vlan4, uptime: 1w5d, igmp
   Vlan7, uptime: 3w5d, igmp
cleaf1#
cleaf1# show interface vlan 4
Vlan4 is up, line protocol is up
 Hardware EtherSVI, address is 0000.0c07.aclf
 Internet Address is 10.31.31.1/24
 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
  reliability 255/255, txload 1/255, rxload 1/255
 Carrier delay is 10 sec
 Encapsulation ARPA, loopback not set
 Keepalive not supported
 ARP type: ARPA
 Last clearing of "show interface" counters never
 30 seconds input rate 0 bits/sec, 0 packets/sec
 30 seconds output rate 0 bits/sec, 0 packets/sec
 Load-Interval #2: 5 minute (300 seconds)
    input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
 L3 Switched:
    input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
 L3 in Switched:
   ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
 L3 out Switched:
    ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
cleaf1# show interface vlan 7
Vlan7 is up, line protocol is up
 Hardware EtherSVI, address is 0000.0c07.ac20
 Internet Address is 10.32.32.1/24
 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec
  reliability 255/255, txload 1/255, rxload 1/255
 Carrier delay is 10 sec
 Encapsulation ARPA, loopback not set
 Keepalive not supported
 ARP type: ARPA
 Last clearing of "show interface" counters never
 30 seconds input rate 0 bits/sec, 0 packets/sec
 30 seconds output rate 0 bits/sec, 0 packets/sec
 Load-Interval #2: 5 minute (300 seconds)
   input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
 L3 Switched:
   input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes
 L3 in Switched:
   ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
 L3 out Switched:
   ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes
```

```
cleaf1#
```

!!!! Non-border leaf node has (\*, G) only, (S,G) is not supported. cleaf2# show ip mroute 228.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default"

(\*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel16, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 3) Vlan3, uptime: 1w5d, igmp Vlan30, uptime: 3w5d, igmp cleaf2# show ip mroute 229.0.0.1 vrf common:default

IP Multicast Routing Table for VRF "common:default" (\*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel16, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 3) Vlan3, uptime: 1w5d, igmp Vlan30, uptime: 3w5d, igmp Vlan9, uptime: 3w5d, igmp cleaf2# cleaf2# show interface vlan 3 Vlan3 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.aclf Internet Address is 10.31.31.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf2# show interface vlan 30 Vlan30 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.ac5b Internet Address is 10.91.91.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf2# show interface vlan 9 Vlan9 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.ac20 Internet Address is 10.32.32.1/24

MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec

reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf2# cleaf1# show ip mroute 228.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel14, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 2) Vlan4, uptime: 1w5d, igmp Vlan7, uptime: 3w5d, igmp cleaf1# show ip mroute 229.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel14, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 2) Vlan4, uptime: 1w5d, igmp Vlan7, uptime: 3w5d, igmp cleaf1# cleaf1# show interface vlan 4 Vlan4 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.aclf Internet Address is 10.31.31.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf1# show interface vlan 7 Vlan7 is up, line protocol is up

Hardware EtherSVI, address is 0000.0c07.ac20 Internet Address is 10.32.32.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

cleaf1#

!!!! Non-border leaf node has (\*, G) only, (S,G) is not supported. cleaf2# show ip mroute 228.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 228.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel16, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 3) Vlan3, uptime: 1w5d, igmp Vlan30, uptime: 3w5d, igmp Vlan9, uptime: 3w5d, igmp cleaf2# show ip mroute 229.0.0.1 vrf common:default IP Multicast Routing Table for VRF "common:default" (\*, 229.0.0.1/32), uptime: 3w5d, igmp ip pim Incoming interface: Tunnel16, RPF nbr: 10.0.80.91 Outgoing interface list: (count: 3) Vlan3, uptime: 1w5d, igmp Vlan30, uptime: 3w5d, igmp Vlan9, uptime: 3w5d, igmp cleaf2# cleaf2# show interface vlan 3 Vlan3 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.aclf Internet Address is 10.31.31.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes

L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf2# show interface vlan 30 Vlan30 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.ac5b Internet Address is 10.91.91.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes cleaf2# show interface vlan 9 Vlan9 is up, line protocol is up Hardware EtherSVI, address is 0000.0c07.ac20 Internet Address is 10.32.32.1/24 MTU 9000 bytes, BW 10000000 Kbit, DLY 1 usec reliability 255/255, txload 1/255, rxload 1/255 Carrier delay is 10 sec Encapsulation ARPA, loopback not set Keepalive not supported ARP type: ARPA Last clearing of "show interface" counters never 30 seconds input rate 0 bits/sec, 0 packets/sec 30 seconds output rate 0 bits/sec, 0 packets/sec Load-Interval #2: 5 minute (300 seconds) input rate 0 bps, 0 pps; output rate 0 bps, 0 pps L3 Switched: input: 0 pkts, 0 bytes - output: 0 pkts, 0 bytes L3 in Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes L3 out Switched: ucast: 0 pkts, 0 bytes - mcast: 0 pkts, 0 bytes

#### cleaf2#

#### References

ACI 2.0 Multicast Routing