

The background features a vibrant, abstract design. On the left, there are horizontal, wavy bands of color in shades of red, orange, yellow, and green. On the right, a bright white light source emits a series of colorful rays in shades of blue, cyan, and yellow, creating a sunburst effect.

CISCO *Live!*

Let's go

#CiscoLiveAPJC



The bridge to possible

Troubleshooting Multicast:

The "Usual Suspects"

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Technical Leader, CCIE #46482
BRKENT-2264

CISCO *Live!*

#CiscoLiveAPJC



“Reconciliation”- Dustin Koa Art

Cisco Webex App

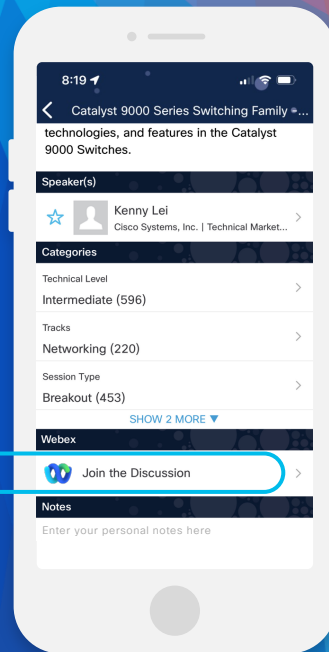
Questions?

Use Cisco Webex App to chat with the speaker after the session

How

- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
- 3 Install the Webex App or go directly to the Webex space
- 4 Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until December 22, 2023.

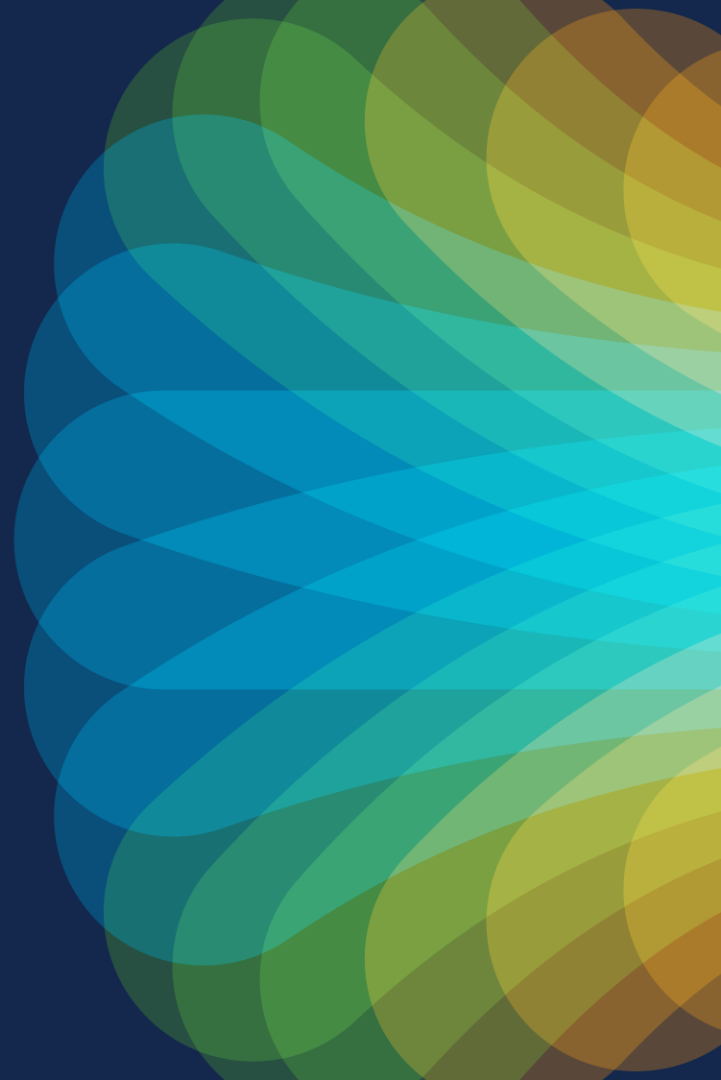


<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKENT-2264>

Agenda

- Multicast Fundamentals
- ASM and SSM overview
- Multicast Troubleshooting Methodology

Multicast Fundamentals



Frequently Used Terms

ASM Any Source Multicast

FHR First Hop Router

SSM Source Specific Multicast

LHR Last Hop Router

MDT Multicast Distribution Tree

RP Rendezvous Point

DR Designated Router

IGMP Internet Group Management Protocol

PIM Protocol Independent Multicast

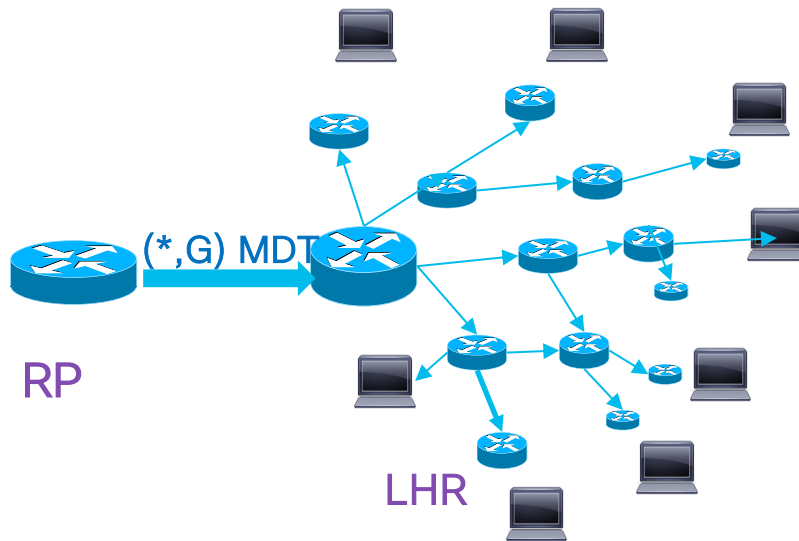
MRIB Multicast Routing Information Base

Frequently Used Terms

- Any Source Multicast (**ASM**)
 - Original (Classic) PIM-SM
 - Supports both Shared and Source Trees
- Source Specific Multicast (**SSM**)
 - a.k.a. Single Source Multicast
 - Supports only Source Trees

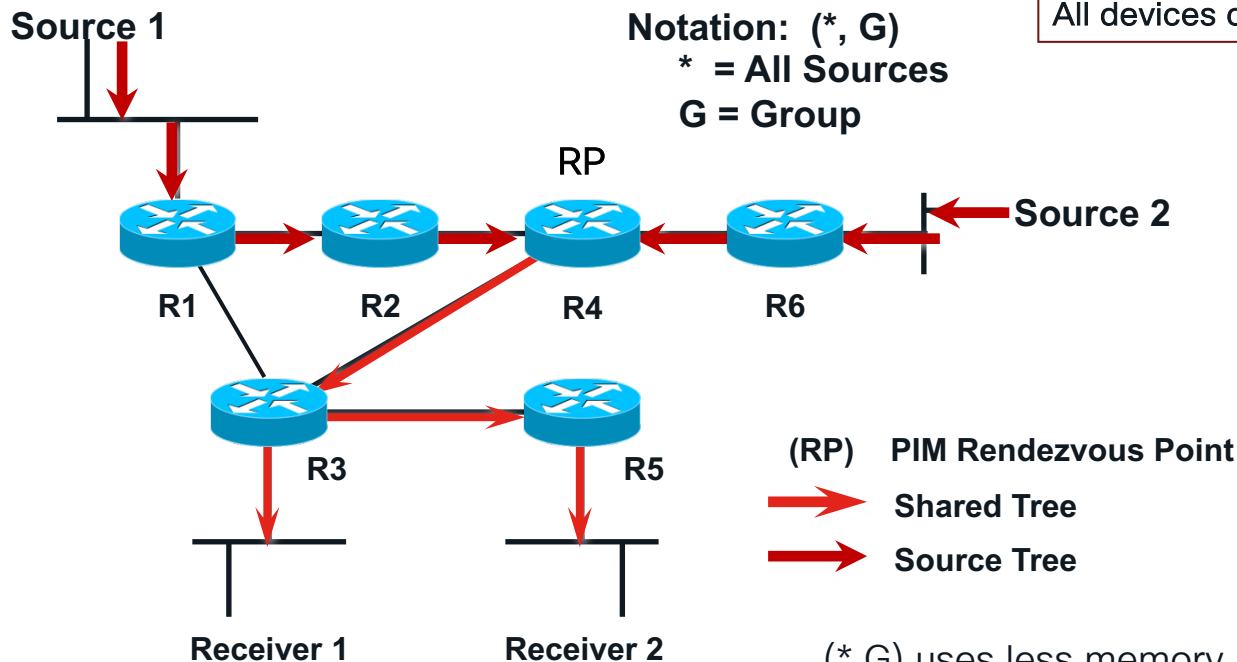
Frequently Used Terms

$(*,G)$ = $*,G$
= Shared Tree
= RP tree (RPT)



Multicast Distribution Trees

- Shared Tree

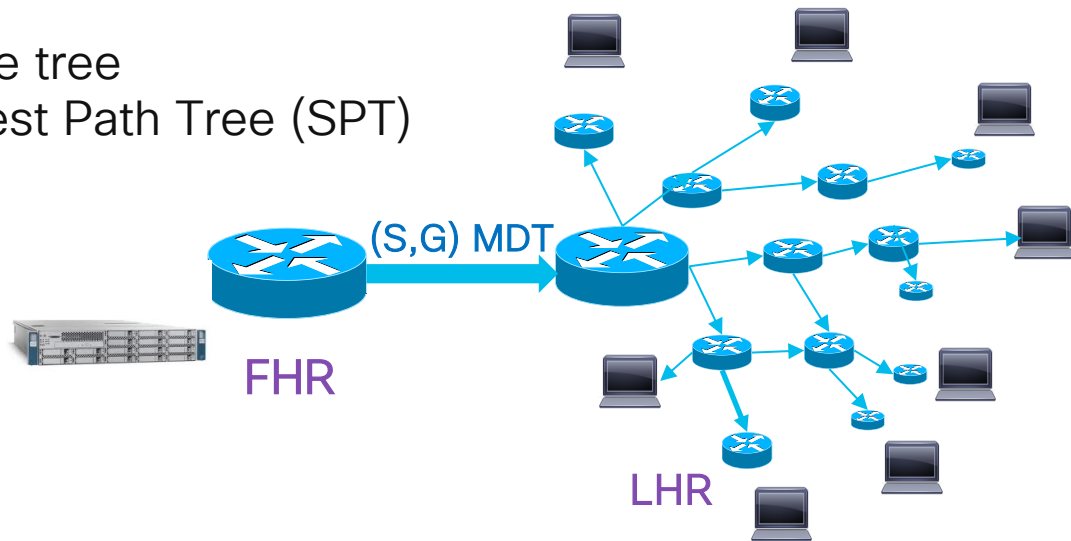


All devices configured to know who the RP is

(*,G) uses less memory but you may get sub-optimal paths from source to all receivers; may introduce extra delay.

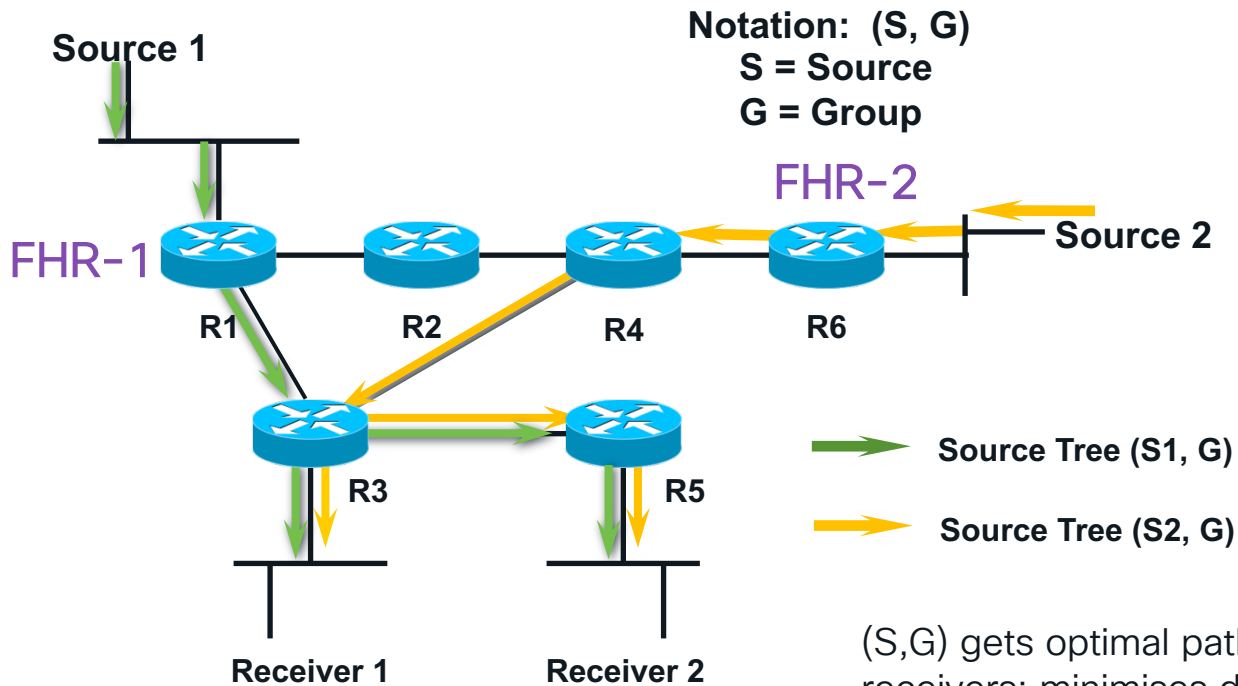
Frequently Used Terms

(S,G) = S,G
= Source tree
= Shortest Path Tree (SPT)



Multicast Distribution Trees

- Shortest Path/Source Tree



Frequently Used Terms

$(*,G)$ = $*,G$
= Shared Tree
= RP tree

(S,G) = S,G
= Source Tree
= Shortest Path Tree

The Root of the $(,G)$ Tree is =*

RP

The Root of the (S,G) Tree? =

Source

Frequently Used Terms

IIF Incoming Interface

Interface towards the root of the tree

OIL Outgoing Interface List

Interfaces that have received PIM Joins or IGMP membership requests

IIF of the (*,G) Tree point towards

RP

IIF of the (S,G) Tree point towards?

Source

MRIB Entry

R5# *show ip mroute 239.1.1.1*

** ,G* → *(*, 239.1.1.1), 01:33:55/00:02:13, RP 2.2.2.2, flags: SJC*

IIF → *Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.4.5.4*

OIL → *Outgoing interface list:*

GigabitEthernet1/0/5, Forward/Sparse, 01:33:55/00:02:13

RP → *RP 2.2.2.2*

flags → *flags: SJC*

RPF nbr → *RPF nbr 10.4.5.4*

MRIB flags

Commonly seen flags in native multicast

R5#*show ip mroute x.x.x.x*

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

Any-Source Multicast (ASM) Overview

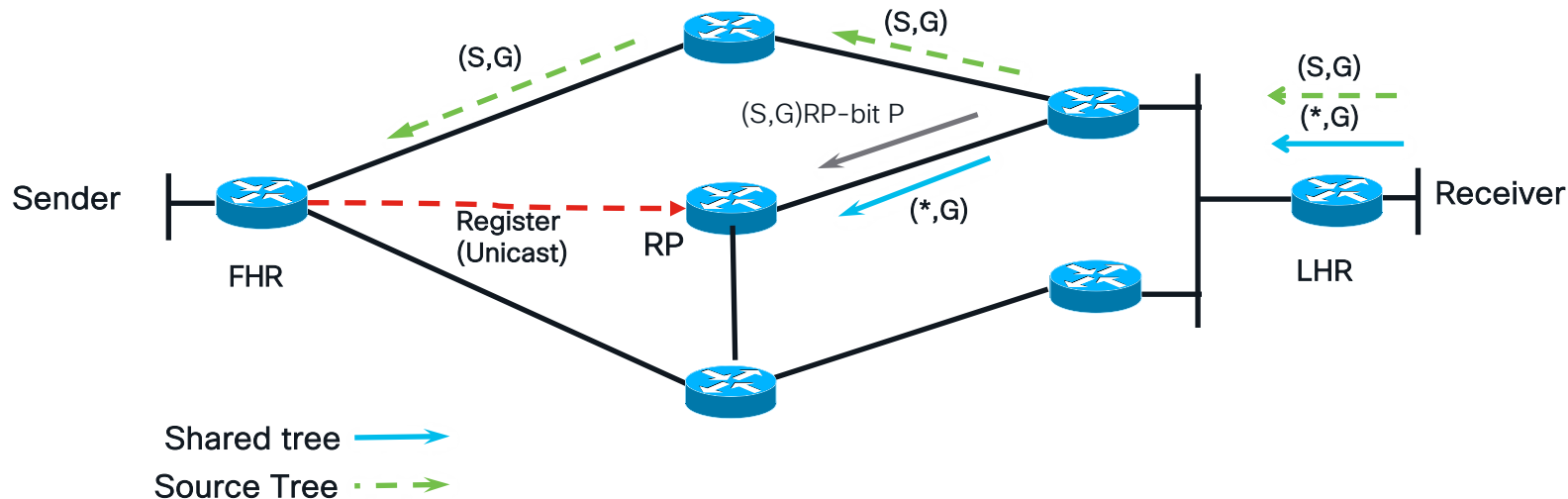
Any-Source Multicast – Control plane

Scenario #1:

1. FHR – Registering
2. Receiver – Joining shared tree
3. LHR – SPT Switchover

Scenario #2:

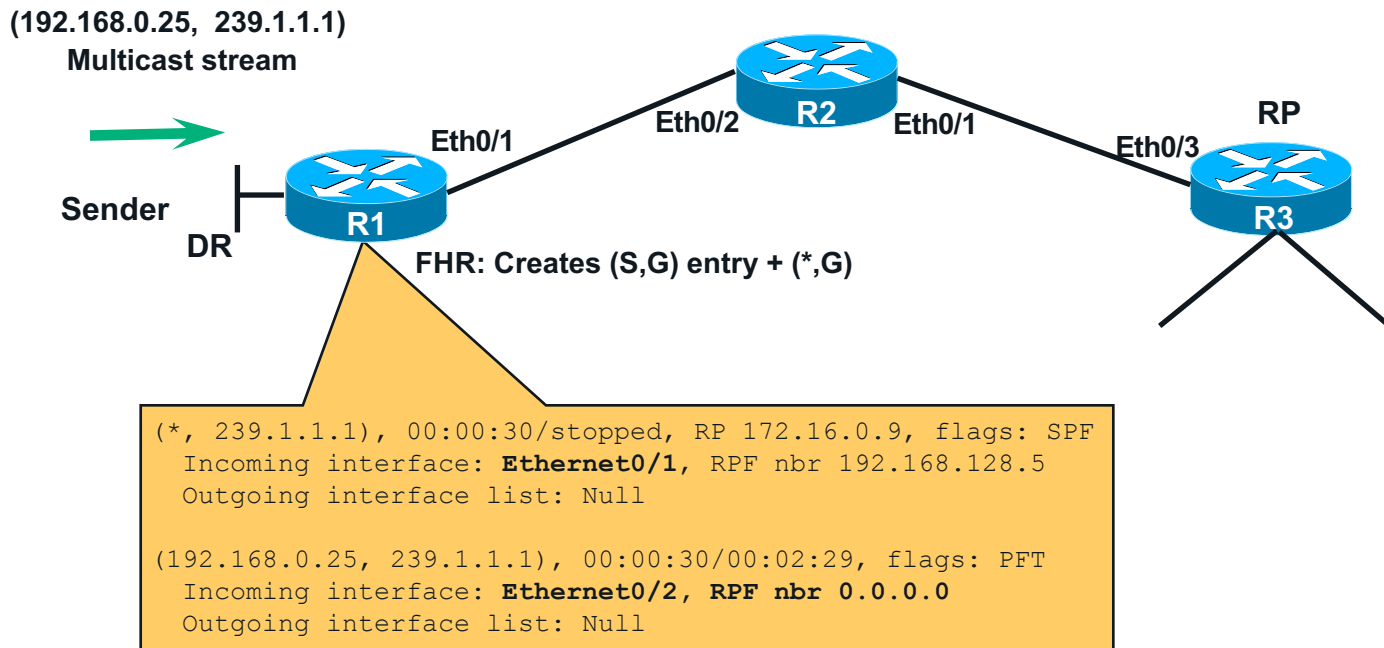
1. Receiver – Joining shared tree
2. FHR – Registering
3. LHR – SPT Switchover



PIM SM Registering

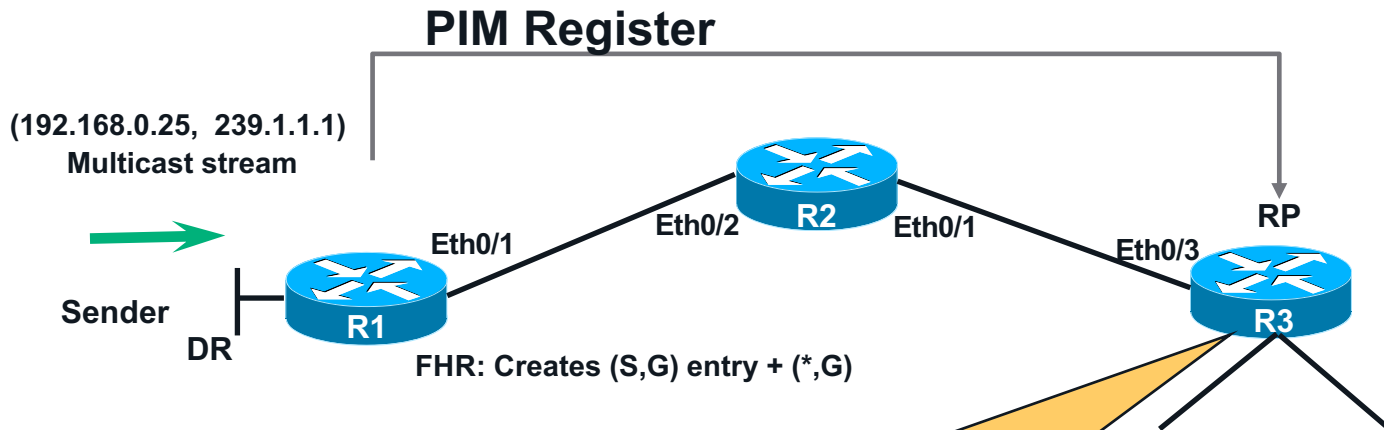
Source Registers First

PIM SM Registering



PIM SM Registering

FHR: Generates a PIM register message to notify RP that we have a new source in our network



```
(* , 239.1.1.1), 00:17:03/stopped, RP 172.16.0.9, flags: SP  
Incoming interface: Null, RPF nbr 0.0.0.0  
Outgoing interface list: Null
```

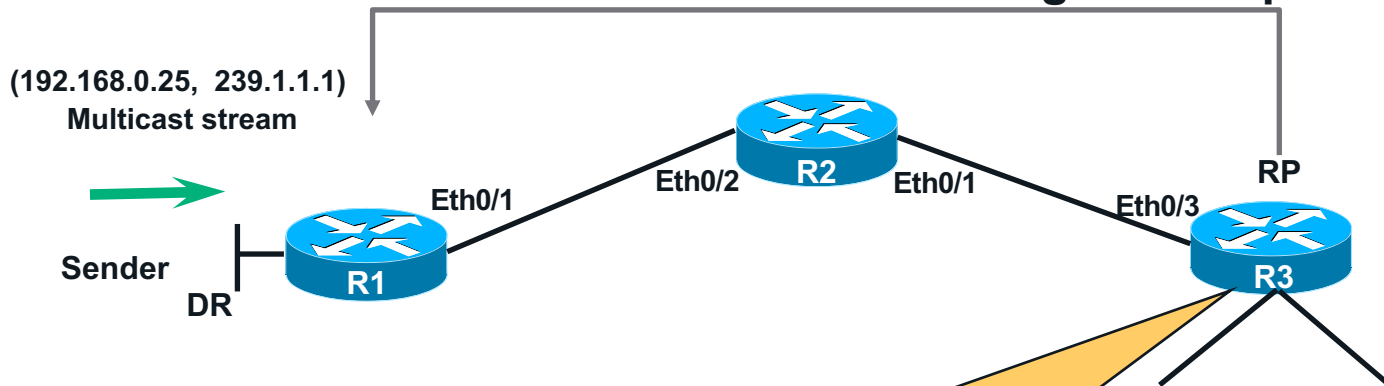
```
(192.168.0.25, 239.1.1.1), 00:17:03/00:01:57, flags: P  
Incoming interface: Ethernet0/3, RPF nbr 192.168.128.5  
Outgoing interface list: Null
```

PIM SM Registering

RP: Generates a PIM register-stop message to notify FHR registration was complete

Null registers are to be sent every 60s

PIM Register Stop



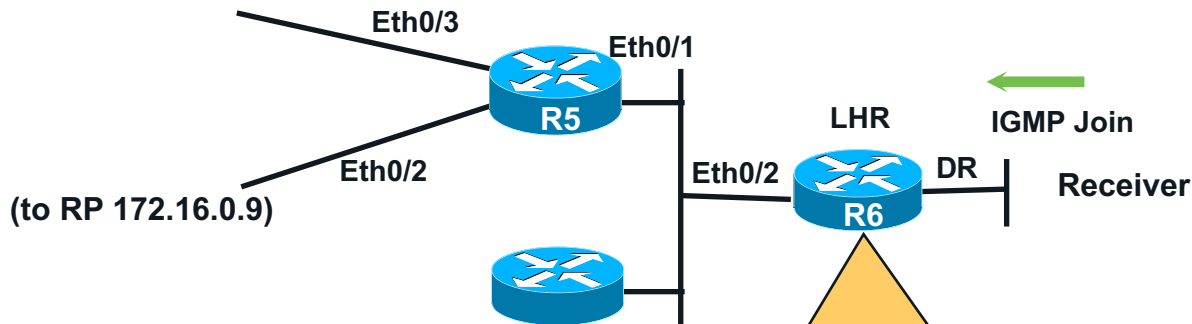
```
(*, 239.1.1.1), 00:17:03/stopped, RP 172.16.0.9, flags: SP  
Incoming interface: Null, RPF nbr 0.0.0.0  
Outgoing interface list: Null
```

```
(192.168.0.25, 239.1.1.1), 00:17:03/00:01:57, flags: P  
Incoming interface: Ethernet0/3, RPF nbr 192.168.128.5  
Outgoing interface list: Null
```

PIM SM Joining Shared Tree

PIM SM Joining Shared Tree

Receiver wishes to receive group G traffic.
Sends IGMP Join for G

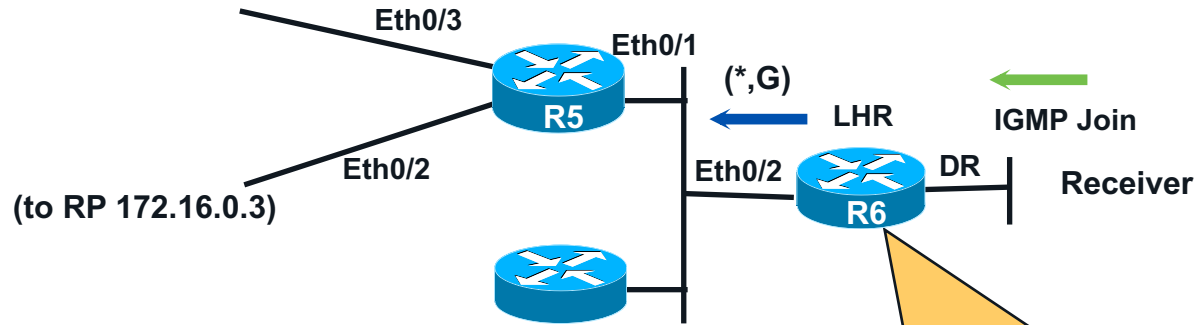


```
R6#show ip igmp groups
```

```
IGMP Connected Group Membership
```

Group Address	Interface	Uptime	Expires	Last Reporter
239.1.1.1	Ethernet0/1	00:00:13	00:02:46	192.168.0.1

PIM SM Joining Shared Tree



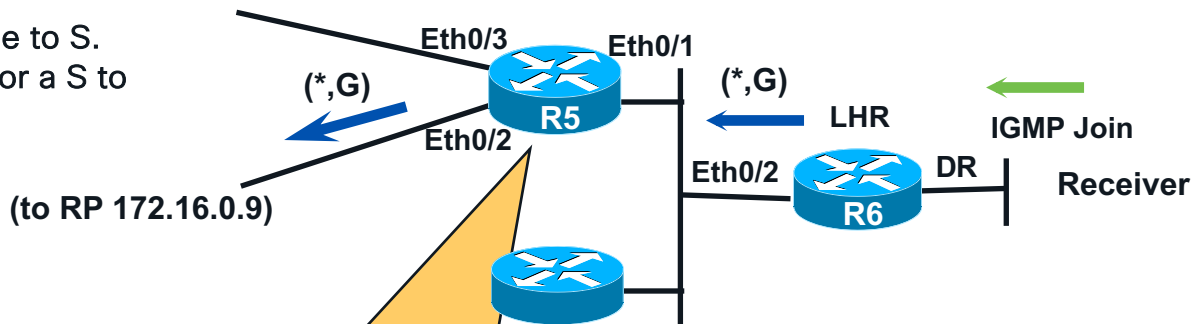
```
(*, 239.1.1.1), 00:20:05/00:02:20, RP 172.16.0.9, flags: SJC  
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.18  
Outgoing interface list:  
Ethernet0/1, Forward/Sparse, 00:05:04/00:02:20
```

R6 has no existing (*, G) state for group “G” and therefore creates an entry

PIM SM Joining Shared Tree

How does the RP join the tree?

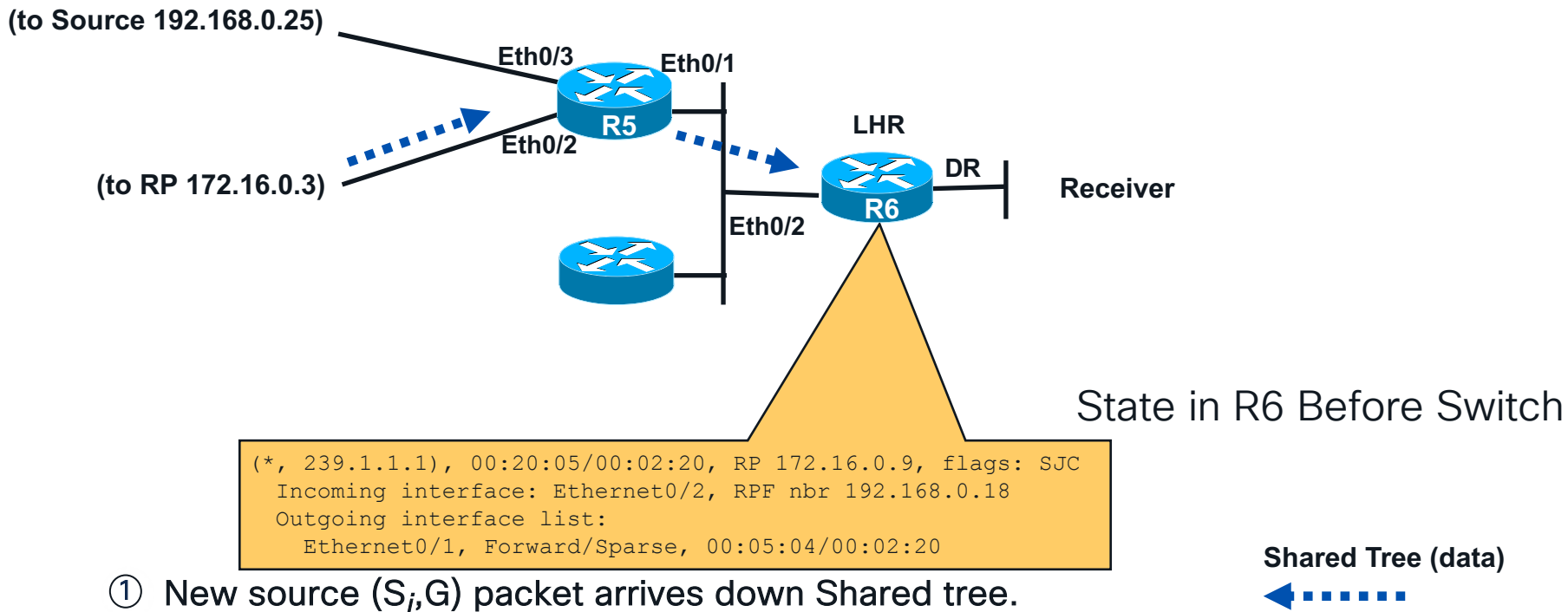
If RP has (S,G) info we join the tree to S.
If RP doesn't have (S,G) we wait for a S to register.



```
(*, 239.1.1.1), 00:06:44/00:02:34, RP 172.16.0.9, flags: S
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.5
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:06:44/00:02:34
```

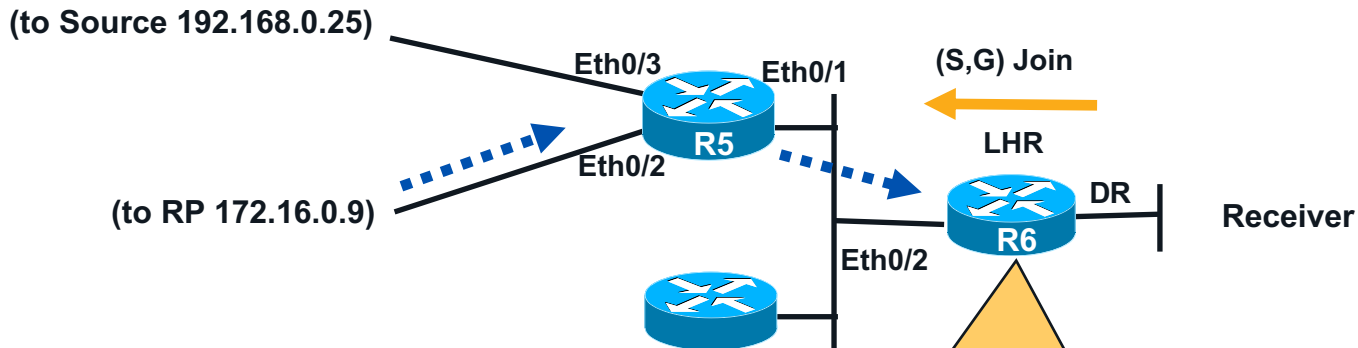
PIM SM – SPT Switchover

PIM SM – SPT Switchover



PIM SM – SPT Switchover

Because of “J” bit, R6 creates (S,G) state to cut over to SPT.



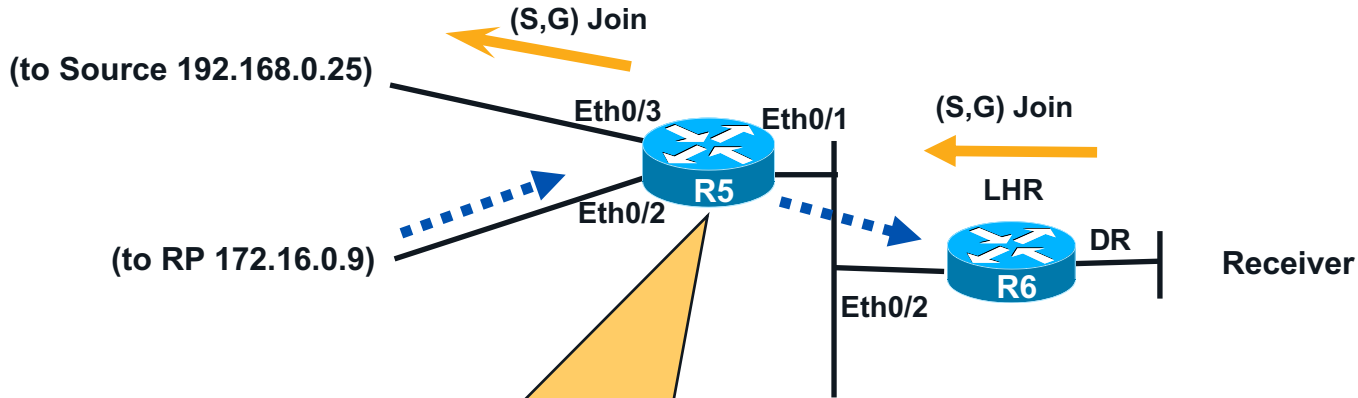
```
(*, 239.1.1.1), 00:45:56/stopped, RP 172.16.0.9, flags: SJC
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.18
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:30:54/00:02:24

(192.168.0.25, 239.1.1.1), 00:00:05/00:02:54, flags: CJ
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.18
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:00:05/00:02:54
```

Shared Tree



PIM SM – SPT Switchover



```
(*, 239.1.1.1), 00:52:41/00:02:52, RP 172.16.0.9, flags: S
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.5
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:52:41/00:02:52

(192.168.0.25, 239.1.1.1), 00:03:05/00:03:24, flags:
Incoming interface: Ethernet0/3, RPF nbr 192.168.0.9
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:03:05/00:03:22
```

Shared Tree



PIM SM – SPT Switchover

Shared Tree

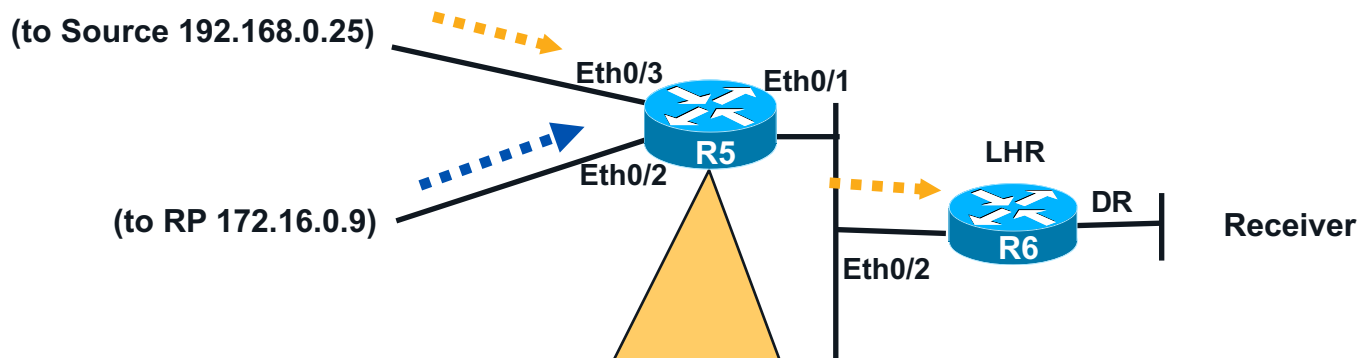


Source Tree



Reminder:

LHR need to know where the Source to SPT



```
(*, 239.1.1.1), 00:52:41/00:02:52, RP 172.16.0.9, flags: S
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.5
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:52:41/00:02:52

(192.168.0.25, 239.1.1.1), 00:03:05/00:03:24, flags: T
Incoming interface: Ethernet0/3, RPF nbr 192.168.0.9
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:03:05/00:03:22
```

“T”Flag Set by
Arriving Traffic on
SPT

PIM SM Pruning

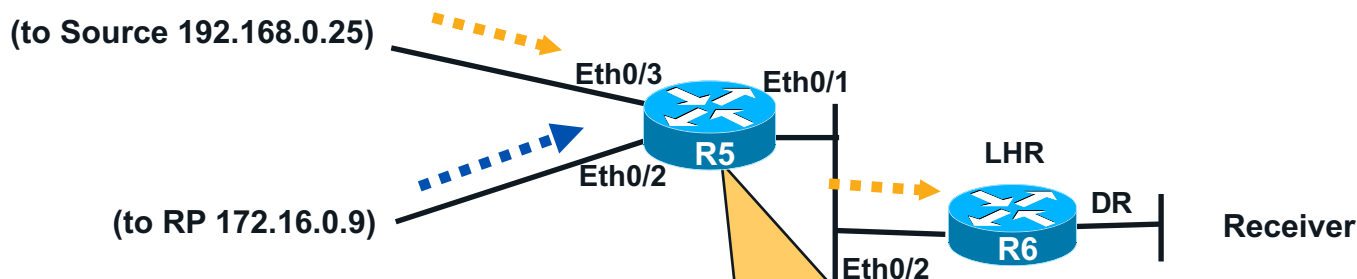
PIM SM – Pruning

Once T Flag is set, R5 triggers (S,G) RP-bit Prunes toward RP.

Shared Tree



Source Tree



```
(* , 239.1.1.1), 00:52:41/00:02:52, RP 172.16.0.9, flags: S
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.5
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:52:41/00:02:52

(192.168.0.25, 239.1.1.1), 00:03:05/00:03:24, flags: T
Incoming interface: Ethernet0/3, RPF nbr 192.168.0.9
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:03:05/00:03:22
```

Note RPF Info
Does Not Match.
This Indicates
SPT and RPT
Diverge.

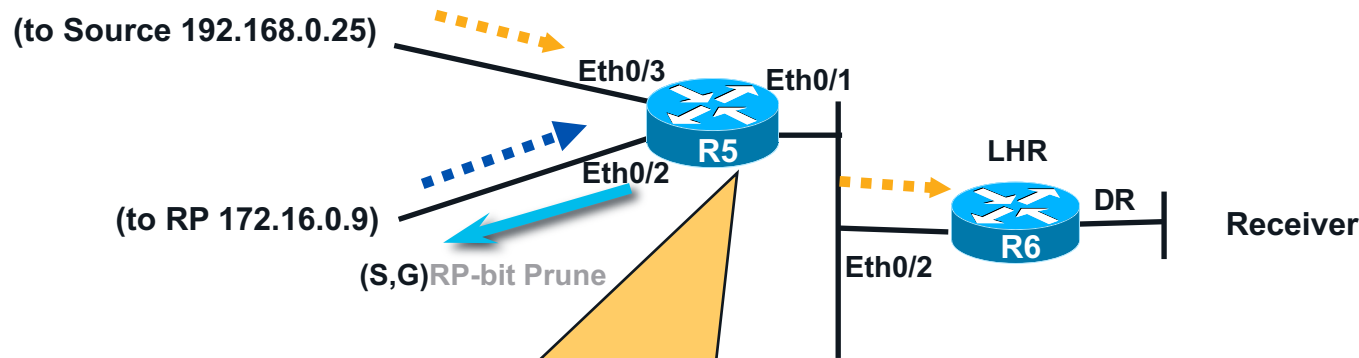
PIM SM – Pruning

(S,G)RP-bit Prune will originate at the point where the shared tree and the SPT diverge

Shared Tree



Source Tree



```
(* , 239.1.1.1), 00:52:41/00:02:52, RP 172.16.0.9, flags: S
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.5
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:52:41/00:02:52

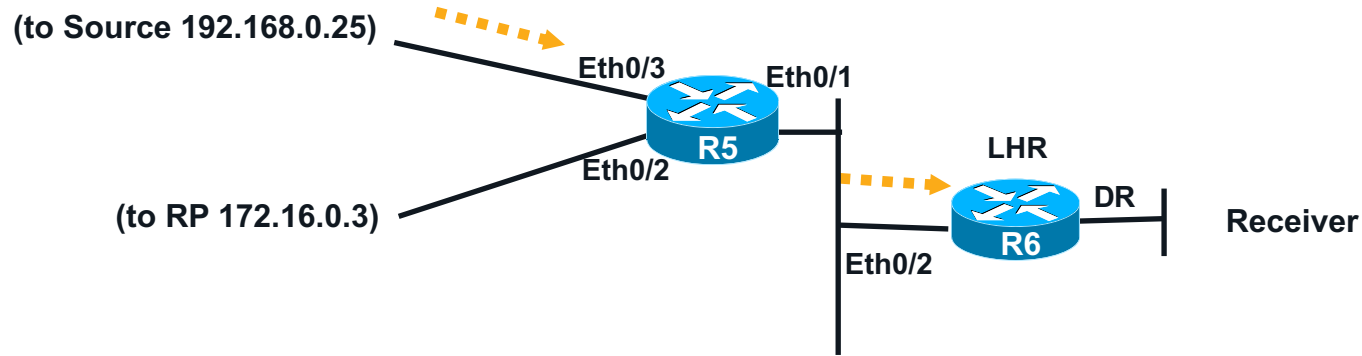
(192.168.0.25, 239.1.1.1), 00:03:05/00:03:24, flags: T
Incoming interface: Ethernet0/3, RPF nbr 192.168.0.9
Outgoing interface list:
  Ethernet0/1, Forward/Sparse, 00:03:05/00:03:22
```

PIM SM – Pruning

Shared Tree



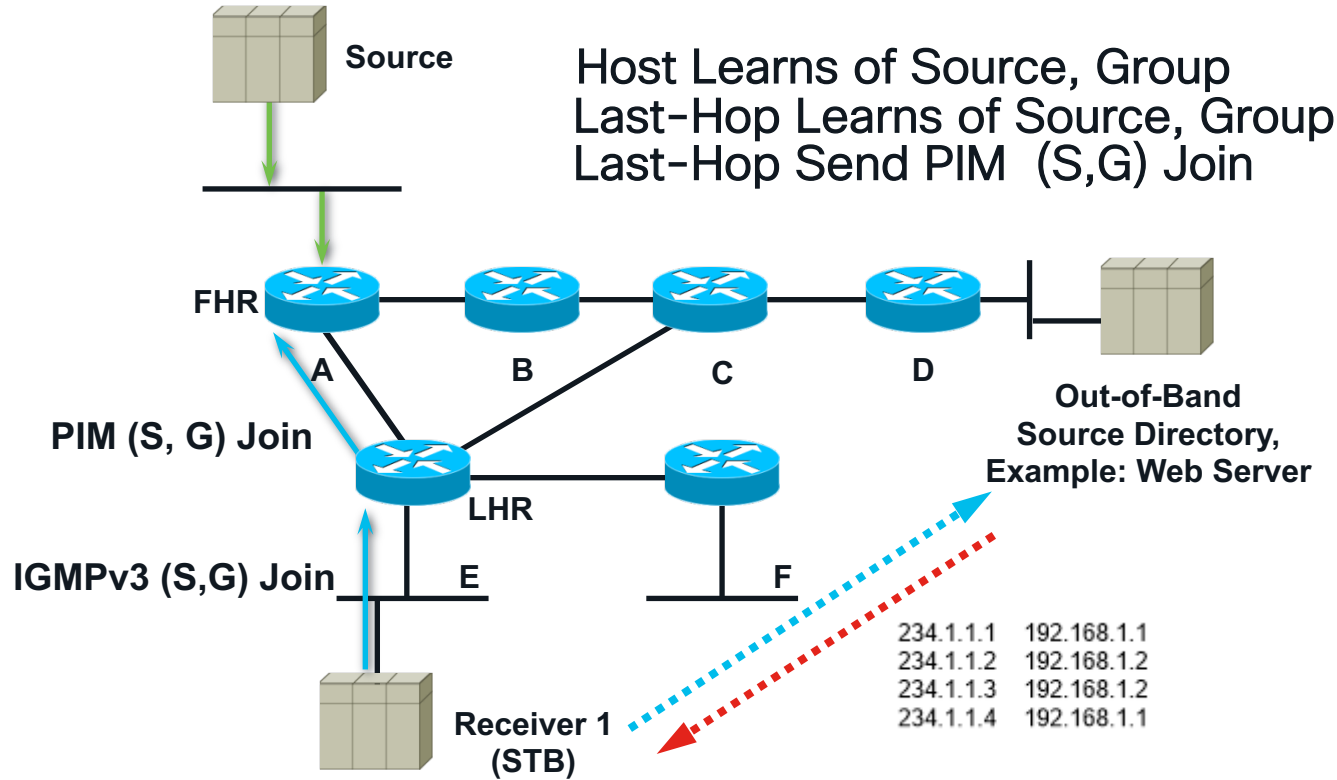
Source Tree



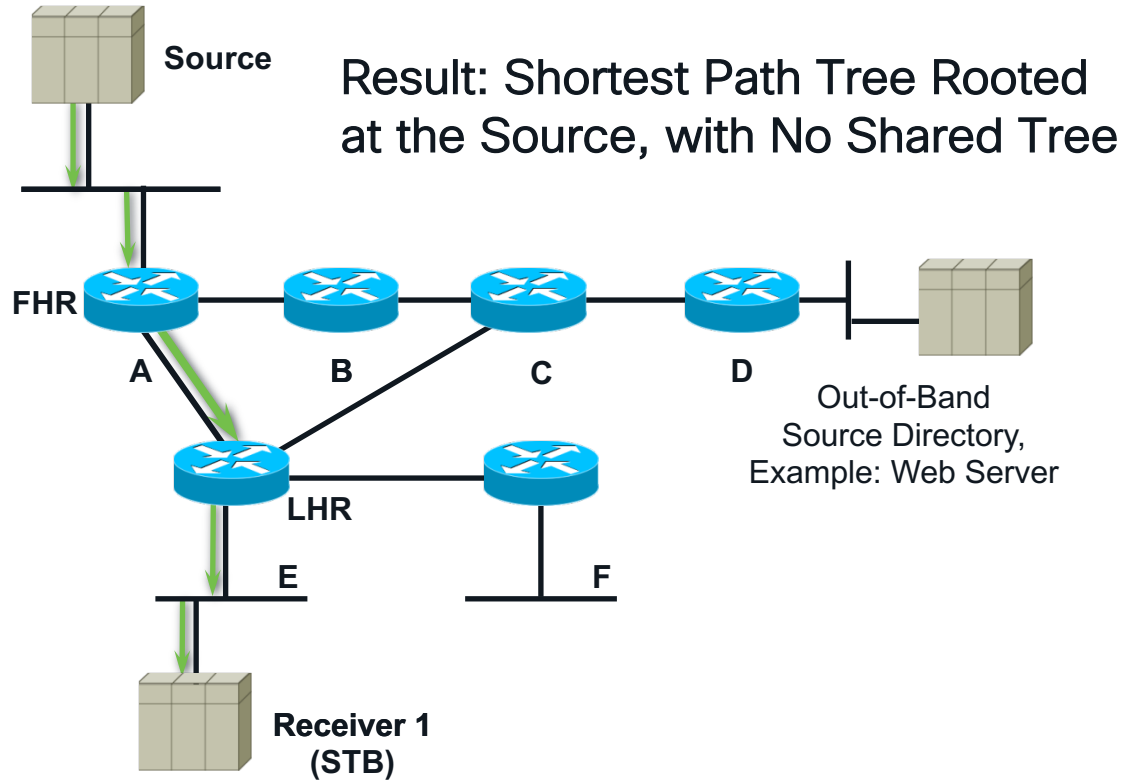
SSM Overview

- Hosts join a specific source within a group
 - (S,G) instead of (*,G)
 - Hosts responsible for learning (S,G) information
- Last-hop router sends (S,G) join toward source
 - No Shared Tree
 - No RPs
 - No SPT switchover complexity

SSM Example



SSM Example



SSM Consideration

- Dependent on IGMPv3
 - Microsoft supports IGMPv3 in Windows natively (since XP)
 - Apple MacOS supports IGMPv3
 - Many IPTV STB's have or are adding support.

Workaround / Transition mechanism

In case you still have IGMPv2 devices but want to implement SSM.

- Static Source Mapping
- Router maps IGMPv2 Joins in SSM range to well-known sources via **DNS**

RP Choices

How Does the Network Learn RP Address?

- **Option 1:** Static RP configuration

Configure **ALL** routers in the network with the IP address of the RP

```
ip pim rp-address 192.168.0.1
```

- **Option 2:** Dynamic RP configuration

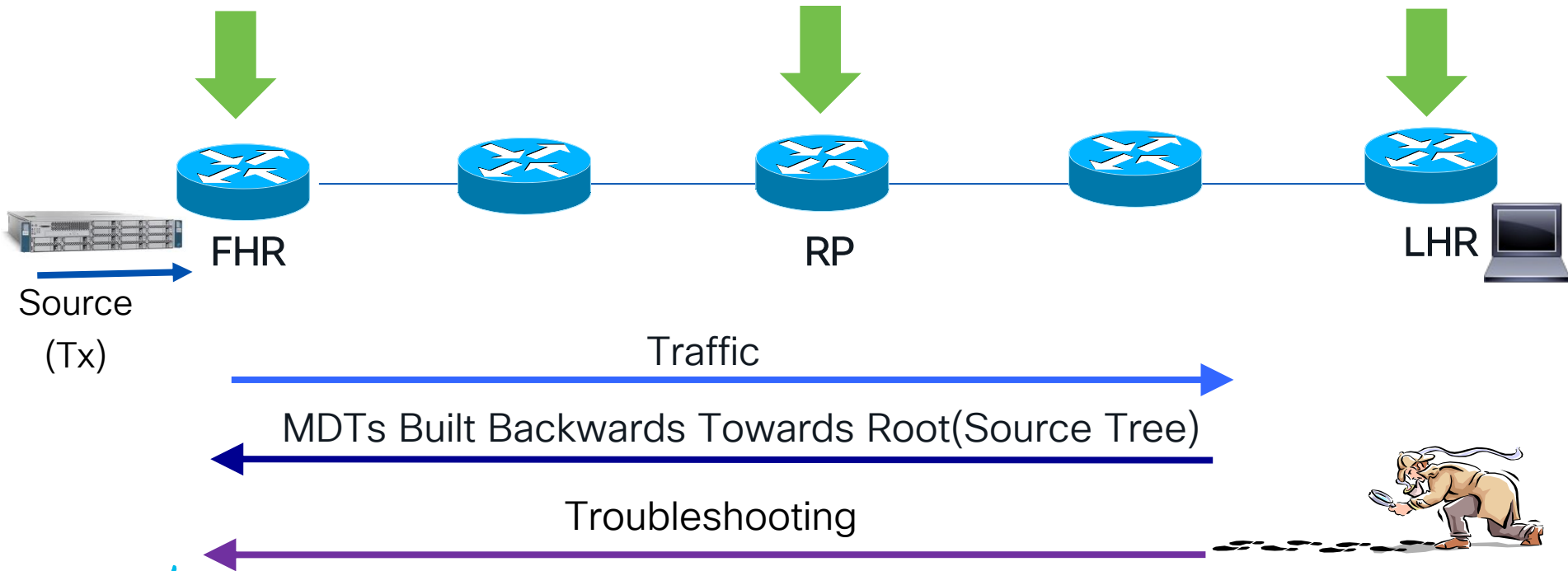
Configure the RP to tell all other routers that it is the RP

- Cisco proprietary mechanism is called “Auto-RP”
- IETF standard is known as Bootstrap Router (BSR) – RFC 5059

Multicast Troubleshooting Methodology

Troubleshooting Starting Point

Start on these 3 devices: LHR, RP, FHR



Who is the root?

```
show ip pim rp mapping 239.1.1.1
PIM Group-to-RP Mappings

Group(s): 224.0.0.0/4, Static
RP: 172.16.0.9 (?)
R1#
```

What neighbour?

```
show ip pim neighbour
PIM Neighbour Table
Mode: B - Bidir Capable, DR - Designated Router, N - Default DR Priority,
      P - Proxy Capable, S - State Refresh Capable, G - GenID Capable,
      L - DR Load-balancing Capable
Neighbour      Interface      Uptime/Expires      Ver      DR
Address                                     Prio/Mode
192.168.0.19    Ethernet0/2      00:08:03/00:01:34  v2       100/ DR S P G
```

Where is the root?

```
show ip rpf 172.16.0.9
RPF information for ? (172.16.0.9)
RPF interface: Ethernet0/2
RPF neighbour: ? (192.168.0.19)
RPF route/mask: 172.16.0.9/32
RPF type: unicast (ospf 1)
Doing distance-preferred lookups across tables
RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```



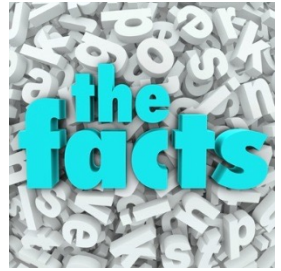
If your ever lost, use the
above three magic question.
Thanks Fish Fishburne

Enable Multicast on routers
ip multicast-routing

Enable PIM on interfaces
ip pim sparse-mode

Troubleshooting Toolbox

Facts to Remember



- Multicast Routing must be enabled globally
- PIM must be enabled on the interfaces for PIM neighbors to form
- Multicast Trees get built backwards towards the root
- Multicast traffic in ASM and SSM are triggered via PIM Join
- High on the “food chain” dependent on routing working and PIM working

Troubleshooting Toolbox

Questions to Remember

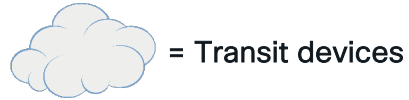


- ☐ Which router I'm in?
- ☐ Who is the root?
- ☐ Where is the root?
- ☐ What is the PIM RPF neighbor towards the root?

Usual Suspects scenario #1

Troubleshooting scenario #1

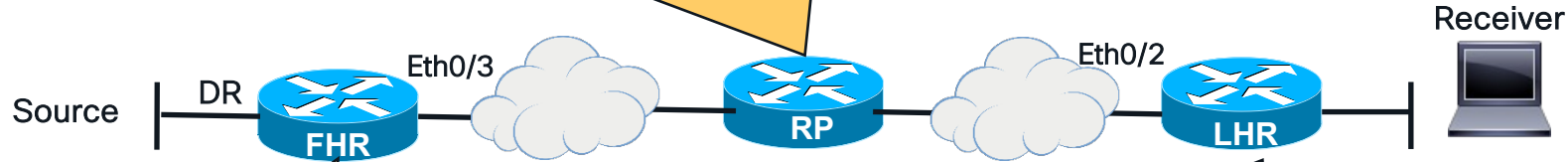
Problem Description: Receiver is having issues, multicast is not working



```
(*, 239.1.1.1), 00:29:58/00:03:05, RP 172.16.0.9, flags: S
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:
  Ethernet0/2, Forward/Sparse, 00:29:58/00:03:05

(192.168.0.25, 239.1.1.1), 00:01:54/00:01:09, flags: PT
Incoming interface: Ethernet0/3, RPF nbr 192.168.128.5
Outgoing interface list: Null
```

To see multicast routing table
use *show ip mroute <group>*



```
(*, 239.1.1.1), 00:02:41/stopped, RP 172.16.0.9, flags: SPF
Incoming interface: Ethernet0/1, RPF nbr 192.168.128.1
Outgoing interface list: Null

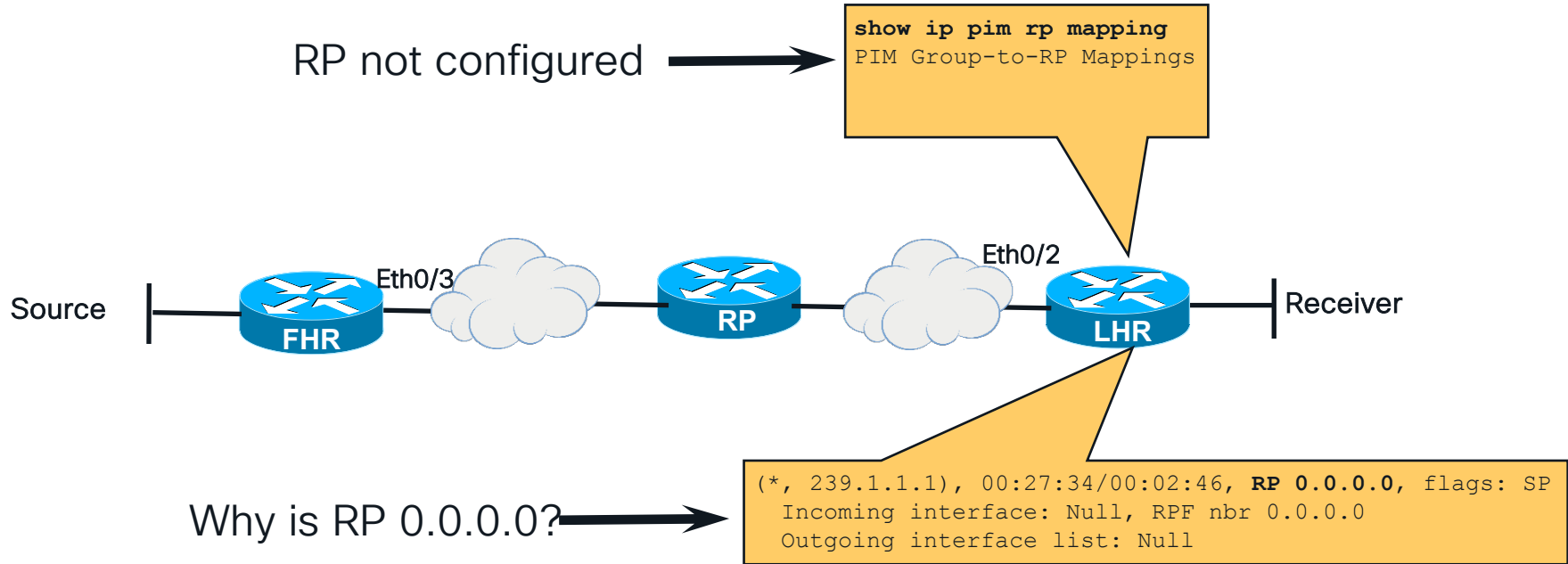
(192.168.0.25, 239.1.1.1), 00:02:41/00:02:52, flags: FT
Incoming interface: Ethernet0/2, RPF nbr 0.0.0.0
Outgoing interface list:
  Ethernet0/3, Forward/Sparse, 00:02:41/00:02:46
```

```
(*, 239.1.1.1), 00:27:34/00:02:46, RP 0.0.0.0, flags: SP
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list: Null
```

Three checkpoints:
LHR, RP, FHR

Troubleshooting scenario #1

Problem Description: LHR is having issues, multicast is not working



Troubleshooting scenario #1

Problem Description: LHR is having issues, multicast is not working

```
show ip igmp groups
```

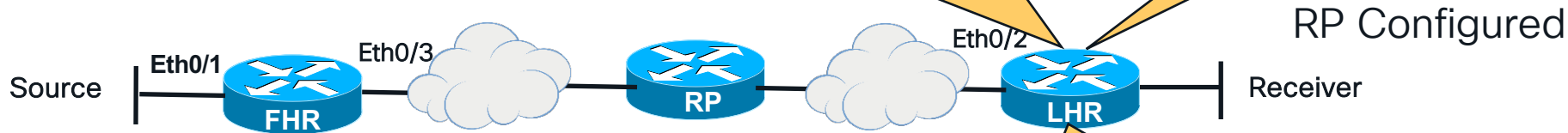
IGMP Connected Group Membership

Group Address	Interface	Uptime	Expires	Last Reporter	Group Accounted
239.1.1.1	Ethernet0/1	00:07:26	00:02:57	192.168.0.17	

```
show ip pim rp mapping
```

PIM Group-to-RP Mappings

Group(s): 224.0.0.0/4, Static
RP: 172.16.0.9 (?)



RP Configured

```
(*, 239.1.1.1), 00:02:55/00:02:35, RP 172.16.0.9, flags: SP  
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.13  
Outgoing interface list: Null
```

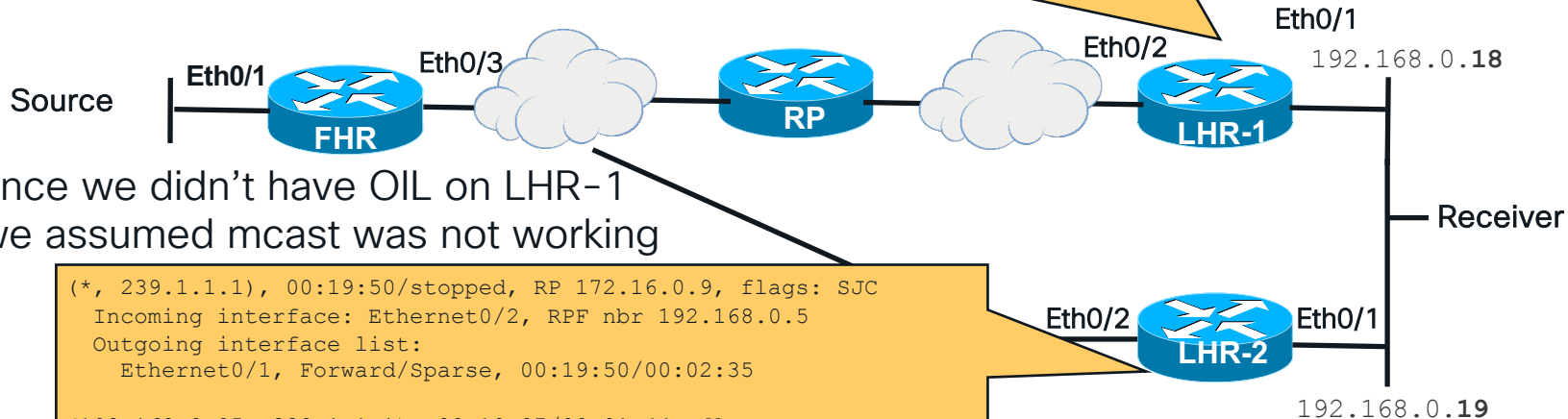
Why do we have Null OIL?

Troubleshooting scenario #1

Problem Description: LHR is having issues, multicast is not working

```
show ip pim int
```

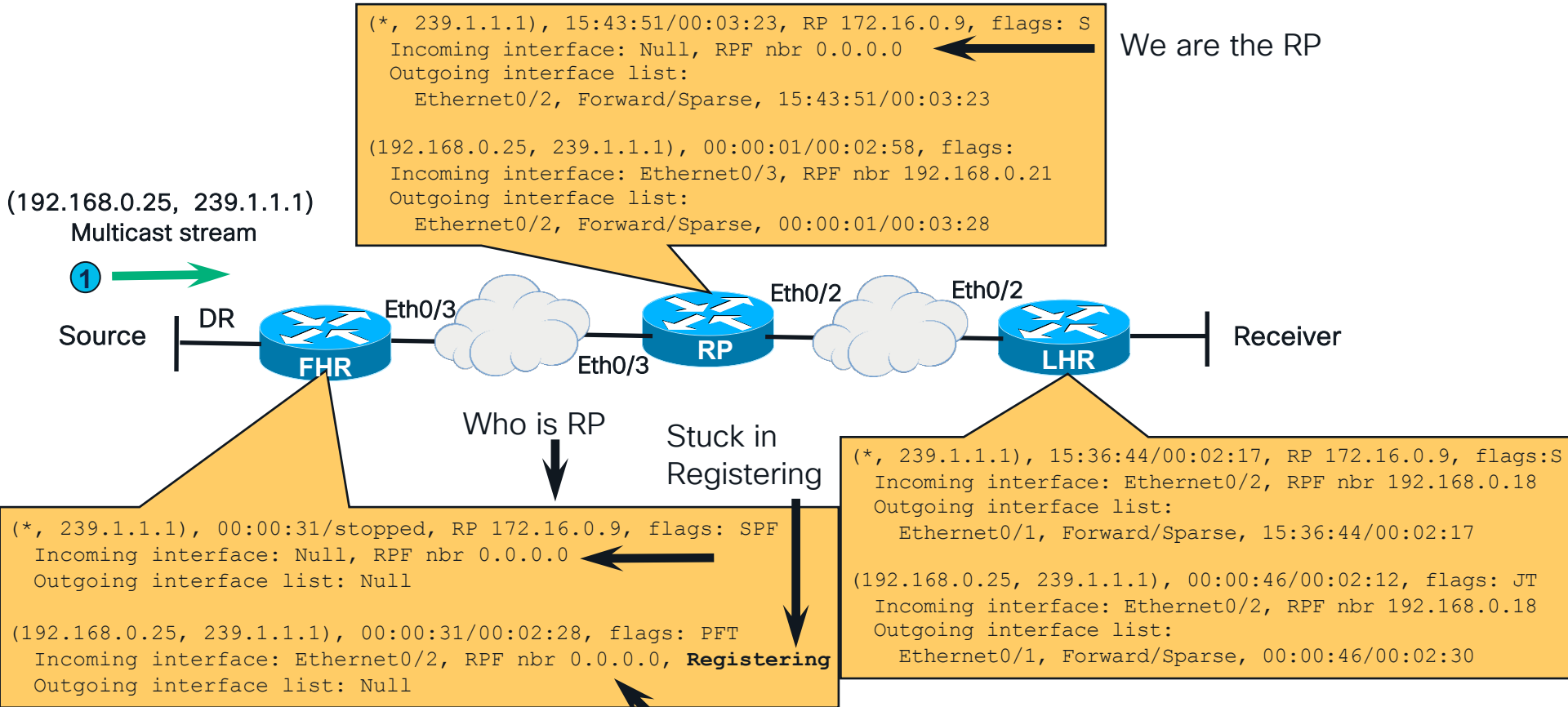
Address	Interface	Ver/ Mode	Nbr Count	Query Intvl	DR Prior	DR
192.168.0.18	Ethernet0/1	v2/S	1	30	1	192.168.0.19
192.168.0.14	Ethernet0/2	v2/S	1	30	1	192.168.0.14



Usual Suspects scenario #2

Troubleshooting scenario #2

Problem Description: Poor picture quality on group 239.1.1.1

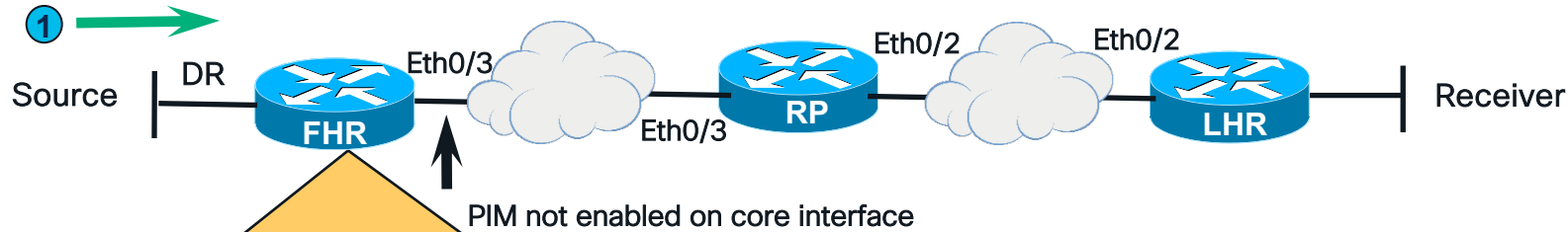


Troubleshooting scenario #2

Problem Description: Poor picture quality on group 239.1.1.1

(192.168.0.25, 239.1.1.1)

Multicast stream



```
show ip pim neighbour
```

PIM Neighbour Table

Mode: B - Bidir Capable, DR - Designated Router, N - Default DR Priority,
P - Proxy Capable, S - State Refresh Capable, G - GenID Capable,
L - DR Load-balancing Capable

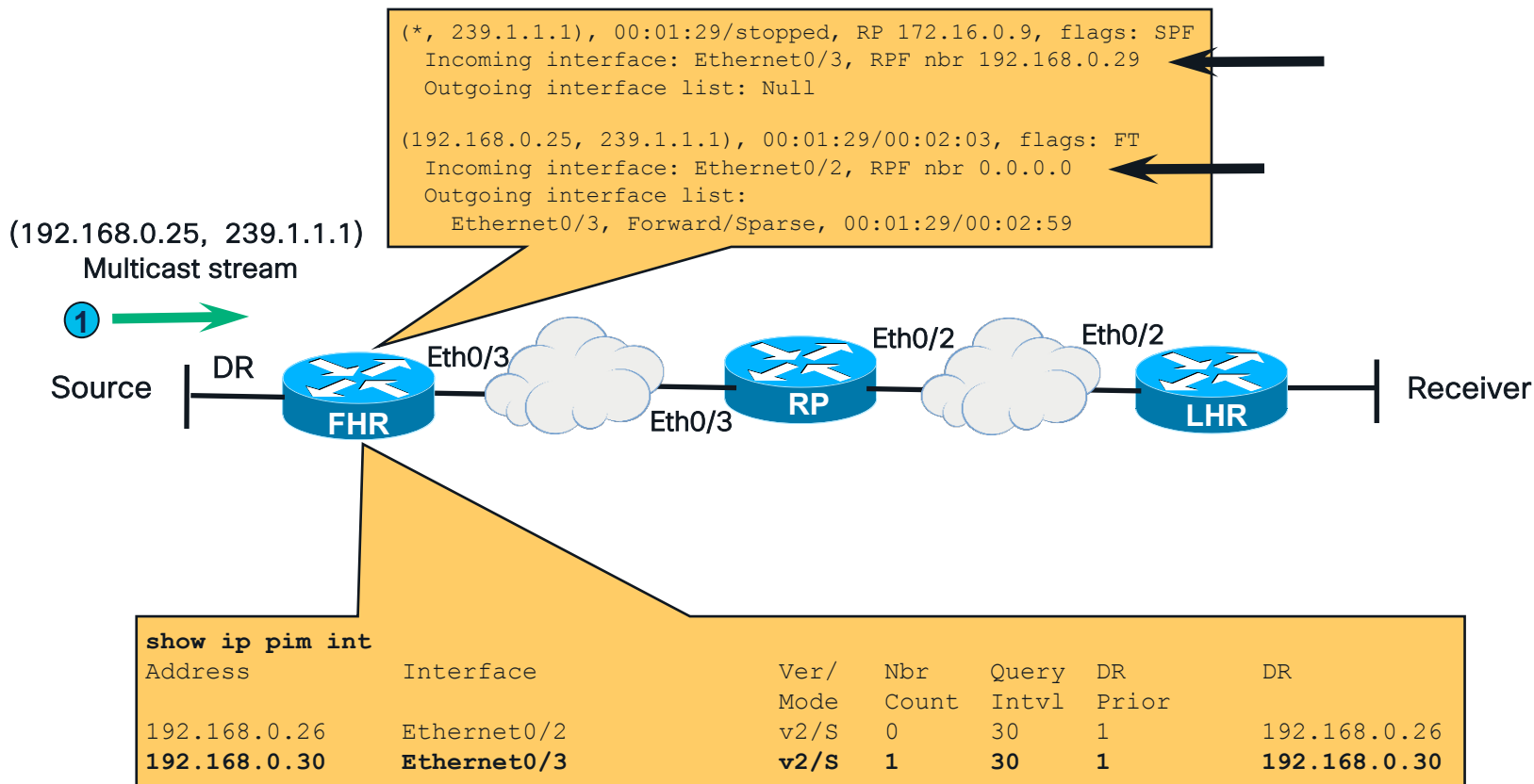
Neighbour Address	Interface	Uptime/Expires	Ver	DR Prio/Mode
-------------------	-----------	----------------	-----	--------------

<EMPTY>

Troubleshooting scenario #2

FIXED

Problem Description: Poor picture quality on group 239.1.1.1

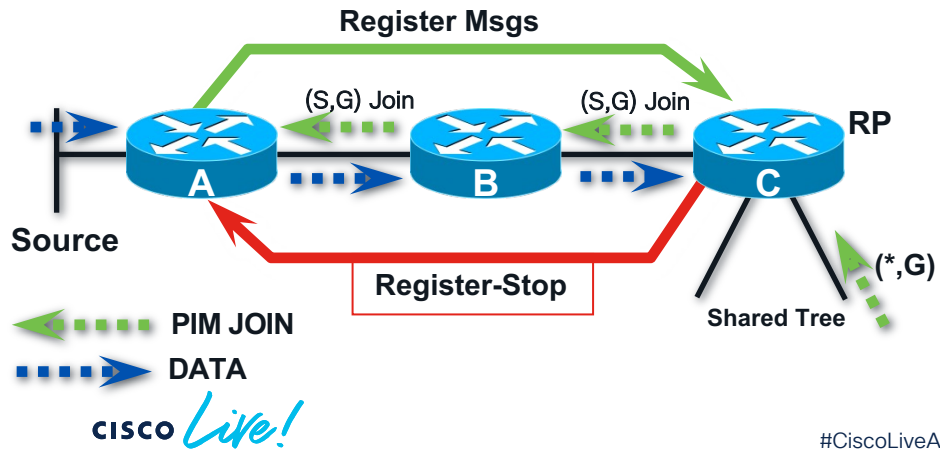


PIM Register-Stop Mechanism

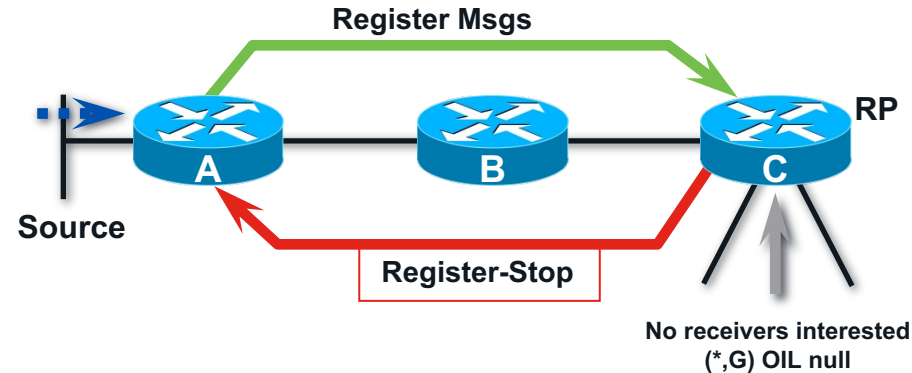
The RP unicasts PIM Register-Stop messages to the first-hop DR, instructing it to stop sending (S, G) Register messages under any of the following conditions:

1. When the RP begins receiving multicast traffic from Source S1 via the (S1, G) SPT between the source and the RP.
2. If the RP has no need for the traffic because there is no active shared tree for the group.

Receiver Joins Group First



No Receivers for G present on RP



PIM SM Registering



Possible reasons for Registering failing:

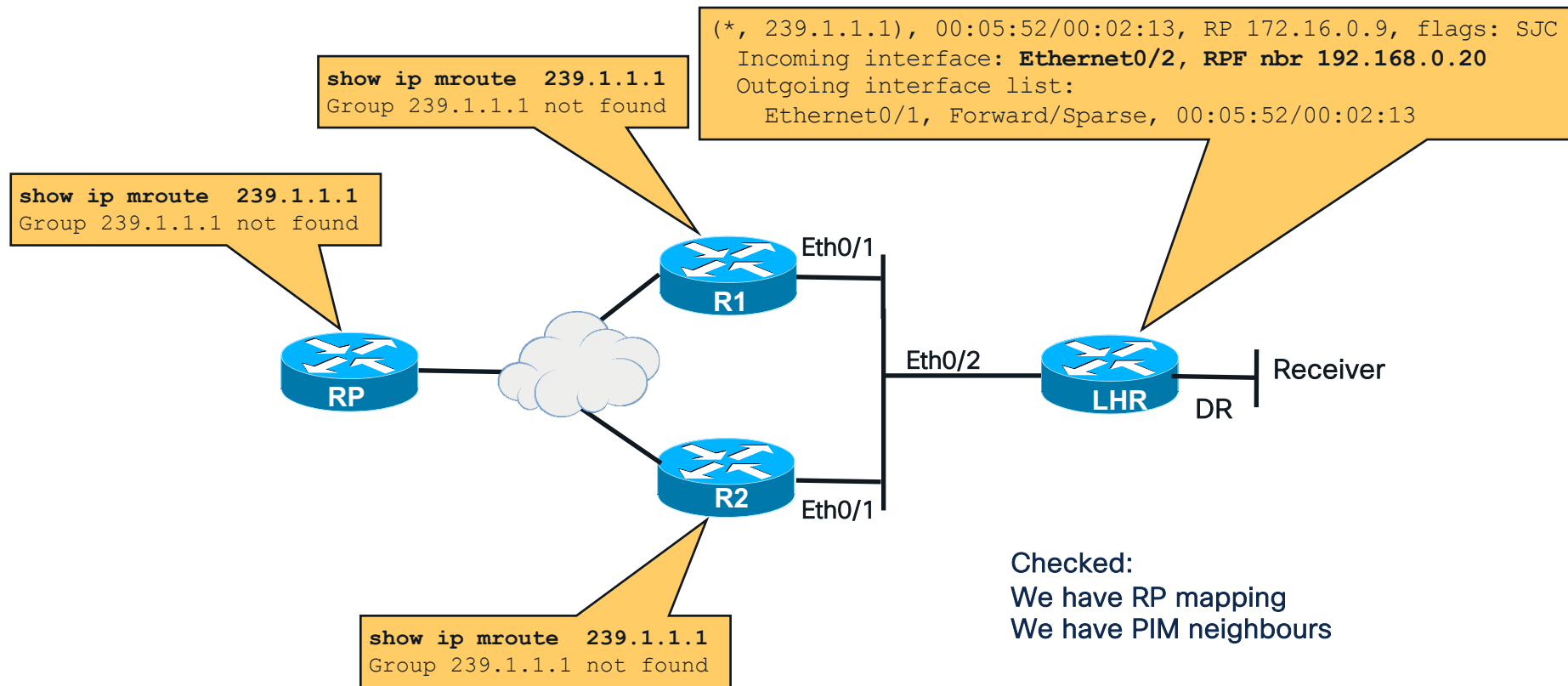
- PIM not enabled on all needed interfaces
- TTL too low
- MTU (and DF bit set)
- RP address configured is incorrect
- ACLs/ Reachability issues.
- RP not knowing the backward route
-

```
show ip traffic | be PIM
PIMv2 statistics: Sent/Received
Total: 22/18, 0 checksum errors, 0 format errors
Registers: 100/0 (0 non-rp, 0 non-sm-group), Register
Stops: 0/0,
```

Usual Suspects scenario #3

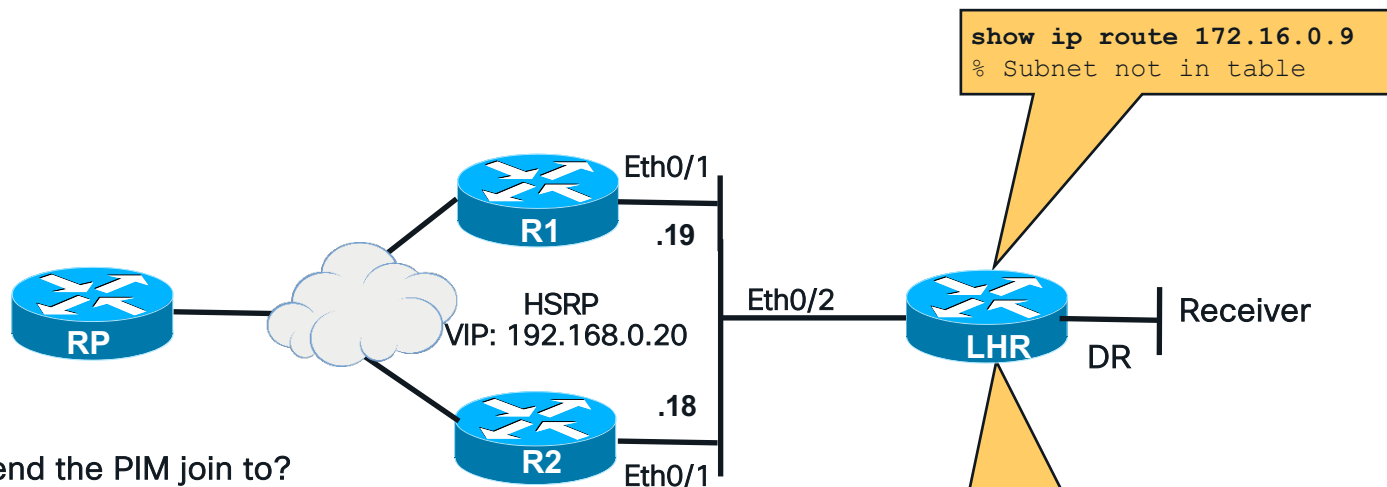
Troubleshooting scenario #3

Problem Description: Multicast tree is not being built from LHR



Troubleshooting scenario #3

Problem Description: Multicast tree is not being built.



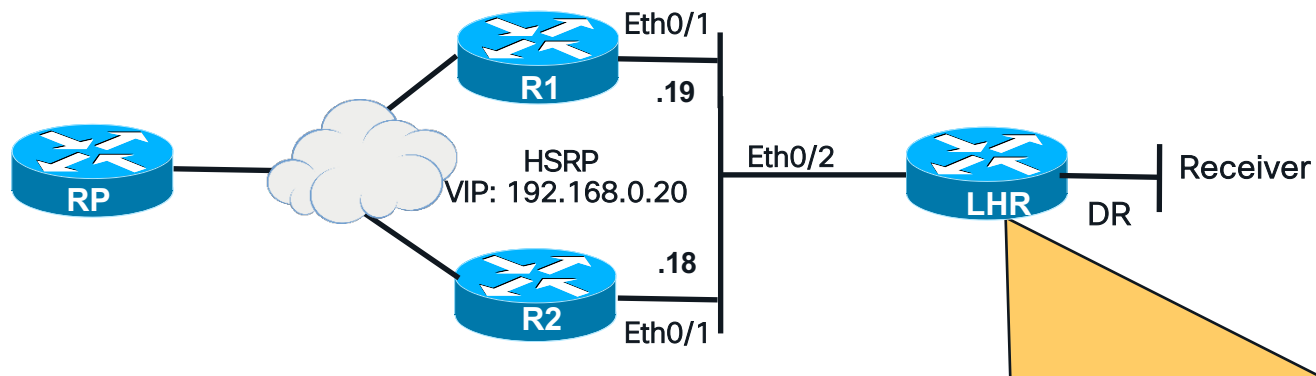
So.. Where do we send the PIM join to?

```
show ip cef 172.16.0.9
0.0.0.0/0
nexthop 192.168.0.20 Ethernet0/2
```

Troubleshooting scenario #3

Problem Description: Multicast tree is not being built.

Solution:
HSRP Aware PIM



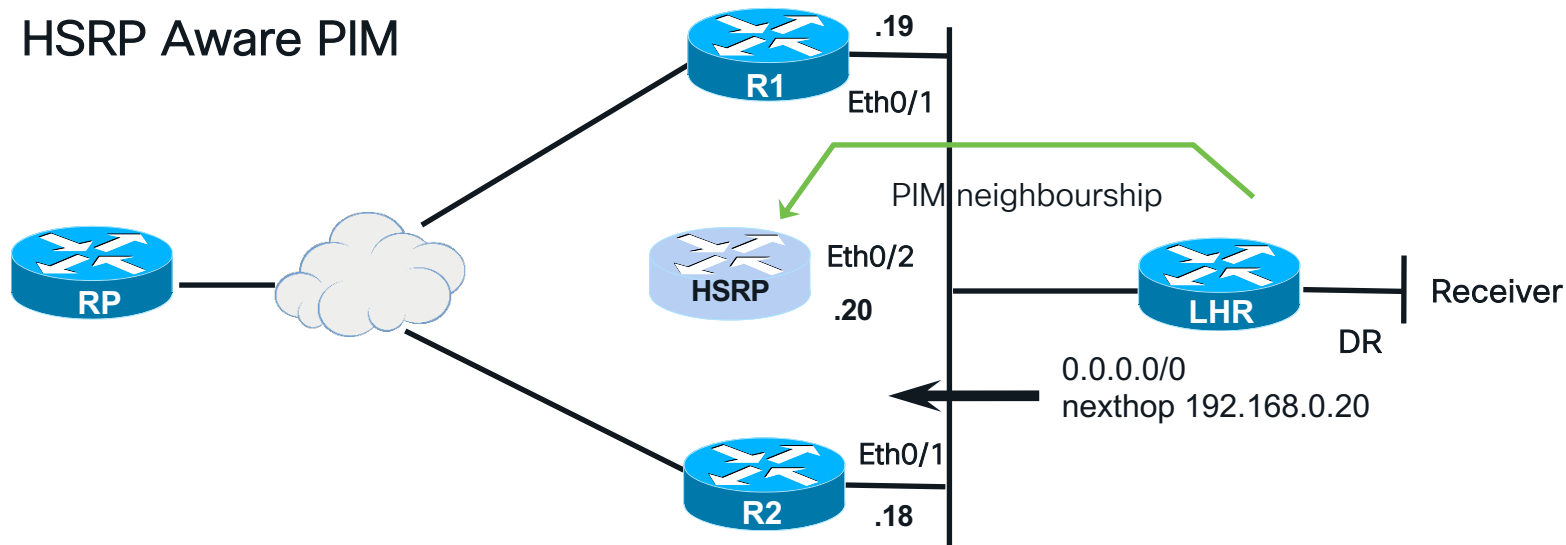
```
show ip pim neighbour
```

Neighbour Address	Interface	Uptime/Expires	Ver	DR Prio/Mode
192.168.0.19	Ethernet0/2	00:52:31/00:01:22	v2	100/ DR S P G
192.168.0.18	Ethernet0/2	00:52:31/00:01:20	v2	100/ S P G

Troubleshooting scenario #3

Problem Description: Multicast tree is not being built.

Solution:
HSRP Aware PIM



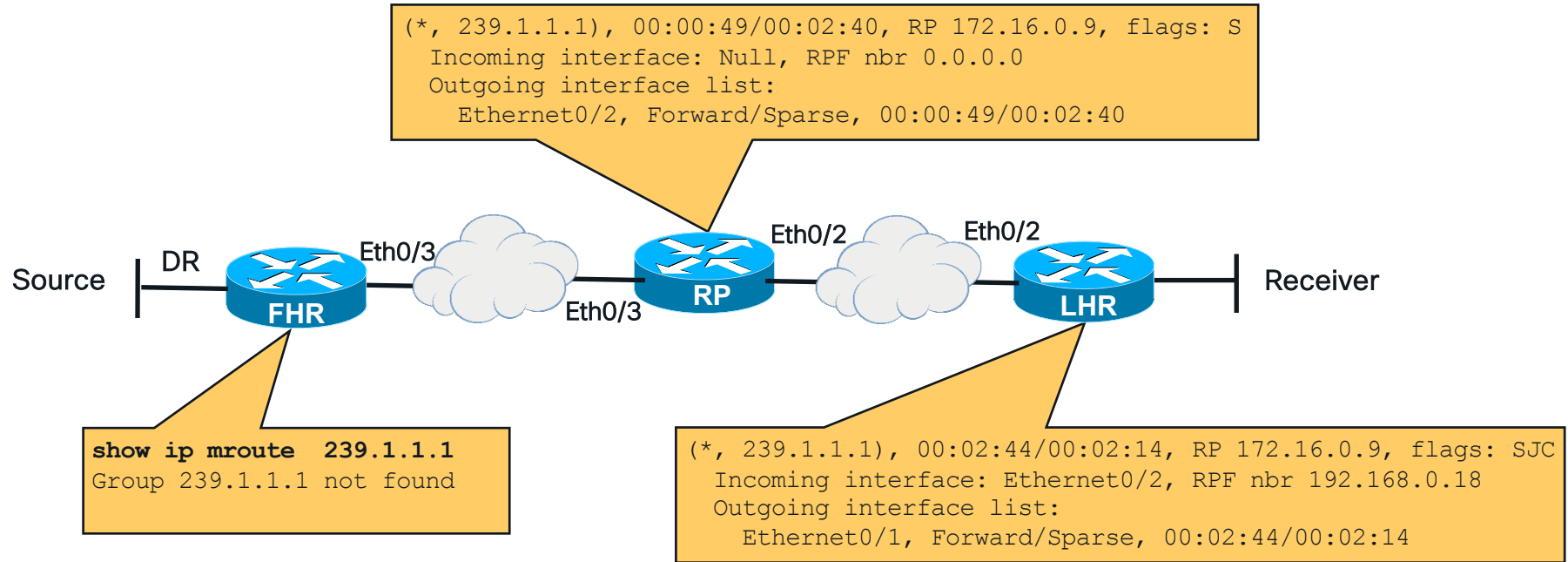
The PIM join/prune can now be sent to the RPF neighbour since we have a PIM neighbourship.

1. When there is a HSRP failover, standby becomes active and takes over to generate the hellos with source IP = VIP
2. In failover new Active generates new **Generation ID** to trigger downstream LHR to send joins for all active groups.

Usual Suspects scenario #4

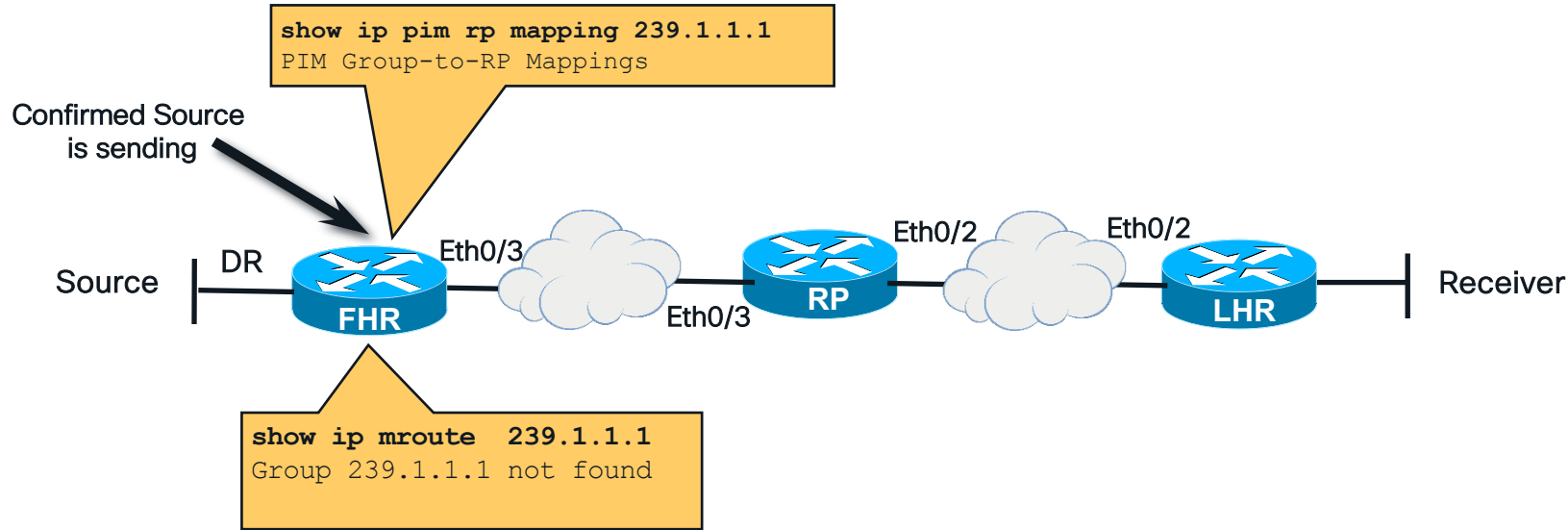
Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic



Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic



Without RP I cannot create (*,G) and also (S,G)
(May vary between release and platform)

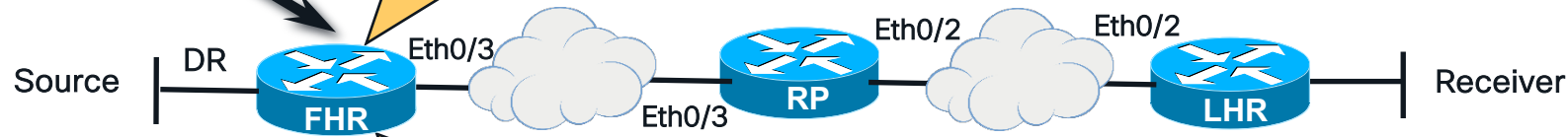
Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic

Configure RP: `ip pim rp-address 172.16.0.9`

```
show ip pim rp mapping 239.1.1.1
PIM Group-to-RP Mappings
Group(s): 224.0.0.0/4, Static
RP: 172.16.0.9 (?)
```

Confirmed Source
is sending

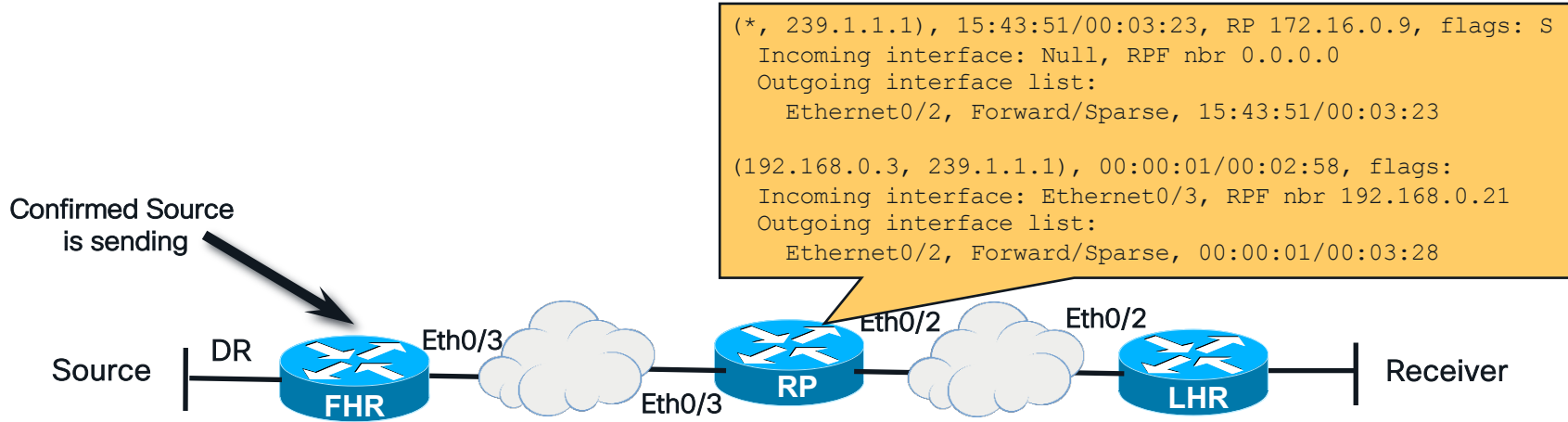


```
(*, 239.1.1.1), 00:02:57/stopped, RP 172.16.0.9, flags: SPF
Incoming interface: Ethernet0/1, RPF nbr 192.168.128.1
Outgoing interface list: Null

(192.168.0.3, 239.1.1.1), 00:02:57/00:02:36, flags: FT
Incoming interface: Ethernet0/2, RPF nbr 0.0.0.0
Outgoing interface list:
Ethernet0/3, Forward/Sparse, 00:02:57/00:02:31
```

Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic



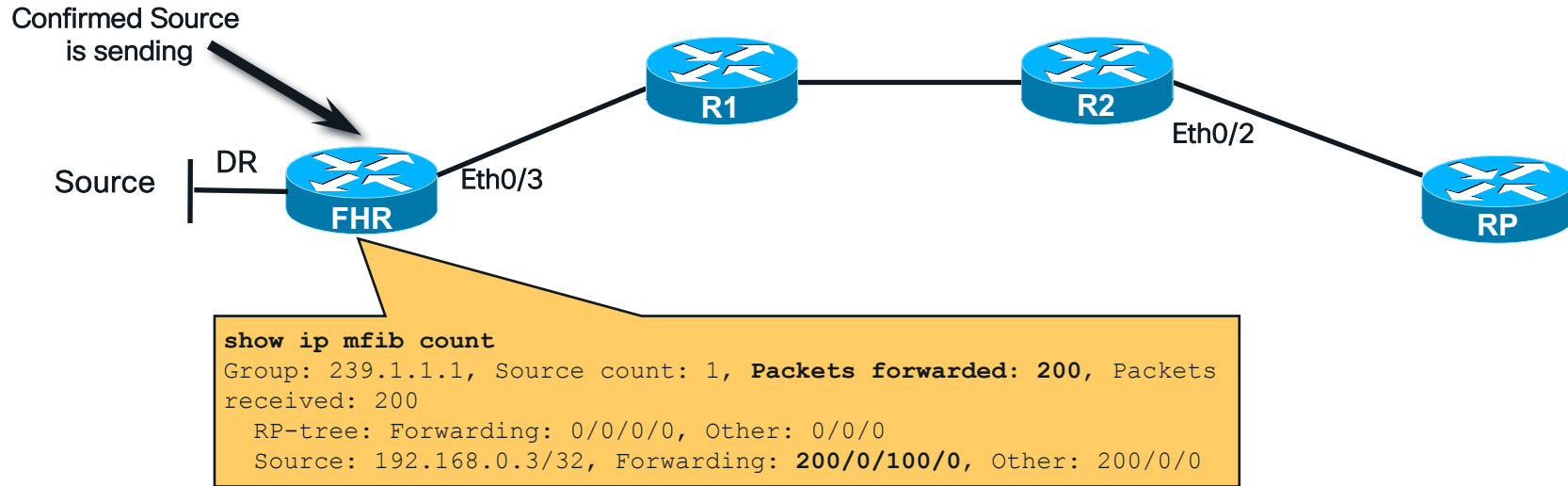
After the RP has been created we still don't receive multicast traffic on receivers?

1. Make sure we have PIM enabled on the interfaces.
2. Follow the stream through transit routers.



Troubleshooting scenario #4

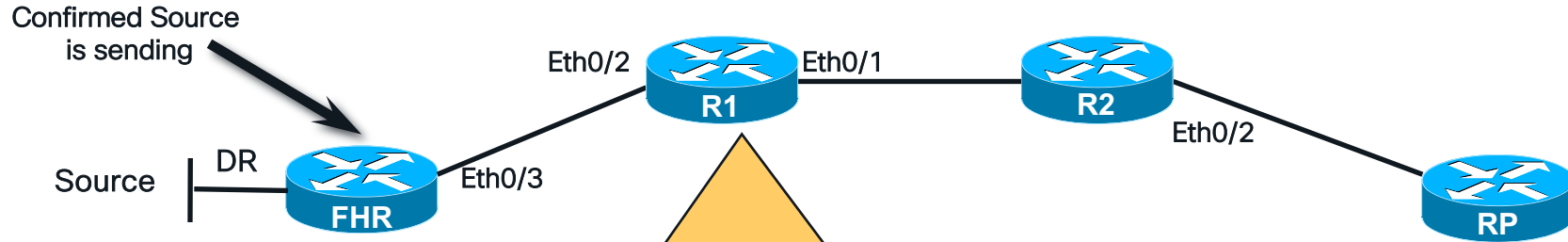
Problem Description: Some receivers are not receiving multicast traffic



After the RP has been created
we still don't receive multicast traffic?

Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic



```
show ip mfib 239.1.1.1 verbose
(*,239.1.1.1) Flags: C K
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  Ethernet0/1 Flags: RA A MA
(192.168.0.3,239.1.1.1) Flags: K DDE
  SW Forwarding: 299/0/100/0, Other: 0/0/0
  Ethernet0/2 Flags: RA A MA NS
  Ethernet0/1 Flags: RF F NS
  CEF: Adjacency with MAC: 01005E010101FA163ED2C4520800
Pkts: 299/0
```

Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic

```
(*, 239.1.1.1), 00:21:15/00:02:46, RP 172.16.0.12, flags: S
Incoming interface: Ethernet0/2, RPF nbr 192.168.128.6
Outgoing interface list:
Ethernet0/1, Forward/Sparse, 00:21:15/00:02:46
(192.168.0.3, 239.1.1.1), 00:16:33/00:00:06, flags:
Incoming interface: Ethernet0/3, RPF nbr 192.168.128.13
Outgoing interface list:
Ethernet0/1, Forward/Sparse, 00:16:33/00:02:47
```

We have state
Control-plane built

Confirmed Source
is sending

Source

DR

FHR

Eth0/3

Eth0/2

R1

Eth0/1

Eth0/3

R2

Eth0/2

RP

show ip mfib count
show ip mfib 239.1.1.1 verbose
show ip pim int count

show ip pim int count

For switching state use "show ip mfib interface"

Address	Interface	Mpackets In/Out
172.16.0.8	Loopback0	0/0
192.168.0.11	Ethernet0/1	0/0
192.168.128.5	Ethernet0/2	0/0
192.168.128.14	Ethernet0/3	0/0

Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic

```
show ip traffic
```

```
IP statistics:
```

```
Rcvd: 2687 total, 2388 local destination
```

```
0 format errors, 0 checksum errors, 0 bad hop count
```



Eth0/1

MRIB
Had 299 packets sent



Eth0/3



Check counters on interface
Check MTU
Packet capture

```
show ip traffic
```

```
IP statistics:
```

```
Rcvd: 268007 total, 236988 local destination
```

```
0 format errors, 0 checksum errors, 299 bad hop count
```

Troubleshooting scenario #4

Problem Description: Some receivers are not receiving multicast traffic

```
show ip traffic
  IP statistics:
    Rcvd: 2687 total, 2388 local destination
  0 format errors, 0 checksum errors, 0 bad hop count
```



Check counters on interface
Check logs on both routers
Check MTU
Packet capture

```
Internet Protocol Version 4, Src: 192.168.0.3 (192.168.0.3), Dst: 239.1.1.1 (239.1.1.1)
  Version: 4
  Header length: 20 bytes
  + Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
  + Type of service: 0x00 (None)
  Total Length: 110
  Identification: 0x0000 (0)
  + Flags: 0x00
  Fragment offset: 0
  Time to live: 1
  Protocol: ICMP (1)
  + Header checksum: 0x08e2 [correct]
  Source: 192.168.0.3 (192.168.0.3)
  Destination: 239.1.1.1 (239.1.1.1)
  [Source GeoIP: Unknown]
  [Destination GeoIP: Unknown]
+ Internet Control Message Protocol
```

TTL of the stream was 3

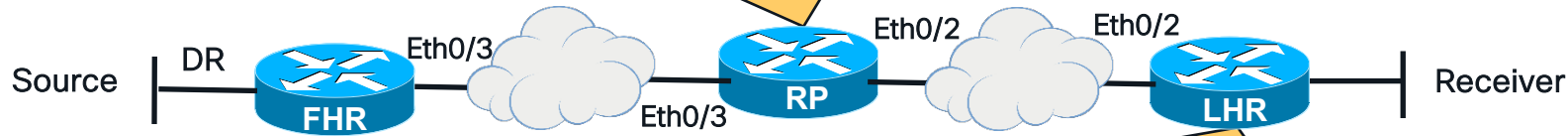
Usual Suspects scenario #5

Troubleshooting scenario #5

Problem Description: Multicast tree not built from LHR

```
(*, 239.1.1.1), 00:01:19/stopped, RP 172.16.0.12, flags: SP
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list: Null ←

(192.168.0.3, 239.1.1.1), 00:01:19/00:01:40, flags: P
Incoming interface: Ethernet0/3, RPF nbr 192.168.0.21
Outgoing interface list: Null ←
```



```
(*, 239.1.1.1), 00:18:57/stopped, RP 172.16.0.12, flags: SPF
Incoming interface: Ethernet0/1, RPF nbr 192.168.0.17
Outgoing interface list: Null

(192.168.0.3, 239.1.1.1), 00:14:21/00:02:38, flags: PFT
Incoming interface: Ethernet0/2, RPF nbr 0.0.0.0
Outgoing interface list: Null
```

```
(*, 239.1.1.1), 00:00:11/00:02:48, RP 172.16.0.12, flags: SJC
Incoming interface: Ethernet0/2, RPF nbr 192.168.0.9, Mroute
Outgoing interface list:
Ethernet0/1, Forward/Sparse, 00:00:11/00:02:48
```

How do we get to RP 172.16.0.12?

Troubleshooting scenario #5

Problem Description: Multicast tree not built from LHR

We see a discrepancy between RPF database and unicast RIB



```
show ip rpf 172.16.0.12
RPF information for ? (172.16.0.12)
  RPF interface: Ethernet0/2
  RPF neighbour: ? (192.168.0.9)
  RPF route/mask: 0.0.0.0/0
  RPF type: multicast (static)
  Doing distance-preferred lookups across tables
  RPF topology: ipv4 multicast base
```

```
show ip route 172.16.0.12
Routing entry for 172.16.0.12/32
  Known via "ospf 1", distance 110, metric 3, type intra area
  Last update from 192.168.0.11 on Ethernet0/2, 00:27:01 ago
  Routing Descriptor Blocks:
    * 192.168.0.11, from 172.16.0.12, 00:27:01 ago, via Ethernet0/2
      Route metric is 3, traffic share count is 1
```

RPF Calculation

RPF is used for

- **Control plane:** Determining interface/neighbour to send PIM Join/Prune to
- **Data plane:** Check incoming interface for mcast traffic, assuring loop-free forwarding

Picking RPF route: The best routes are chosen from these set of routes:

Static Mroute

DVMRP Routing Table

MBGP SAFI 2 table

Unicast Routing Table

The the longest match rule is used to pick the best route inside one of the four groups.

One from each group: the lowest Administrative distance wins

- If distance is the same, then the above order is used

Troubleshooting scenario #5

Problem Description: Multicast tree not built from LHR

Without ip multicast [vrf vrf-name] longest-match

Less specific route may be preferred with
distance-preferred
Lowest Distance preferred



```
show ip rpf 172.16.0.12
RPF information for ? (172.16.0.12)
  RPF interface: Ethernet0/2
  RPF neighbour: ? (192.168.0.9)
  RPF route/mask: 0.0.0.0/0
  RPF type: multicast (static)
Doing distance-preferred lookups across tables
  RPF topology: ipv4 multicast base
```



ip mroute 0.0.0.0 0.0.0.0 192.168.0.9 = default distance of 0

With ip multicast [vrf vrf-name] longest-match

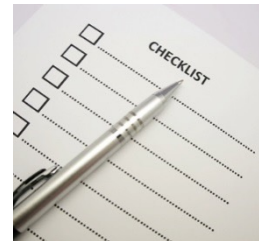
More specific route preferred



```
show ip rpf 172.16.0.12
RPF information for ? (172.16.0.12)
  RPF interface: Ethernet0/2
  RPF neighbour: ? (192.168.0.11)
  RPF route/mask: 172.16.0.12/32
  RPF type: unicast (ospf 1)
Doing longest-match lookups across tables
  RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

Key Takeaways

Troubleshooting Toolbox Checklist



- ☐ “Which” router I’m in?
- ☐ “Who” is the root?
- ☐ “Where” is the root?
- ☐ “What” is the PIM RPF neighbor towards the root?

PIM Model – IOS IPv4

```
show ip mroute  
show ip mroute count  
show ip pim neighbour  
show ip pim interface  
show ip igmp group  
show ip pim rp [group]  
show ip pim rp mapping [group]  
show ip rpf [address]  
show ip msdp sa-cache
```



PIM New Model – IOS-XR example

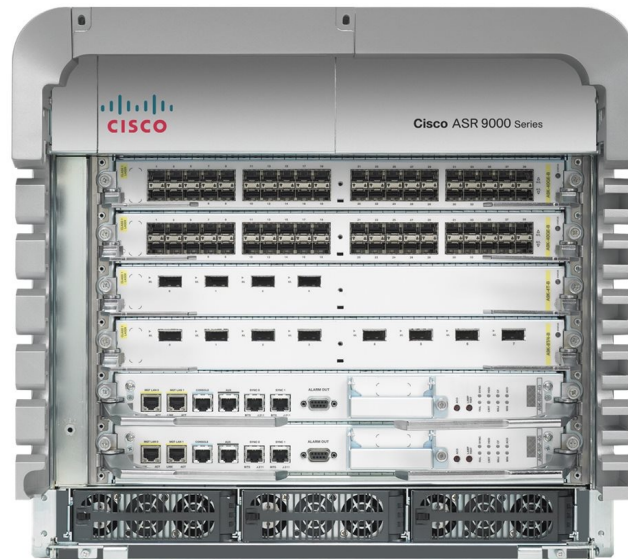
show pim group-map
show pim topology [sh ip mroute]
show igmp groups
show igmp snooping <xxx>
show msdp sa-cache

show mrib route [sh ip mroute]

show mfib route [sh ip mroute]
show mfib connections
show mfib counter

show mfib hardware route olist loc <>
show mfib hardware connection loc <>
show mfib hardware ltrace loc <>
show mfib hardware interface loc <>

Hardware
Dependent



PIM New Model – NX-OS example

show ip pim topology [sh ip mroute]
show ip pim route [sh ip mroute]
show ip igmp route
show ip igmp snooping groups
show ip msdp route

show routing ip multicast [sh ip mroute]

show forwarding distribution ip multicast route
show forwarding distribution ip igmp snooping

show forwarding ip multicast route

show system internal forwarding ip multicast route
show system internal ip igmp snooping

Hardware
Dependent





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Thank you

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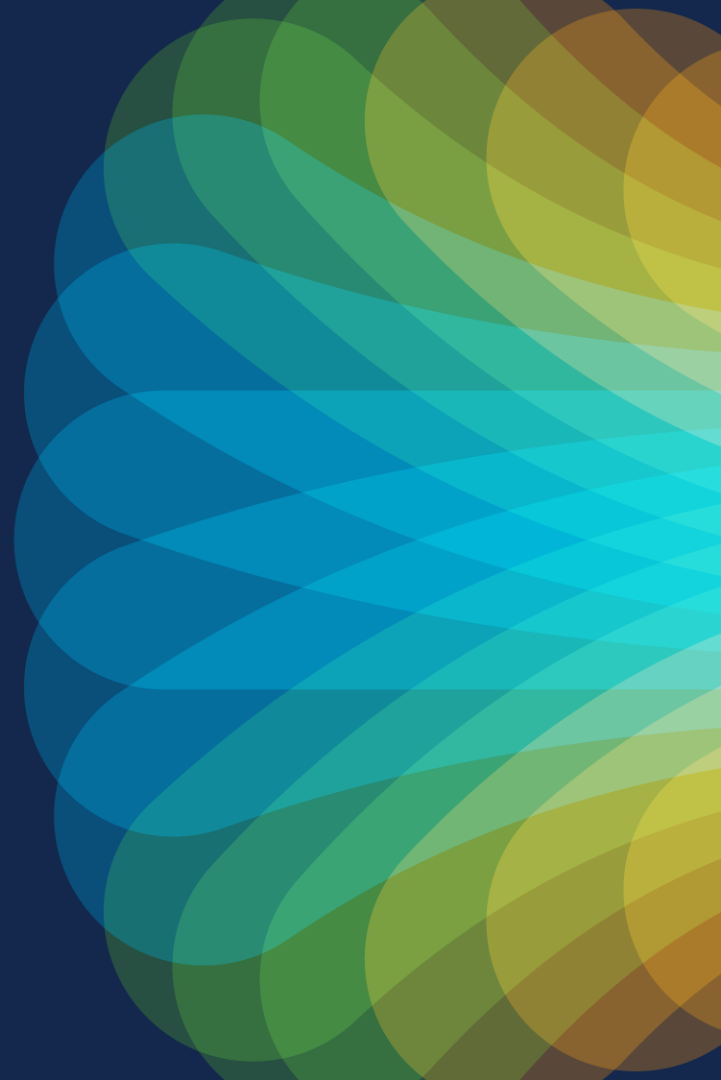


The bridge to possible

Thank you

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The background is a vibrant, abstract graphic featuring a spectrum of colors from red and orange on the left to blue and green on the right. The colors are arranged in a series of overlapping, wavy bands that create a sense of movement and depth. A bright, white, starburst-like light emanates from the right side, casting rays of light across the entire scene.

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