

PIM Sparse Mode (IPv6)



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Agenda



Topics:

- Recap of PIM-ASM
- IPv6 Multicast Scope
- Embedded RP

Demos:

- Send PIM Join
- Embedded RP Extraction

Packet Analysis:

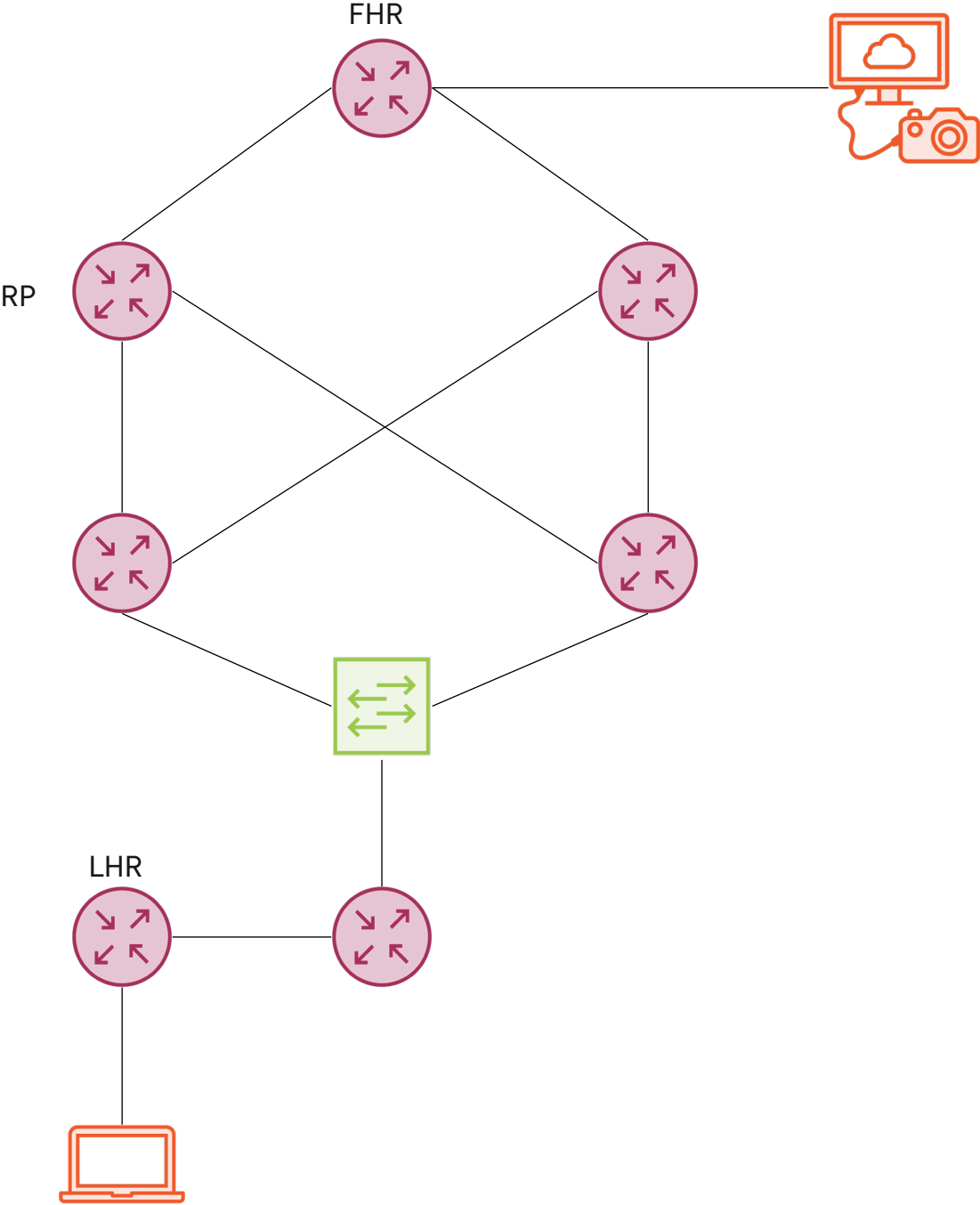
- PIM Hello
- PIM Register/Register Stop
- PIM Join/Prune



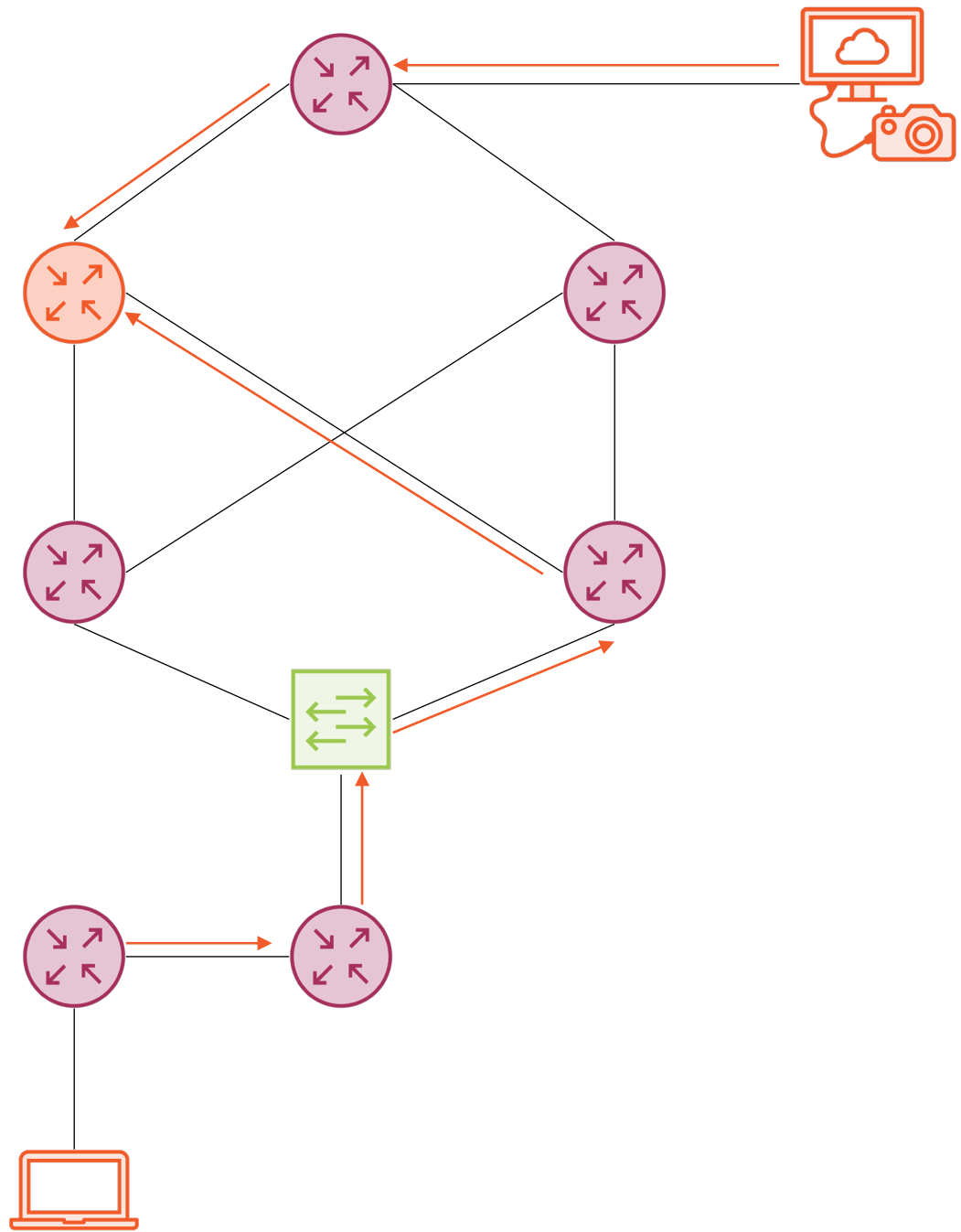
Globomantics Multicast Deployment Continues



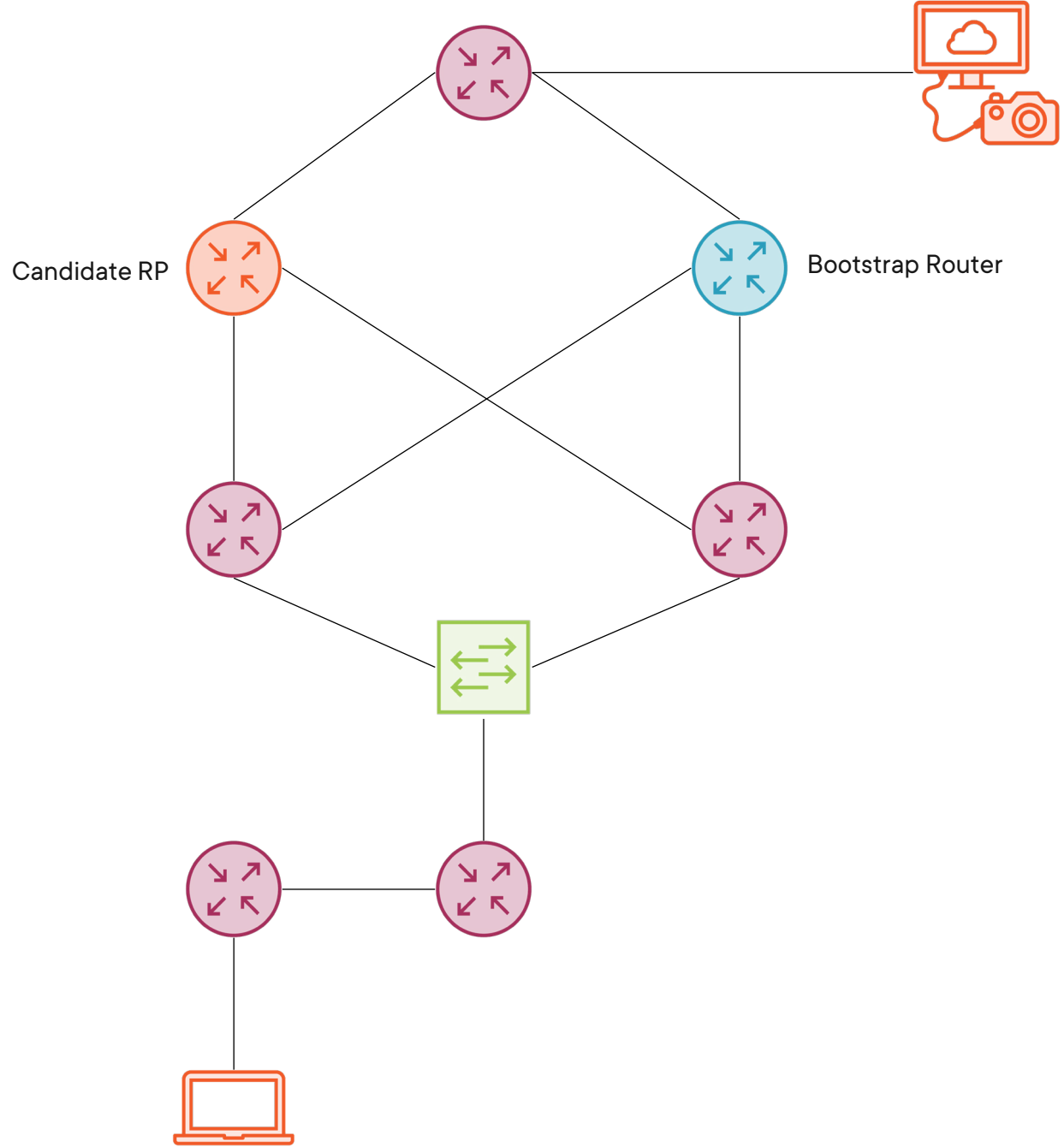
Lab Network



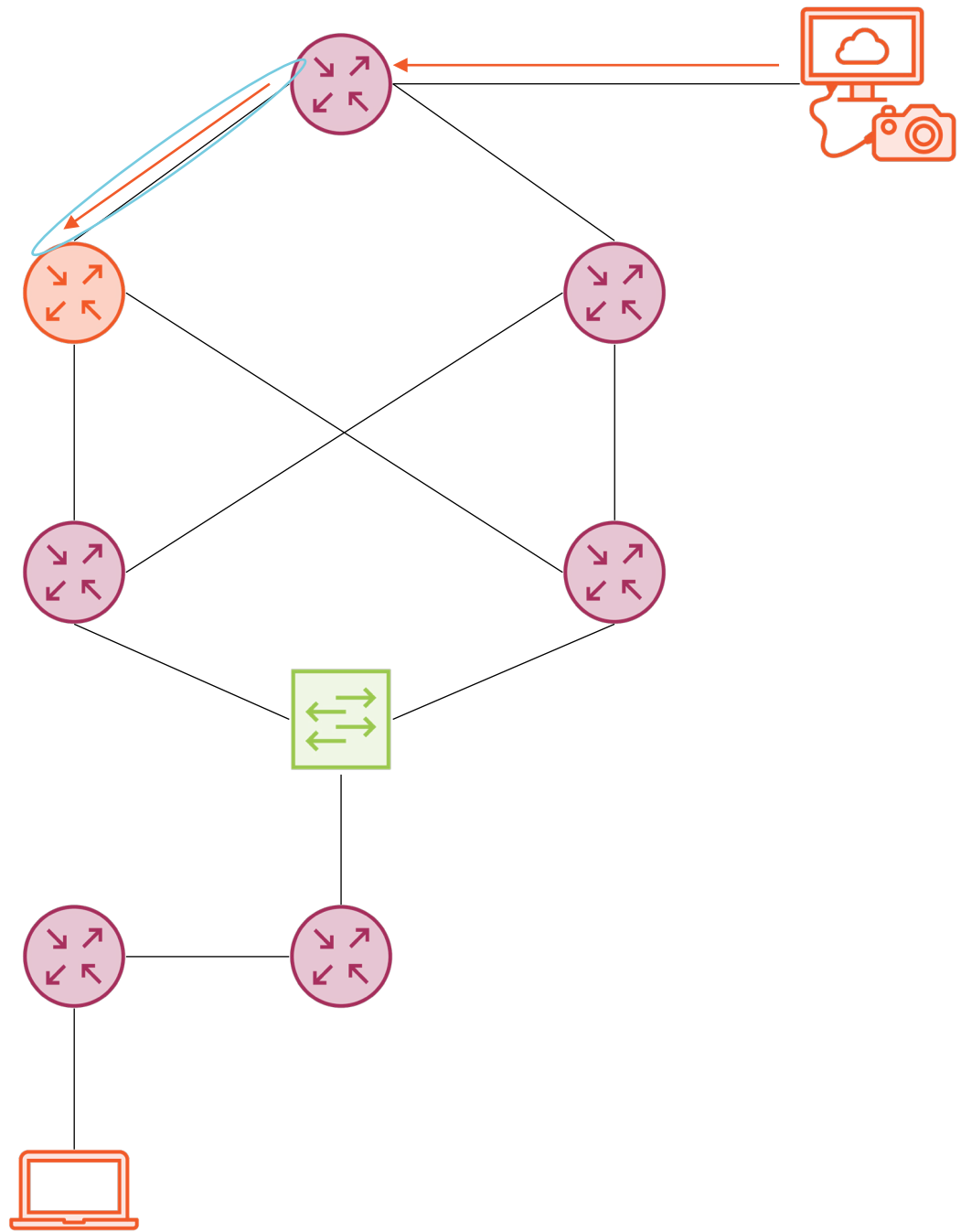
Rendezvous Point



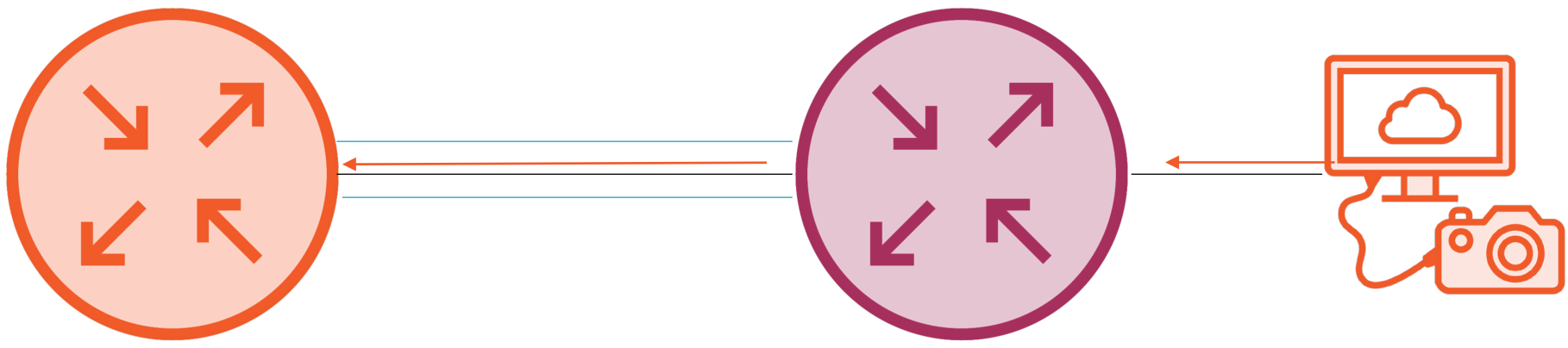
RP and BSR



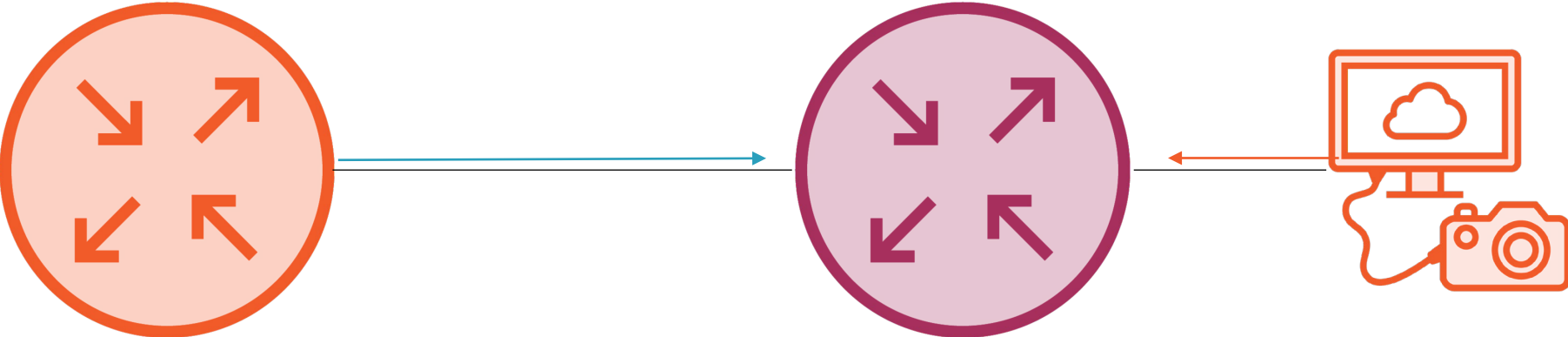
PIM Register



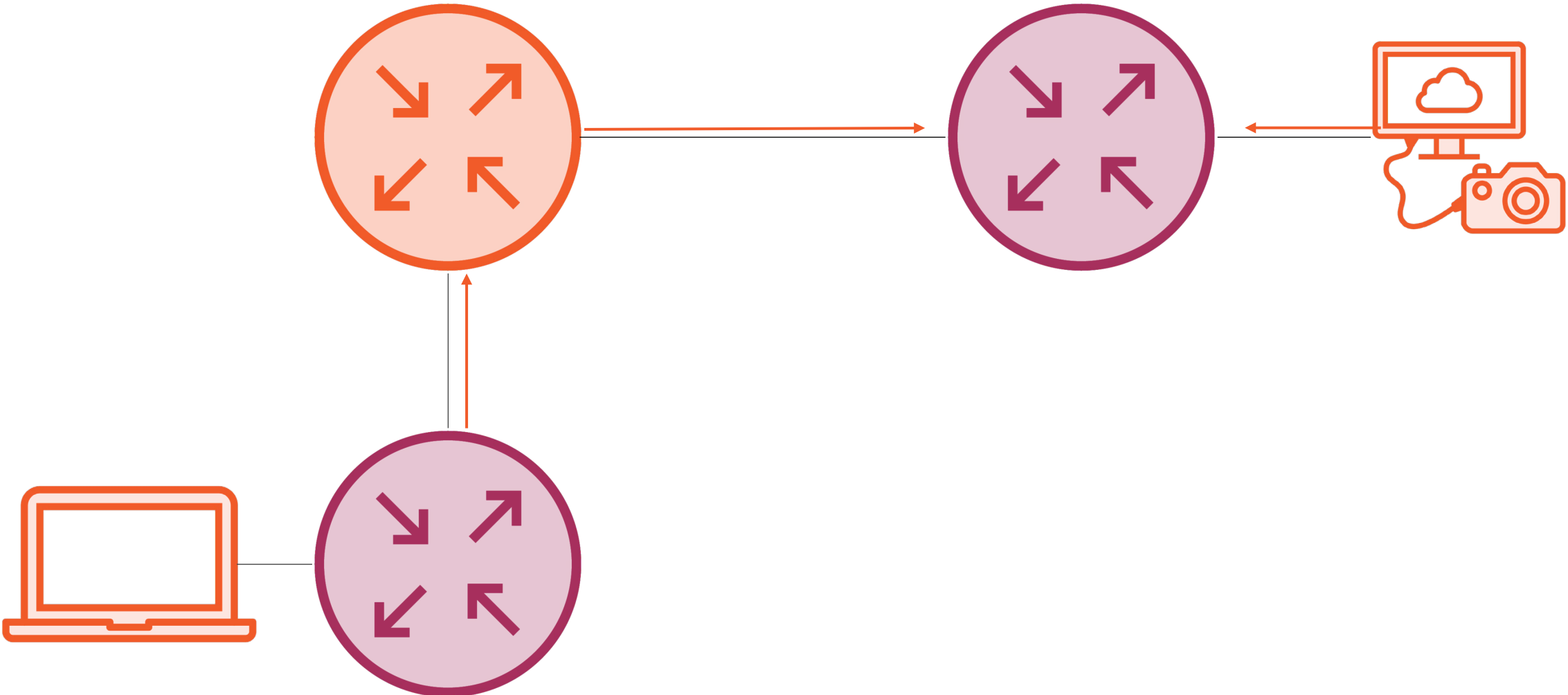
PIM Register



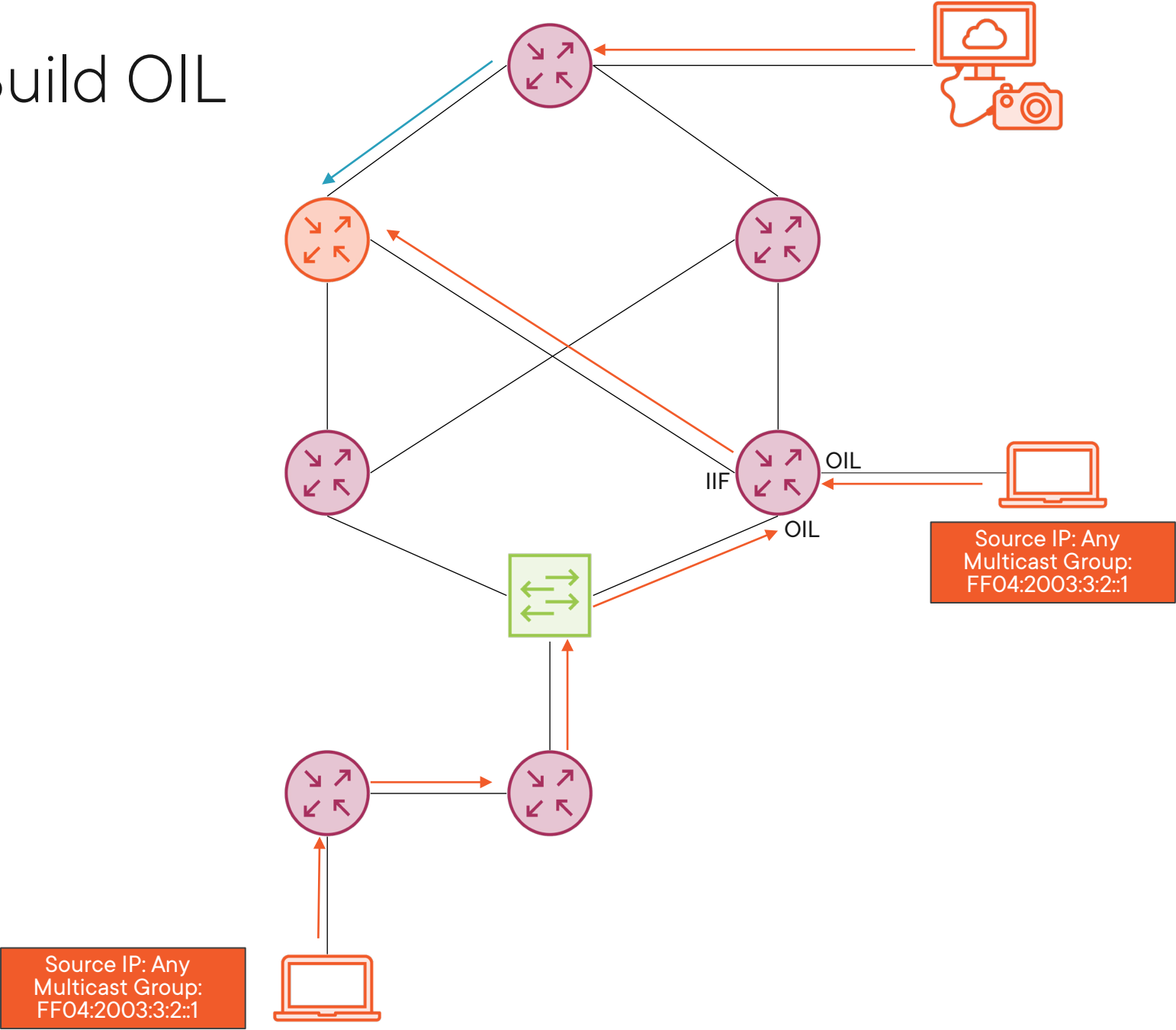
PIM Register Stop



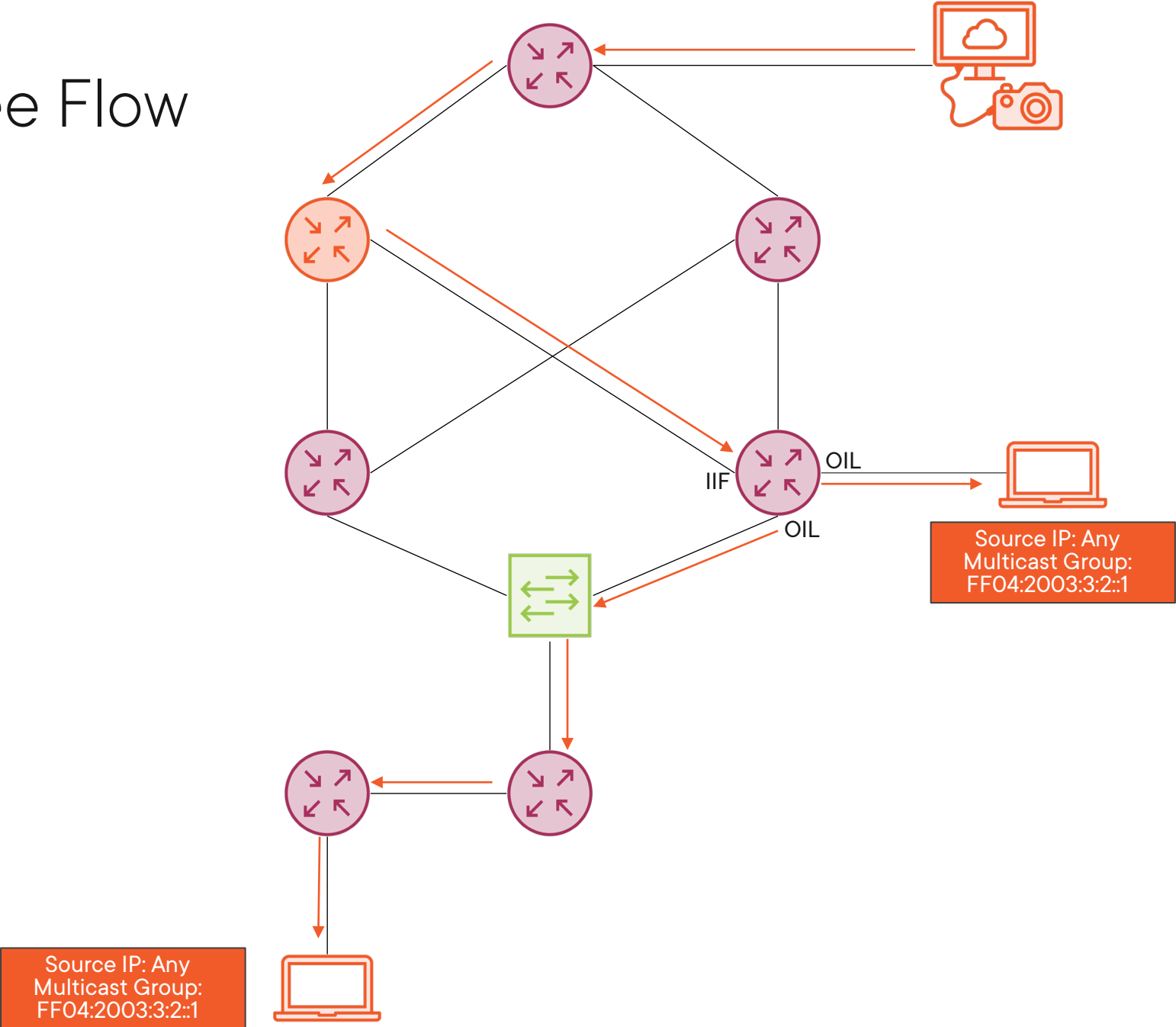
PIM Join From RP



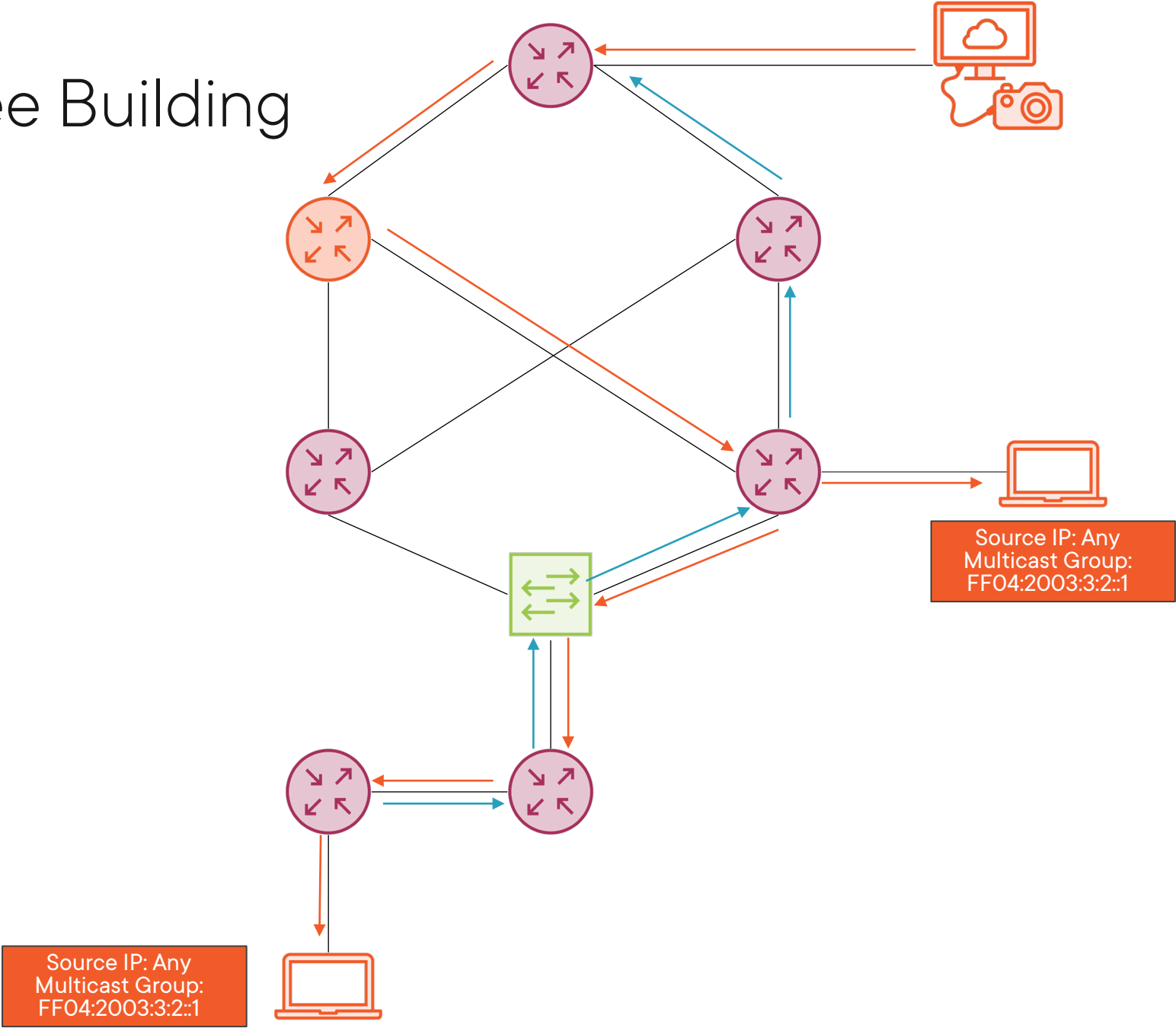
PIM Joins Build OIL



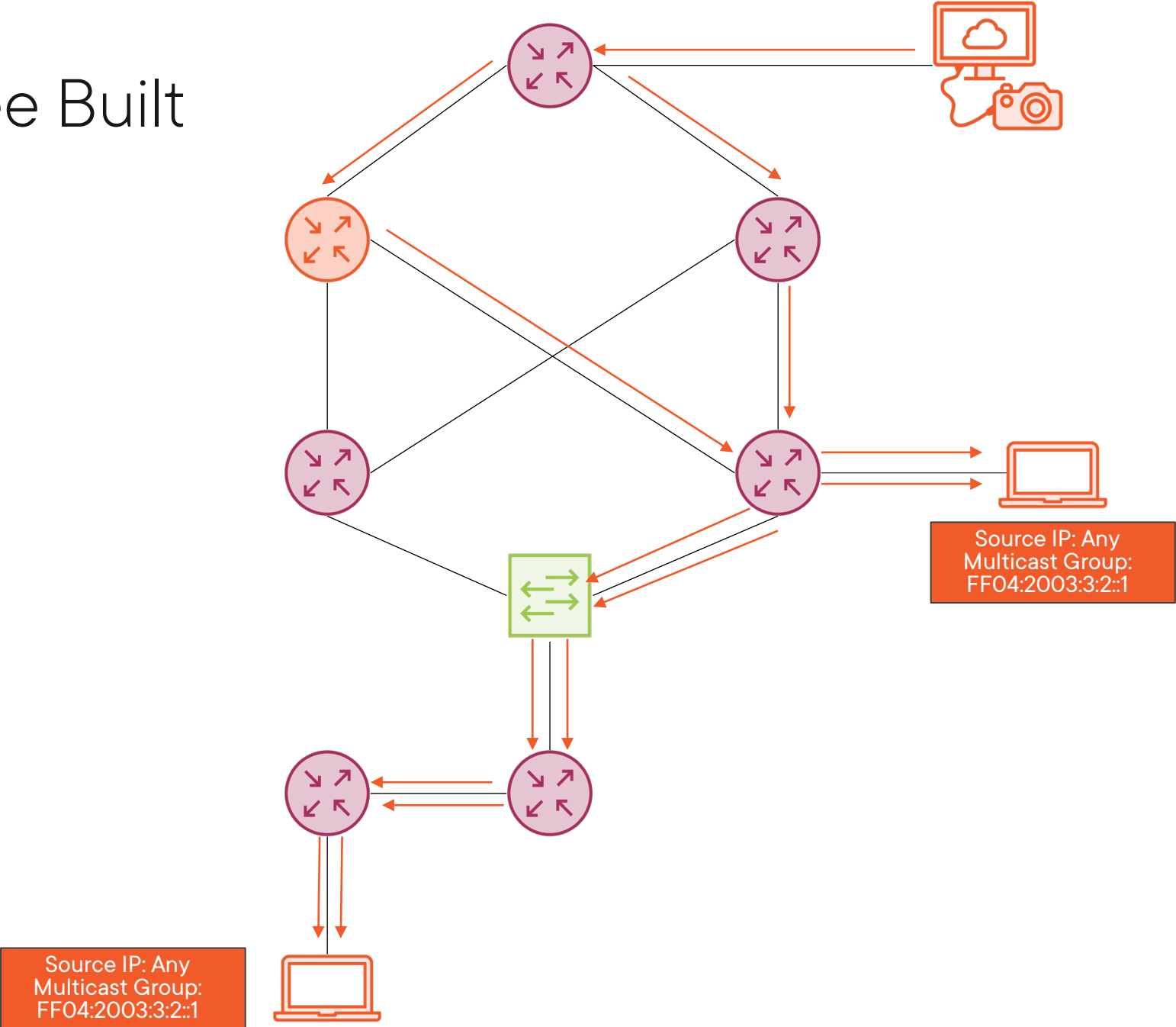
Shared Tree Flow



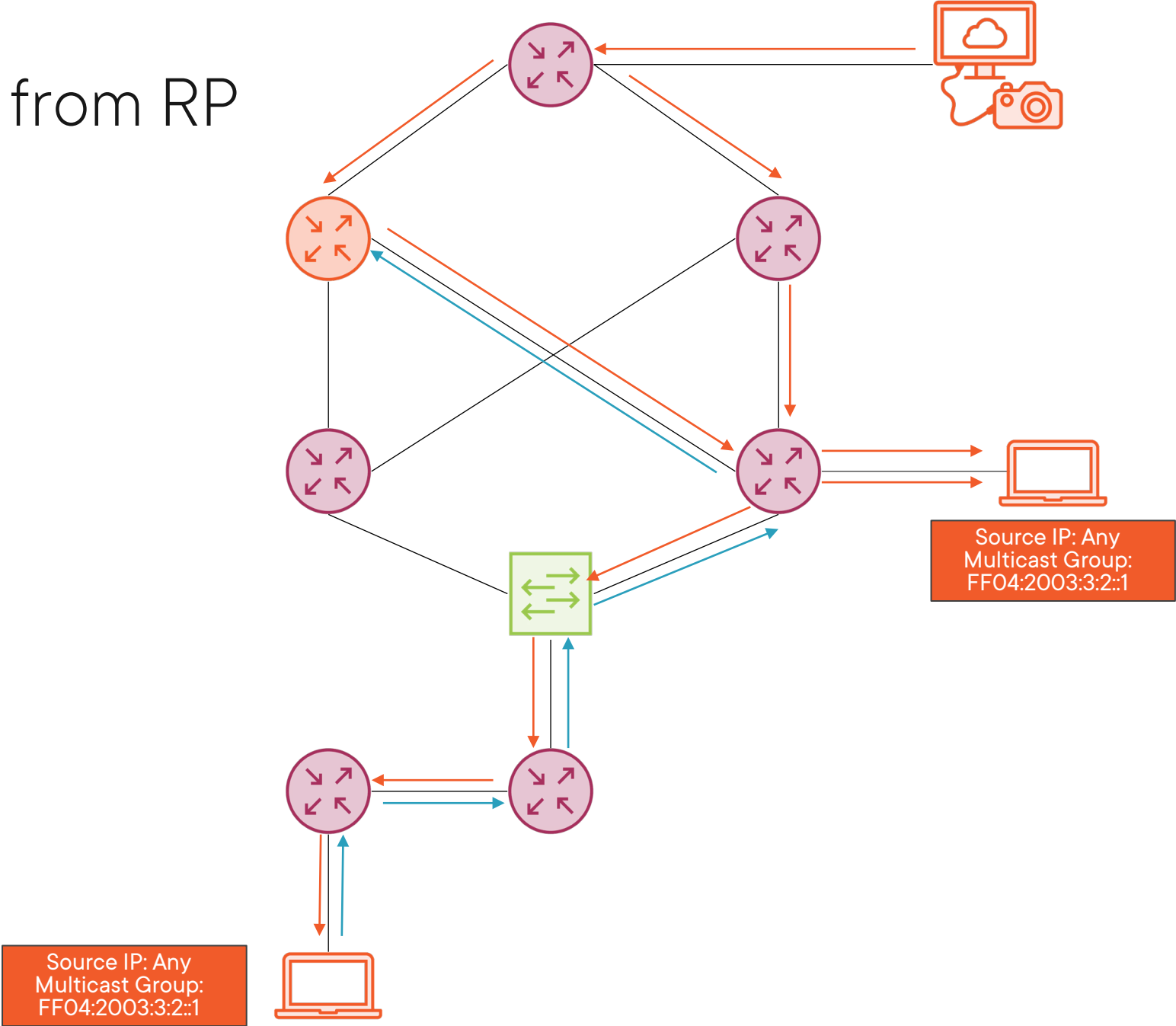
Source Tree Building



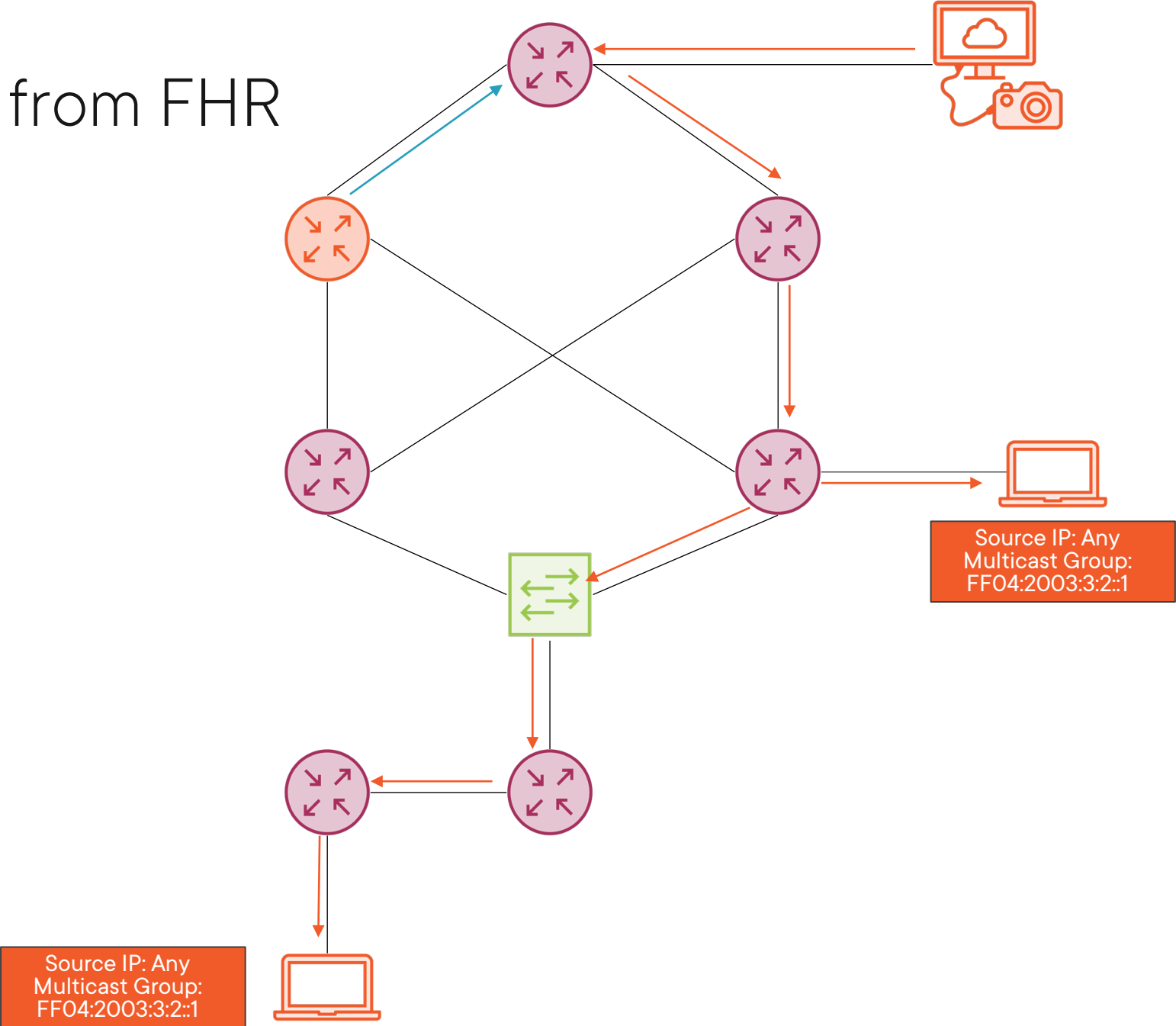
Source Tree Built



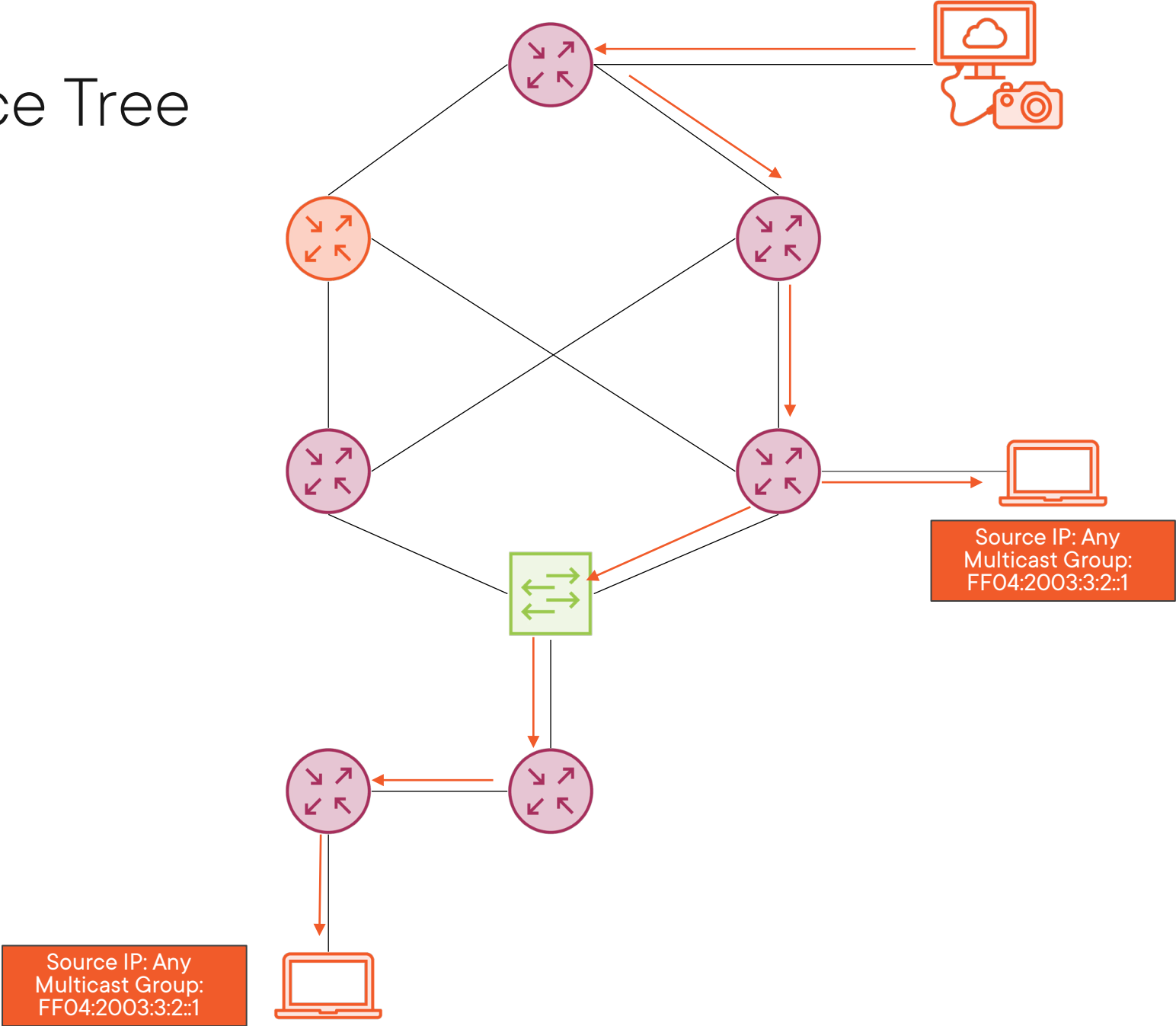
PIM Prune from RP



PIM Prune from FHR



(S,G) Source Tree



IPv6 Multicast Scoping



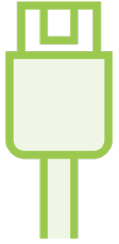
IPv6 is Global Scope



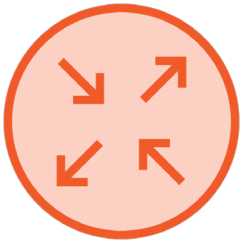
**Some Scopes are Automatic
Some are Administrative**



IPv6 Multicast Scopes (Automatic)



FF01::/16 is Interface-Local Scope



FF02::/16 is Link-Local Scope



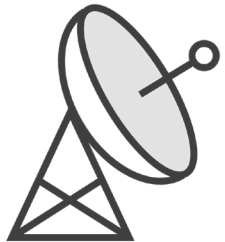
FF03::/16 is Realm-Local Scope



IPv6 Multicast Scopes (Configured)



FF04::16 is Admin-Local Scope



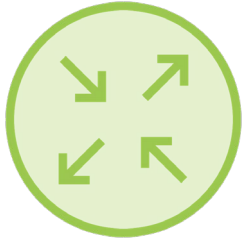
FF05::16 is Site-Local Scope



FF08::16 is Organization-Local Scope



Prevent IPv6 Multicast Scope Creep



Rendezvous Points can be configured to accept only groups of predetermined scope



BSRs can be configured to look for candidate RPs only serving certain scope sizes for use



Configure interfaces facing untrusted zones as BSR borders



Further Reading for IPv6 Multicast Scopes



RFC 4007/4291: Covers IPv6 address and multicast scopes



RFC 7346: Further defines IPv6 multicast scope addressing



Demo

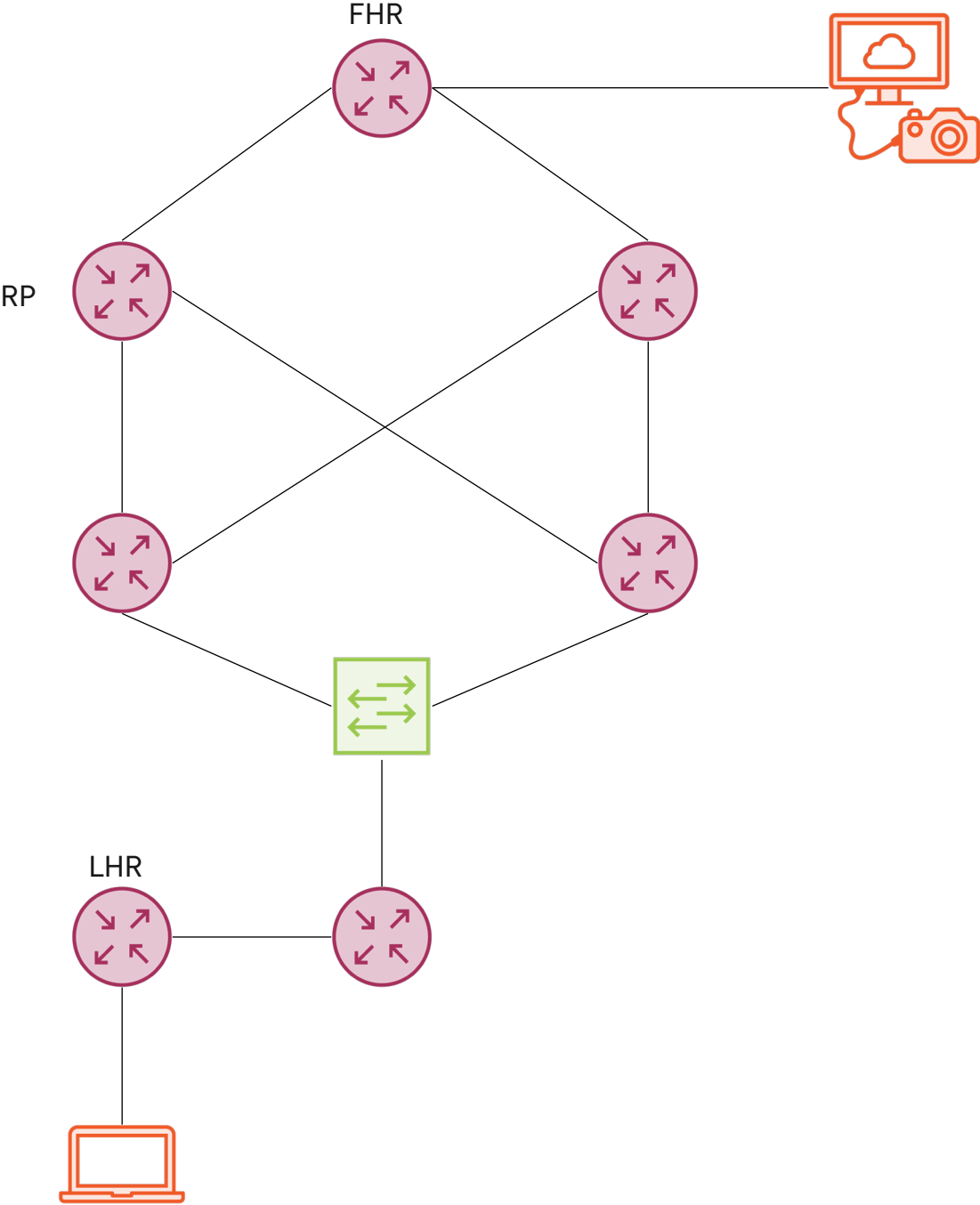


Send PIM Join

- Configure a receiver for MLD
- Configure a source to send traffic
- Track Multicast State



Lab Network



IPv6 Embedded RP



Embedded RP is possible because the IPv6 address is 128 bits



Allows the RP address to be embedded within the multicast group address



Since RP Address is extracted, no need to configure or learn RP address



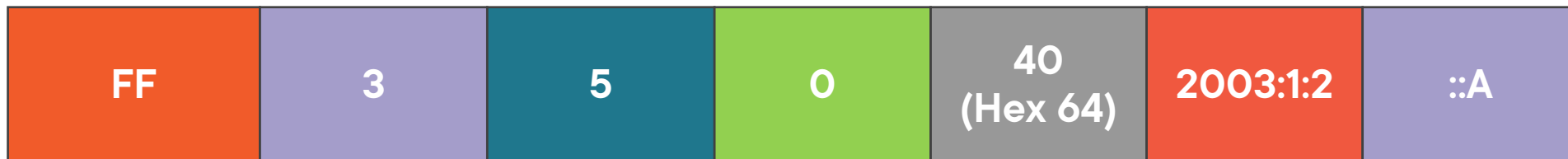
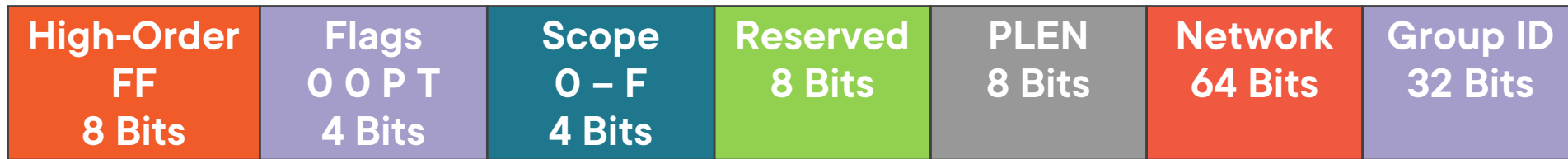
IPv6 Multicast Packet Format (RFC 2373)



All Routers Multicast Group Address



IPv6 Multicast Packet Format (RFC 3306)

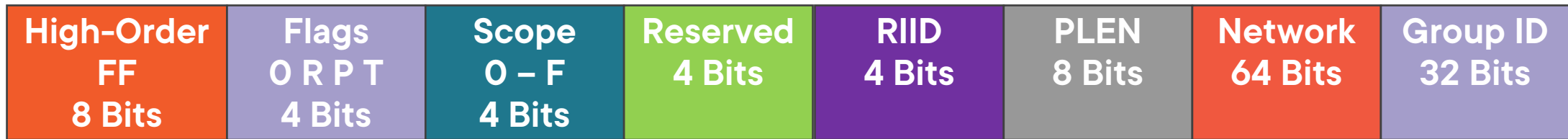


Global Prefix-Based Group: FF35:040:2003:1:2::A

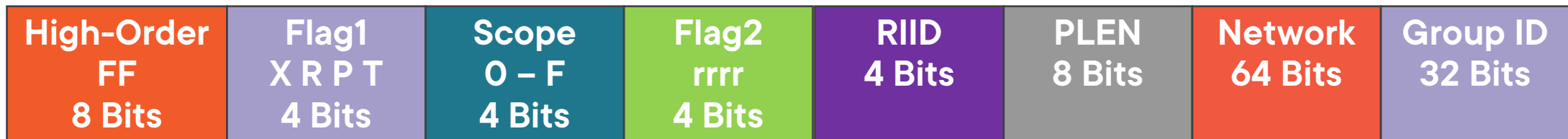
SSM Group: FF35:0::A



IPv6 Multicast Packet Format (RFC 3956)



IPv6 Multicast Packet Format (RFC 7371)



IPv6 Multicast Packet Format (RFC 7371)



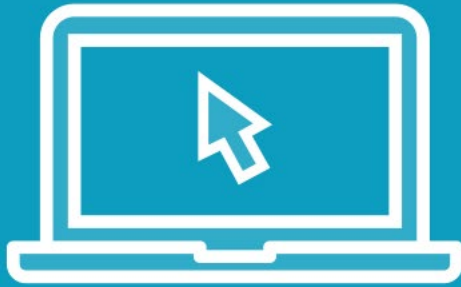
IPv6 Embedded RP Group



RP: 2003:1:1:1::1



Demo

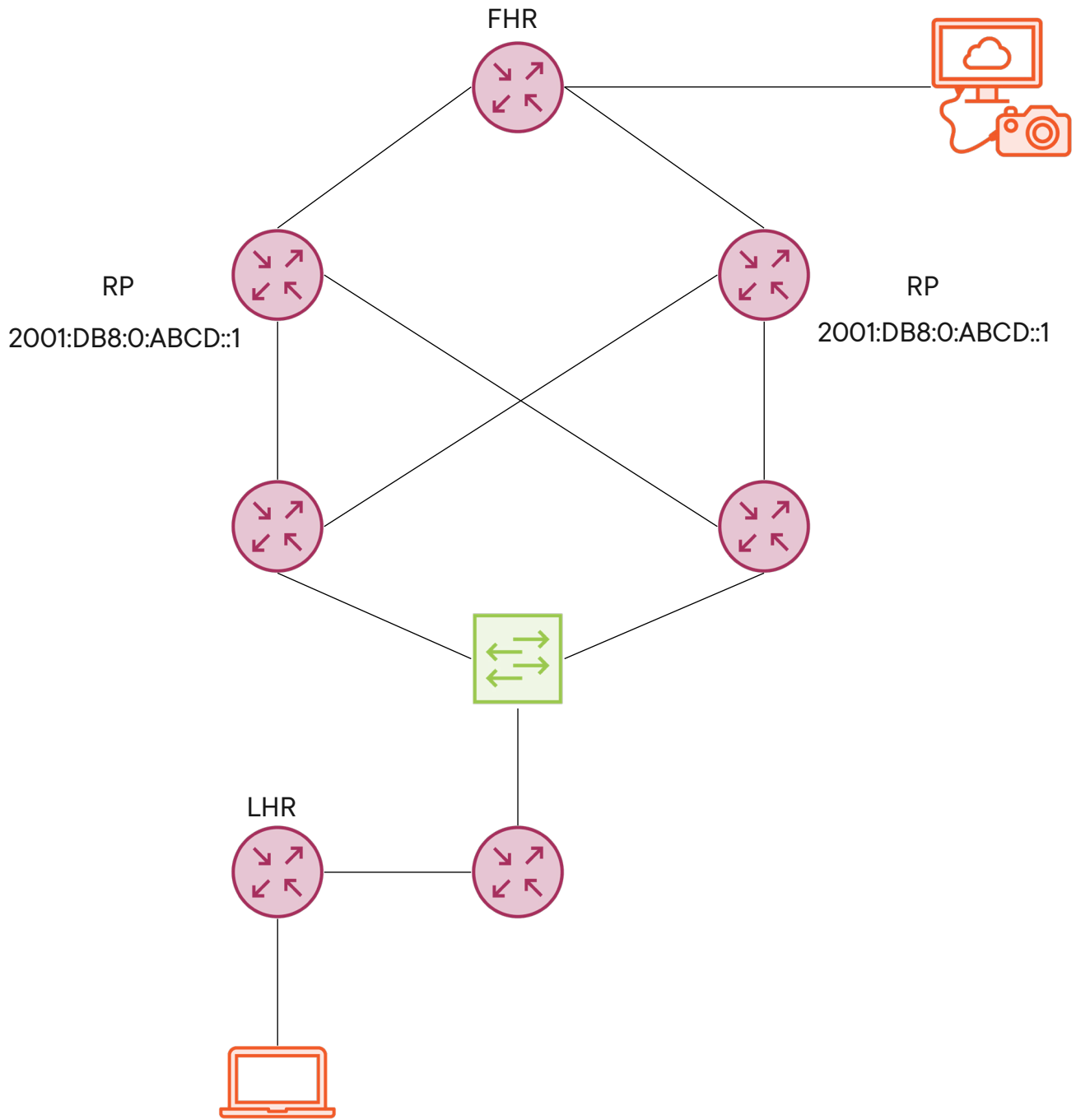


Embedded RP Extraction

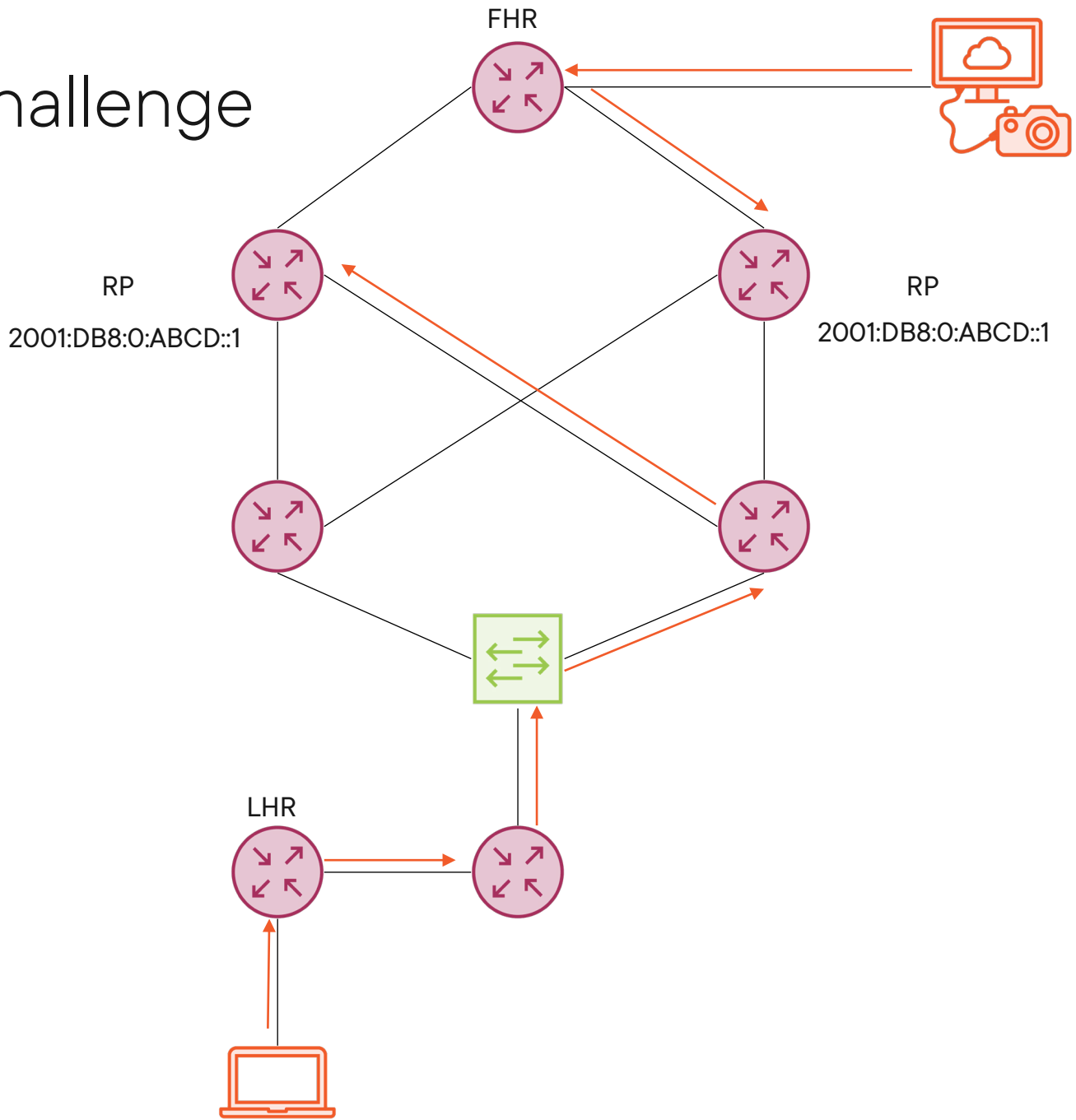
- Debug Embedded RP extraction
- Verify multicast state on RP



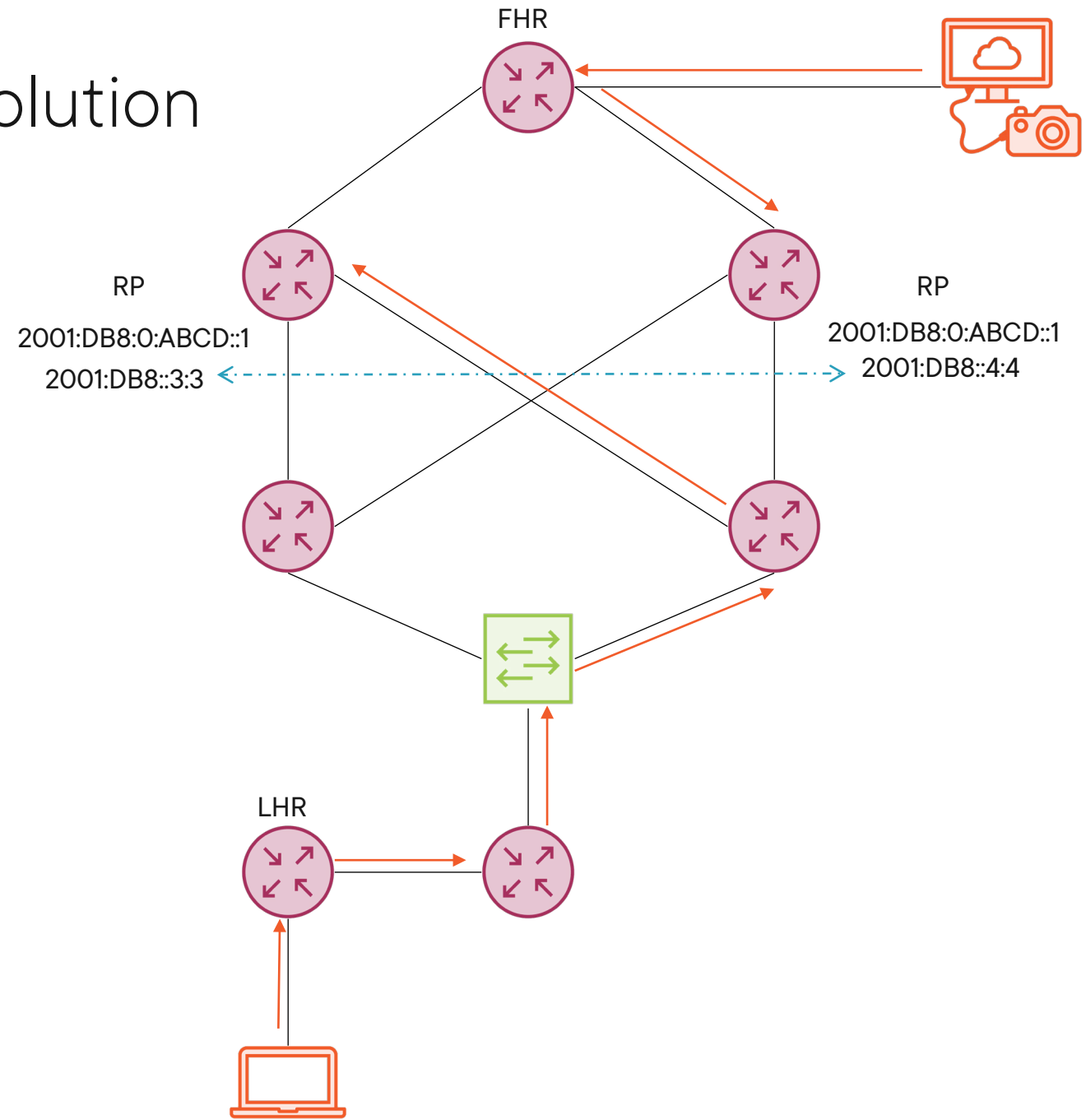
Anycast RP



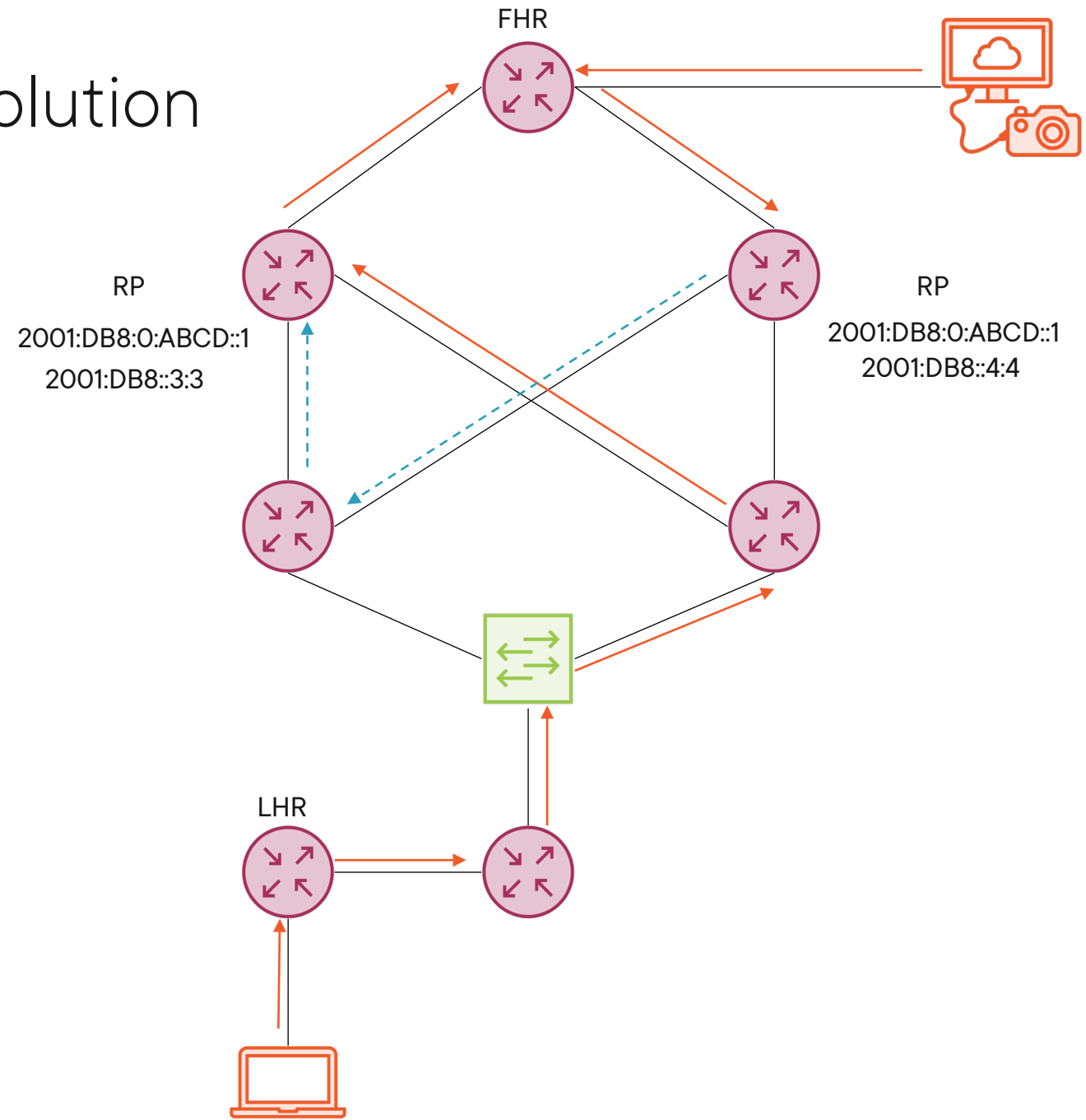
Anycast RP Challenge



Anycast RP Solution



Anycast RP Solution



PIM Hello (IPv6)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	fe80:10:10:255::2	ff02::d	PIMv2	136	Hello

- > Frame 1: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits) on interface eth0, id 0
- > Ethernet II, Src: 50:00:00:09:00:01 (50:00:00:09:00:01), Dst: IPv6mcast_0d (33:33:00:00:00:0d)
- > Internet Protocol Version 6, Src: fe80:10:10:255::2, Dst: ff02::d
- ▼ Protocol Independent Multicast
 - 0010 = Version: 2
 - 0000 = Type: Hello (0)
 - Reserved byte(s): 00
 - Checksum: 0xd0c [correct]
 - [Checksum Status: Good]
 - ▼ PIM Options: 7
 - > Option 1: Hold Time: 105
 - > Option 2: LAN Prune Delay: T = 0, Propagation Delay = 100ms, Override Interval = 400ms
 - > Option 19: DR Priority: 1
 - > Option 20: Generation ID: 3586437799
 - > Option 22: Bidirectional Capable
 - > Option 24: Address List
 - > Option 65001: Address list, old implementation



PIM Register (IPv6)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	2003:10:99:1::100	ff04:2003:3:2::1	PIMv2	162	Register
2	0.005964033	2003:1:1:1::1	2003:10:255:10::254	PIMv2	96	Register-stop


```
> Frame 1: 162 bytes on wire (1296 bits), 162 bytes captured (1296 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:04:00:00 (50:00:00:04:00:00), Dst: 50:00:00:05:00:00 (50:00:00:05:00:00)
> Internet Protocol Version 6, Src: 2003:10:255:10::254, Dst: 2003:1:1:1::1
v Protocol Independent Multicast
  0010 .... = Version: 2
  .... 0001 = Type: Register (1)
  Reserved byte(s): 00
  Checksum: 0x99bd [correct]
  [Checksum Status: Good]
v PIM Options
  v Flags: 0x00000000
    0... .. = Border: No
    .0.. .. = Null-Register: No
    0110 .... = IP Version: IPv6 (6)
> Internet Protocol Version 6, Src: 2003:10:99:1::100, Dst: ff04:2003:3:2::1
> Internet Control Message Protocol v6
```



PIM Register-Stop(IPv6)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	2003:10:99:1::100	ff04:2003:3:2::1	PIMv2	162	Register
2	0.005964033	2003:1:1:1::1	2003:10:255:10::254	PIMv2	96	Register-stop


```
> Frame 2: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:05:00:00 (50:00:00:05:00:00), Dst: 50:00:00:04:00:00 (50:00:00:04:00:00)
> Internet Protocol Version 6, Src: 2003:1:1:1::1, Dst: 2003:10:255:10::254
v Protocol Independent Multicast
  0010 .... = Version: 2
  .... 0010 = Type: Register-stop (2)
  Reserved byte(s): 00
  Checksum: 0x5360 [correct]
  [Checksum Status: Good]
v PIM Options
  v Group: ff04:2003:3:2::1/128
    Address Family: IPv6 (2)
    Encoding Type: Native (0)
  v Flags: 0x00
    0... .... = Bidirectional PIM: Not set
    .000 000. = Reserved: 0x00
    .... ...0 = Admin Scope Zone: Not set
  Masklen: 128
  Group: ff04:2003:3:2::1
  v Source: 2003:10:99:1::100
    Address Family: IPv6 (2)
    Encoding Type: Native (0)
    Unicast: 2003:10:99:1::100
```



PIM Join/Prune(IPv6)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	fe80:10:10:255::2	ff02::d	PIMv2	124	Join/Prune


```
> Frame 1: 124 bytes on wire (992 bits), 124 bytes captured (992 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:09:00:01 (50:00:00:09:00:01), Dst: IPv6mcast_0d (33:33:00:00:00:0d)
> Internet Protocol Version 6, Src: fe80:10:10:255::2, Dst: ff02::d
v Protocol Independent Multicast
  0010 .... = Version: 2
  .... 0011 = Type: Join/Prune (3)
  Reserved byte(s): 00
  Checksum: 0xd3e8 [correct]
  [Checksum Status: Good]
v PIM Options
  v Upstream-neighbor: fe80:10:10:255::1
    Address Family: IPv6 (2)
    Encoding Type: Native (0)
    Unicast: fe80:10:10:255::1
    Reserved byte(s): 00
    Num Groups: 1
    Holdtime: 210
  v Group 0
    v Group 0: ff04:2003:3:2:1::1/128
      Address Family: IPv6 (2)
      Encoding Type: Native (0)
      > Flags: 0x00
      Masklen: 128
      Group: ff04:2003:3:2:1::1
    v Num Joins: 1
      v IP address: 2001:db8:0:abcd::1/128 (SWR)
        Address Family: IPv6 (2)
        Encoding Type: Native (0)
        v Flags: 0x07, Sparse, WildCard, Rendezvous Point Tree
          0000 0... = Reserved: 0x00
          .... .1.. = Sparse: Set
          .... ..1. = WildCard: Set
          .... ...1 = Rendezvous Point Tree: Set
          Masklen: 128
          Source: 2001:db8:0:abcd::1
        Num Prunes: 0
```



Summary



Topics:

- Recap of PIM-ASM
- IPv6 Multicast Scope
- Embedded RP

Demos:

- Send PIM Join
- Embedded RP Extraction

Packet Analysis:

- PIM Hello
- PIM Register/Register Stop
- PIM Join/Prune

