BiDirectional Multicast (IPv4)

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Agenda

Topics:

- Basic Operation of BIDIR-PIM

Demos:

- Designated Forwarder Election
- BiDir State Tracking in Multicast

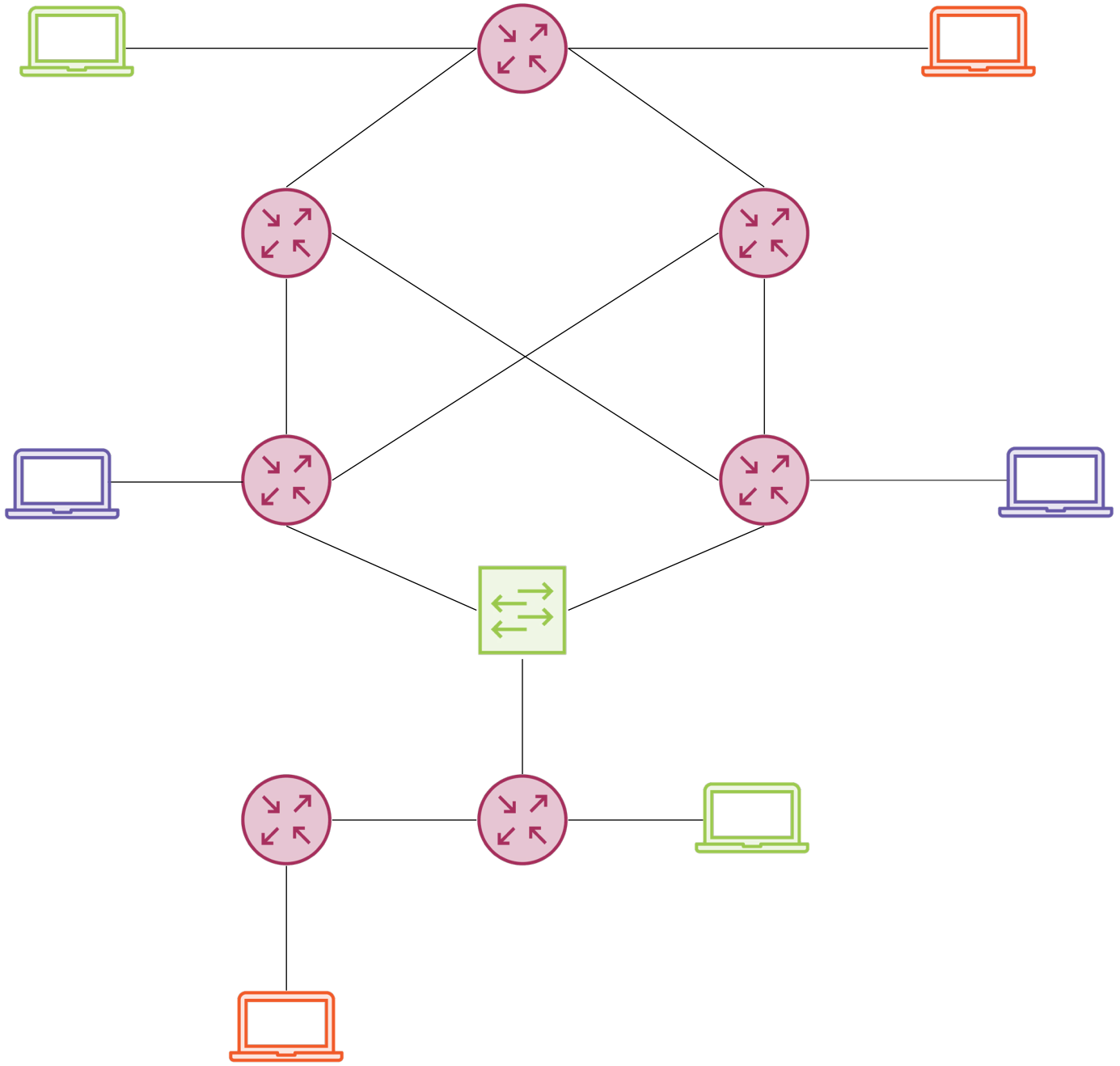
Packet Analysis:

- PIM Hello (BiDir)
- PIM Join/Prune (BiDir)
- PIM DF Packets

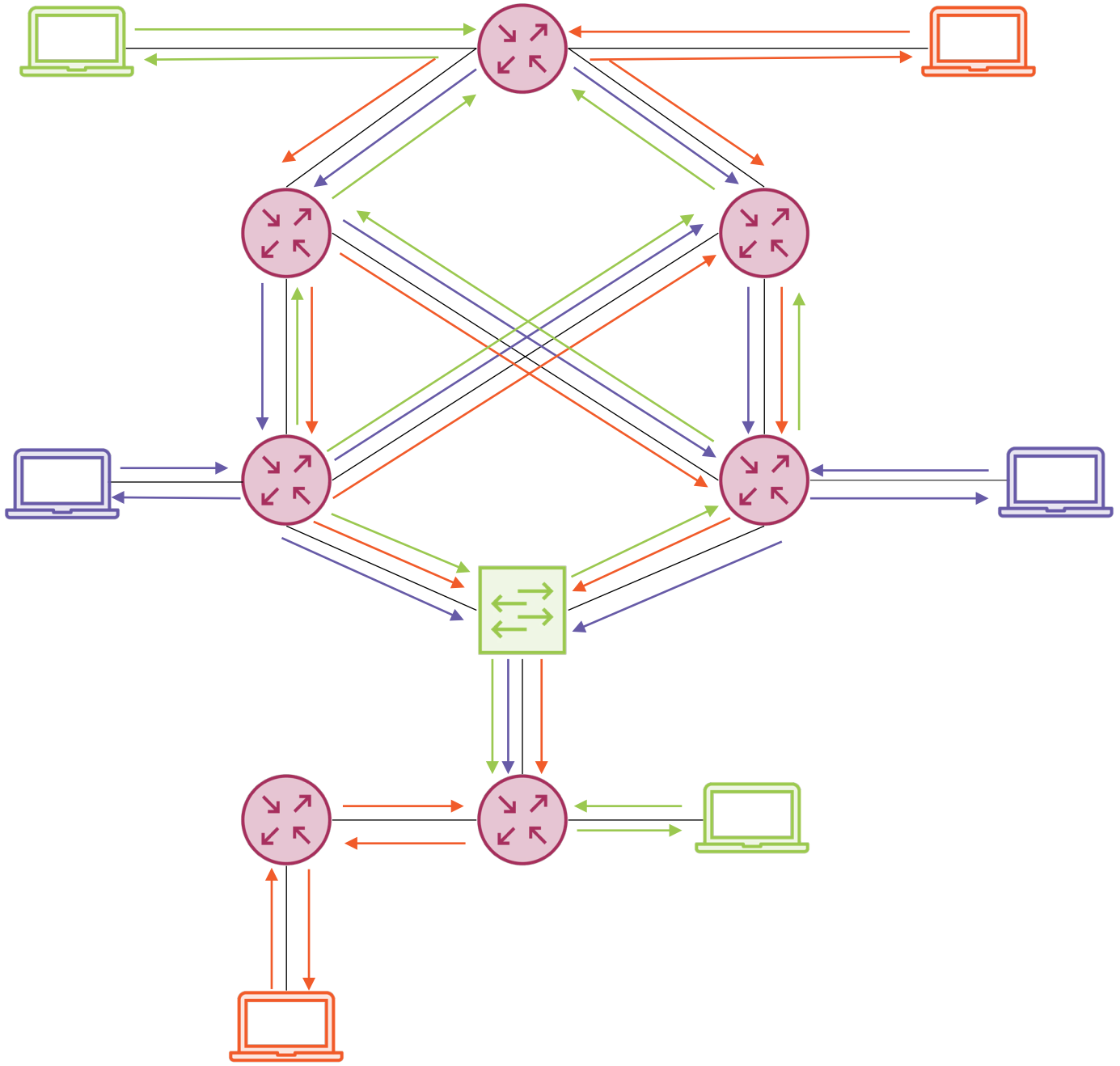
Globomantics Multicast Deployment Continues

BiDirectional PIM: Why?

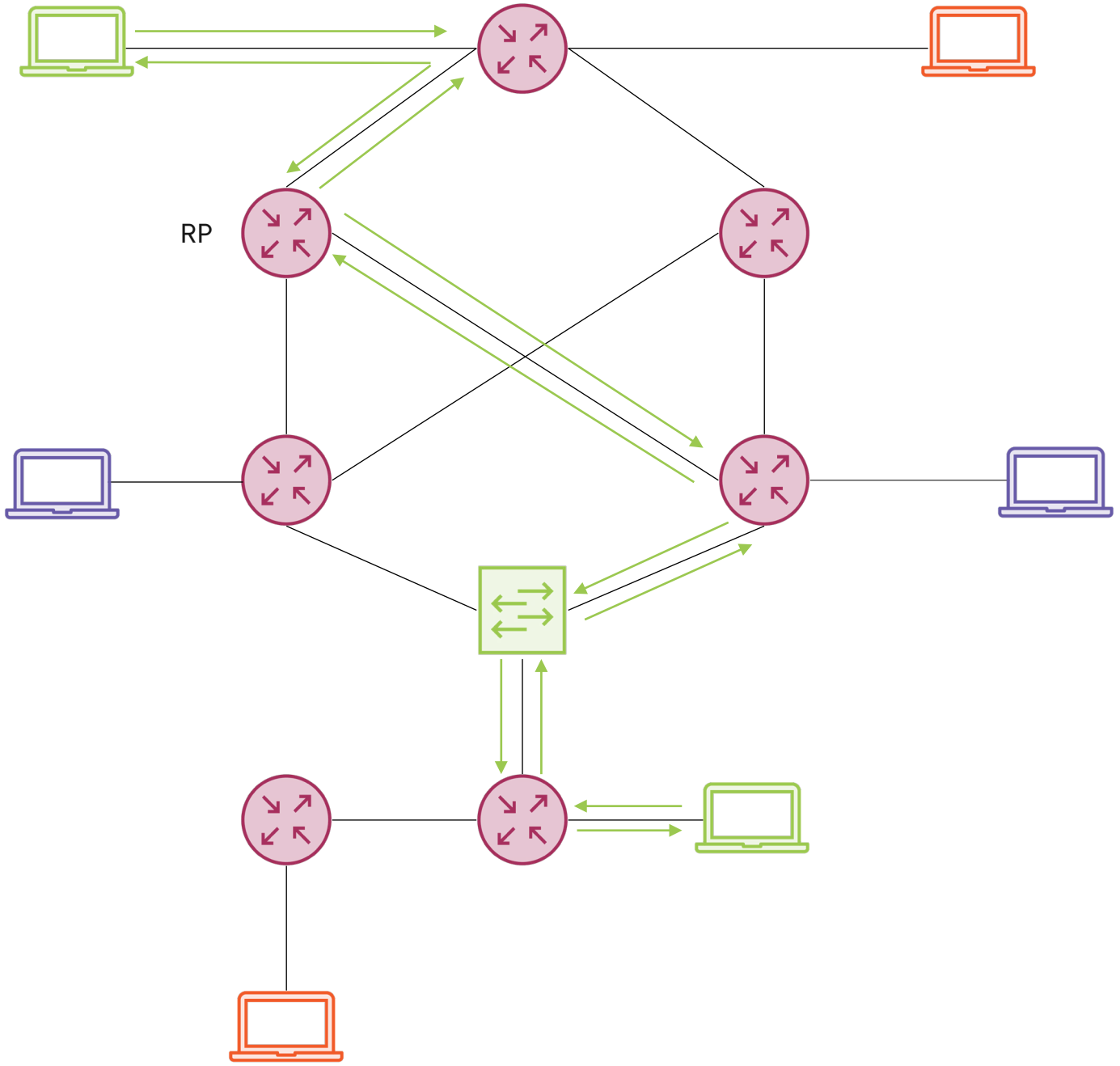
Many-to-Many Multicast



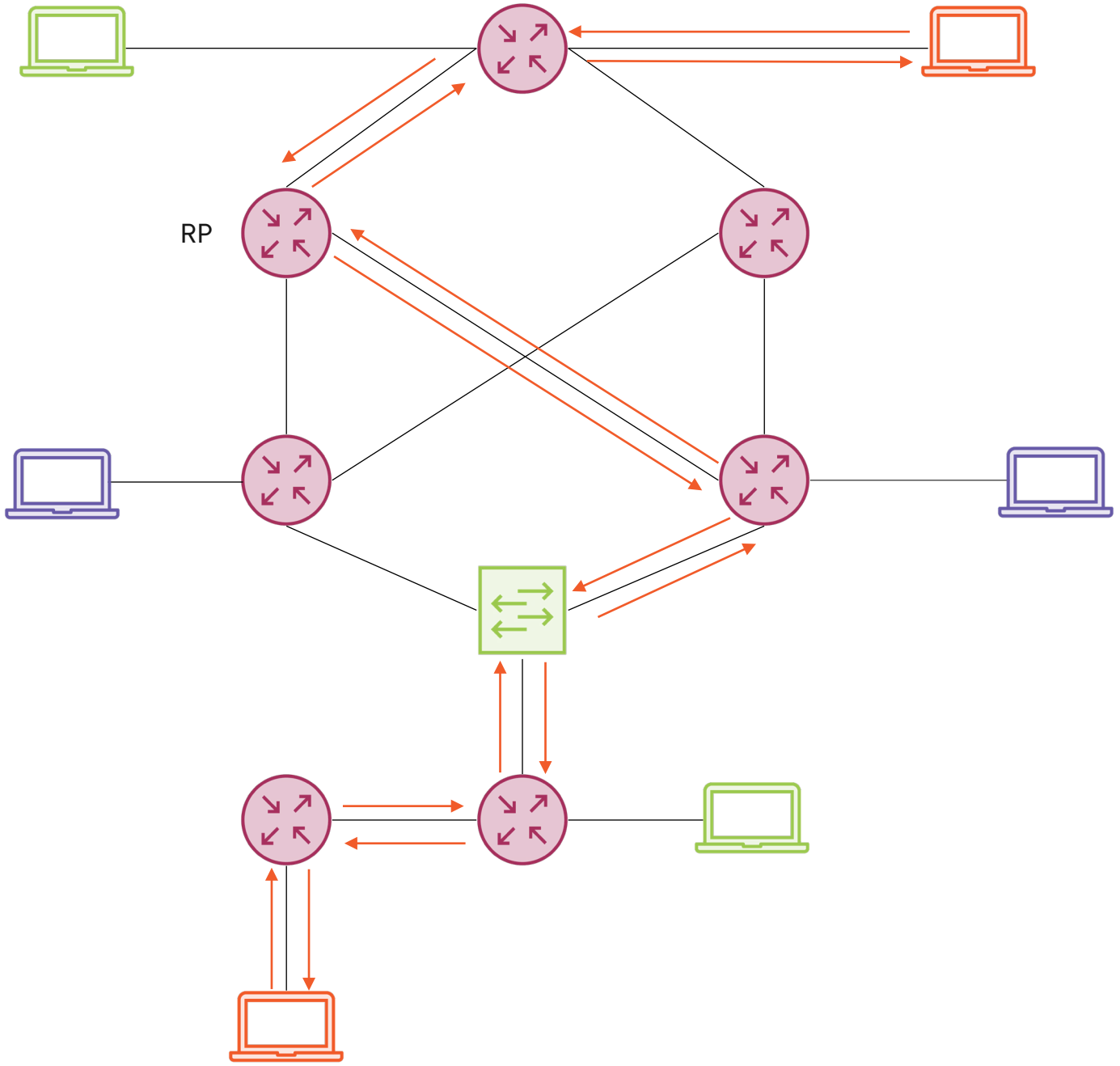
Many-to-Many Flows



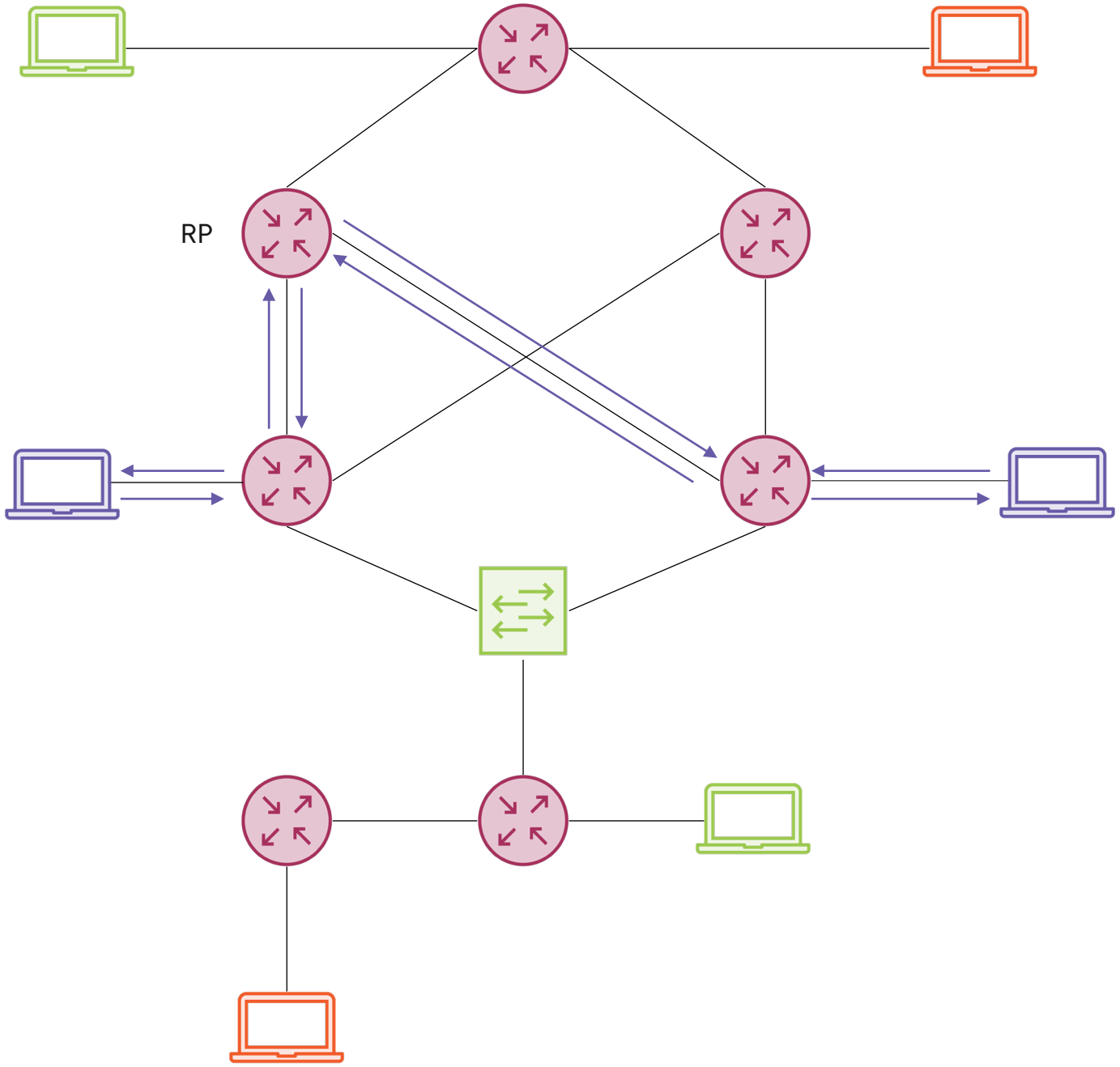
BIDIR-PIM (Green)



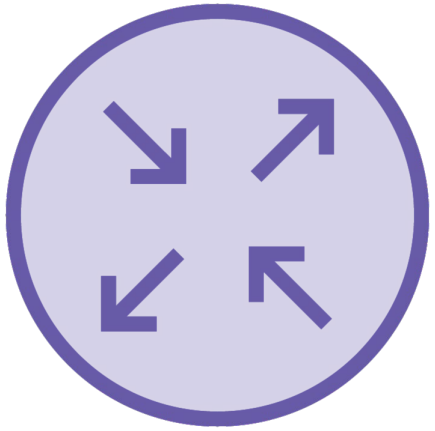
BIDIR-PIM (Orange)



BIDIR-PIM (Purple)



Designated Forwarder

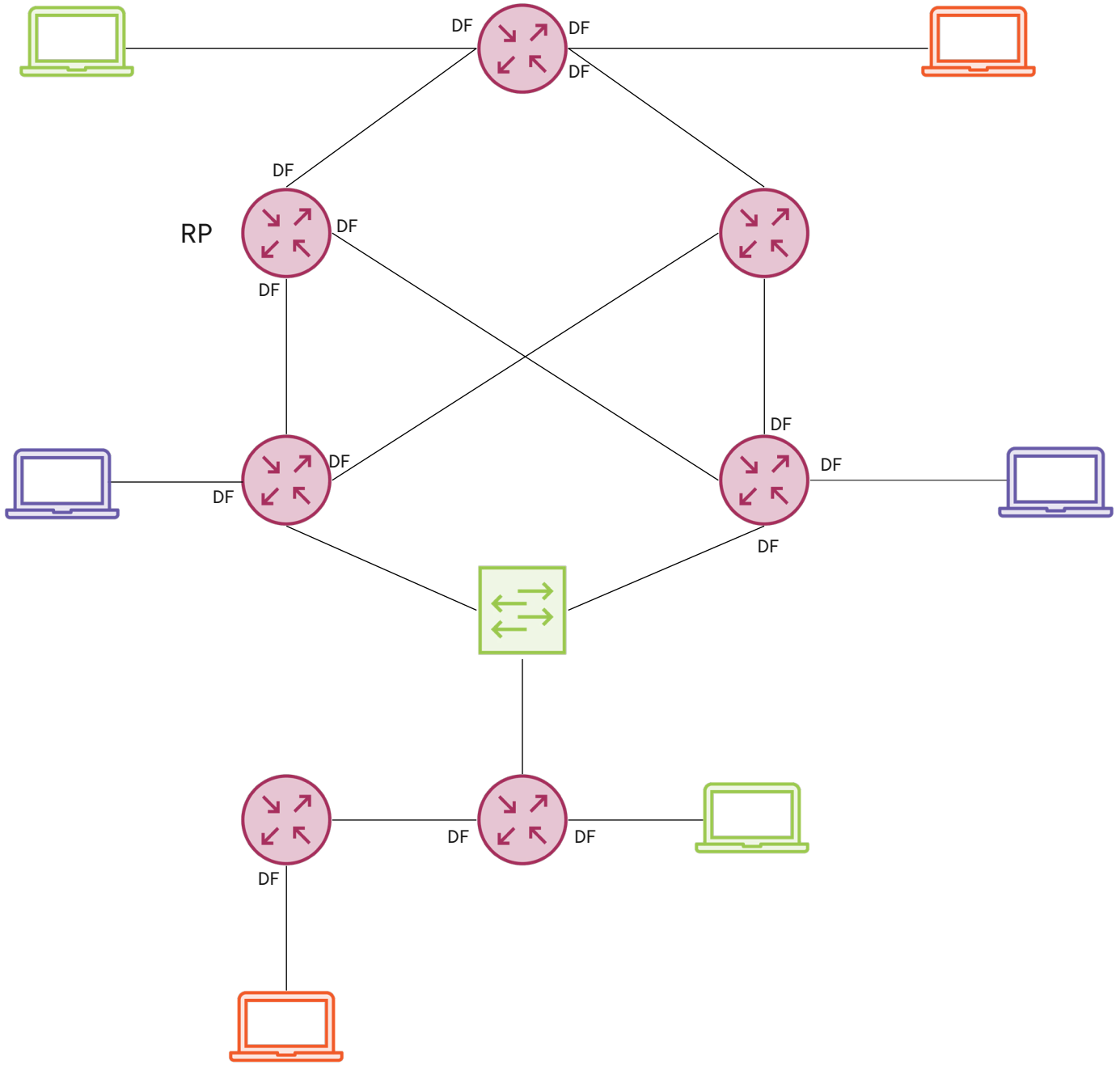


Forwarding
Forwards Multicast Up/Downstream on Segment

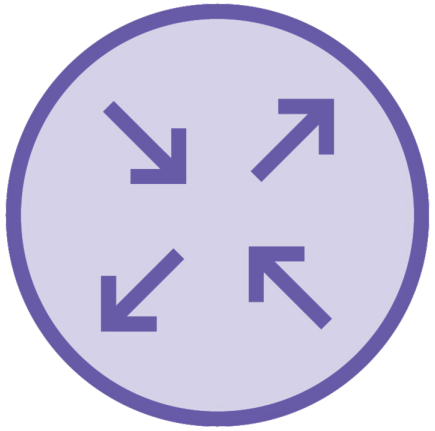
PIM Join
Forwards PIM Joins Upstream for Segment

Local Delivery
Delivers Multicast Locally to Receivers

Designated Forwarder Election



Phantom RP

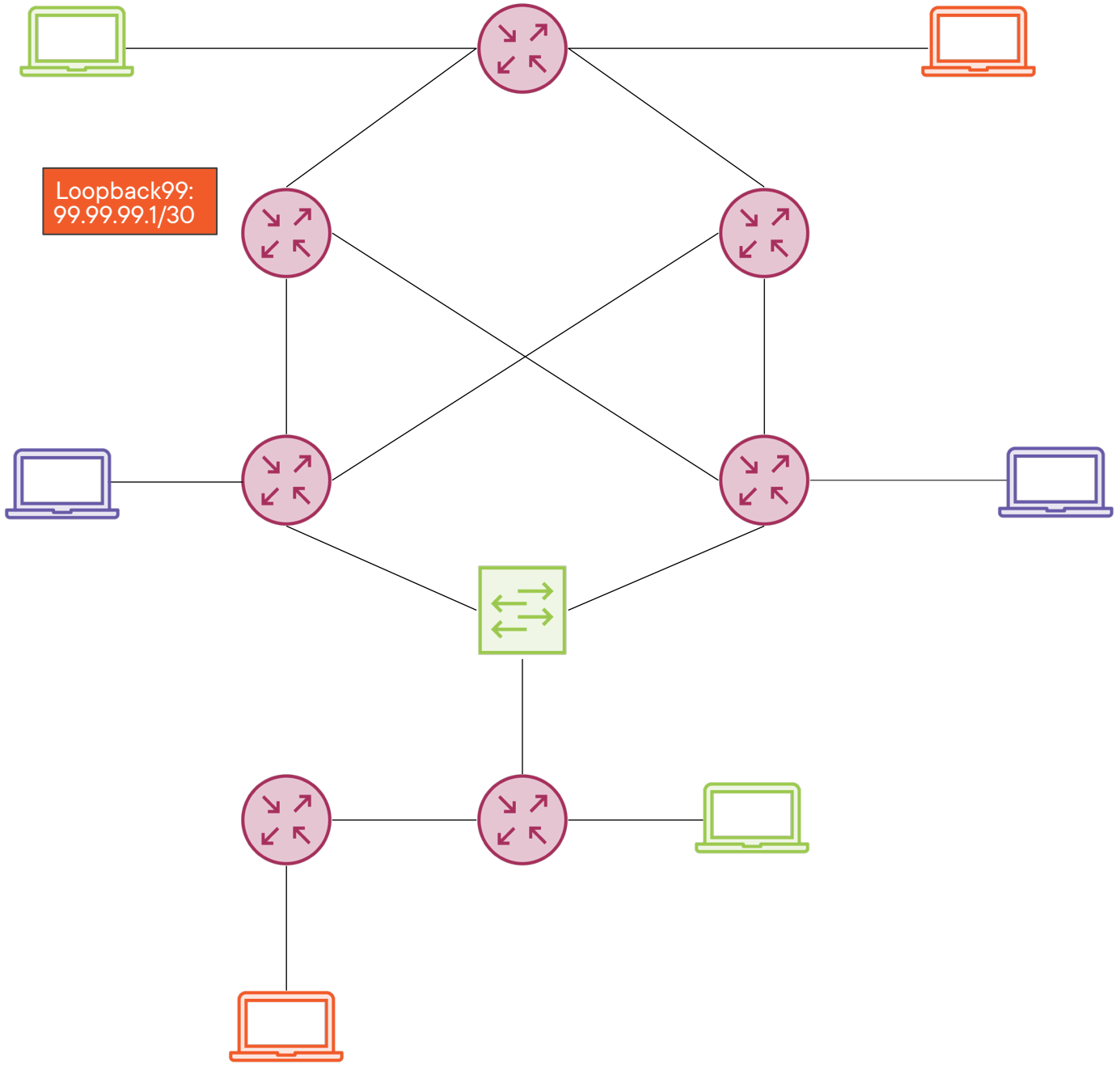


No Source Registration
No Source Tracking in BiDir PIM

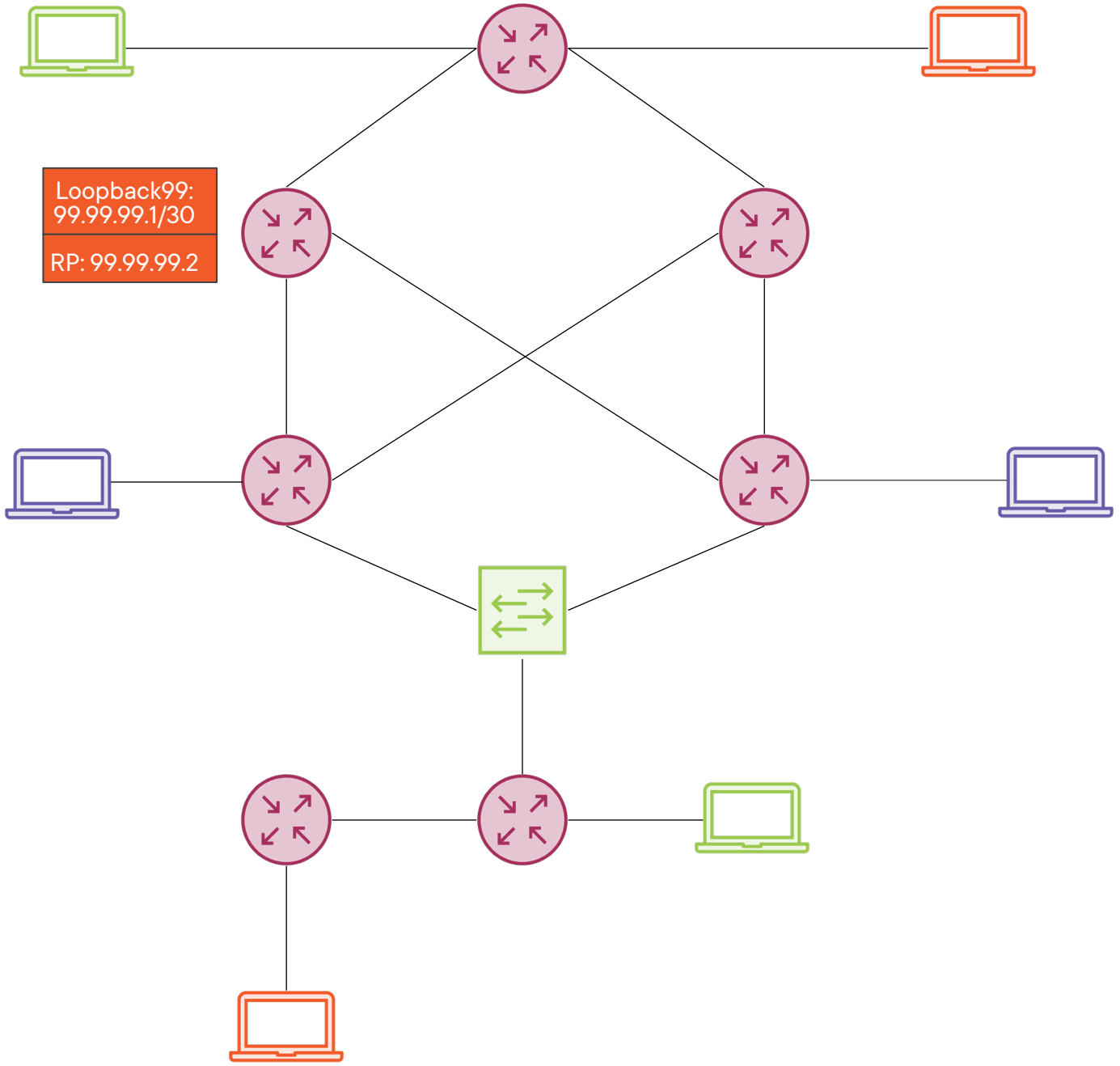
No Source Join
RP is the root of the shared tree

RP is Arbitrary
RP Link is an agreed-upon point to build a shared tree

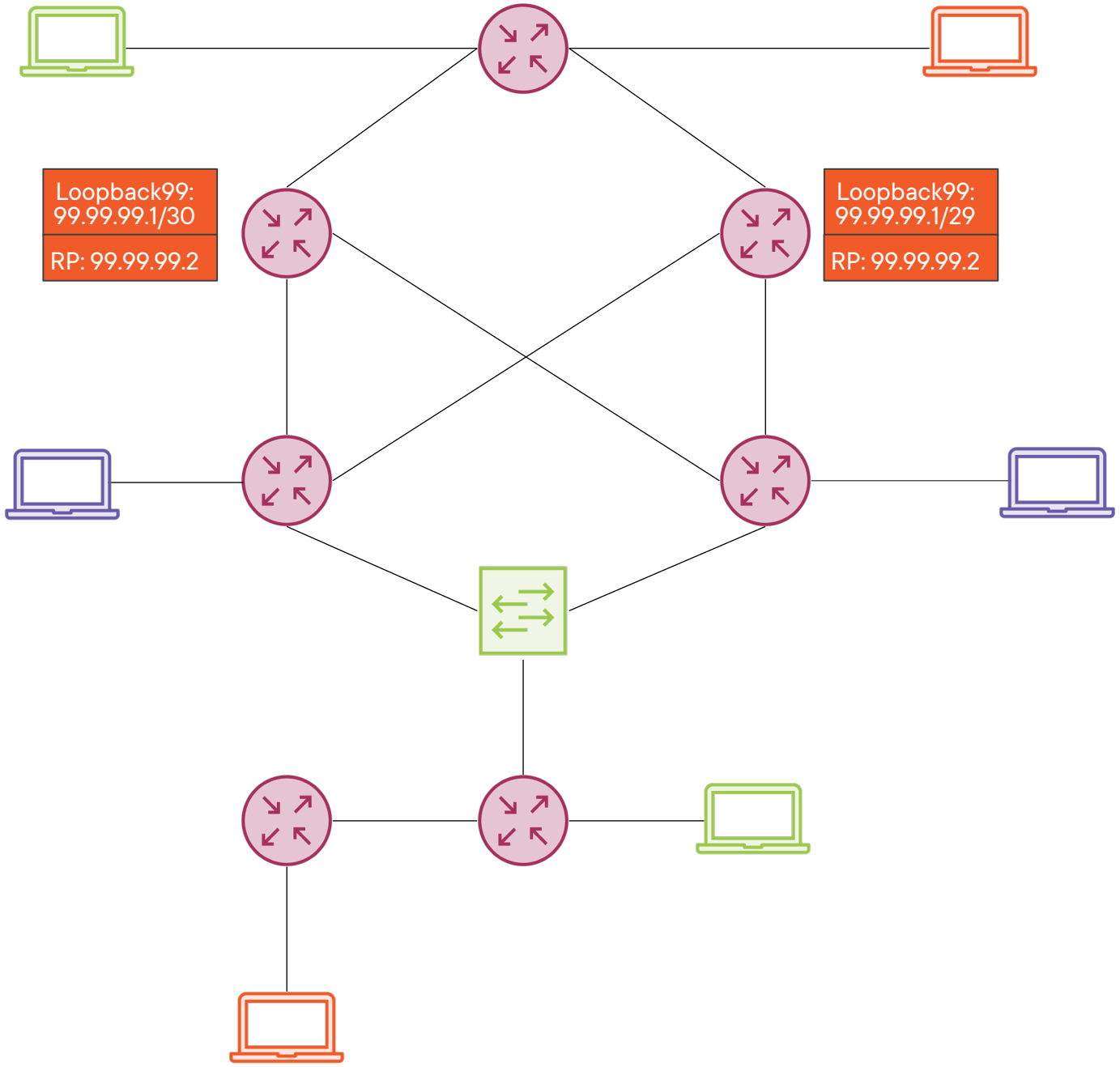
Phantom RP



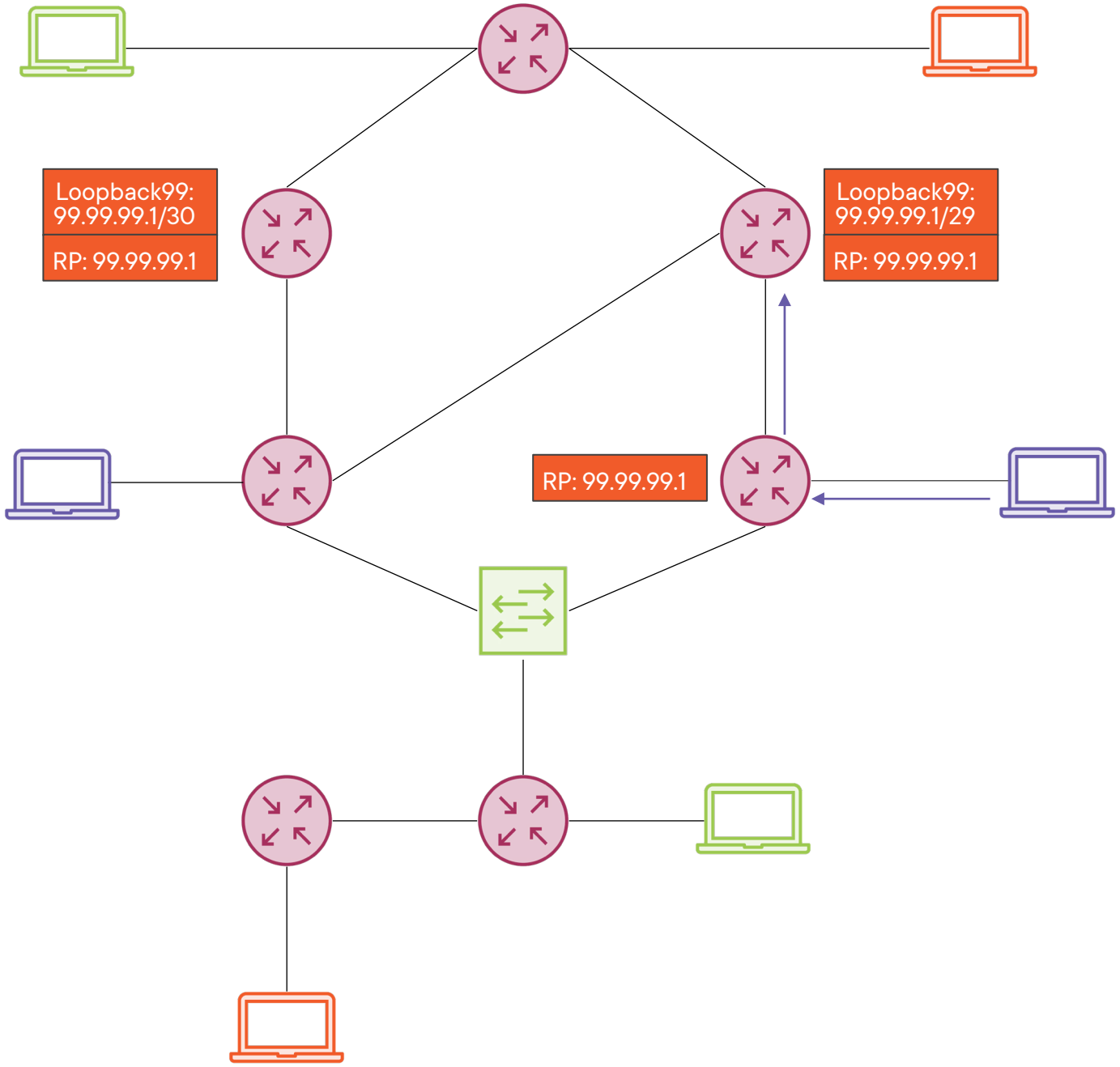
Phantom RP



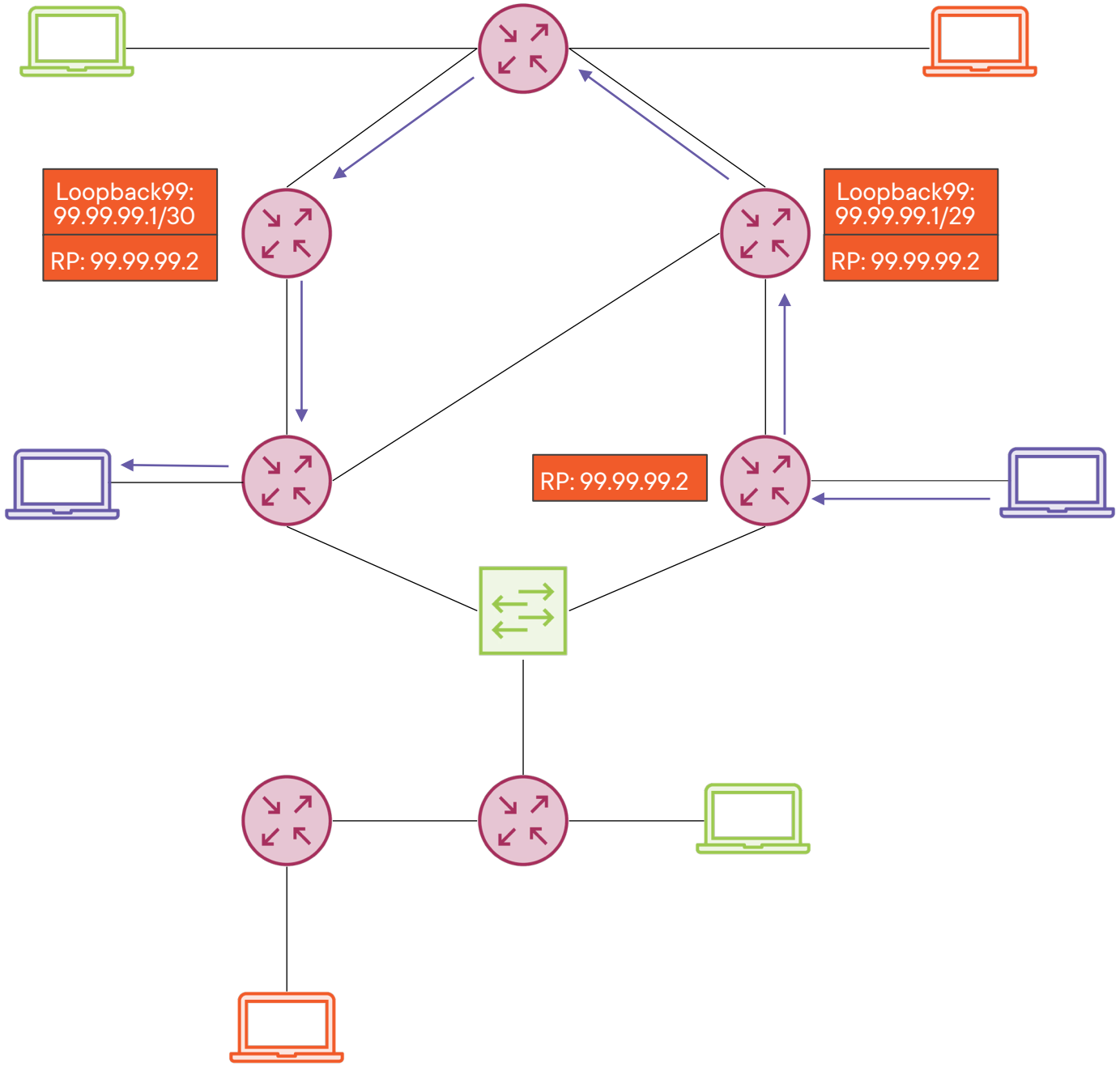
Phantom RP


Loopback99:
99.99.99.1/30
RP: 99.99.99.2
Loopback99:
99.99.99.1/29
RP: 99.99.99.2

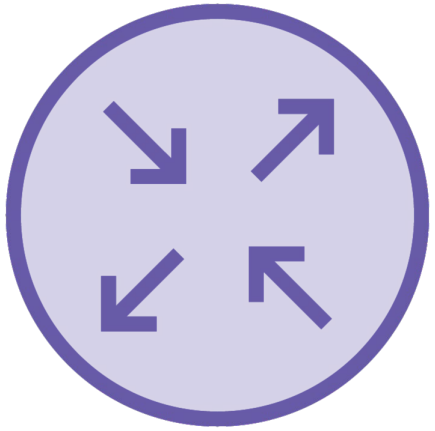
PIM Join Hijack



PIM Join Forwarded



BiDir PIM Only Works If...

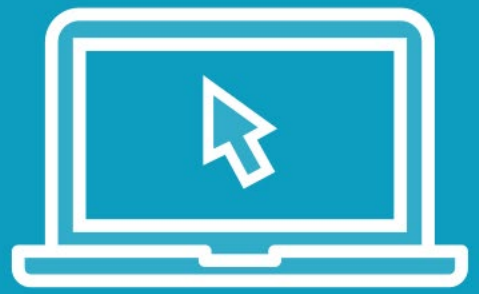


Every Router Agrees on Same RP Address/Link

Source Traffic Forwarded Upstream to RP Link

PIM Joins Forwarded Upstream to RP Link to Build OIL

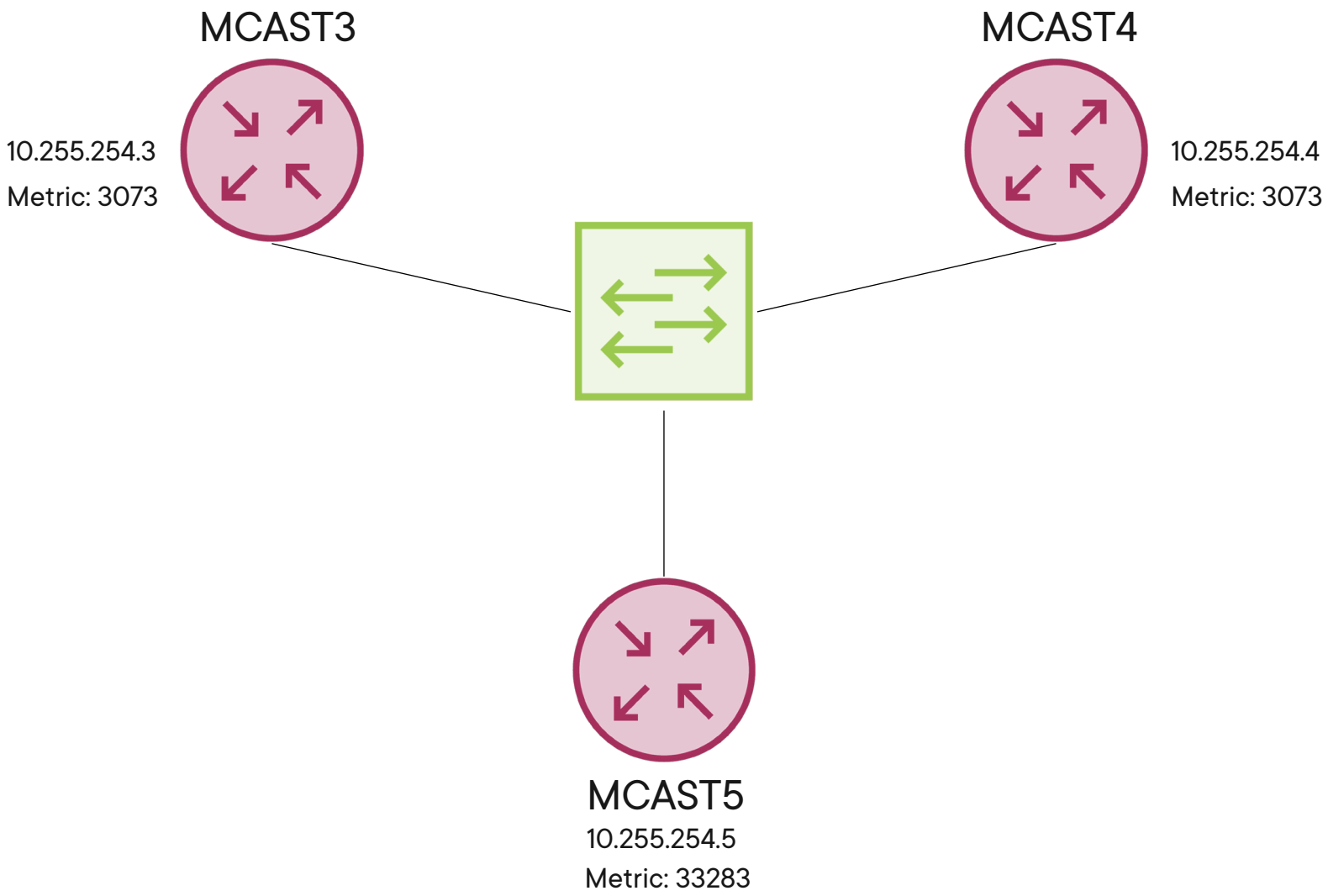
Demo



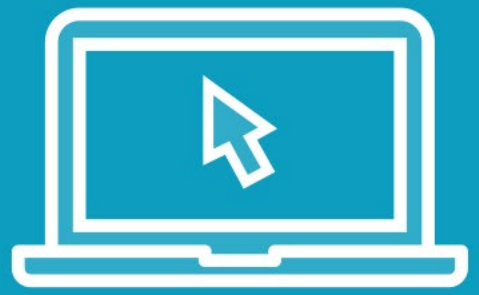
BIDIR-PIM Designated Forwarder Election

- Debug DF Election
- Change Metrics to See DF Reconverge

PIM Designated Forwarder Election



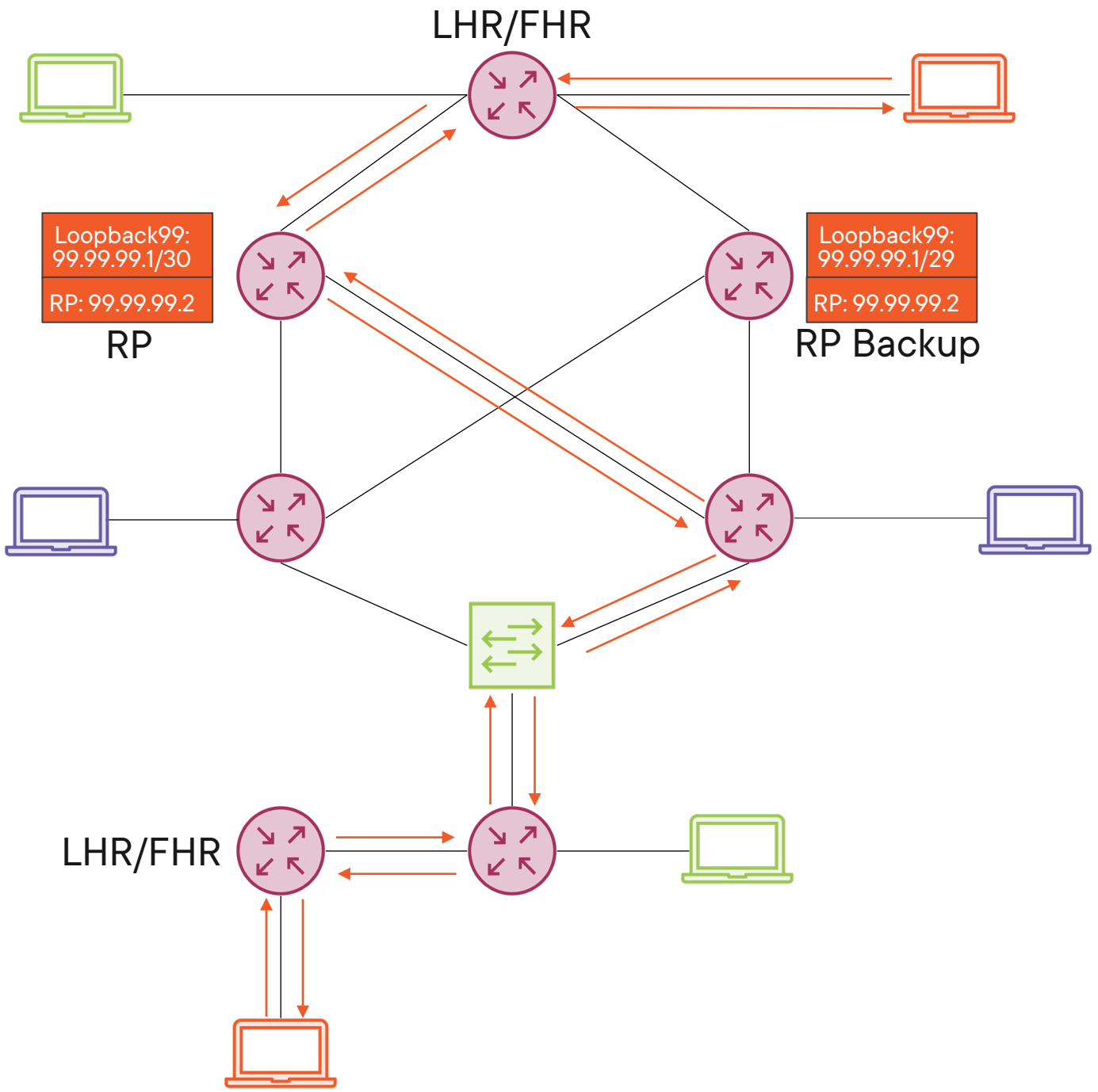
Demo



BIDIR-PIM Multicast State Tracking

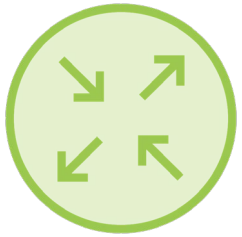
- Show IGMPv3/PIM Join from LHR
- Show Source Flow from FHR
- Show RP/Shared Tree Flow

BiDir PIM State Tracking

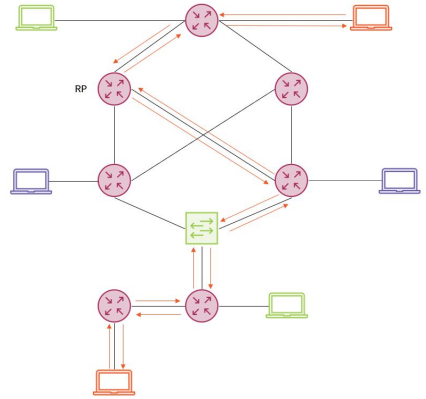


BiDir PIM Facts

DF Election
Like Spanning Tree Protocol

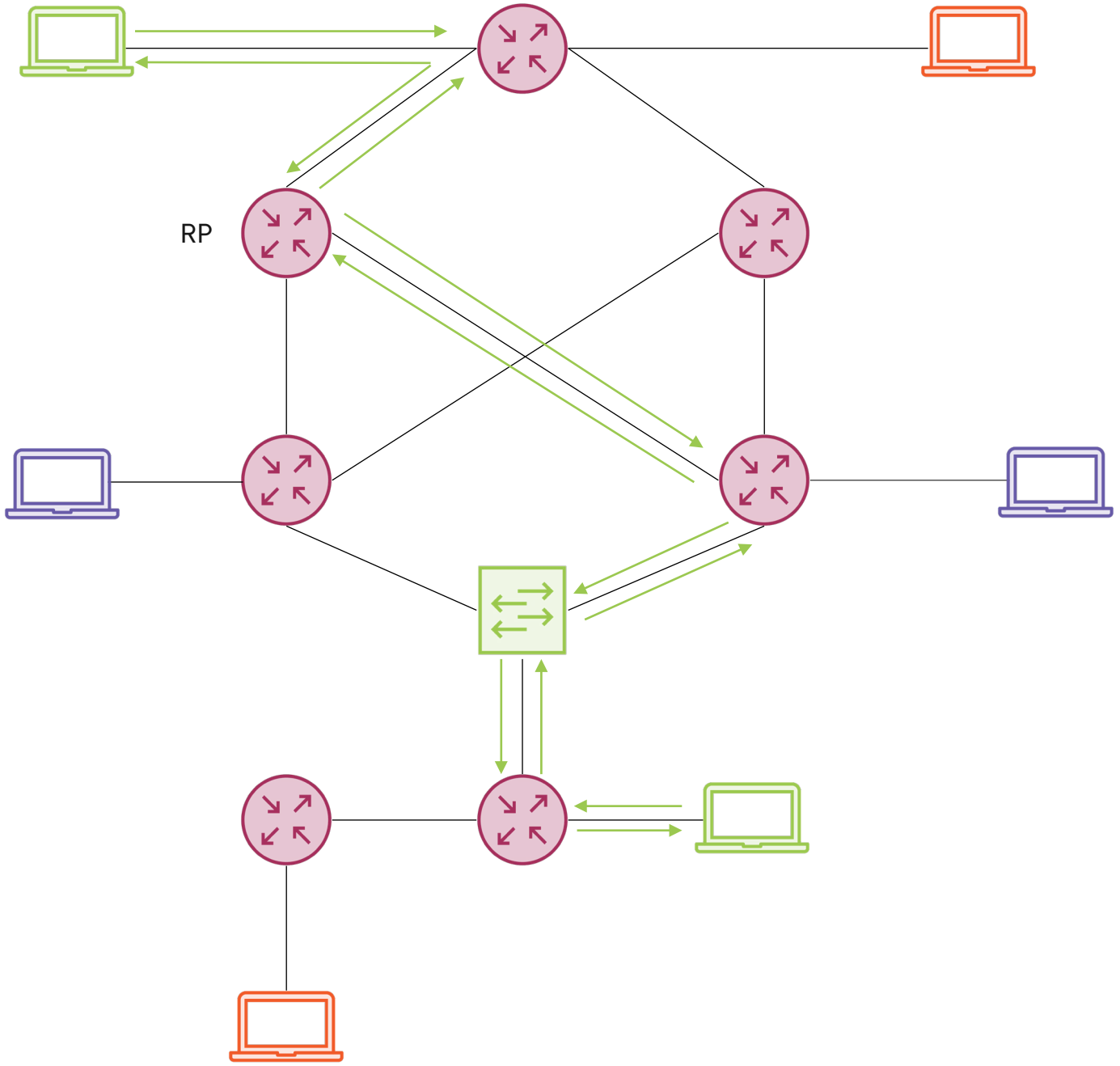


Rendezvous Point
Can be a Link instead of a Router



Shared Tree Only
No Source Tree and No Source Tracking

BIDIR-PIM (Green)



PIM Hello (BiDir)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.255.254.4	224.0.0.13	PIMv2	76	Hello

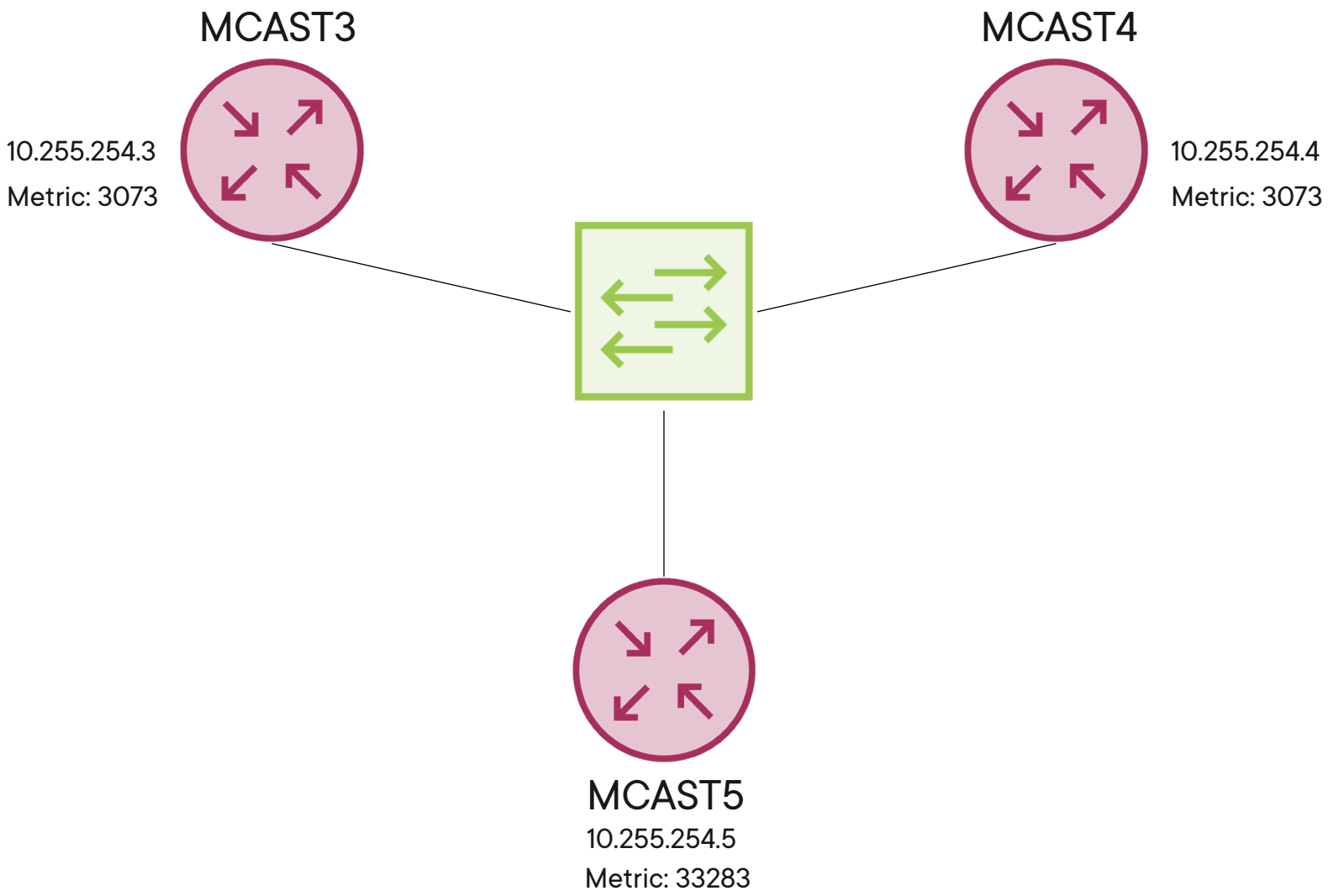
```
> Frame 1: 76 bytes on wire (608 bits), 76 bytes captured (608 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:02:00:00 (50:00:00:02:00:00), Dst: IPv4mcast_0d (01:00:5e:00:00:0d)
> Internet Protocol Version 4, Src: 10.255.254.4, Dst: 224.0.0.13
v Protocol Independent Multicast
    0010 .... = Version: 2
    .... 0000 = Type: Hello (0)
    Reserved byte(s): 00
    Checksum: 0xb816 [correct]
    [Checksum Status: Good]
  v PIM Options: 6
    > Option 1: Hold Time: 105
    > Option 20: Generation ID: 2455803245
    v Option 22: Bidirectional Capable
        Type: 22
        Length: 0
    > Option 19: DR Priority: 100
    > Option 21: State-Refresh: Version = 1, Interval = 0s
    > Option 65004: RPF Proxy Vector (Cisco proprietary)
```

PIM Join/Prune (BiDir)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.255.254.5	224.0.0.13	PIMv2	68	Join/Prune

```
> Frame 1: 68 bytes on wire (544 bits), 68 bytes captured (544 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:06:00:00 (50:00:00:06:00:00), Dst: IPv4mcast_0d (01:00:5e:00:00:0d)
> Internet Protocol Version 4, Src: 10.255.254.5, Dst: 224.0.0.13
v Protocol Independent Multicast
    0010 .... = Version: 2
    .... 0011 = Type: Join/Prune (3)
    Reserved byte(s): 00
    Checksum: 0x117d [correct]
    [Checksum Status: Good]
  v PIM Options
    v Upstream-neighbor: 10.255.254.4
        Address Family: IPv4 (1)
        Encoding Type: Native (0)
        Unicast: 10.255.254.4
      Reserved byte(s): 00
      Num Groups: 1
      Holdtime: 210
    v Group 0
      v Group 0: 239.3.2.1/32
          Address Family: IPv4 (1)
          Encoding Type: Native (0)
        > Flags: 0x00
          Masklen: 32
          Group: 239.3.2.1
      v Num Joins: 1
        v IP address: 99.99.99.2/32 (SWR)
            Address Family: IPv4 (1)
            Encoding Type: Native (0)
          > Flags: 0x07, Sparse, WildCard, Rendezvous Point Tree
            Masklen: 32
            Source: 99.99.99.2
      Num Prunes: 0
```

PIM Designated Forwarder Election



DF Election (Offer)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.255.254.3	224.0.0.13	PIMv2	54	DF election

```
> Frame 1: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:01:00:00 (50:00:00:01:00:00), Dst: IPv4mcast_0d (01:00:5e:00:00:0d)
> Internet Protocol Version 4, Src: 10.255.254.3, Dst: 224.0.0.13
v Protocol Independent Multicast
    0010 .... = Version: 2
    .... 1010 = Type: DF election (10)
    0001 .... = DF Subtype: offer (1)
    .... 0000 = DF reserved: 0
    Checksum: 0x01cc [correct]
    [Checksum Status: Good]
  v PIM Options
    v RP: 99.99.99.2
        Address Family: IPv4 (1)
        Encoding Type: Native (0)
        Unicast: 99.99.99.2
      DF Metric Preference: 90
      Metric: 3072
```

DF Election (Winner)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.255.254.3	224.0.0.13	PIMv2	54	DF election

```
> Frame 1: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:01:00:00 (50:00:00:01:00:00), Dst: IPv4mcast_0d (01:00:5e:00:00:0d)
> Internet Protocol Version 4, Src: 10.255.254.3, Dst: 224.0.0.13
v Protocol Independent Multicast
    0010 .... = Version: 2
    .... 1010 = Type: DF election (10)
    0010 .... = DF Subtype: DF Winner (2)
    .... 0000 = DF reserved: 0
    Checksum: 0x01bc [correct]
    [Checksum Status: Good]
  v PIM Options
    v RP: 99.99.99.2
        Address Family: IPv4 (1)
        Encoding Type: Native (0)
        Unicast: 99.99.99.2
      DF Metric Preference: 90
      Metric: 3072
```

DF Election (Backoff)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.255.254.3	224.0.0.13	PIMv2	71	DF election

```
> Frame 1: 71 bytes on wire (568 bits), 71 bytes captured (568 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:01:00:00 (50:00:00:01:00:00), Dst: IPv4mcast_0d (01:00:5e:00:00:0d)
> Internet Protocol Version 4, Src: 10.255.254.3, Dst: 224.0.0.13
v Protocol Independent Multicast
    0010 .... = Version: 2
    .... 1010 = Type: DF election (10)
    0011 .... = DF Subtype: DF Backoff (3)
    .... 0000 = DF reserved: 0
    Checksum: 0xcea5 [correct]
    [Checksum Status: Good]
  v PIM Options
    v RP: 99.99.99.2
        Address Family: IPv4 (1)
        Encoding Type: Native (0)
        Unicast: 99.99.99.2
      DF Metric Preference: 90
      Metric: 3072
```

DF Election (Pass)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.255.254.3	224.0.0.13	PIMv2	70	DF election

```
> Frame 1: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface eth0, id 0
> Ethernet II, Src: 50:00:00:01:00:00 (50:00:00:01:00:00), Dst: IPv4mcast_0d (01:00:5e:00:00:0d)
> Internet Protocol Version 4, Src: 10.255.254.3, Dst: 224.0.0.13
v Protocol Independent Multicast
    0010 .... = Version: 2
    .... 1010 = Type: DF election (10)
    0100 .... = DF Subtype: DF Pass (4)
    .... 0000 = DF reserved: 0
    Checksum: 0xeb96 [correct]
    [Checksum Status: Good]
  v PIM Options
    v RP: 99.99.99.2
        Address Family: IPv4 (1)
        Encoding Type: Native (0)
        Unicast: 99.99.99.2
      DF Metric Preference: 90
      Metric: 3072
```

Summary

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- Basic Operation of BIDIR-PIM

Demos:

- Designated Forwarder Election
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Packet Analysis:

- PIM Hello (BiDir)
- PIM Join/Prune (BiDir)
- PIM DF Packets