



Cisco TechAdvantage Webinars

Next Gen MVPN

Rabiul Hasan

Ujjwal Vinod

Agenda

- MULTICAST VPN BUSINESS DRIVERS
- OVERVIEW
- PROVIDER-TREE
- mLDP and P2MP-TE
- DESIGN DETAILS
 - UPSTREAM MULTICAST HOP
 - DUPLICATE TRAFFIC AVOIDANCE
 - SWITCHING FROM SHARED TREE TO SOURCE C-TREE
 - PIM-SM WITHOUT INTER-SITE SHARED C-TREES
- SUPPORTED PROFILES
- SAMPLE CONFIGURATIONS
 - IOS/XE
 - IOS-XR

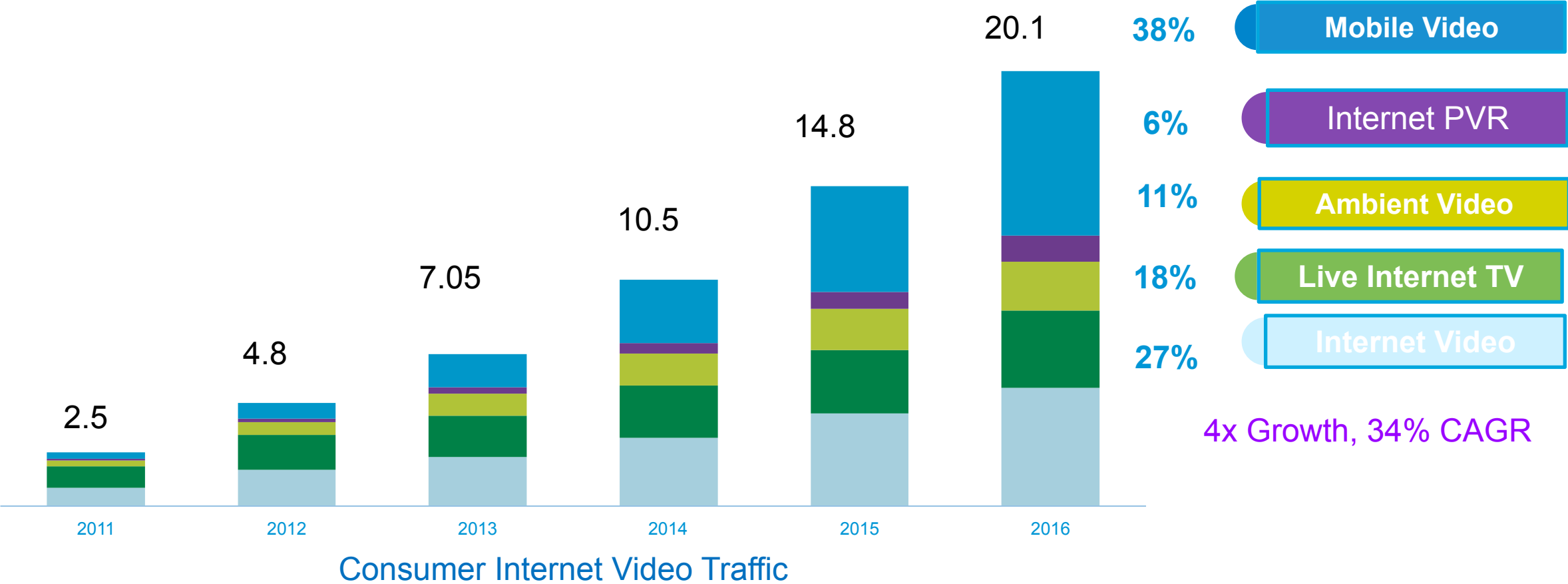


Multicast VPN Business Drivers



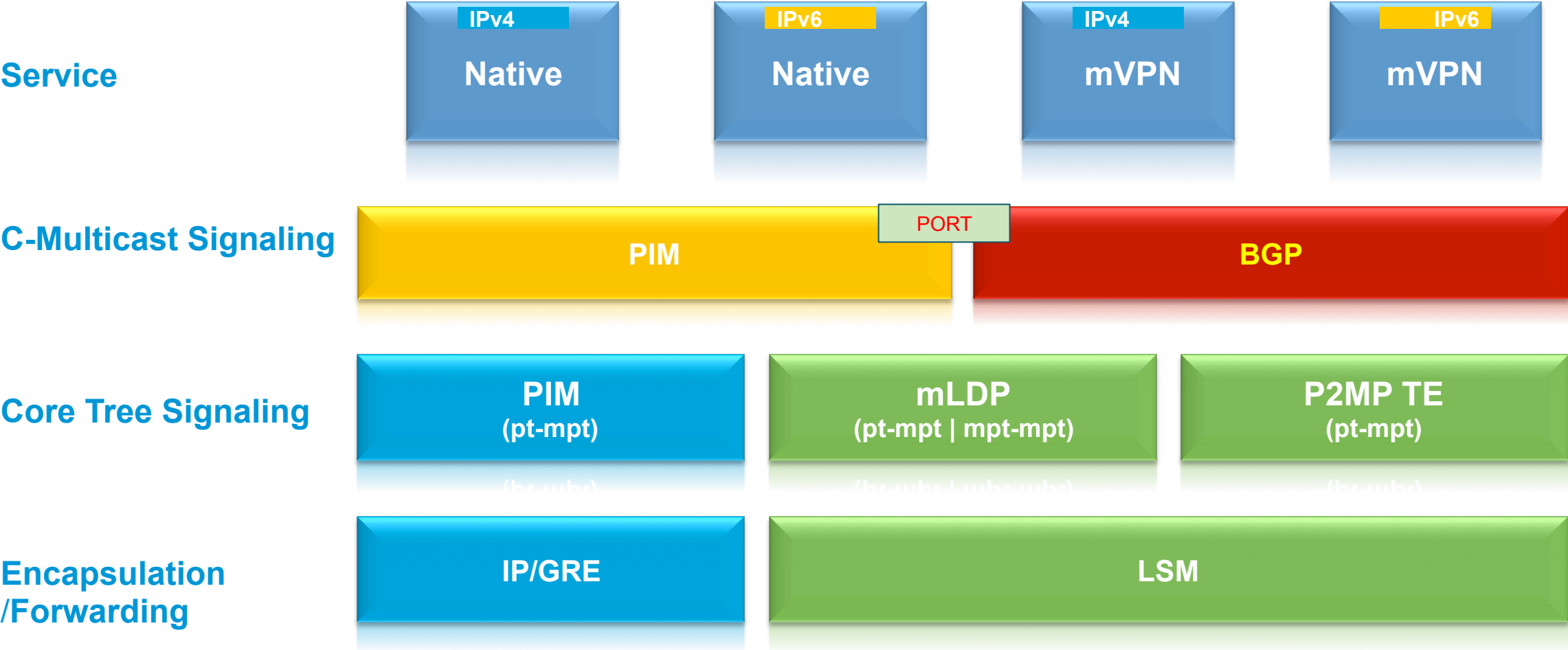
Internet Video Will Drive Most Consumer Internet Traffic Through 2016

Consumer Internet Video traffic will reach 20 EB/month in 2016



Source: Cisco Visual Networking Index—Forecast, 2011-2016

Multicast VPN Solution Space



What is Label Switched Multicast ?

1

IP multicast packets are transported using MPLS encapsulation.

2

MPLS encoding for LSM documented in RFC-5332.

3

Unicast and Multicast share the same label space.

4

MPLS protocols RSVP-TE and LDP are modified to support P2MP and MP2MP LSPs.

LSM Applications

IPTV / Internet multicast transport

- mLDP in-band-signaling
- 1:1 mapping between IP multicast flow and LSP
- non-VPN

VPLS LSM

- Multicast over VPLS VPN
- P2MP mLDP or RSVP TE for P-tree
- Dynamic tunnels

Carriers Carrier service

- A provider offering services to another provider

MVPN (RFC-6037 i.e. Rosen Model)

- MP2MP mLDP for MI-PMSI (i.e. default MDT)
- P2MP mLDP or RSVP TE for MS-PMSI (i.e. data MDT)

MVPN (Dynamic partitioned MDT)

- Dynamic model of above.
- Using mLDP MP2MP for the dynamic MDT.

Multicast VPN Drivers

- **Growing Demand**

- Growing number of MPLS-VPN customers have IP Multicast Traffic
- Volume and Type of multicast Traffic
 - Expected to grow to a significant share of the total traffic
 - Increasing demand for video, rich-media

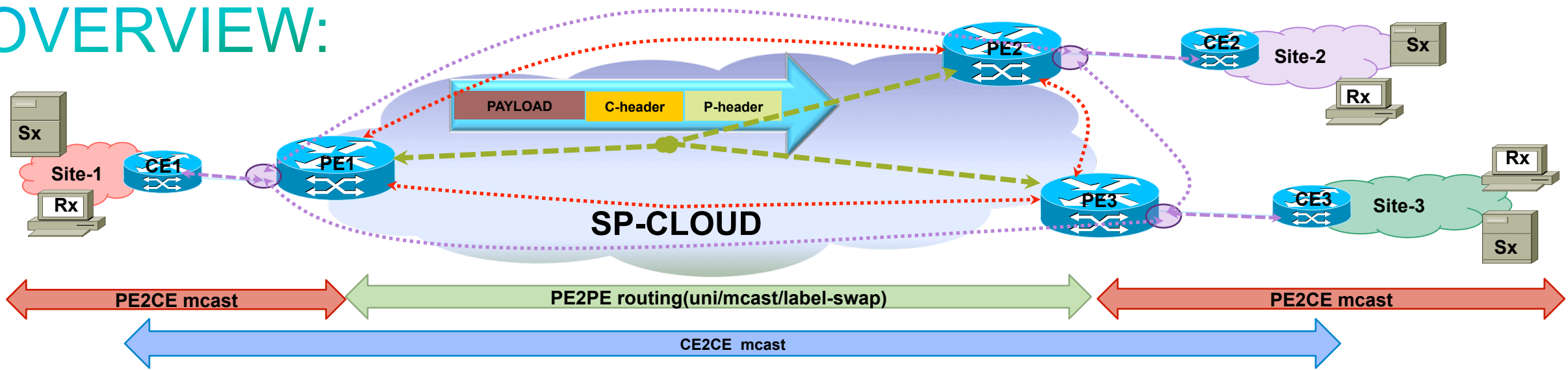
- **Evolution of Label Switched Multicast**

- Extend MPLS-VPN service offering to include support for multicast traffic
- Same architecture/Model as 4364 VPN unicast
- Re-use the 4364 unicast mechanisms with extensions
 - BGP as the Signaling Protocol for all services
 - No PIM in the Core
- Same flexibility and scalability of 4364 VPN unicast

OVERVIEW

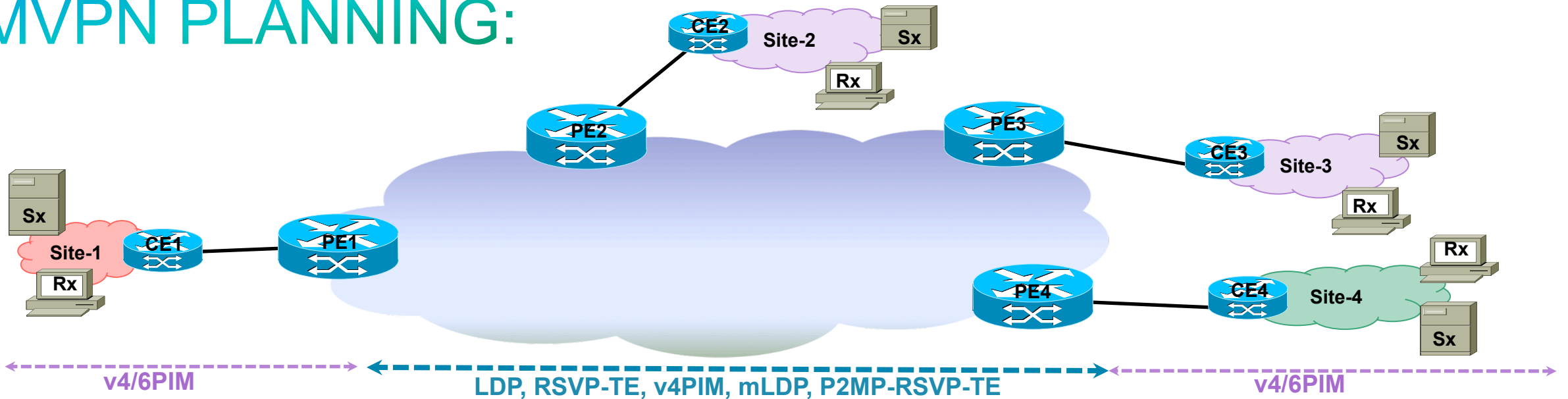


OVERVIEW:



	CLASSICAL-support		NG-support
ENCAPSULATION OPTIONS IN CORE	IP/GRE	+	MPLS
OPTIONS TO DISCOVER PEs	PIM	+	BGP
CORE/PROVIDER-TREE	PIM-ASM/SSM/BIDIR	+	mLDP, P2MP-TE, INGRESS-REPLICATION
C-MCAST ROUTING OPTIONS (PE-PE)	PIM	+	BGP
PE-CE MCAST ROUTING	PIM-ASM/SSM/BIDIR	+	mLDP, BGP
BINDING BTW FLOW & P-TREE	PIM	+	BGP

MVPN PLANNING:



MULTICAST CORE PROTOCOL OPTIONS

- 1) PIM (SM, SSM, BIDIR)
- 2) MPLS mLSP using mLDP
- 3) MPLS mLSP using RSVP P2MP-TE

CORE/PROVIDER TREE

- 1) P2MP
- 2) MP2MP
- 3) P2P

MODEL

- 1) **ROSEN**: Default MDT (MI-PMSI) [MUST], On-Demand Data MDT (S-PMSI) [OPTIONAL]
- 2) **PARTITIONED**: On-Demand Partition MDT (MS-PMSI) [MUST], On-Demand Data MDT (S-PMSI) [OPTIONAL]
- 3) **IN-BAND**: On-Demand core-tree per-VRF, per-S,G

AUTO-DISCOVERY

- 1) [RFC-6037] PIM (ASM, SSM, BIDIR) + BGP
- 2) [RFC-6514] BGP

C-MULTICAST ROUTING OPTIONS

- 1) PIM (ASM, SSM, BIDIR)
- 2) BGP

WHY NG-MVPN?

Unified signalling protocol for unicast and multicast VPN

Without Enhancements

NO

With Enhancements

YES

Unified forwarding plane using MPLS labels

NO

YES

Auto-Discovery with Unidirectional P-Tree

NO

YES

PIM-SM in VRF without SHARED tree creation

NO

YES

Inherent Stability & Reliability of BGP in use

NO

YES

Simplification of ASSERT in core

NO

YES

MVPN EVOLUTION:

①

BGP EXTENDED COMMUNITY: Here PE loopback (source address) information is sent as a **VPNv4 prefix using Route Distinguisher (RD) Type 2** (to distinguish it from unicast VPNv4 prefixes). The MDT group address is carried in a BGP extended community.

Prior to the introduction of MDT SAFI support, the BGP extended community attribute was used as an interim solution to advertise the IP address of the source PE and default MDT group before IETF standardization.

A BGP extended community attribute in an MVPN environment, however, has certain limitations: it cannot be used in inter-AS scenarios (because the attribute is non-transitive), and it uses RD Type 2 (which is not a supported standard).

SAFI:

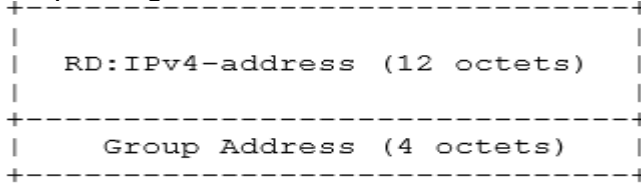
- 001: NLRI used for unicast forwarding
- 002: NLRI used for multicast forwarding
- 128: MPLS-labeled VPN address
- 129: Multicast for BGP/MPLS IP VPNs

- 066: BGP MDT SAFI
- 005: MCAST-VPN

<http://www.iana.org/assignments/safi-namespace/safi-namespace.xml>

②

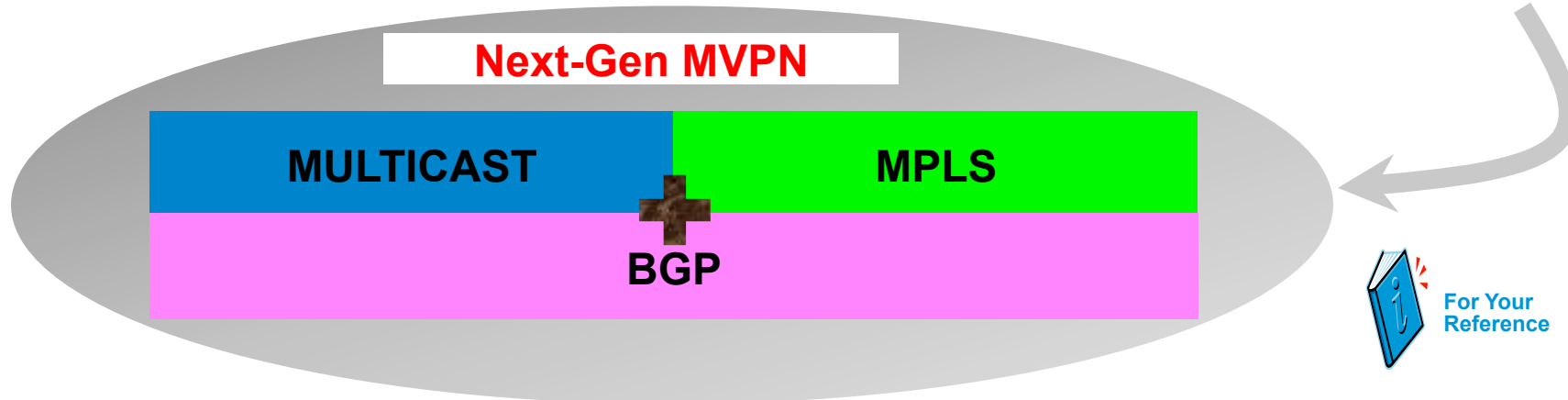
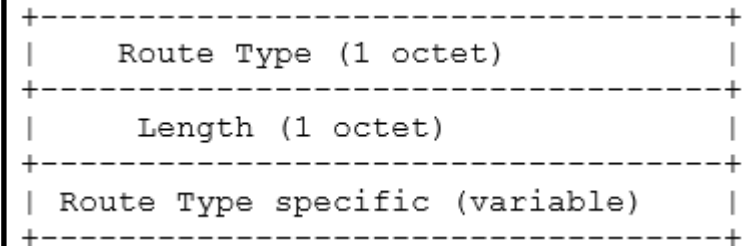
BGP MDT SAFI: The source PE address and the MDT group address are passed to PIM using BGP MDT SAFI updates. The RD type has changed to RD type 0 and BGP determines the best path for the MDT updates before passing the information to PIM.



The IPv4 address identifies the PE that originated this route, and the RD identifies a VRF in that PE. The group address MUST be an IPv4 multicast group address and is used to build the P-tunnels. All PEs attached to a given MVPN MUST specify the same group address, even if the group is an SSM group. MDT-SAFI routes do not carry RTs, and the group address is used to associate a received MDT-SAFI route with a VRF.

③

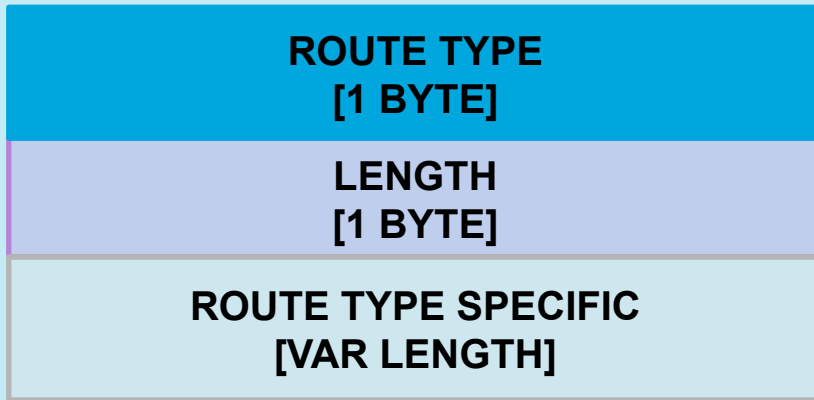
BGP MCAST-VPN SAFI: The MCAST-VPN NLRI is carried in BGP using BGP Multiprotocol Extensions with an AFI of 1 or 2 and SAFI of MCAST-VPN. The NLRI field in the MP_REACH_NLRI/MP_UNREACH_NLRI attribute contains the MCAST-VPN NLRI.



NLRI AND ATTRIBUTES:

NLRI

1) MCAST-VPN NLRI



- 1) **INTRA-AS I-PMSI A-D ROUTE** [Originated by ALL MVPN PEs]
- 2) **INTER-AS I-PMSI A-D ROUTE** [Originated by MVPN ASBRs]
- 3) **S-PMSI A-D ROUTE** [Originated by SENDER PEs]
- 4) **LEAF A-D ROUTE** [Originated by TAIL PEs]
- 5) **SOURCE ACTIVE A-D ROUTE** [Originated by ACTIVE-SOURCE/RP PEs]
- 6) **SHARED TREE JOIN ROUTE** [Originated by RECEIVER PEs]
- 7) **SOURCE TREE JOIN ROUTE** [Originated by RECEIVER PEs]

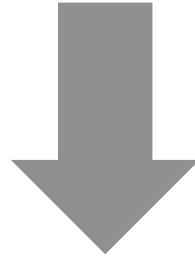
ATTRIBUTES

- 1) **PMSI TUNNEL ATTRIBUTE** [The PTA is used in conjunction with: Intra-AS I-PMSI A-D, Inter-AS I-PMSI A-D, S-PMSI A-D, Leaf A-D]
- 2) **PE DISTINGUISHER LABEL ATTRIBUTE** [PDL is distributed with Intra-AS I-PMSI A-D and/or S-PMSI A-D routes]
- 3) **SOURCE AS EXTENDED COMMUNITY ATTRIBUTE** [AS SPECIFIC extended community. Specifies the originator AS of a route]
- 4) **VRF ROUTE IMPORT EXTENDED COMMUNITY ATTRIBUTE** [IP ADDRESS SPECIFIC extended community. Specifies the originator PE of a route]



LFIB EVOLUTION

[Local Label]	[Outgoing Label]	[Prefix or Tunnel Id]	[Bytes Label switched]	[Outgoing interface]	[Next Hop]
2113	1862	22.22.22.22 0 [39]	187469	Te3/0/1	13.1.1.3



[Local Label]	[Outgoing Label]	[Prefix or Tunnel Id]	[Bytes Label switched]	[Outgoing interface]	[Next Hop]
5851	1912	22.22.22.22 0 [39]	187469	Te3/0/0	13.1.1.3
	3631	22.22.22.22 0 [39]	187491	Te3/0/1	14.1.1.3
	7192	22.22.22.22 0 [39]	187480	Te3/0/2	15.1.1.3
	7089	22.22.22.22 0 [39]	187445	Te3/0/3	16.1.1.3

CONTROL PLANE EVOLUTION

BUILD MULTIPOINT LSPs

Multipoint LDP (mLDP)

- ✓ Extensions to LDP
- ✓ Support both P2MP and MP2MP LSP
- ✓ RFC 6388

P2MP RSVP-TE

- ✓ Extensions to RSVP-TE
- ✓ Support P2MP LSP
- ✓ RFC 487

ASSIGN FLOWS TO LSPs

STATIC

PIM

- ✓ RFC 6037

BGP

- ✓ RFC 6513
- ✓ Also adds Auto-Discovery capability

mLDP IN-BAND SIGNALING

- ✓ draft-ietf-mpls-mldp-in-band-signaling-08
- ✓ In VRF & Global context

PEs DISCOVERY

PIM

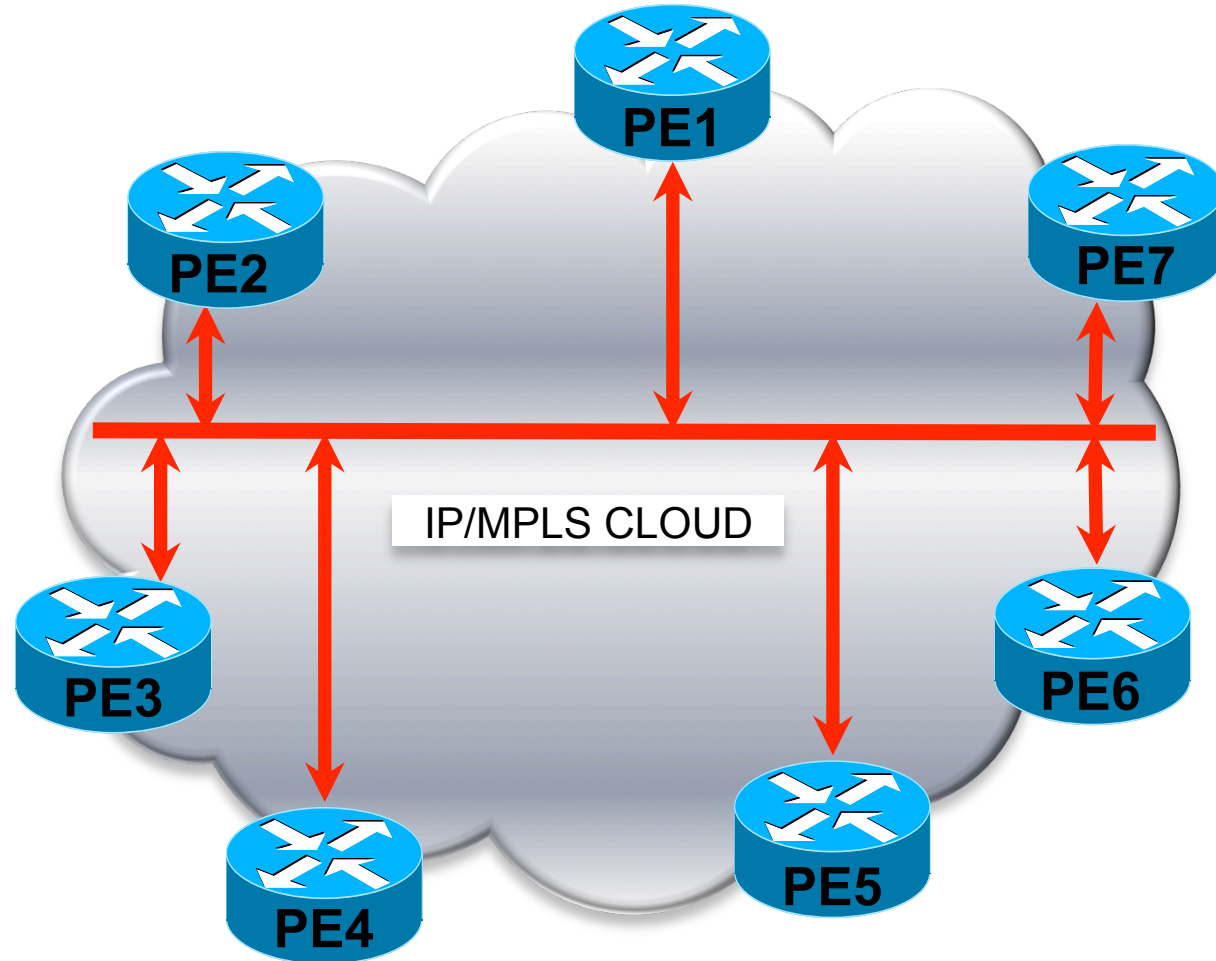
BGP

PROVIDER-TREE



P-Tree (Provider Tree)

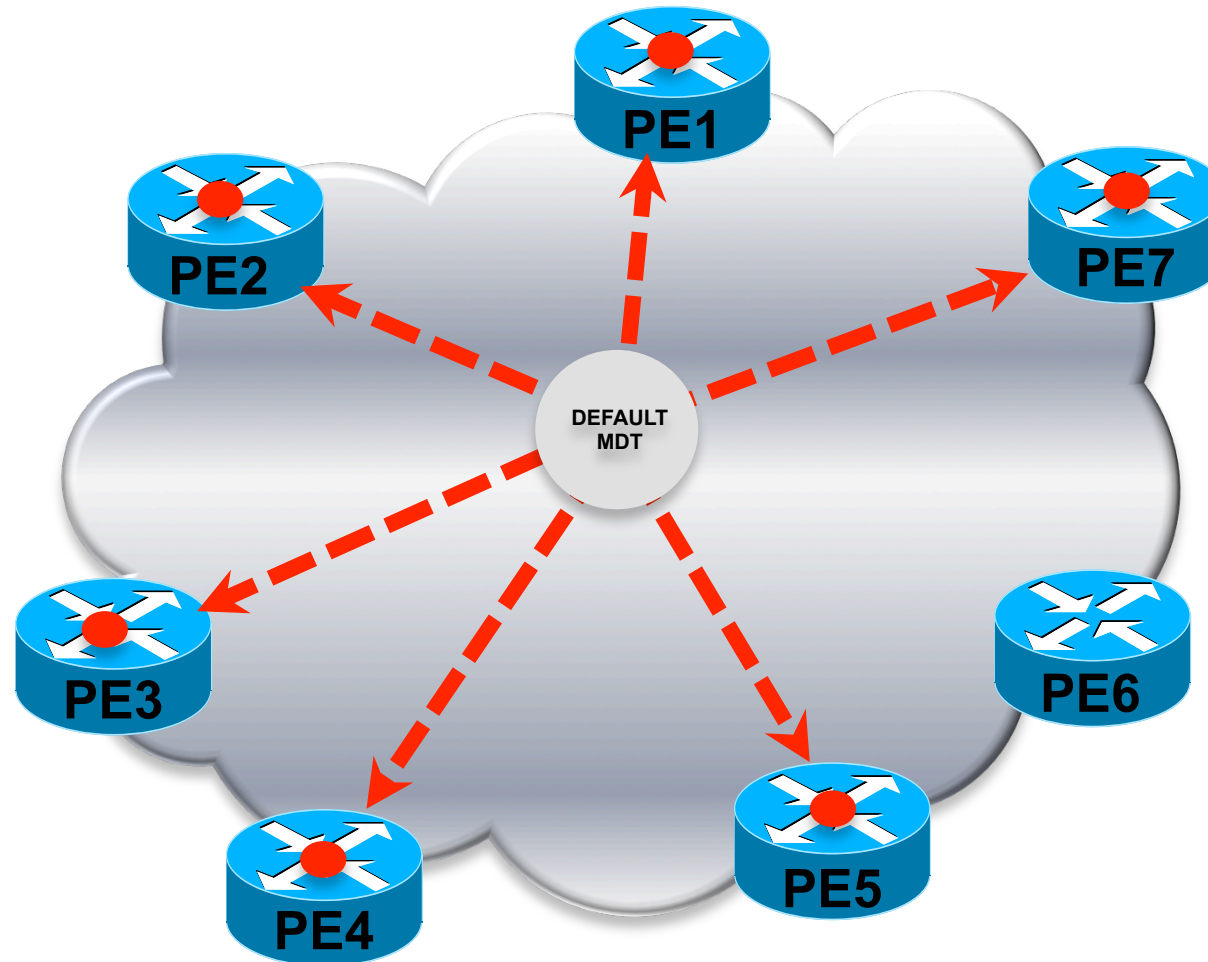
Default MDT



P-Tree (Provider Tree)

Default MDT

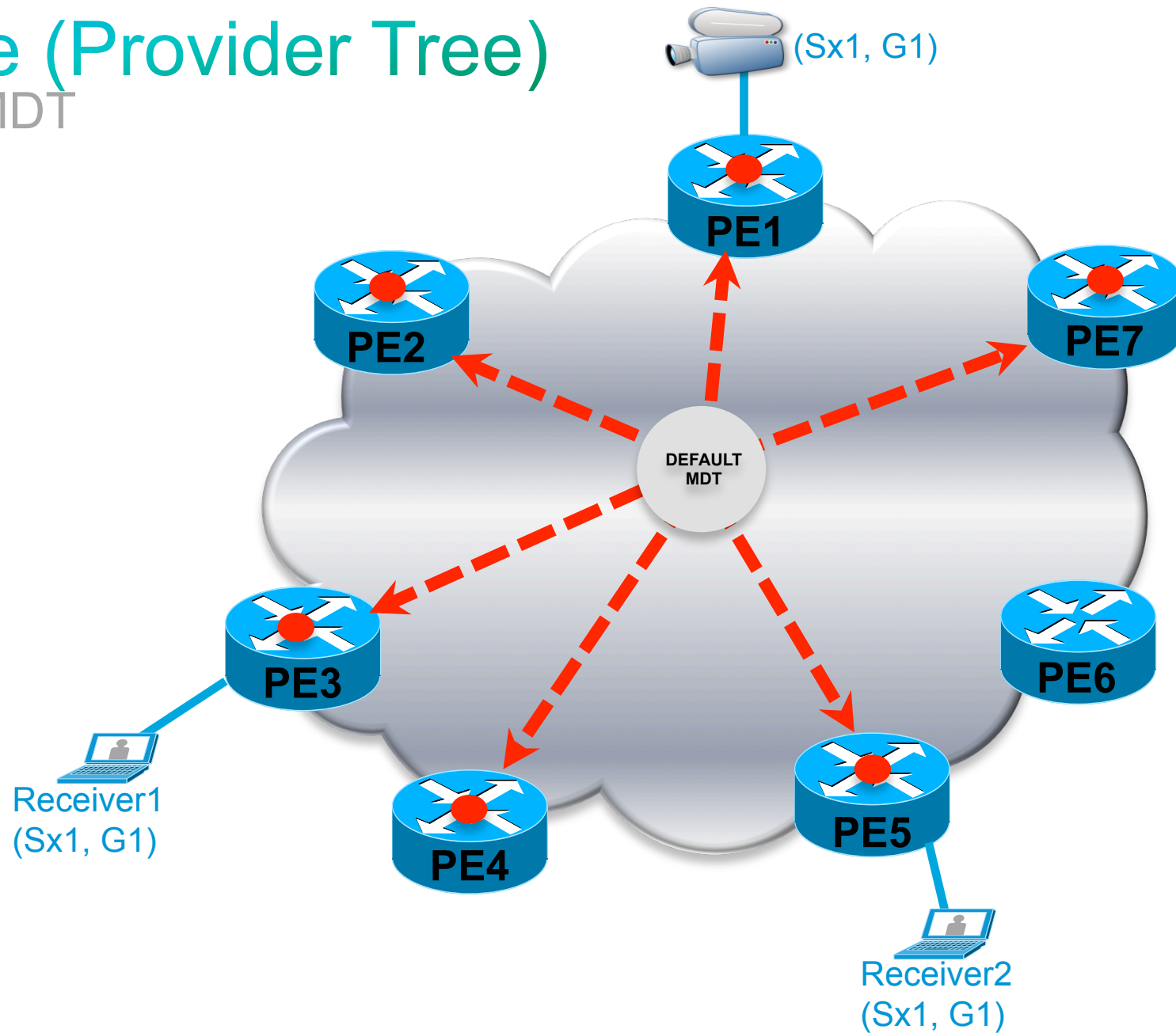
● VRF1 configured with Default group address



P-Tree (Provider Tree)

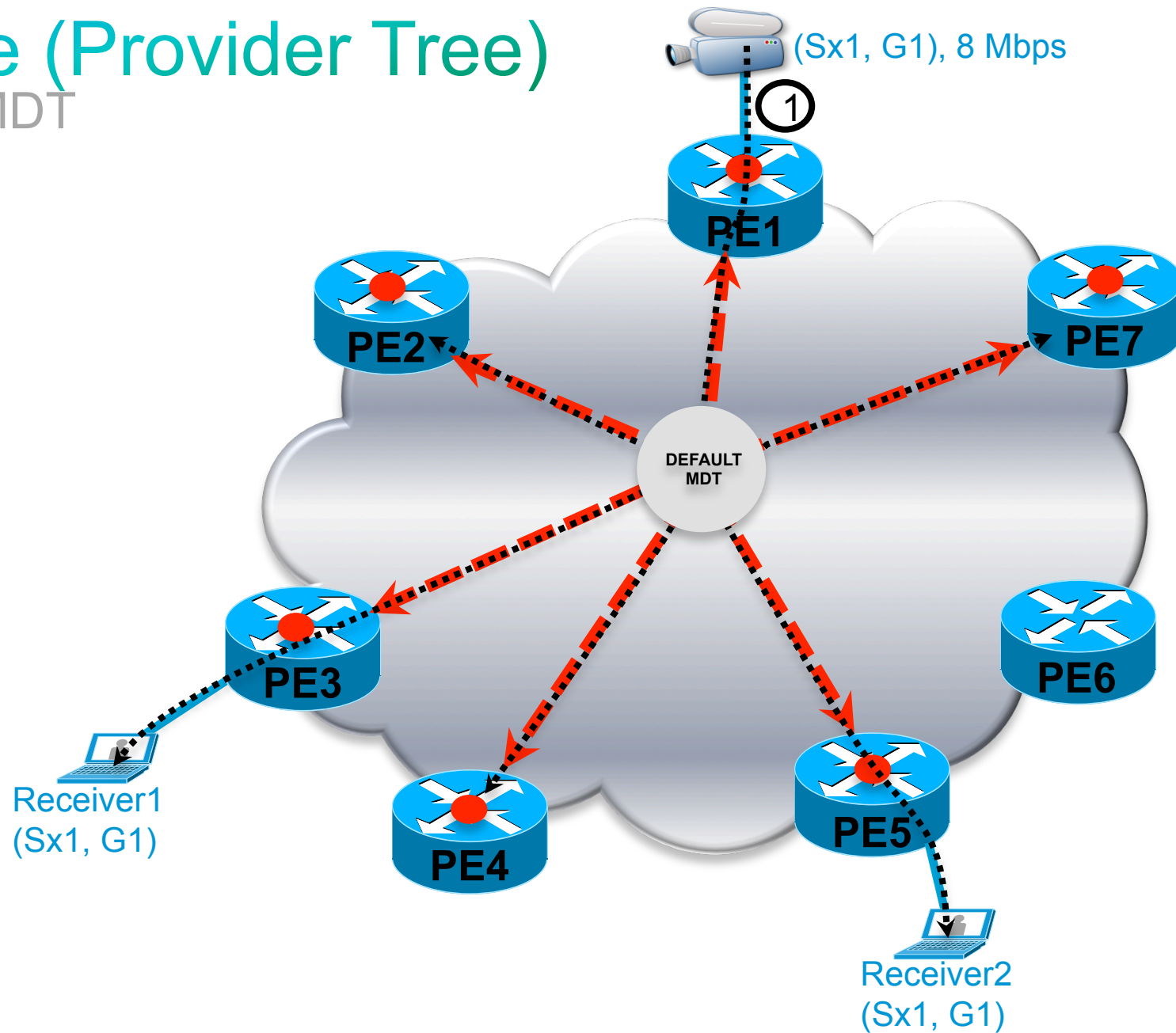
Default MDT

● VRF1 configured with Default group address



P-Tree (Provider Tree)

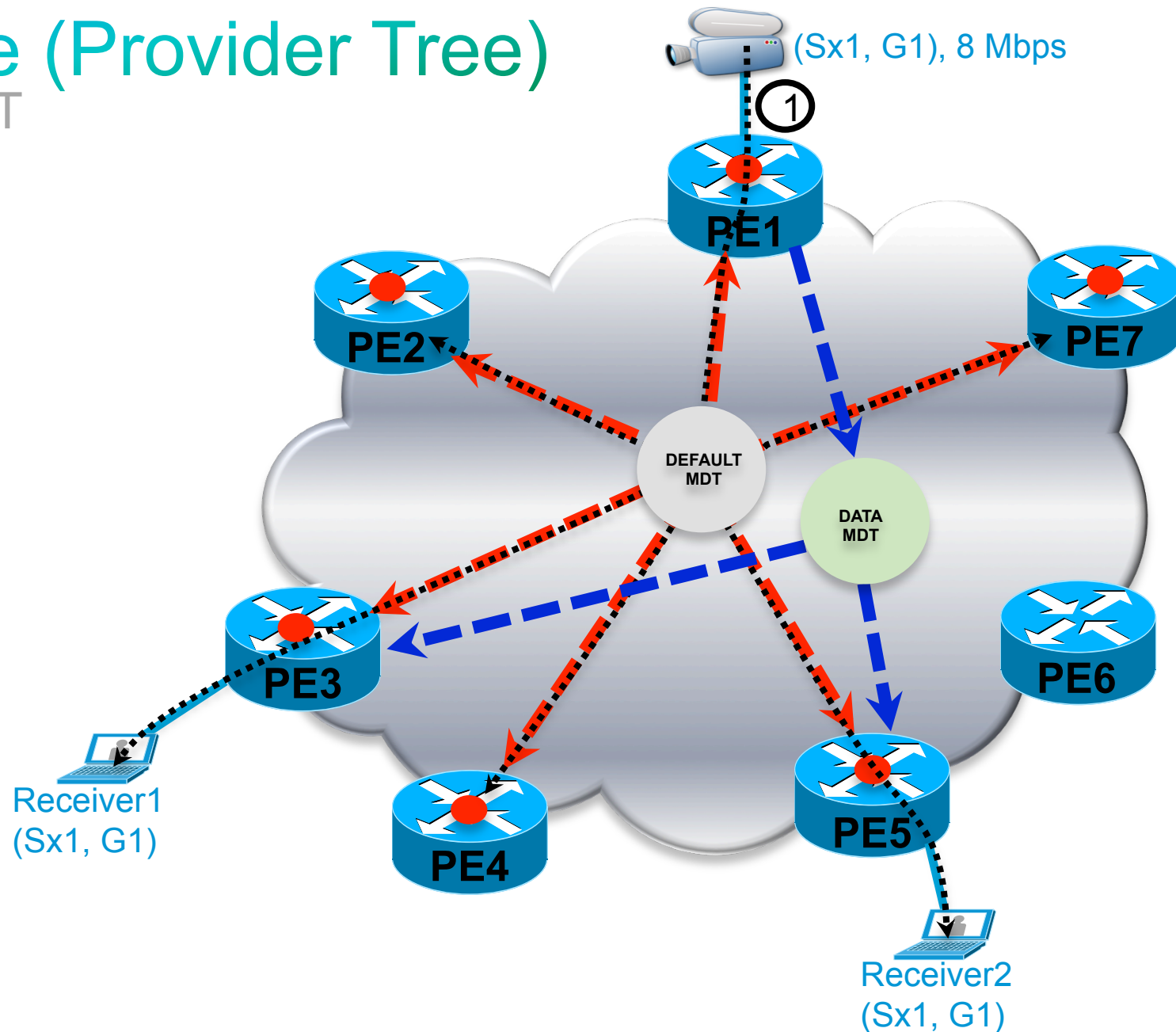
Default MDT



● VRF1 configured with Default group address

P-Tree (Provider Tree)

Data MDT



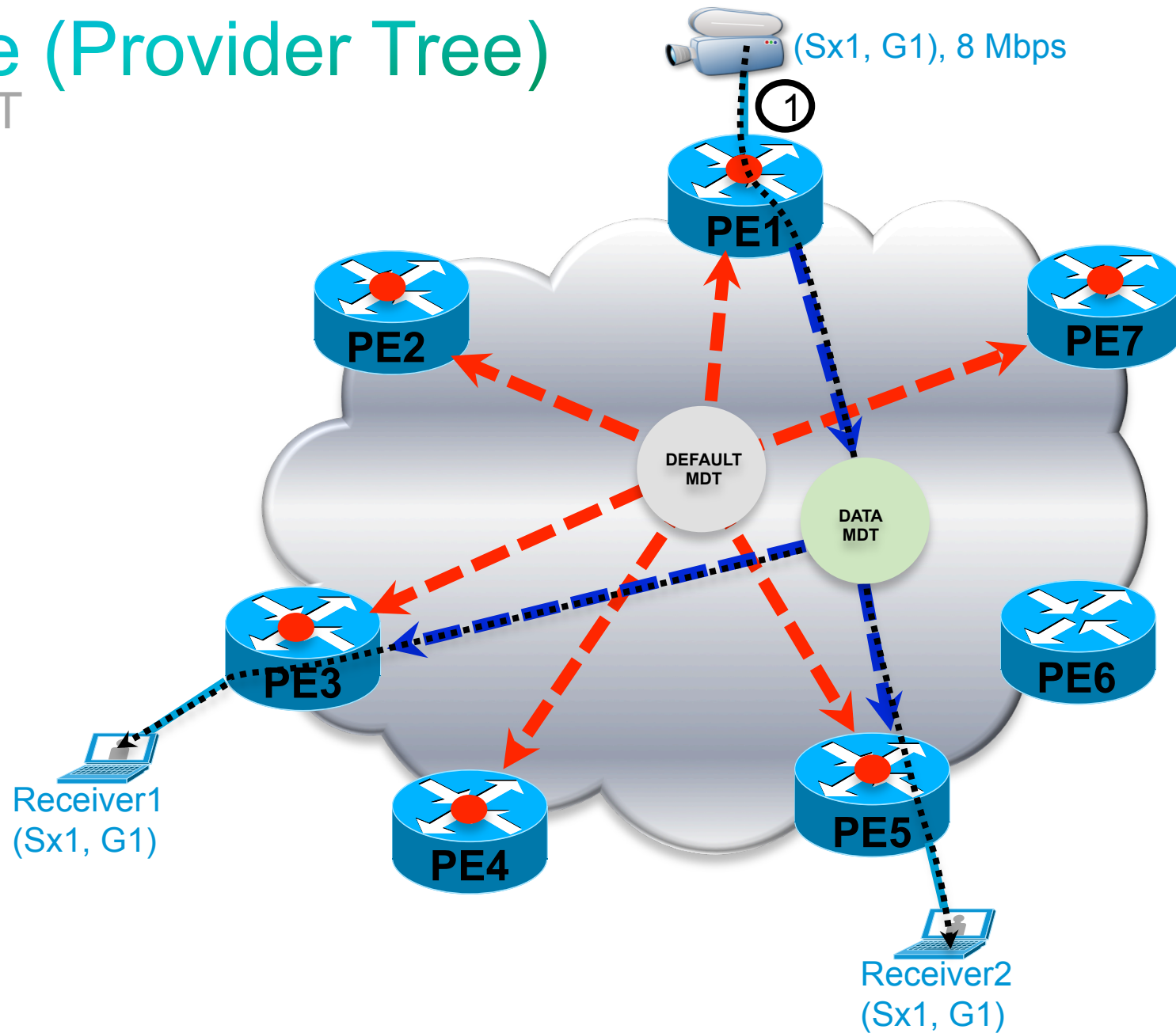
● VRF1 configured with Default group address

THRESHOLD of 5 Mbps is configured at PE1.

NOTE: Each stream in particular VRF with bandwidth in use \geq THRESHOLD, should be switched to DATA MDT

P-Tree (Provider Tree)

Data MDT



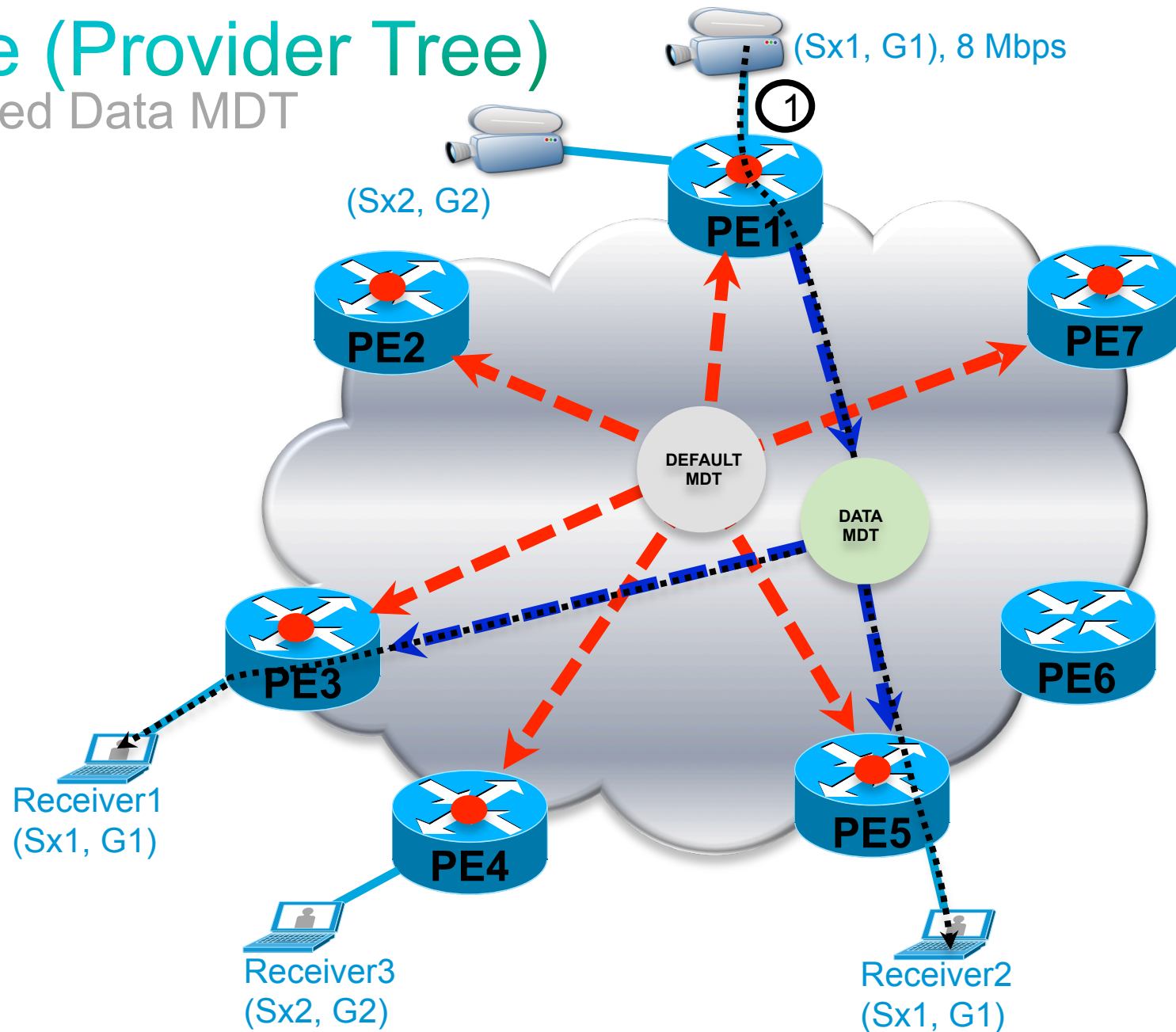
● VRF1 configured with Default group address

THRESHOLD of 5 Mbps is configured at PE1.

NOTE: Each stream in particular VRF with bandwidth in use \geq THRESHOLD, should be switched to DATA MDT

P-Tree (Provider Tree)

Aggregated Data MDT



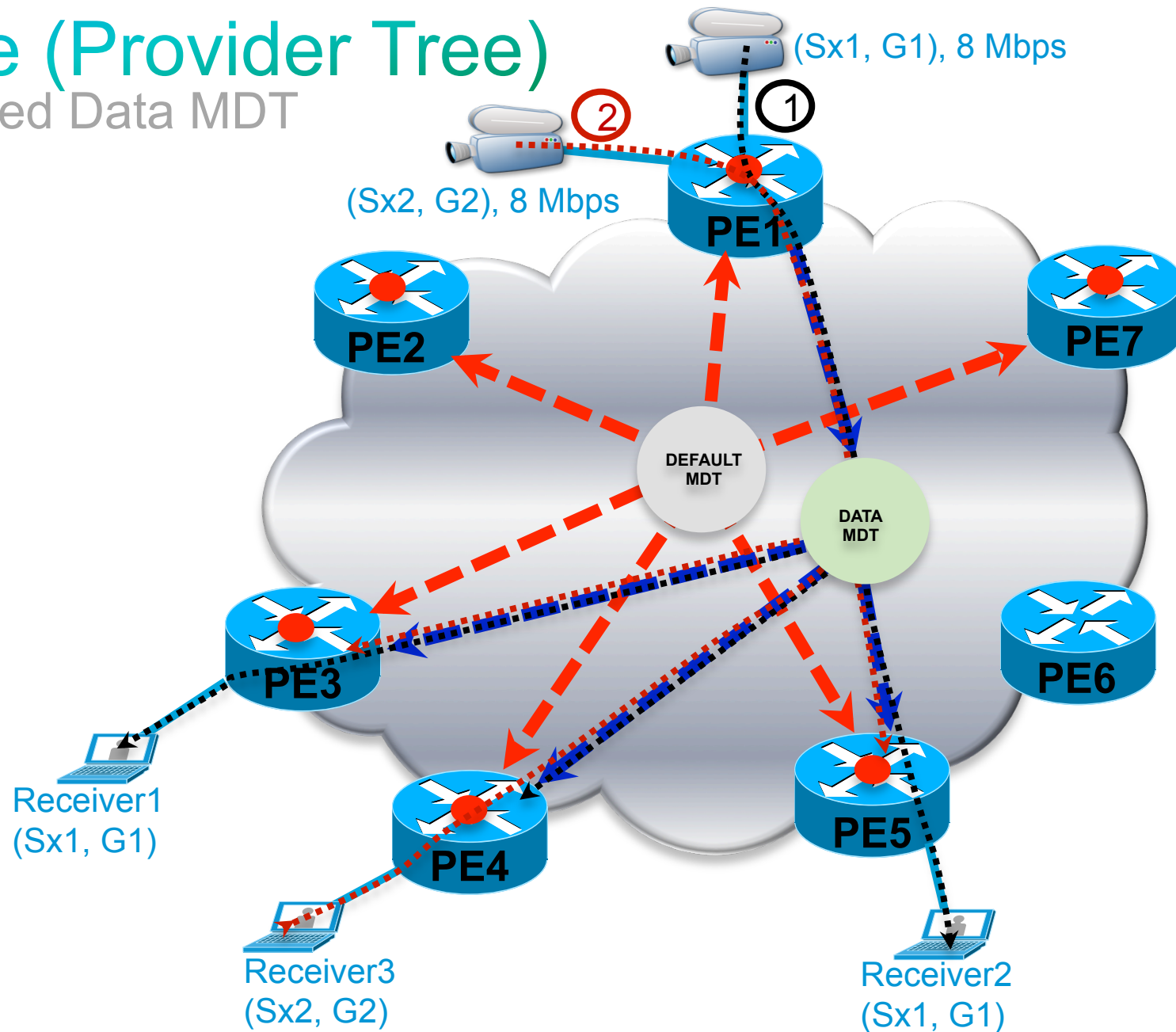
● VRF1 configured with Default group address

THRESHOLD of 5 Mbps is configured at PE1.

NOTE: Each stream in particular VRF with bandwidth in use \geq THRESHOLD, should be switched to DATA MDT

P-Tree (Provider Tree)

Aggregated Data MDT



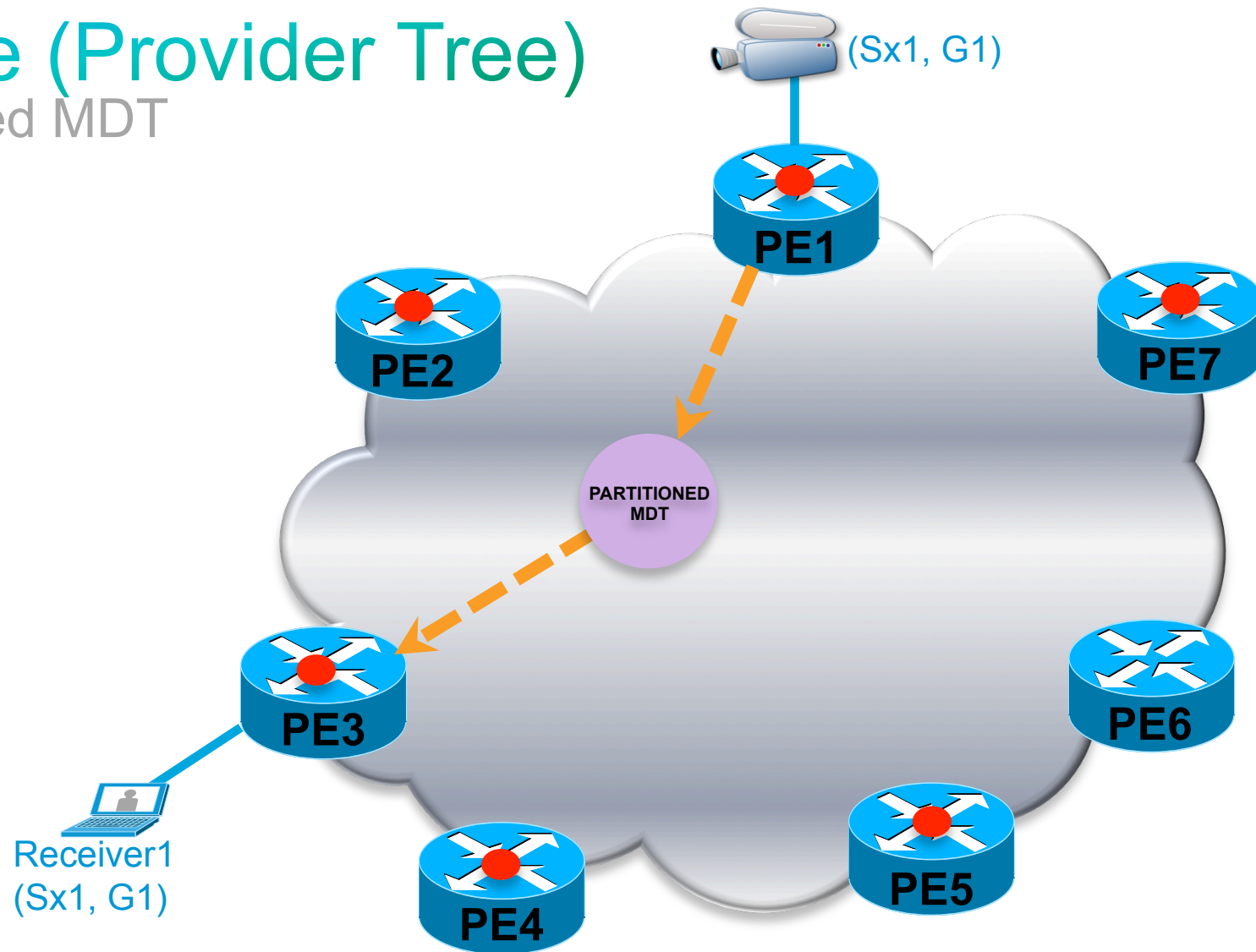
● VRF1 configured with Default group address

THRESHOLD of 5 Mbps is configured at PE1.

NOTE: Each stream in particular VRF with bandwidth in use \geq THRESHOLD, should be switched to DATA MDT

P-Tree (Provider Tree)

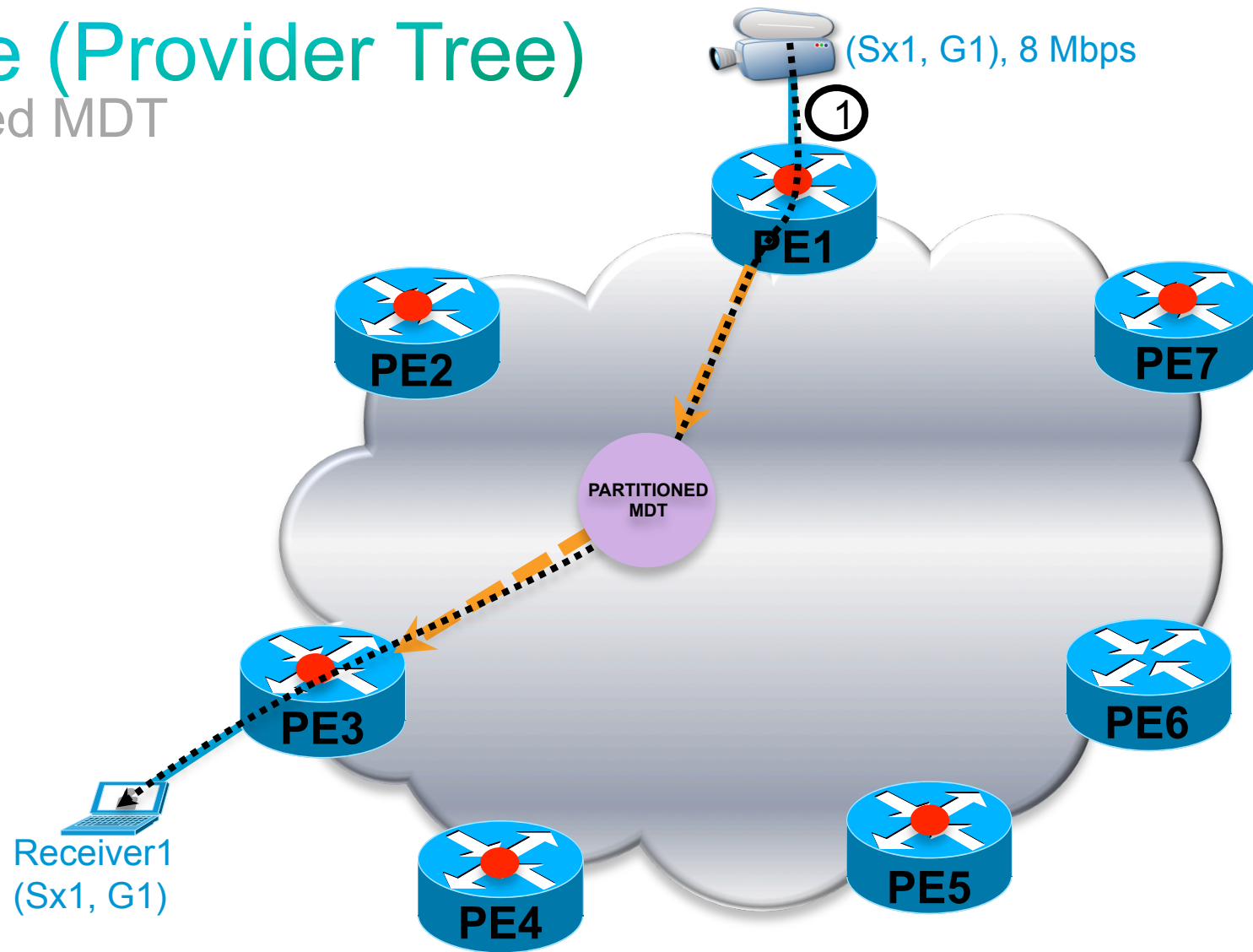
Partitioned MDT



● VRF1 configured

P-Tree (Provider Tree)

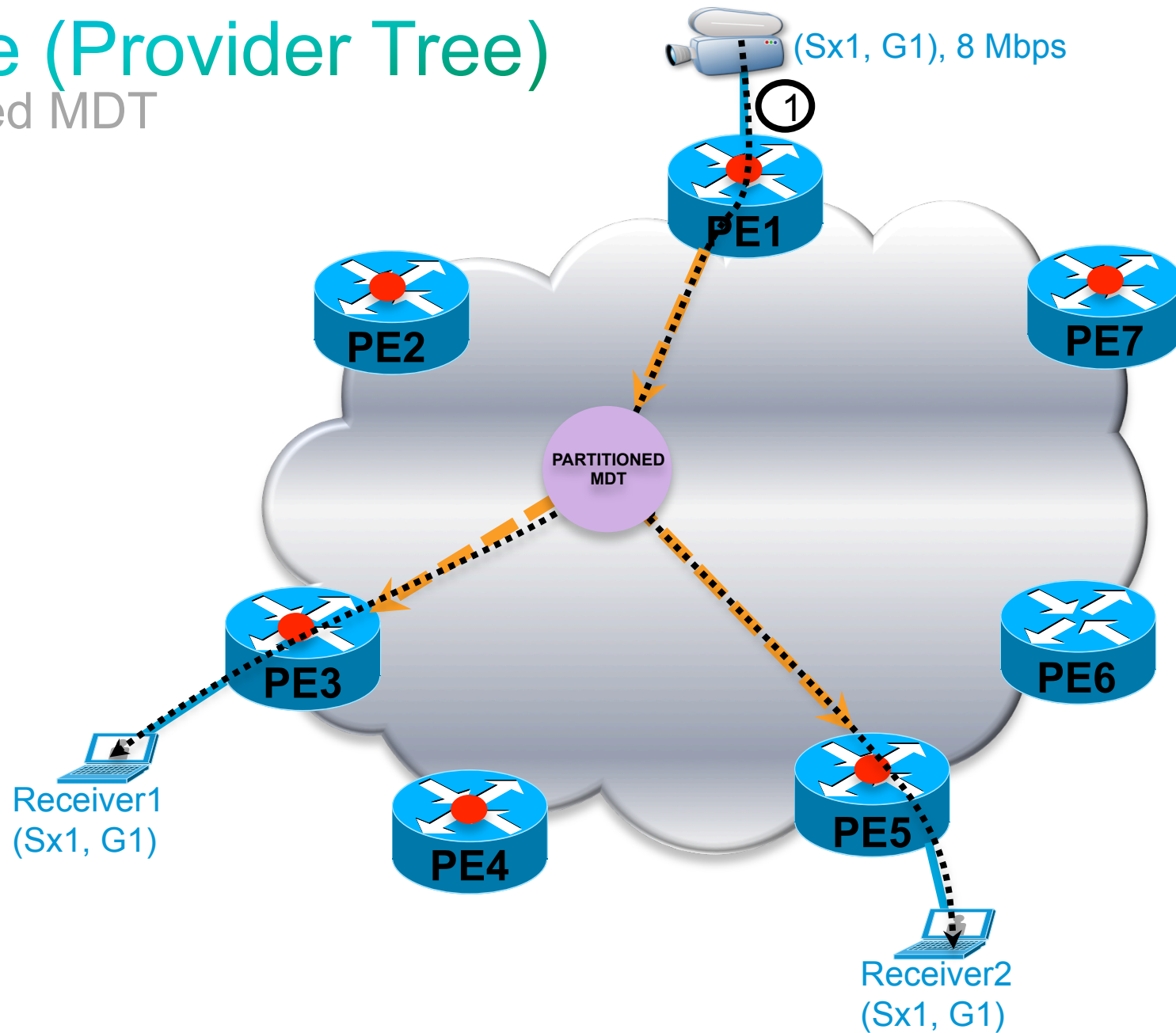
Partitioned MDT



● VRF1 configured

P-Tree (Provider Tree)

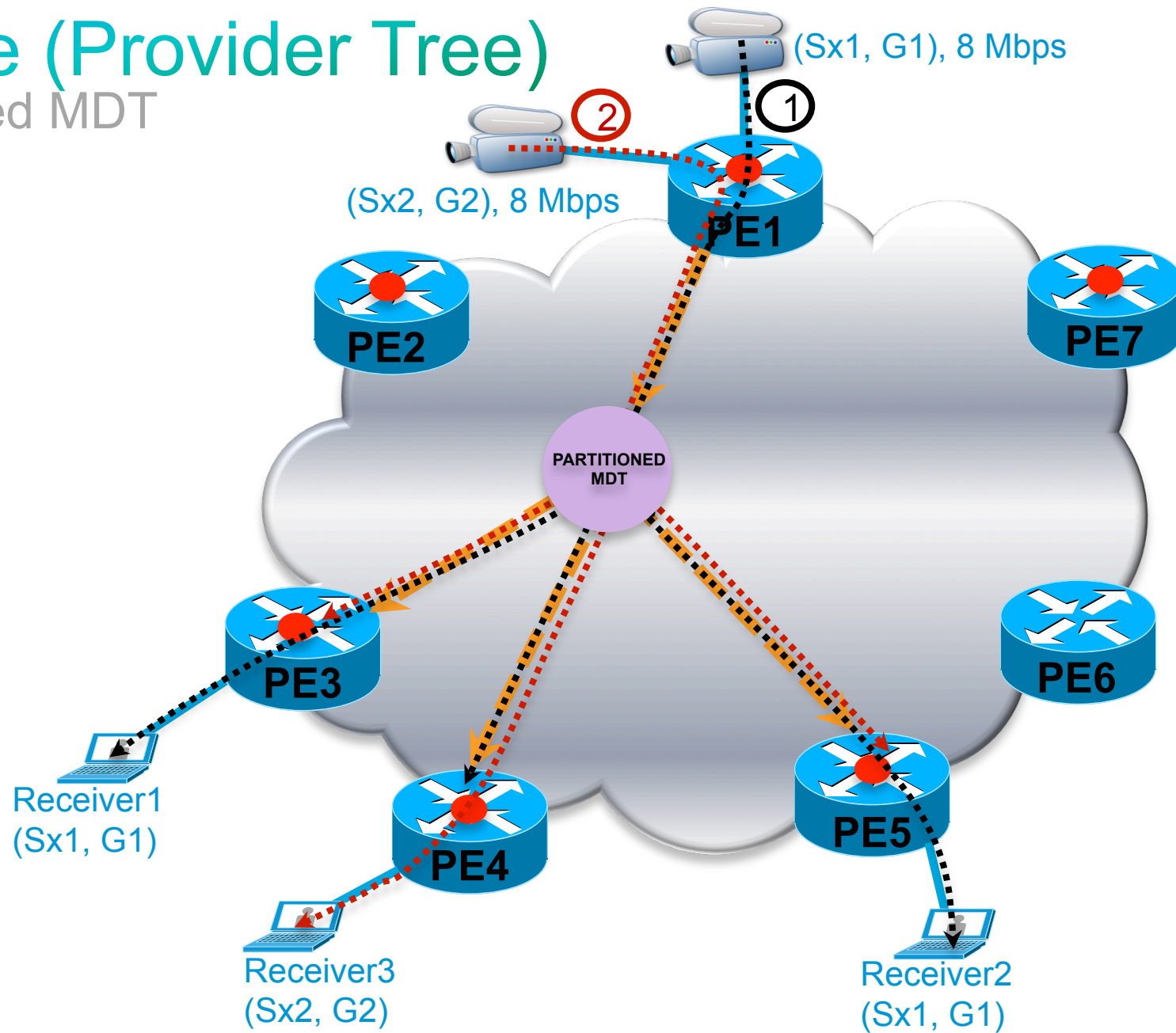
Partitioned MDT



● VRF1 configured

P-Tree (Provider Tree)

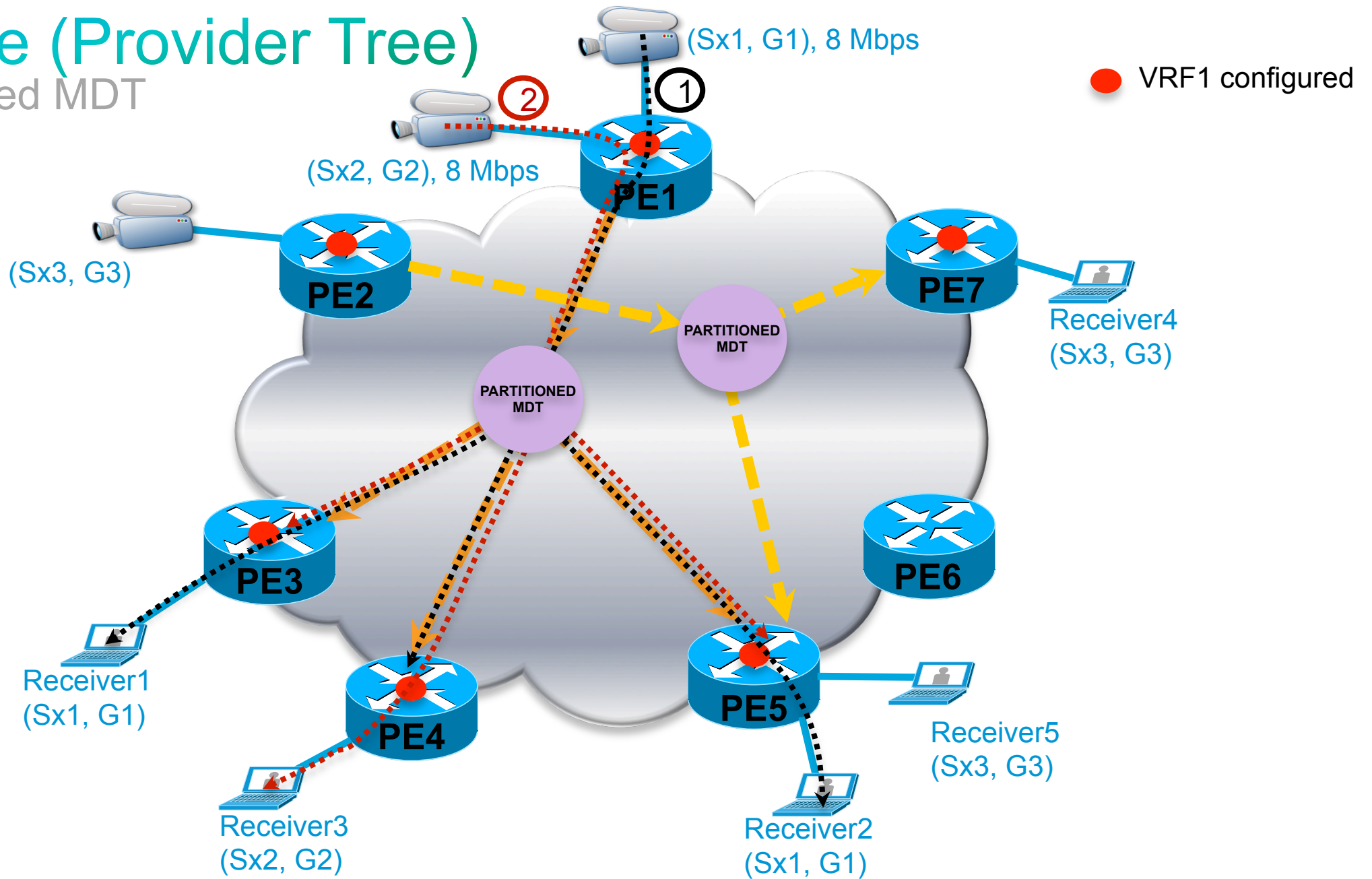
Partitioned MDT



● VRF1 configured

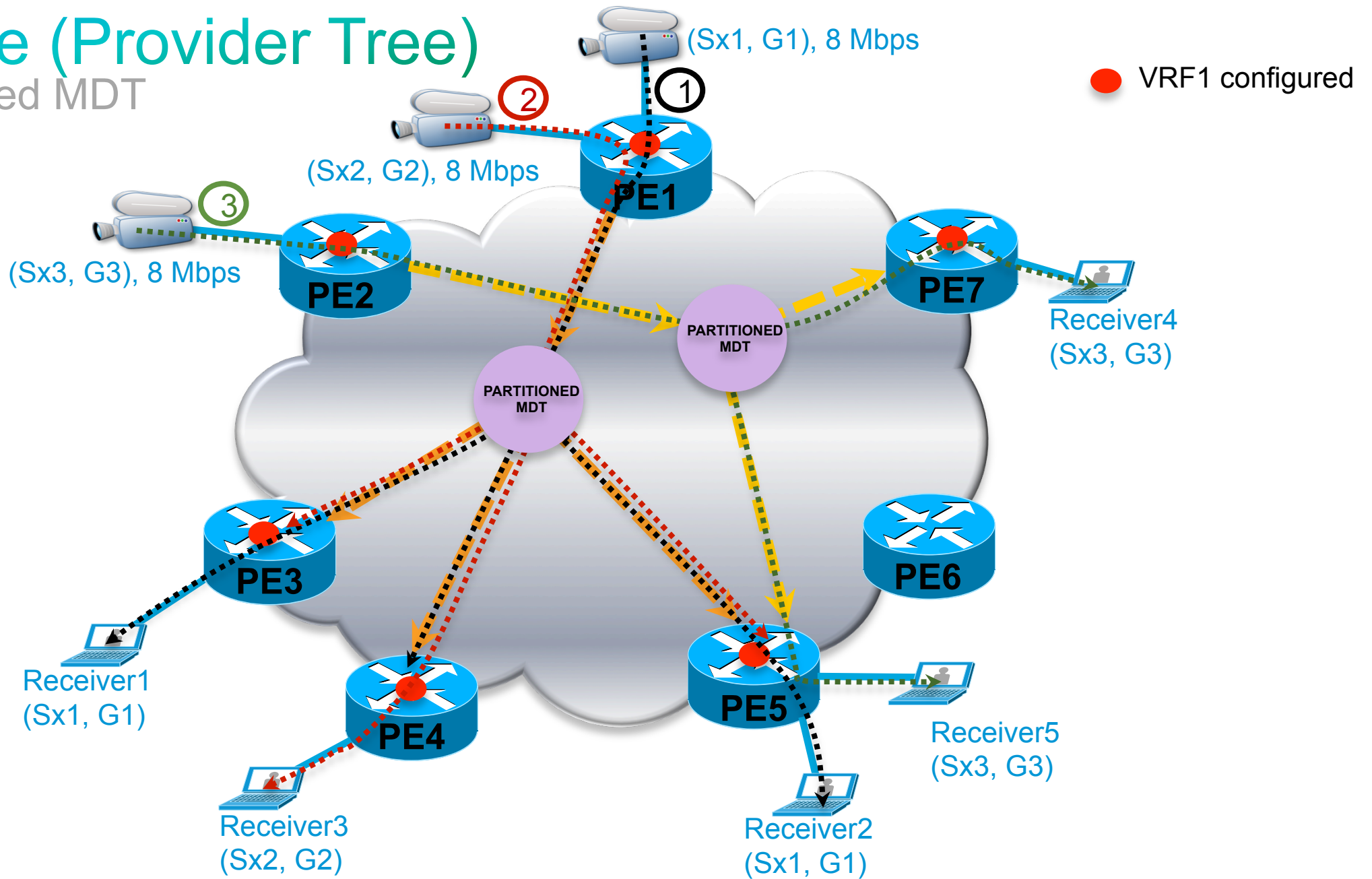
P-Tree (Provider Tree)

Partitioned MDT



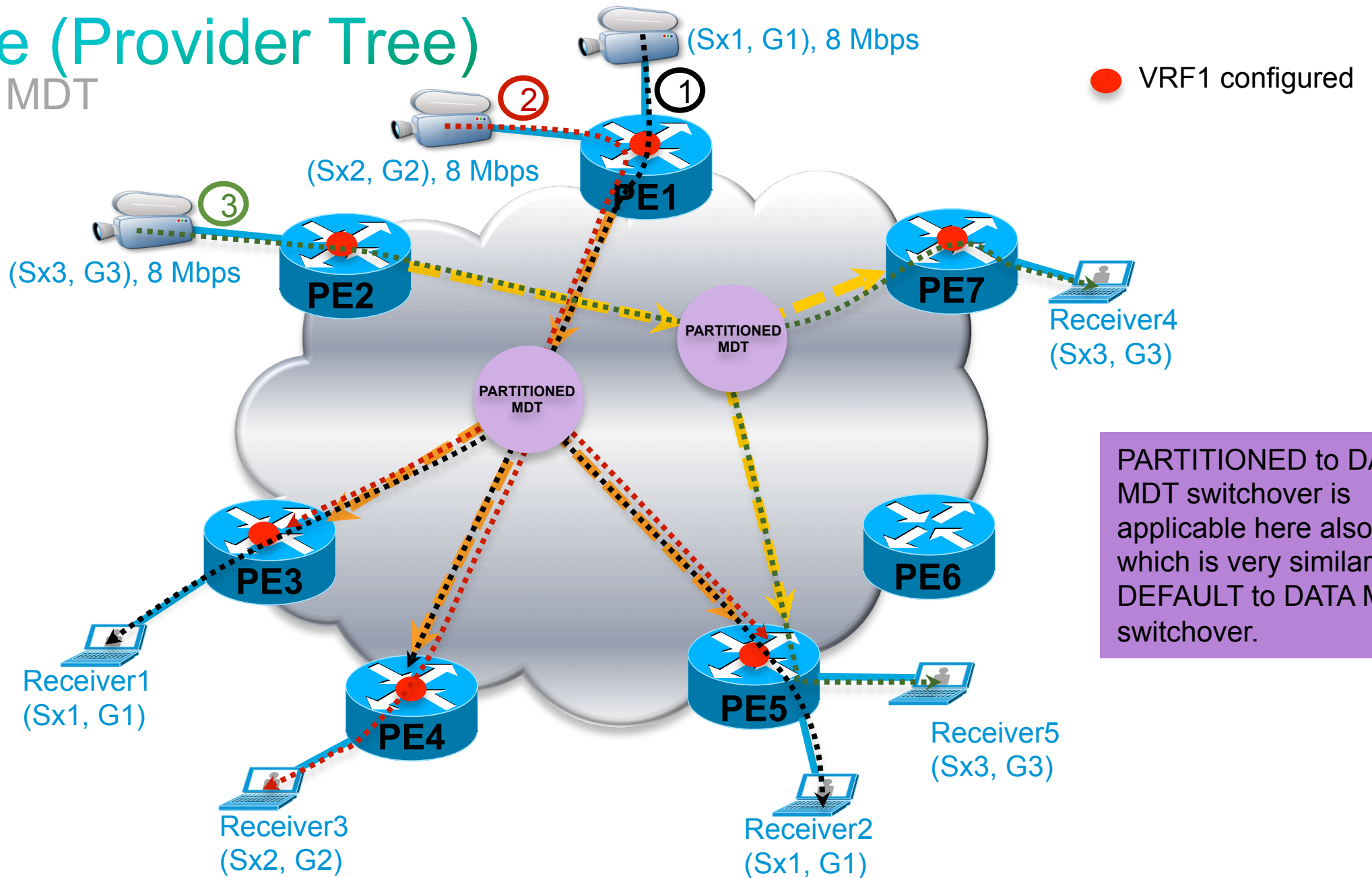
P-Tree (Provider Tree)

Partitioned MDT



P-Tree (Provider Tree)

Partition MDT



PARTITIONED to DATA MDT switchover is applicable here also, which is very similar to DEFAULT to DATA MDT switchover.

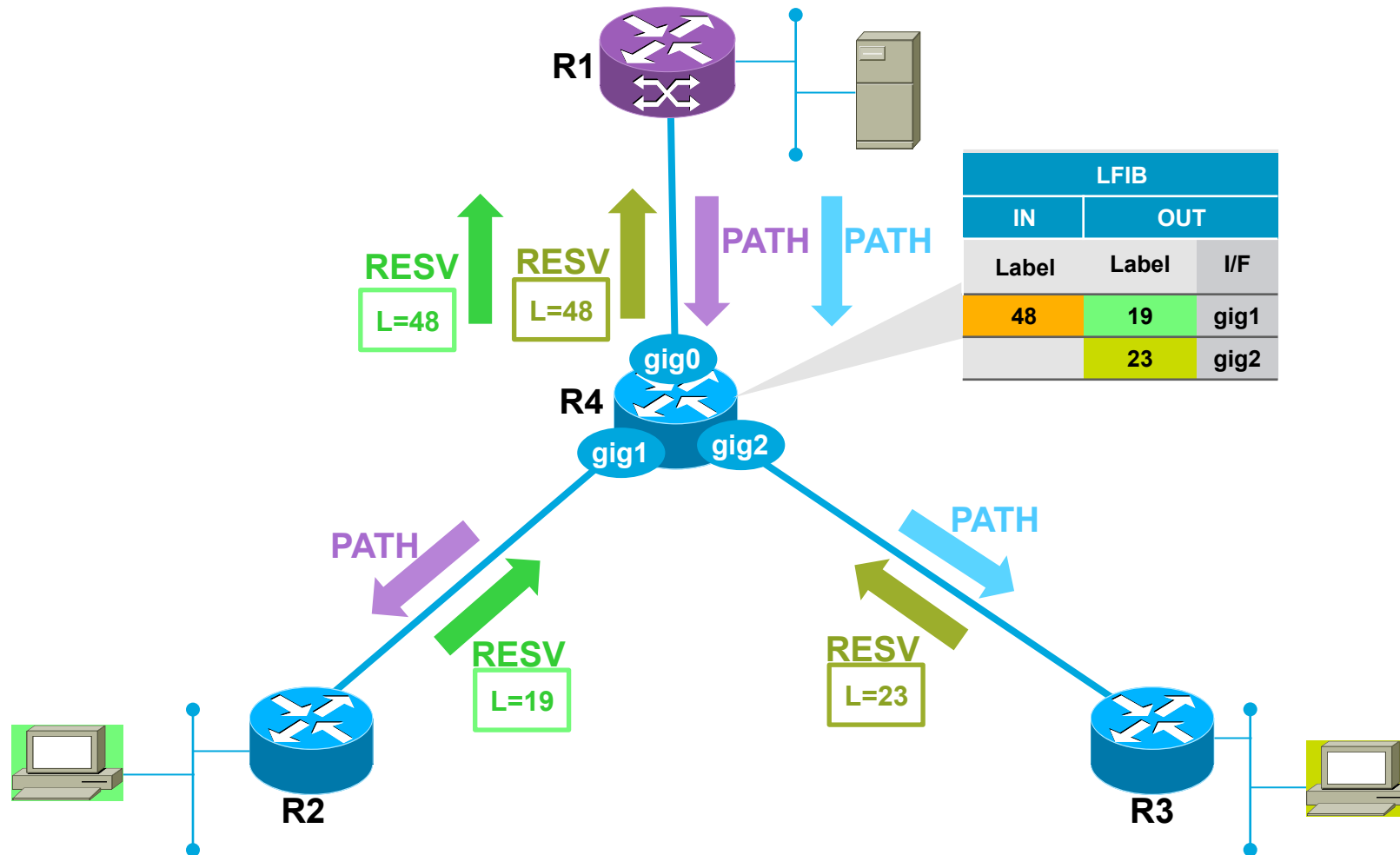
P-Tree (Provider Tree)

#	TREE TYPE	
1	INCLUSIVE P-TREE	<ul style="list-style-type: none"> - Multi-Directional Inclusive Provider Multicast Service Instance (MI-PMSI), like Default MDT. - Using INTRA-AS I-PMSI AD ROUTE. - One per-VRF. - Created on provisioning VRF and related attributes.
2	SELECTIVE P-TREE	<ul style="list-style-type: none"> - Selective Provider Multicast Service Instance (S-PMSI), like Data MDT. - Using S-PMSI AD ROUTE. - One per-VRF, per-(S,G). - Dynamically created for (S,G) once configured threshold for per stream in particular VRF is reached.
3	AGGREGATED SELECTIVE P-TREE	<ul style="list-style-type: none"> - Selective Provider Multicast Service Instance (S-PMSI), like Aggregated Data MDT. - Using S-PMSI AD ROUTE. - One per-VRF, multiple-(S,G). - Multiple (S,G) streams are connected to same Selective-P-Tree when max allowed # of Selective-P-Tree for particular VRF is reached and still unattached (S,G) streams exist.
4	PARTITIONED P-TREE	<ul style="list-style-type: none"> - S-PMSI (like Partitioned MDT). - Using S-PMSI AD ROUTE for (*,*). - One per-VRF, per-INGRESS-PE-NODE. - Dynamically created when receiver for particular (S,G) comes up.

mLDP & P2MP-RSVP-TE

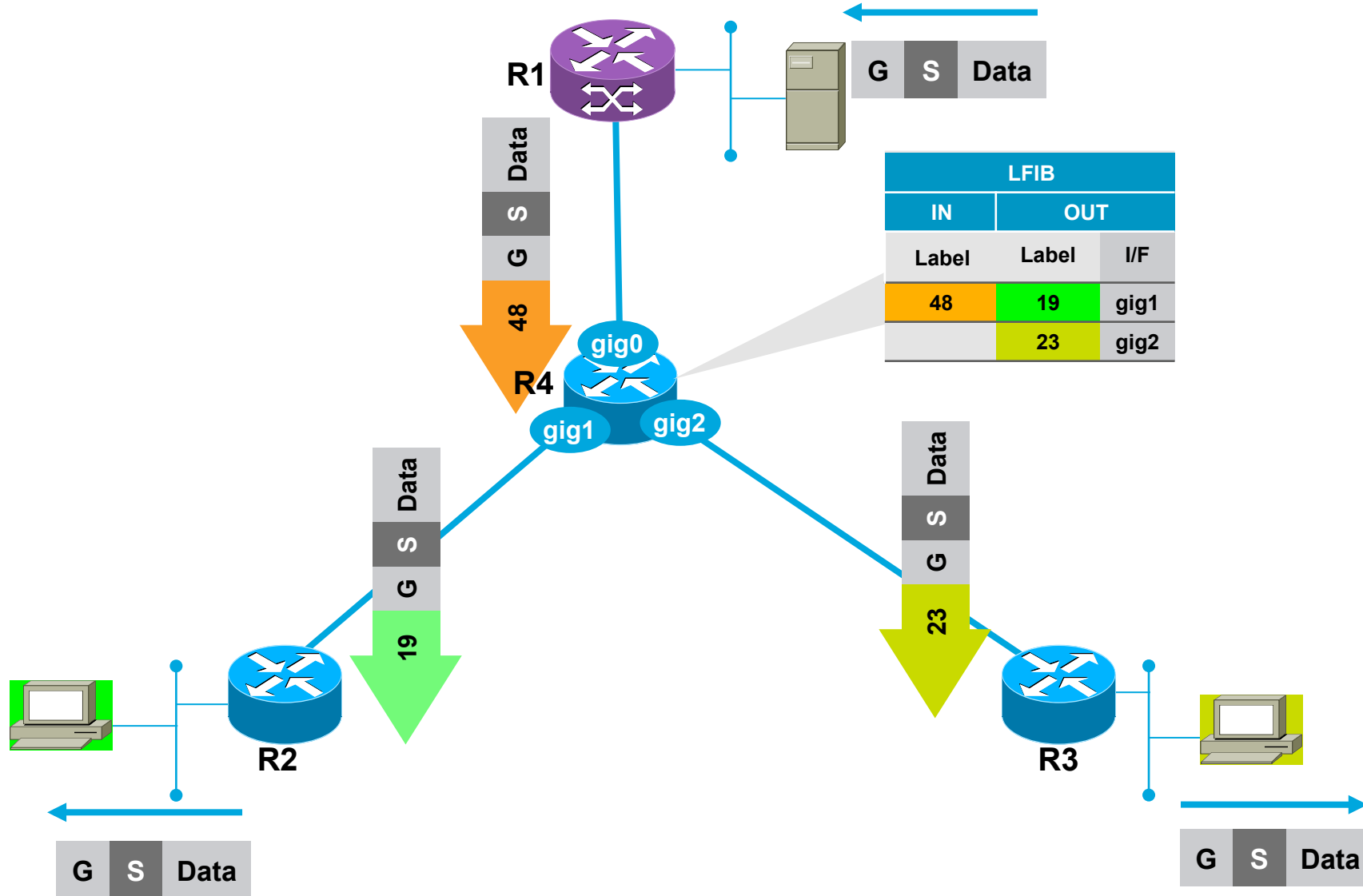


P2MP RSVP-TE: TREE SET-UP



- A P2MP LSP can be signaled using one or more PATH messages.
- A branch LSR can send one or more RESV message upstream.

P2MP RSVP-TE: DATA FORWARDING



P2MP RSVP-TE ENTRY SNIPPET

IOS

```
show mpls traffic-eng tunnels source-id 11.11.11.11
```

```
<..truncated..>
```

```
P2MP SUB-LSPTS:
```

```
LSP: Source: 11.11.11.11, TunID: 1, LSPID: 139
```

```
  P2MP ID: 1, Subgroup Originator: 11.11.11.11
```

```
  Name: PE2_t1
```

```
  Bandwidth: 0, Global Pool
```

```
Sub-LSP to 21.21.21.21, P2MP Subgroup ID: 5, Role: midpoint
```

```
  Path-Set ID: 0x86000001
```

```
  InLabel   : GigabitEthernet0/0, 48
```

```
  Prev Hop  : 7.0.0.2
```

```
  OutLabel  : GigabitEthernet0/1, 19
```

```
  Next Hop  : 9.0.0.2
```

```
  FRR OutLabel : Tunnel105, 38
```

```
  Explicit Route: 9.0.0.2 21.21.21.21
```

```
  Record Route (Path): NONE
```

```
  Record Route (Resv): 21.21.21.21(38)
```

```
Sub-LSP to 31.31.31.31, P2MP Subgroup ID: 22, Role: midpoint
```

```
  Path-Set ID: 0xA4000007
```

```
  InLabel   : GigabitEthernet0/0, 48
```

```
  Prev Hop  : 7.0.0.2
```

```
  OutLabel  : GigabitEthernet0/2, 23
```

```
  Next Hop  : 81.0.0.1
```

```
  FRR OutLabel : Tunnel102, 34
```

```
  Explicit Route: 81.0.0.1 31.31.31.31
```

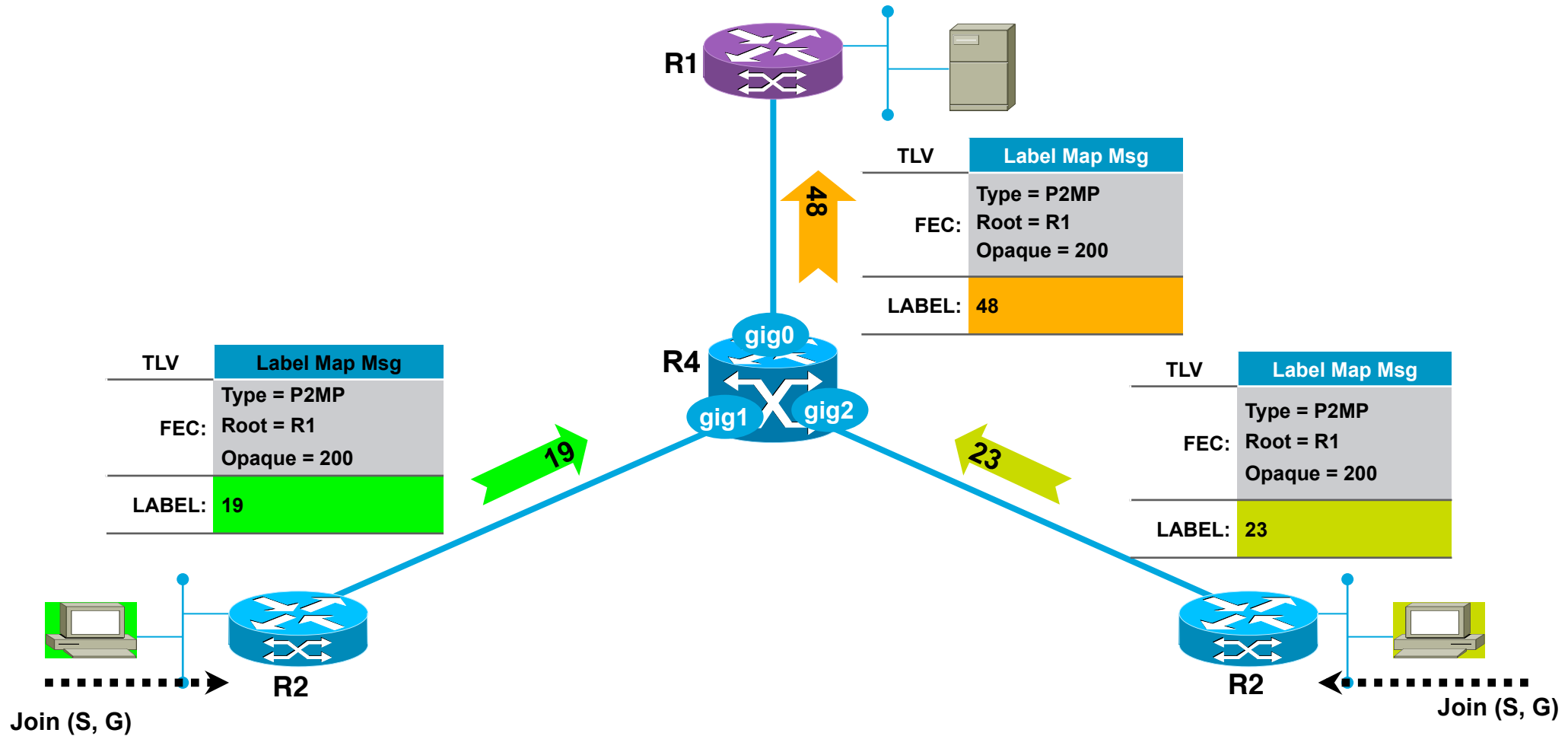
```
  Record Route (Path): NONE
```

```
  Record Route (Resv): 31.31.31.31(34)
```



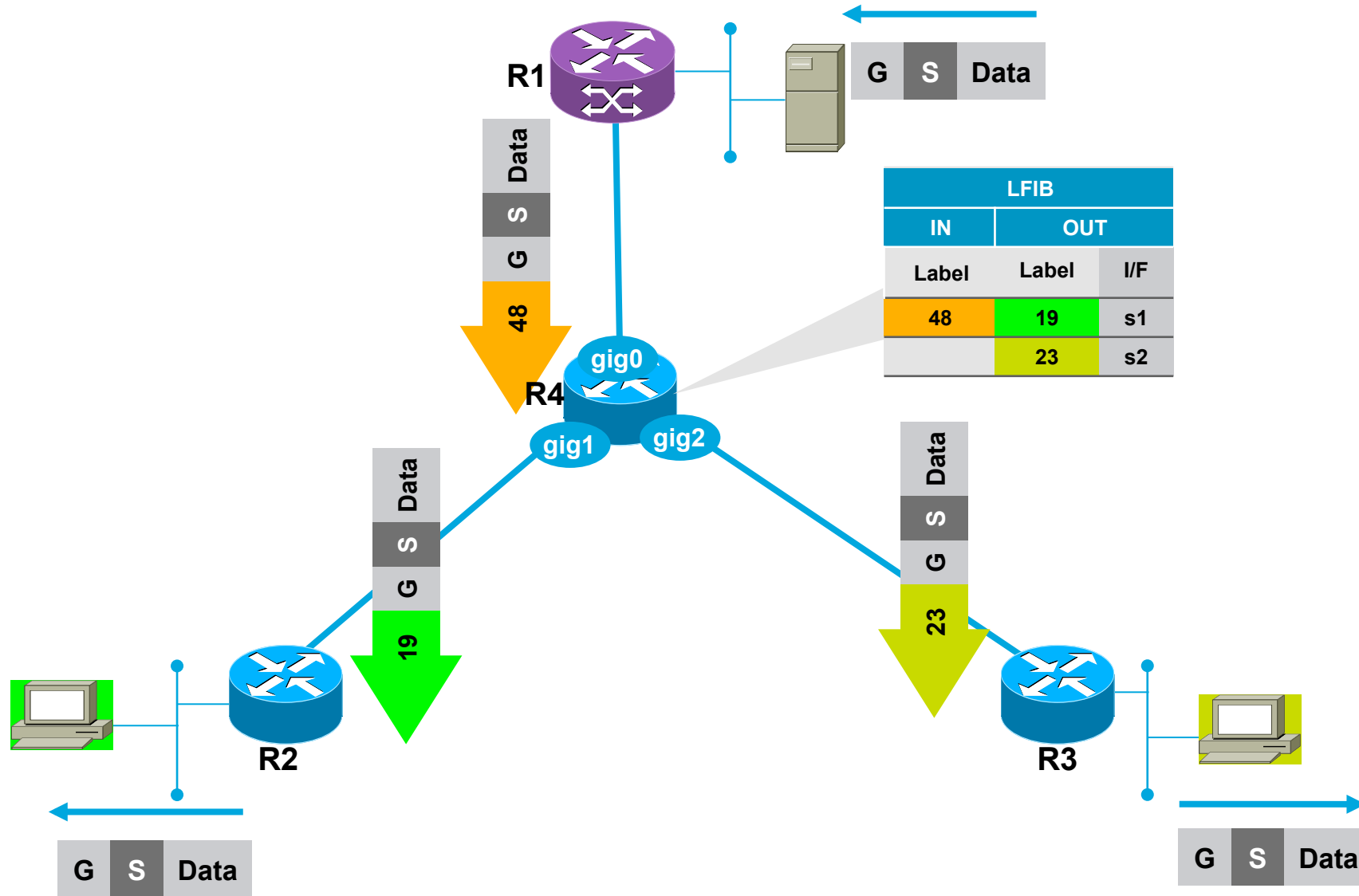
For Your Reference

P2MP mLDP: TREE SET-UP (IN-BAND)

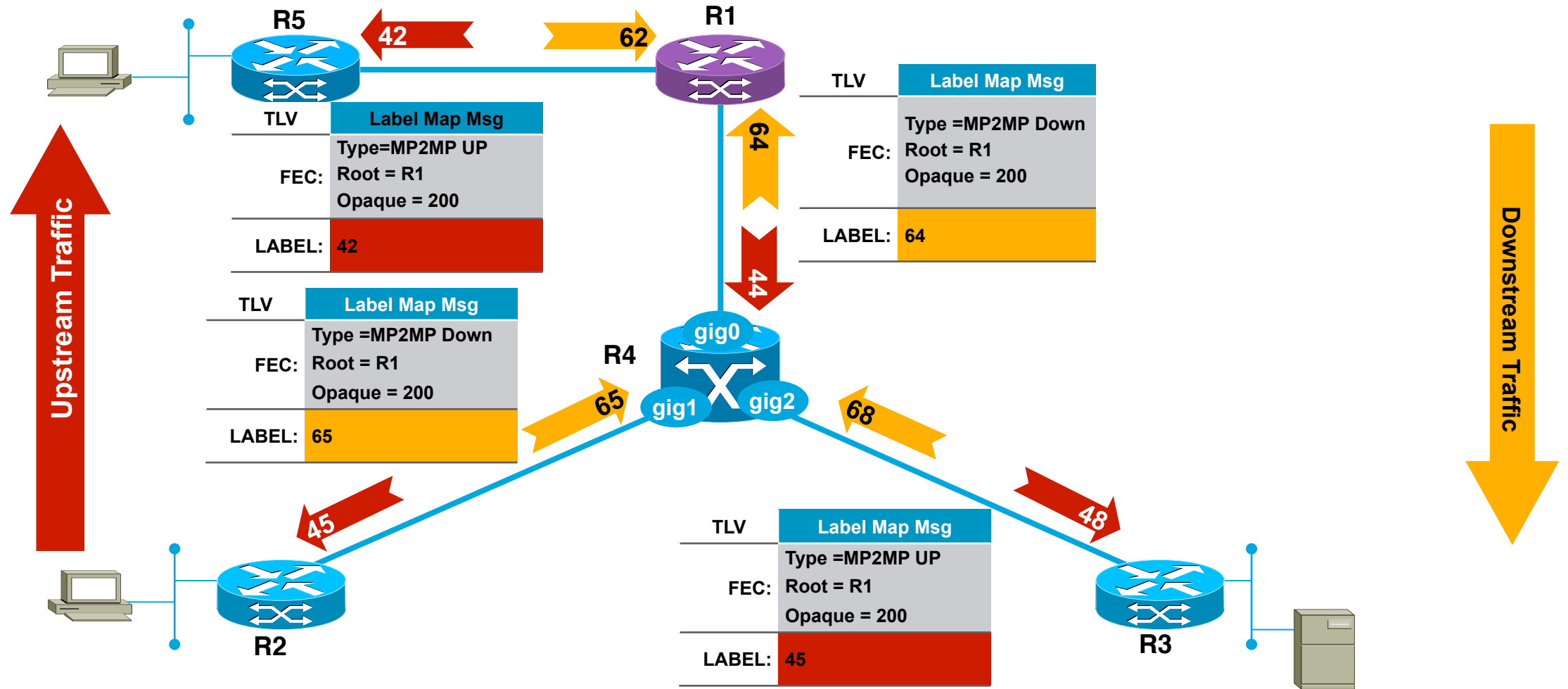


- FECs created are identical for same multicast stream
- Labels allocated from platform label space (same pool as unicast MPLS)

P2MP mLDP: DATA FORWARDING

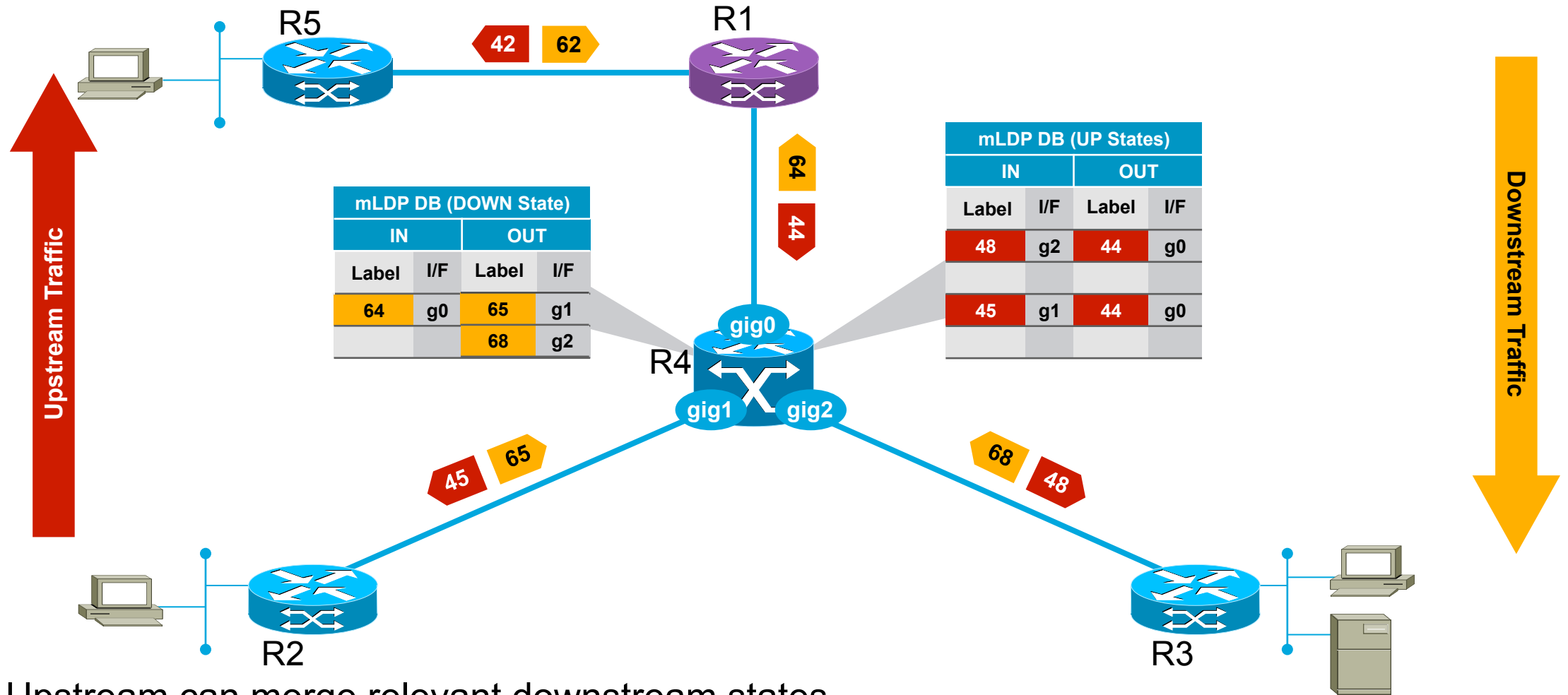


MP2MP mLDP: TREE SET-UP



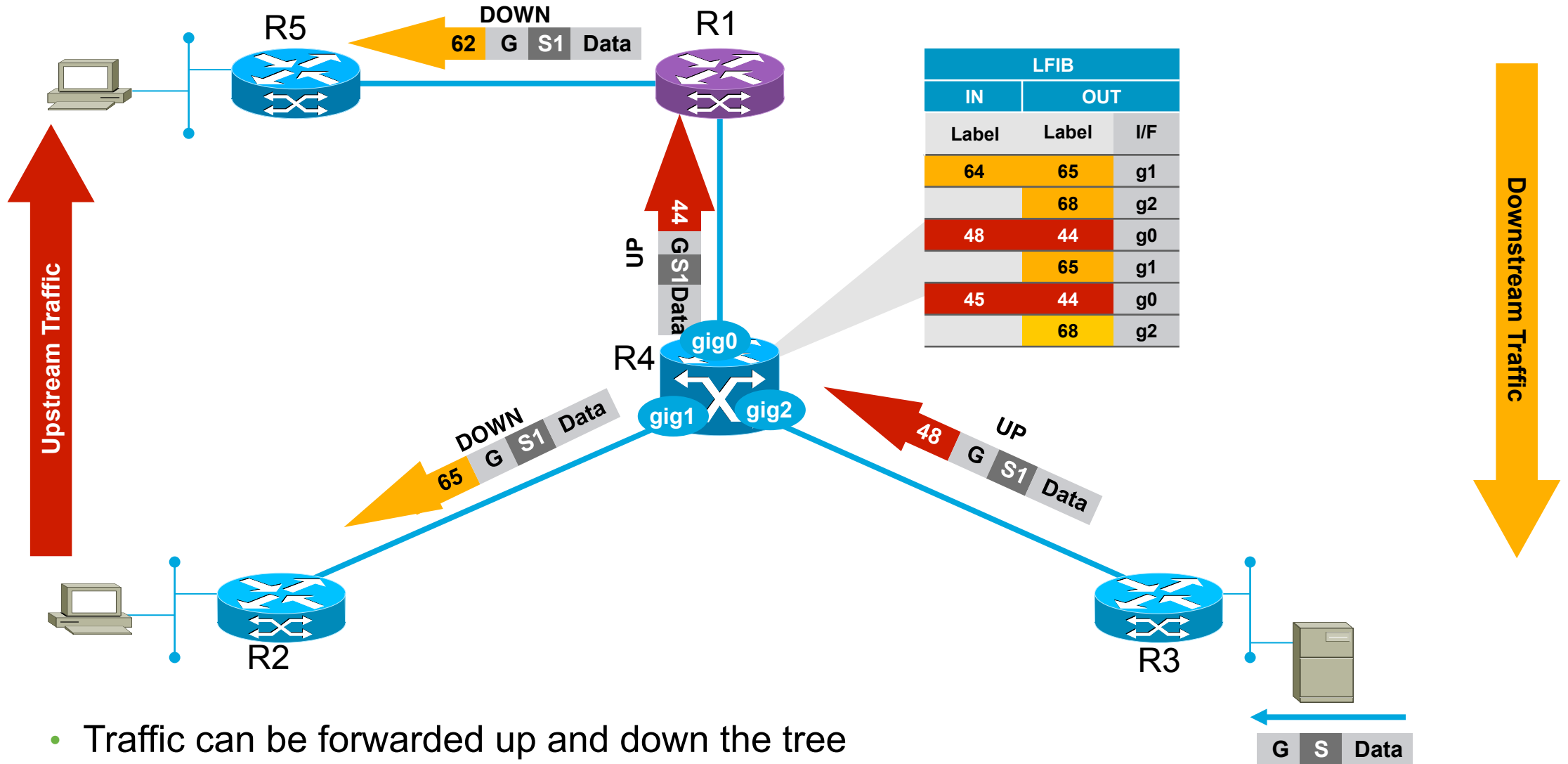
- Root manually configured on all Edge LSR or learned via BGP-AD
- If a MP2MP downstream FEC type is received
 - An MP2MP Upstream reply is sent with a corresponding label
 - One Upstream state entry exists per downstream interface

MP2MP mLDP



- Upstream can merge relevant downstream states
 - If (UPSTATE IN I/F) = (DOWNSTATE Out I/F) then do not merge entries. This prevents traffic being sent back where it came from.

MP2MP mLDP: Data Forwarding



- Traffic can be forwarded up and down the tree
- Up towards the root, Down towards a leaf

mLDP ENTRY SNIPPET

IOS-XR

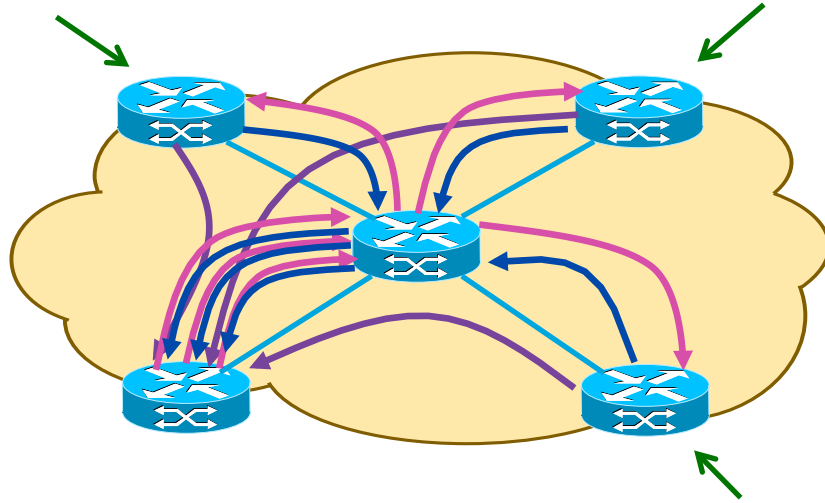
```
RP/0/0/CPU0:P1#sho mpls ldp mldp data 0x3
<..truncated..>
LSM-ID: 0x00000003 (RNR LSM ID: 00000004) Type: MP2MP ..
FEC Root          : 192.192.5.1
Upstream neighbor(s) :
  80.80.80.80:0    [Active]          Uptime: 00:14:55
    Next Hop      : 2.58.1.2
    Interface     : GigabitEthernet0/6/0/3
    Local Label (D) : 16029      Remote Label (U): 16037
Downstream client(s):
  PIM MDT          Uptime: 01:01:12
    Egress intf    : Lmdtp1/2
    Local Label    : 16001 (internal)
  LDP 1.1.1.1:0    Uptime: 00:14:34
    Next Hop      : 2.59.1.2
    Interface     : GigabitEthernet0/6/0/4
    Remote label (D) : 16036      Local label (U) : 16036
```



For Your Reference

LSM Signaling: P2MP-RSVP-TE & mLDP

P2MP RSVP-TE



The egress (leaf) receives a PIM Join.

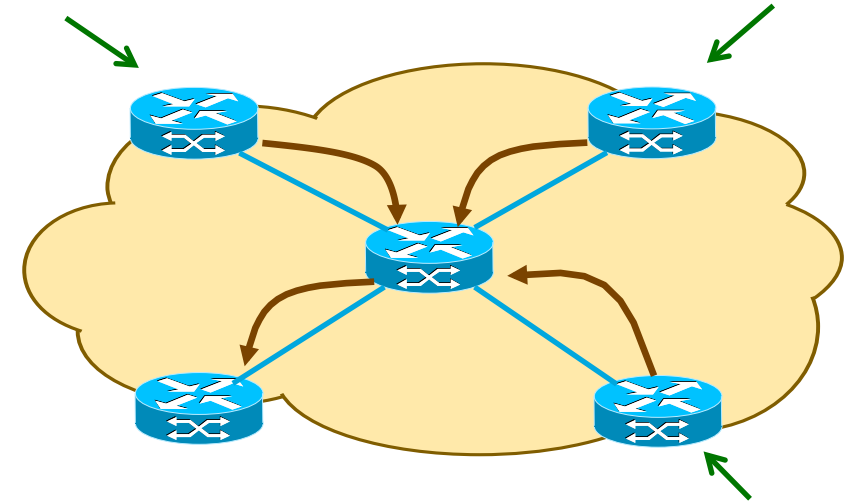
The Leafs sends a BGP A-D leaf to notify the ingress PE

The ingress sends RSVP-TE PATH messages to the leaves

The leaves respond with RSVP-TE RESV messages

The core router received 6 updates.

mLDP



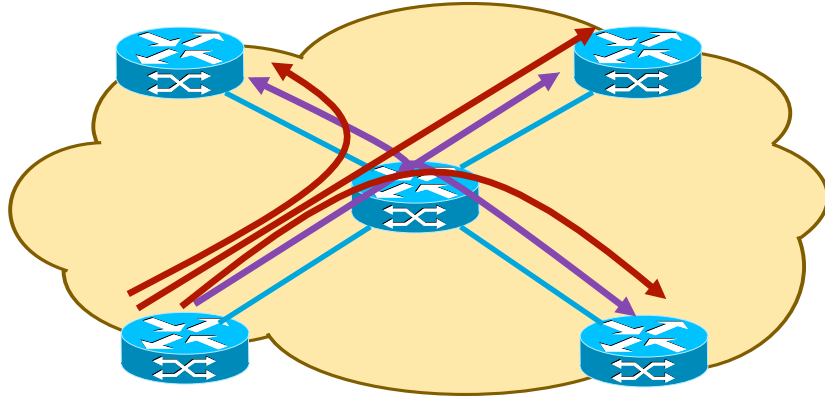
The egress (leaf) receives a PIM Join.

The leaf sends a mLDP label mapping to the ingress PE.

The core router received 3 update messages

LSM State: P2MP-RSVP-TE & mLDP

P2MP RSVP-TE



Control Plane: 3 P2P sub-LSPs from the ingress to the leaves

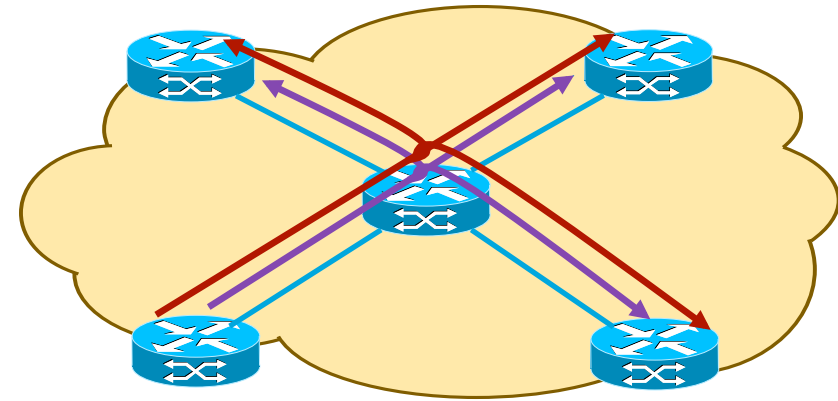
Data Plane: The 3 sub-LSP are merged into one P2MP for replication

P: one state for each individual leaf, total 3 in example; 12 path/resv msg

Ingress PE: 3 LSPs, 6 path/resv msg

When a leaf wants to leave, control-msg is sent all the way to the ingress PE to remove the LSP

mLDP



Control Plane: 1 P2MP LSP

Forwarding Plane: 1 P2MP LSP

P: 1 P2MP FEC (independent of the number of leaves), 4 control msgs

PE: 1 P2MP FEC (independent of the number of leaves), 1 control msg

When a leaf wants to leave, the message is only sent to the next branch point, not all the way to ingress PE

DESIGN DETAILS

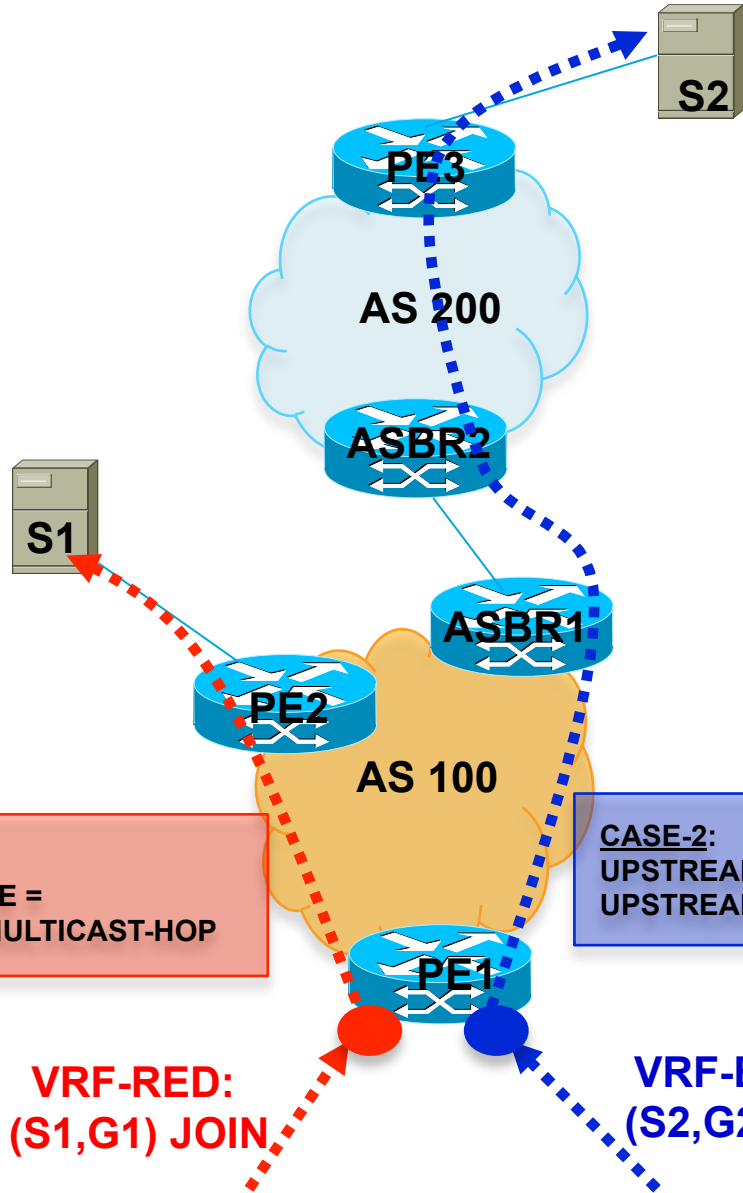


DESIGN DETAILS

UPSTREAM MULTICAST HOP



UPSTREAM MULTICAST HOP:



- ✓ If the route to the C-ROOT is across the VPN backbone, then the PE needs to find the UMH for the (S/*,G) flow.
- ✓ UMH selection is applicable to EGRESS-PEs.
- ✓ UMH is either the PE or ASBR.
- ✓ Routes eligible for UMH selection should have **<VRF Route Import Extended Community & Source AS Extended Community>** attributes.
- ✓ **UMH ROUTE CANDIDATE SET:** <ROUTE, UPSTREAM PE, UPSTREAM RD>

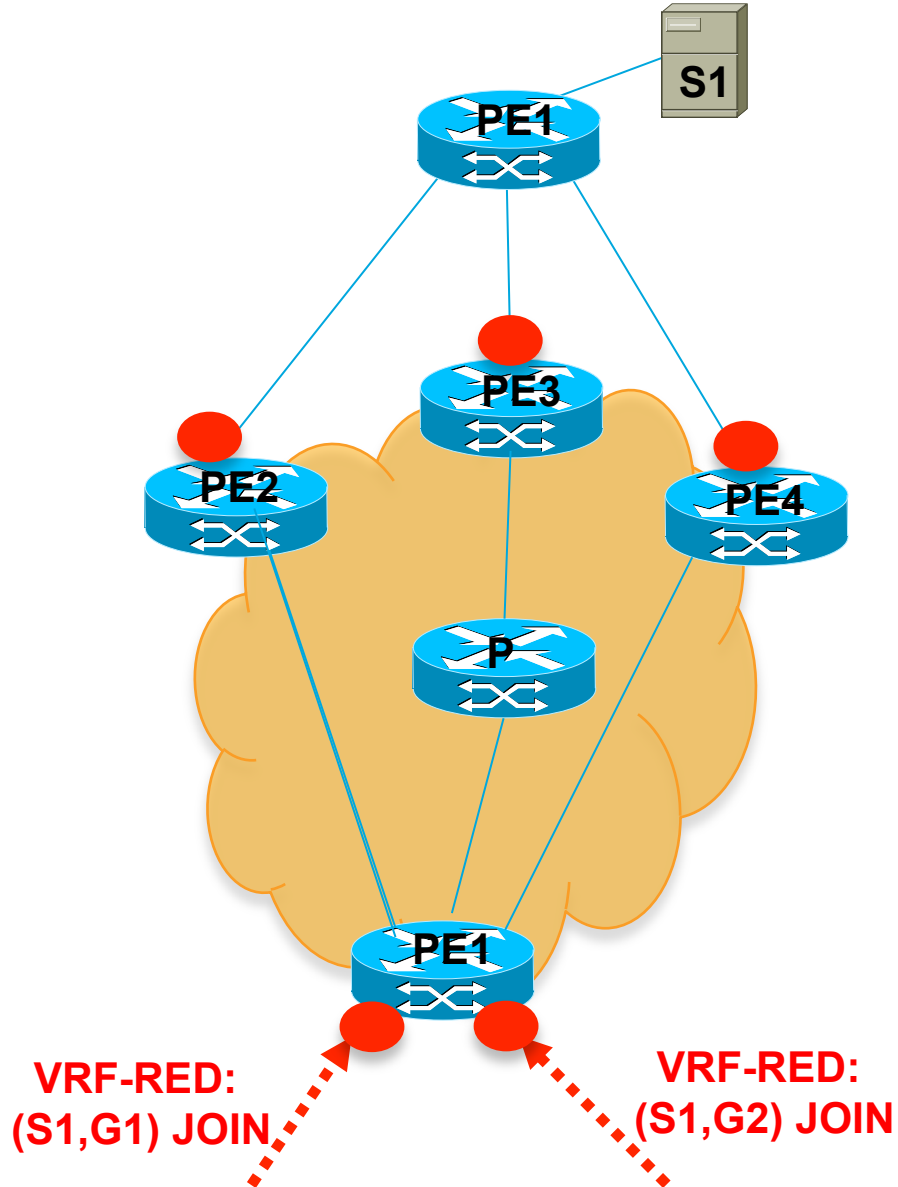
CASE-1:
UPSTREAM-PE =
UPSTREAM-MULTICAST-HOP

CASE-2:
UPSTREAM-PE !=
UPSTREAM-MULTICAST-HOP

VRF-RED:
(S1,G1) JOIN

VRF-BLUE:
(S2,G2) JOIN

UPSTREAM MULTICAST HOP:



- ✓ **INSTALLED ROUTES:** Routes installed in unicast RIB.
- ✓ **INSTALLED PATHS:** Multiple Paths associated with each installed route. These are the ones selected by BGP, by running its best-path selection algorithm and the maximum-paths configuration under BGP.
- ✓ **BGP PATHS:** It is possible for BGP to have additional paths, which are not installed in RIB. This full set of paths in the BGP database, is called as "BGP-Paths".
- ✓ **SELECTED PATH:** When PIM receives the Installed-Paths for a Source/RP, it selects one of the paths for sending (*,G) and (S,G) Joins Upstream. This is called as "Selected-Path".
- ✓ **UMH Selection options available for the Customer.**
 - **Hash of Installed-Paths:** No additional resources are required in BGP or RIB, to support this option.
 - **Highest PE Address:** Highest PE Address among the BGP-paths is tracked.
 - **Hash of BGP-Paths:** Additional resources are required in BGP or RIB, to support this option.

DESIGN DETAILS

DUPLICATE TRAFFIC AVOIDANCE

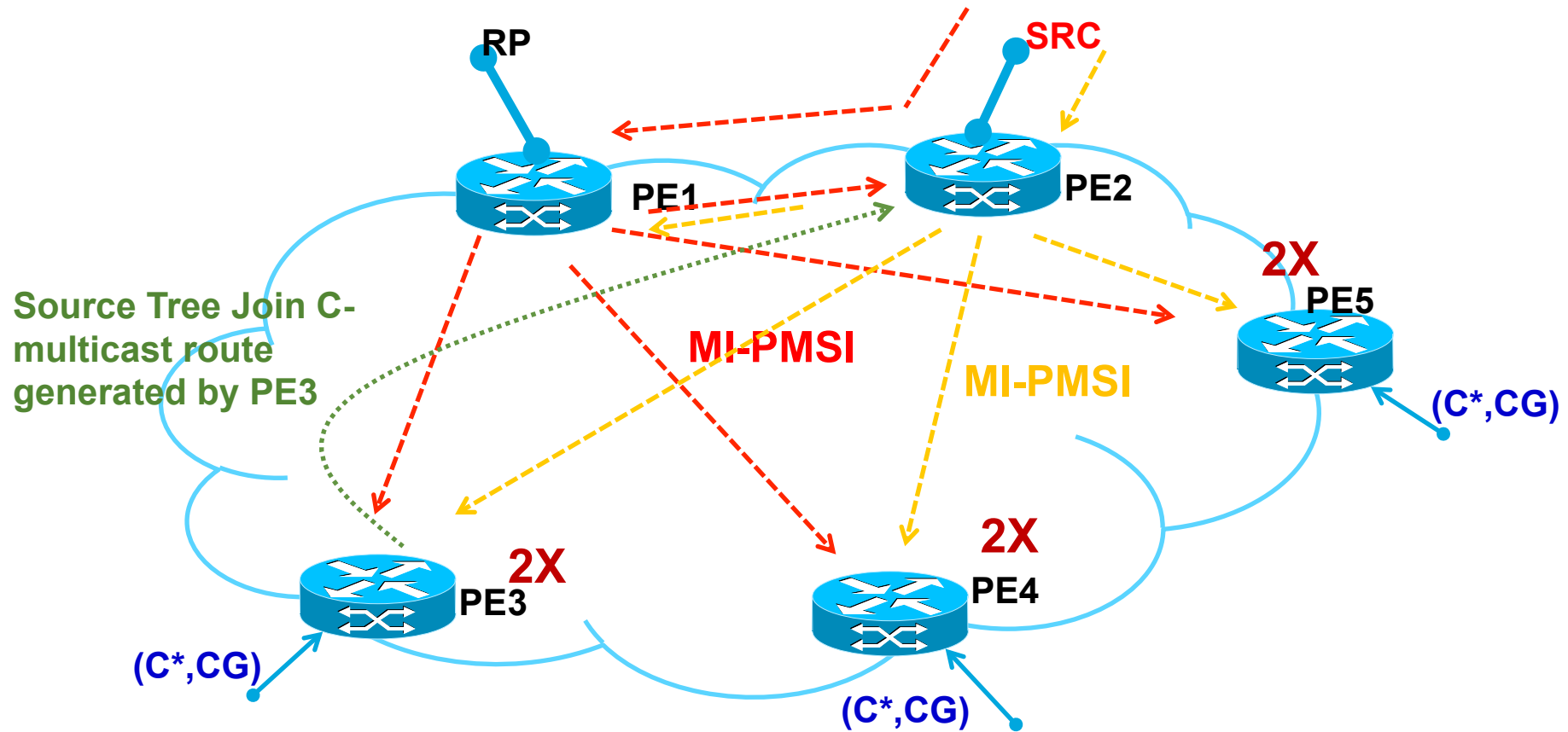


DESIGN DETAILS

SWITCHING FROM SHARED TREE TO SOURCE C-TREE



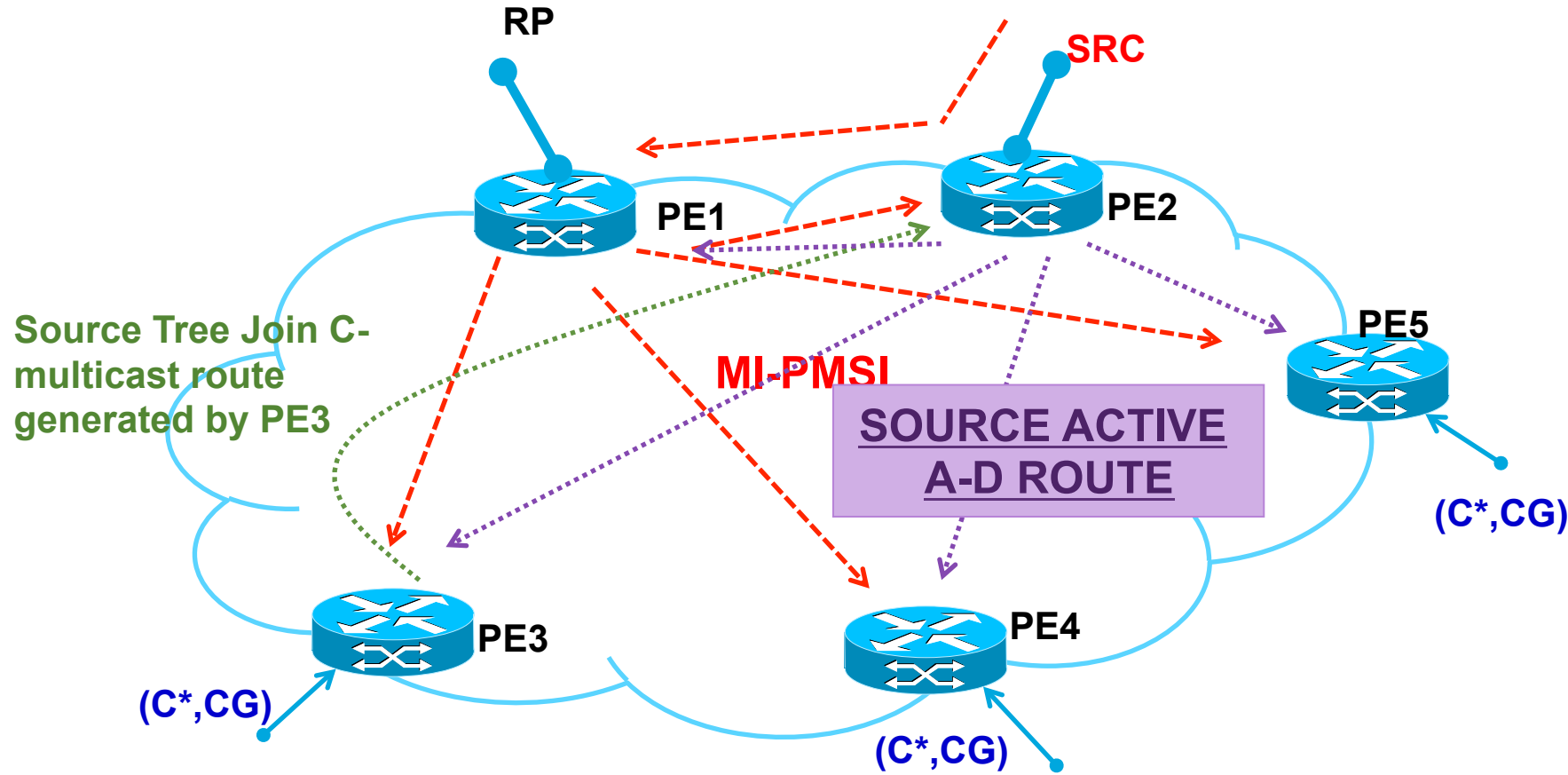
Switching from Shared to Source C-Tree :



If it is desirable to suppress receiving duplicate traffic, then it is necessary to choose a single forwarder PE for (CS,CG).

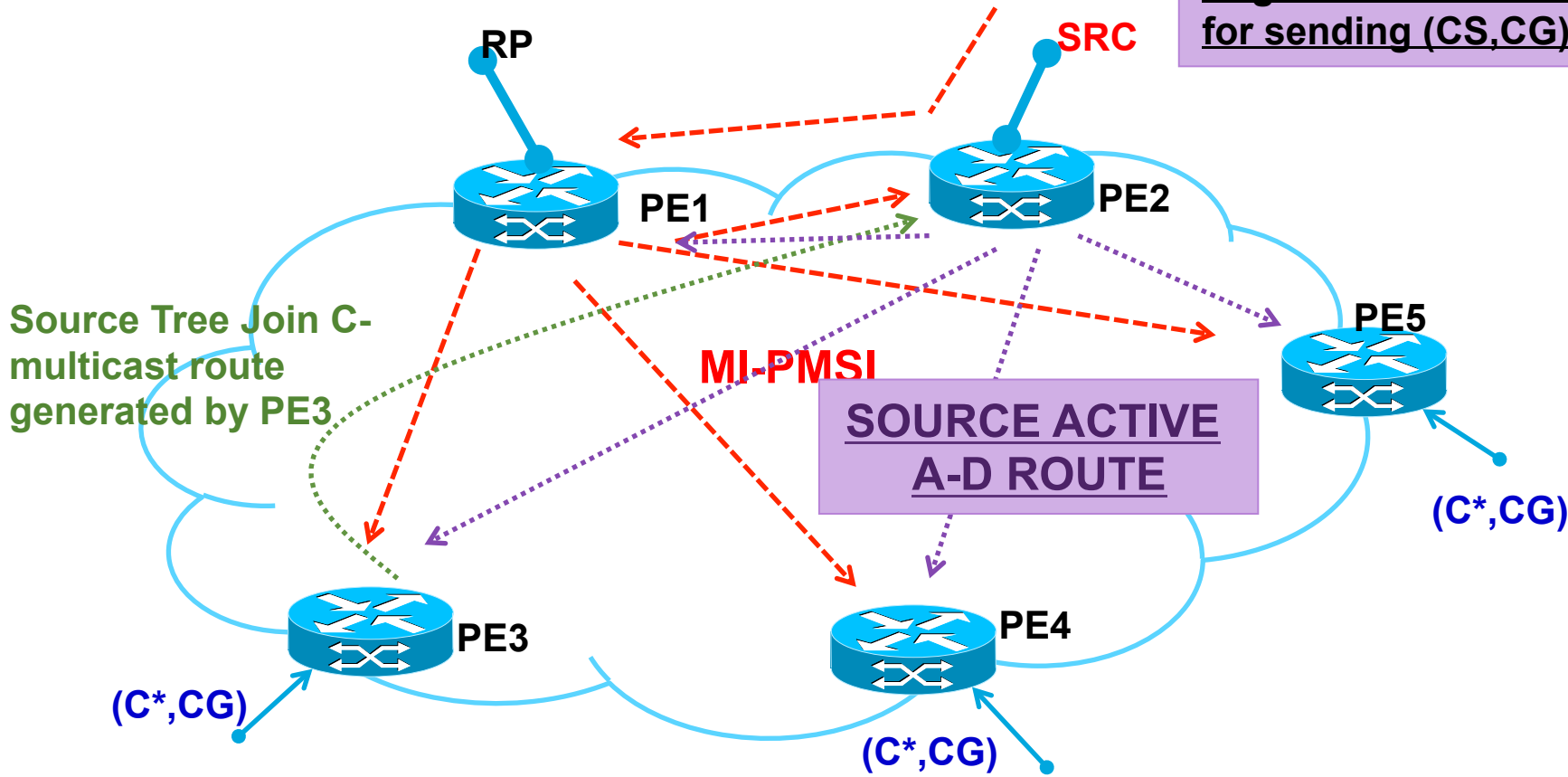
Switching from Shared to Source C-Tree :

When, as a result of receiving a Source Tree Join C-multicast route for (CS,CG) from some other PE the local PE adds either the S-PMSI or the I-PMSI to the outgoing interface list of the (CS,CG) state, the local PE MUST originate a **Source Active A-D route**. The Source Active A-D route is propagated to all the PEs of the MVPN.



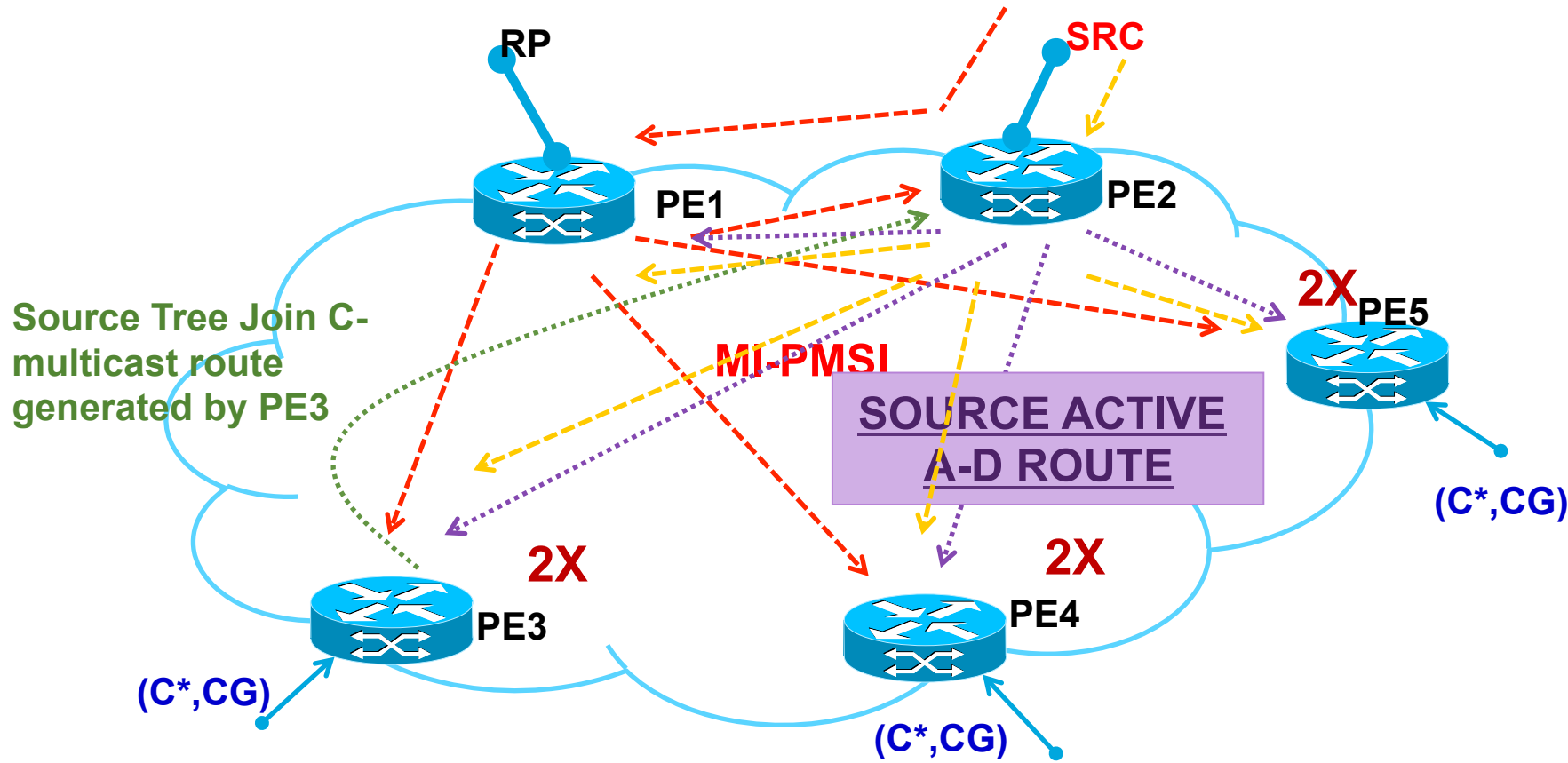
Switching from Shared to Source C-Tree :

If matching (C^*,CG) is found at PE which received "Source-Active A-D Route", PE sets up its forwarding path to receive (CS,CG) traffic from the tunnel the originator of the selected Source Active A-D route uses for sending (CS,CG) .



Switching from Shared to Source C-Tree :

But this 2X traffic is only for transient duration, see how, next.....



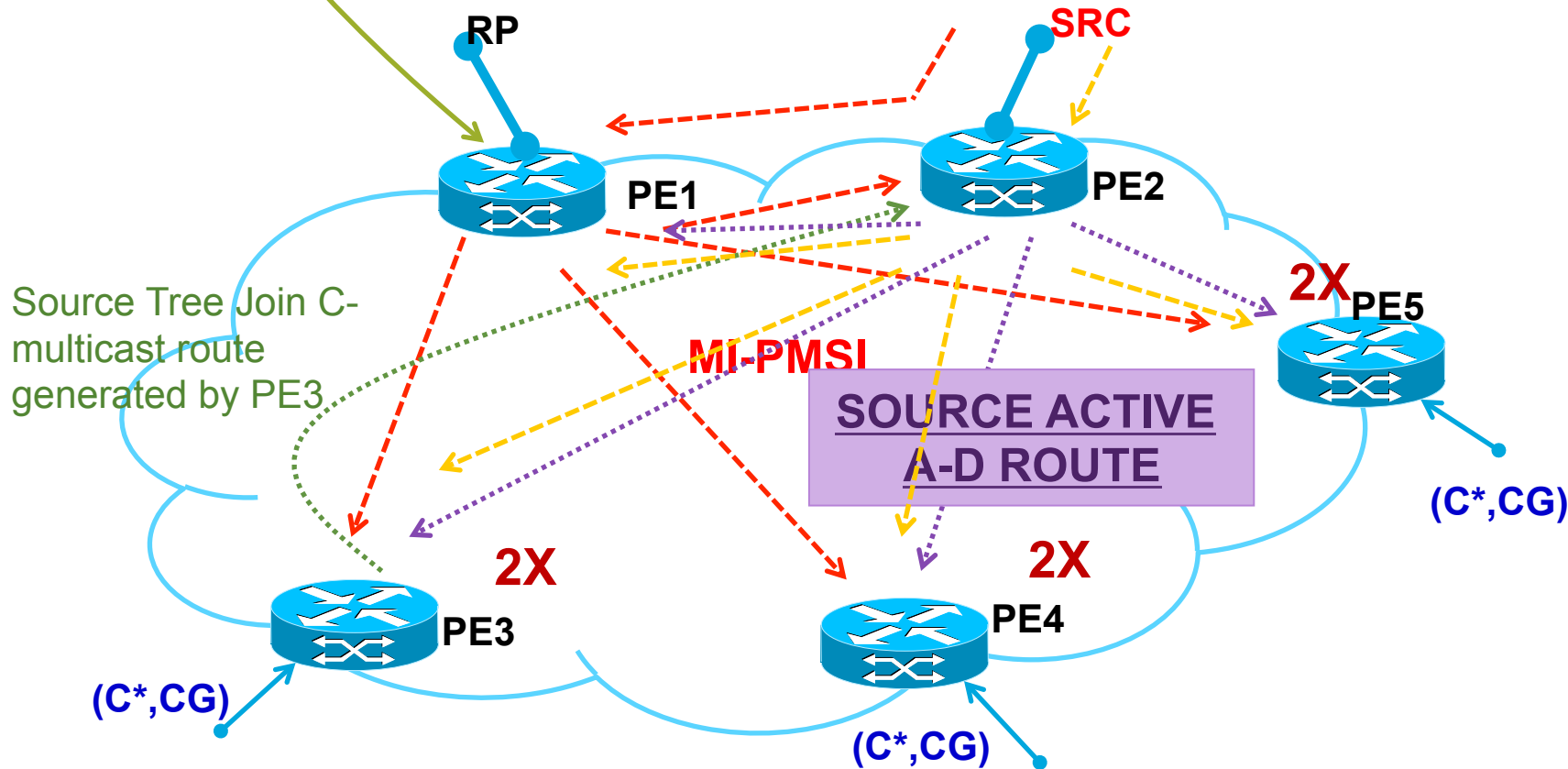
Switching from Shared to Source C-Tree :

If { ((OIF for the (C*,CG) entry in the MVPN-TIB on the PE contains I-PMSI) **OR** (OIF for the (C*,CG) entry in the MVPN-TIB on the PE contains S-PMSI)) **AND** (The PE does not originate the Source Tree Join C-multicast route for CS,CG)}

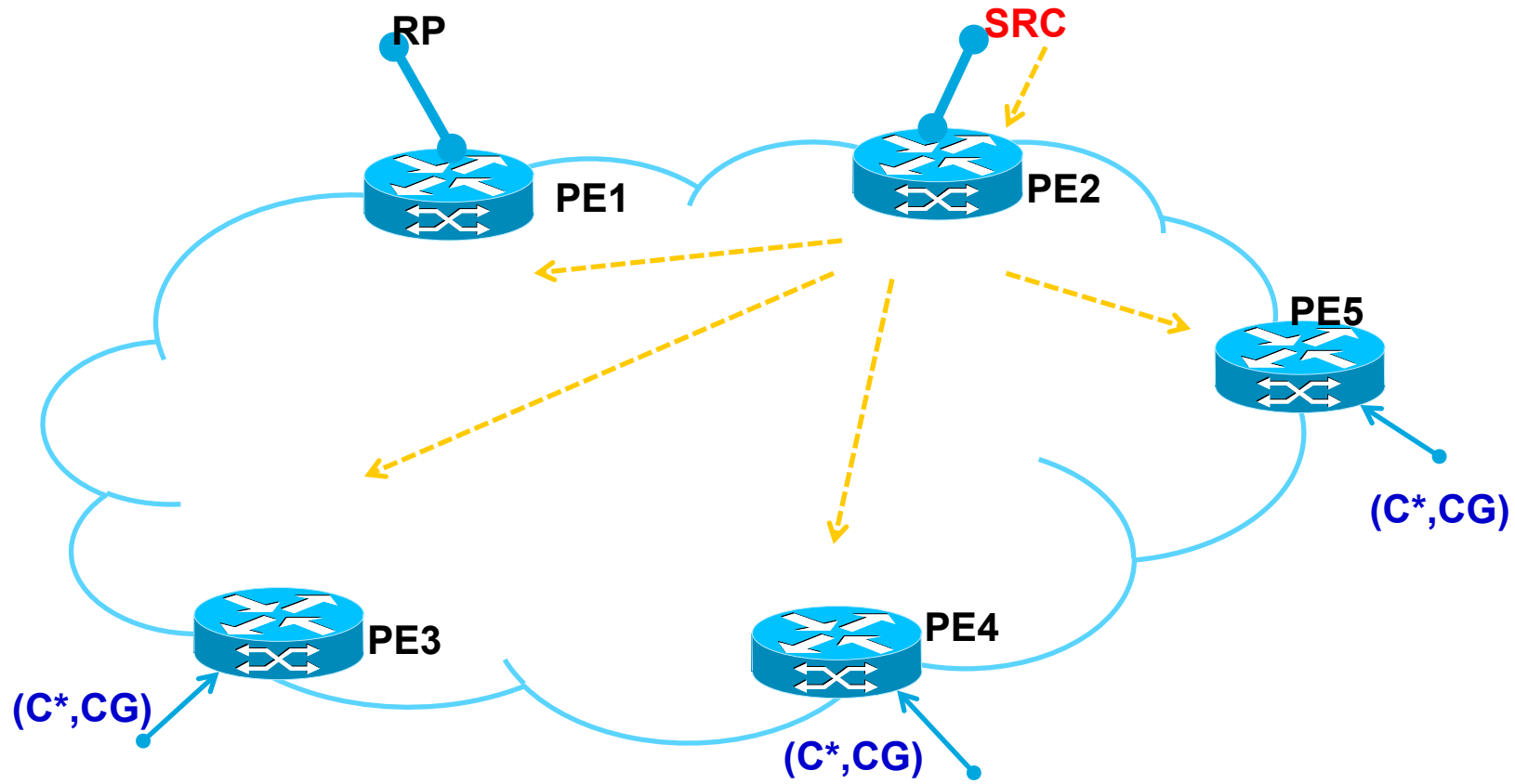
{

The PE MUST transition the (CS,CG,rpt) downstream state machine on I-PMSI/S-PMSI to the Prune state (Conceptually, the C-PIM state machine on the PE will act "as if" it had received Prune (CS,CG,rpt) on I-PMSI/S-PMSI, without actually having received one).

}



Switching from Shared to Source C-Tree :



DESIGN DETAILS

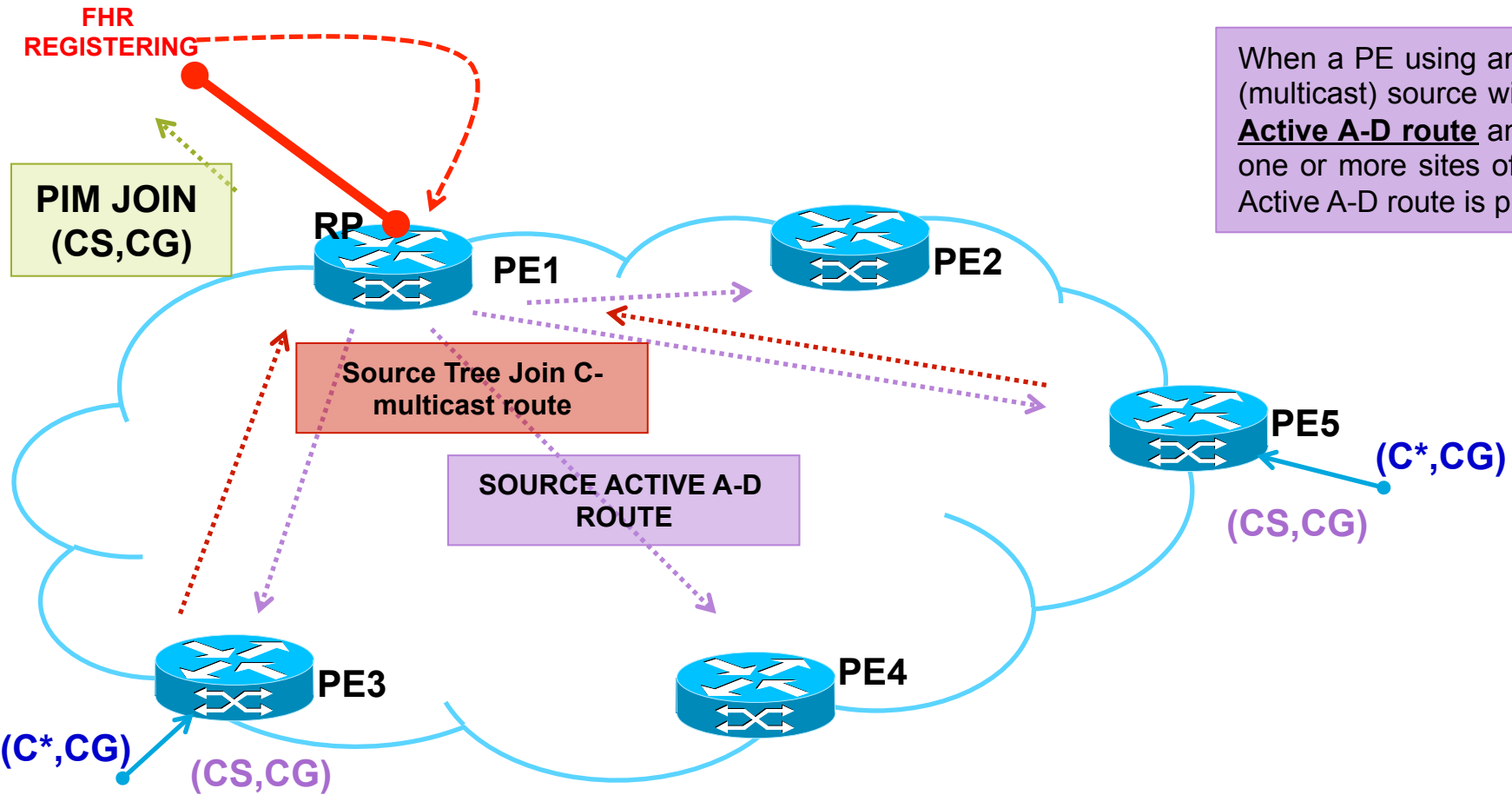
PIM-SM WITHOUT INTER-SITE SHARED C-TREES



PIM-SM without Inter-Site Shared C-Trees :

A PE can obtain information about active multicast sources within a given MVPN in a variety of ways:

- 1) One way is for the PE to act as a fully functional customer RP (C-RP) for that MVPN.
- 2) Another way is to use PIM Anycast RP procedures to convey information about active multicast sources from one or more of the MVPN C-RPs to the PE.
- 3) Yet another way is to use MSDP [MSDP] to convey information about active multicast sources from the MVPN C-RPs to the PE.



When a PE using any of the above methods first learns of a new (multicast) source within that MVPN, the PE constructs a **Source Active A-D route** and sends this route to all other PEs that have one or more sites of that MVPN connected to them. The Source Active A-D route is propagated to all the PEs of the MVPN.

PROFILES





For Your Reference

I: IOS/XE SUPPORTED (15.3(1)S, 3.8S)
X: IOS-XR SUPPORTED (4.3.0)

PROFILES

PIM

- 1) DEFAULT MDT using PIM without BGP-AD [I, X]
- 2) DEFAULT MDT using PIM with BGP-AD [I, X]
- 3) DEFAULT MDT using PIM with BGP-AD & c-mcast routing [I, X]

P2MP mLDP

- 1) Global In-Band signaling with mLDP [I, X]
- 2) VRF in-band-signaling with mLDP [I, X]
- 3) DEFAULT MDT using P2MP mLDP with BGP-AD [X]
- 4) DEFAULT MDT using P2MP mLDP with BGP-AD & c-mcast routing [X]
- 5) PARTITIONED MDT using P2MP mLDP with BGP-AD [X]
- 6) PARTITIONED MDT using P2MP mLDP with BGP-AD & c-mcast routing [X]

MP2MP mLDP

- 1) DEFAULT MDT using MP2MP mLDP without BGP-AD [I, X]
- 2) DEFAULT MDT using MP2MP mLDP with BGP-AD [I, X]
- 3) DEFAULT MDT using MP2MP mLDP with BGP-AD & c-mcast routing [I, X]
- 4) PARTITIONED MDT using MP2MP mLDP without BGP-AD [X]
- 5) PARTITIONED MDT using MP2MP mLDP with BGP-AD [X]
- 6) PARTITIONED MDT using MP2MP mLDP with BGP-AD & c-mcast routing [X]

P2MP RSVP-TE

- 1) Global P2MP-TE [I, X]
- 2) P2MP-TE with BGP-AD in VRF context [X]
- 3) DEFAULT MDT using P2MP-TE with BGP-AD [X]
- 4) DEFAULT MDT using P2MP-TE with BGP-AD & c-mcast routing [X]

SUPPORTED CONFIGURATIONS



SUPPORTED CONFIGURATIONS

IOS/XE



CONFIGURATION KNOBS:

BGP CLI:

1] [MANDATORY] To enable BGP MVPN AD & C-route signaling, configure the below mentioned CLI under BGP router mode.

```
[no] address-family [ipv4 | ipv6] mvpn
```

MULTICAST CLI:

1] [MANDATORY] This CLI needs to be configured for an address-family in a VRF to enable BGP Auto-Discovery advertisements from multicast and to process multicast BGP Customer routes received at a router. If the command is not configured, then the router will not originate any BGP MVPN SAFI Auto-discovery routes for the VRF address-family and will not process received BGP Customer routes as well. The keyword "pim/mldp" determines the core P-Tree that is advertised by multicast for BGP INTRA-AS I-PMSI (Type 1) and S-PMSI (Type 3) A-D routes. The keyword "pim-tlv-announce" is OPTIONAL and it enables origination of periodic UDP TLV messages for data MDTs in addition to S-PMSI A-D routes advertised via BGP. Without "pim-tlv-announce" only Type-3, S-PMSI A-D routes are advertised

```
[no] mdt auto-discovery {pim/mld} [pim-tlv-announce]
```

CONFIGURATION KNOBS:

MULTICAST CLI:

2] [MANDATORY] CLI is configured at the address-family sublevel. This CLI is used to decide which overlay protocol should be used to carry customer join/prunes. Default mode is PIM signaling. The spt-only option is a hidden option and only applies to the use-bgp keyword. This hidden knob needs to be enabled for testing the SPT-only mode for ASM groups.

```
[no] mdt overlay use-bgp [spt-only]
```

SHOW KNOBS:

BGP SHOW KNOB:

```
show bgp [ipv4 | ipv6] mvpn [vrf <vrf>] [route-type <route-type#>] [all | <prefix>]
```

</EX>

```
show bgp ipv4 mvpn vrf <vrf_name> route-type <1> <originator ID>
```

```
show bgp ipv4 mvpn vrf vpn_0 route-type 1 1.1.1.1
```

```
show bgp ipv4 mvpn vrf <vrf_name> route-type <3> <mcast-src-add> <mcast-grp-add>  
<originator-id>
```

```
show bgp ipv4 mvpn vrf vpn_0 route-type 3 12.1.1.2 225.1.1.1 1.1.1.1
```

```
show bgp ipv4 mvpn vrf <vrf_name> route-type <7> <Remote VPN Route Distinguisher> <AS-  
number> <mcast-src-add> <mcast-grp-add> <originator-id>
```

```
show bgp ipv4 mvpn vrf vpn_0 route-type 7 1000:1 1000 12.1.1.1 225.1.2.3
```

<EX/>

MULTICAST SHOW KNOB:

```
show <ip | ipv6> pim [vrf <vrf_name>] mdt bgp [c-mroutes | source-active] [group] [source]  
Show mpls mldp database
```

SAMPLE CONFIGURATIONS:

SAMPLE CONFIG: [P-TREE: PIM SSM/ASM/BIDIR]

```
vrf definition vpn_0
 rd 81:1111
 route-target export 80:1111
 route-target import 80:1111
 !
 address-family ipv4
  mdt auto-discovery pim pim-tlv-announce
  mdt default 232.10.0.0
  mdt data 232.100.0.0 0.0.3.255
  mdt overlay use-bgp spt-only
  route-target export 80:1111
  route-target import 80:1111
 exit-address-family
 !
 address-family ipv6
  mdt auto-discovery pim pim-tlv-announce
  mdt default 232.10.0.0
  mdt data 232.200.0.0 0.0.3.255
  mdt overlay use-bgp spt-only
  route-target export 80:1111
  route-target import 80:1111
 exit-address-family
```

```
router bgp 55
 ...
 neighbor 205.2.0.2 remote-as 55
 neighbor 205.2.0.2 update-source Loopback0
 ...
 !
 address-family ipv4 mvpn
  neighbor 205.2.0.2 activate
  neighbor 205.2.0.2 send-community extended
 exit-address-family
 ...
 address-family ipv6 mvpn
  neighbor 205.2.0.2 activate
  neighbor 205.2.0.2 send-community extended
 exit-address-family
 !
 ...
 ...
```

SAMPLE CONFIGURATIONS:

SAMPLE CONFIG: [P-TREE: mLDP]

```
vrf definition vpn_0
  rd 81:1111
  vpn id 80:1111
  route-target export 80:1111
  route-target import 80:1111
  !
  address-family ipv4
    mdt auto-discovery mldp
    mdt default mpls mldp 205.3.0.3
    mdt data mpls mldp 5000
    mdt overlay use-bgp
    route-target export 80:1111
    route-target import 80:1111
  exit-address-family
  !
  address-family ipv6
    mdt auto-discovery mldp
    mdt default mpls mldp 205.3.0.3
    mdt data mpls mldp 5000
    mdt overlay use-bgp
    route-target export 80:1111
    route-target import 80:1111
  exit-address-family
```

```
router bgp 55
  ...
  neighbor 205.2.0.2 remote-as 55
  neighbor 205.2.0.2 update-source Loopback0
  ...
  !
  address-family ipv4 mvpn
    neighbor 205.2.0.2 activate
    neighbor 205.2.0.2 send-community extended
  exit-address-family
  ...
  address-family ipv6 mvpn
    neighbor 205.2.0.2 activate
    neighbor 205.2.0.2 send-community extended
  exit-address-family
  !
  ...
  ...
```

SUPPORTED CONFIGURATIONS

IOS-XR



SAMPLE CONFIGURATIONS:

SAMPLE CONFIG: [ROSEN-mLDP with BGP-AD, HEAEND]

```
vrf p9_v46
  vpn id 109:1
  address-family ipv4 unicast
    import route-target
      109:1
    export route-target
      109:1
  address-family ipv6 unicast
    import route-target
      109:1
    export route-target
      109:1

interface Loopback0
  ipv4 address 100.0.0.1 255.255.255.255
  ipv6 address 2008:100::1/128

route-policy rosen
  set core-tree mldp-rosen
end-policy

router ospf 100
  router-id 100.0.0.1
  area 0
  interface Loopback0
  interface TenGigE0/0/0/0
```

```
router bgp 100
  mvpn
  bgp router-id 100.0.0.1
  address-family ipv4 unicast
  address-family vpnv4 unicast
  address-family ipv6 unicast
  address-family vpnv6 unicast
  address-family ipv4 mvpn
  address-family ipv6 mvpn
  neighbor 100.0.0.3
    remote-as 100
  update-source Loopback0
  address-family ipv4 unicast
  address-family vpnv4 unicast
  address-family vpnv6 unicast
  address-family ipv4 mvpn
  address-family ipv6 mvpn

vrf p9_v46
  rd 109:1
  address-family ipv4 unicast
  address-family ipv6 unicast
  address-family ipv4 mvpn
  address-family ipv6 mvp
  neighbor 15.0.0.2
    remote-as 200
  address-family ipv4 unicast
  neighbor 2008:15::2
    remote-as 200
  address-family ipv6 unicast
```

SAMPLE CONFIGURATIONS:

```
mpls ldp
router-id 100.0.0.1
mldp
make-before-break delay 30 0
interface TenGigE0/0/0/0

router pim
vrf p9_v46
address-family ipv4
rpf topology route-policy rosen
address-family ipv6
rpf topology route-policy rosen

multicast-routing
address-family ipv4
mdt source Loopback0
rate-per-route
interface all enable
accounting per-prefix
address-family ipv6
rate-per-route
interface all enable
accounting per-prefix
vrf p9_v46
address-family ipv4
bgp auto-discovery mldp
mdt default mldp ipv4 100.0.0.2
address-family ipv6
bgp auto-discovery mldp
mdt default mldp ipv4 100.0.0.2
```


SAMPLE CONFIGURATIONS:

SAMPLE CONFIG: [VRF in-band-signaling with mLDP, HEAEND]

```
vrf p6_v46
  address-family ipv4 unicast
    import route-target
      106:1
    export route-target
      106:1
  address-family ipv6 unicast
    import route-target
      106:1
    export route-target
      106:1

interface Loopback0
  ipv4 address 100.0.0.1 255.255.255.255
  ipv6 address 2008:100::1/128

route-policy inband
  set core-tree mldp-inband
end-policy

router ospf 100
  router-id 100.0.0.1
  area 0
  interface Loopback0
  interface TenGigE0/0/0/0
```

```
router bgp 100
  mvpn
  bgp router-id 100.0.0.1
  address-family ipv4 unicast
  address-family vpnv4 unicast
  address-family ipv6 unicast
  address-family vpnv6 unicast
  neighbor 100.0.0.3
    remote-as 100
  update-source Loopback0
  address-family ipv4 unicast
    next-hop-self
  address-family vpnv4 unicast
  address-family vpnv6 unicast
vrf p6_v46
  rd 106:1
  address-family ipv4 unicast
  address-family ipv6 unicast
  neighbor 15.0.0.2
    remote-as 200
  address-family ipv4 unicast
  as-override
  neighbor 2008:15::2
    remote-as 200
  address-family ipv6 unicast
```

SAMPLE CONFIGURATIONS:

```
mpls ldp
  router-id 100.0.0.1
  mldp
    make-before-break delay 30 0
  interface TenGigE0/0/0/0

multicast-routing
  address-family ipv4
    mdt source Loopback0
  interface all enable
  address-family ipv6
  interface all enable
  vrf p6_v46
    address-family ipv4
      mdt mldp in-band-signaling ipv4
    address-family ipv6
      mdt mldp in-band-signaling ipv4

router pim
  vrf p6_v46
    address-family ipv4
      rpf topology route-policy inband
    address-family ipv6
      rpf topology route-policy inband
```

SAMPLE CONFIGURATIONS:

SAMPLE CONFIG: [Partition-P2MP-mLDP/MS-PMSI-mLDP-P2MP
with BGP-AD, HEAEND]

```
vrf p5_v46
  address-family ipv4 unicast
    import route-target
      105:1
    export route-target
      105:1
  address-family ipv6 unicast
    import route-target
      105:1
    export route-target
      105:1

interface Loopback0
  ipv4 address 100.0.0.1 255.255.255.255
  ipv6 address 2008:100::1/128

route-policy partition-p2mp
  set core-tree mldp-partitioned-p2mp
end-policy

router ospf 100
  router-id 100.0.0.1
  area 0
    interface Loopback0
    interface TenGigE0/0/0/0
```

```
router bgp 100
  bgp router-id 100.0.0.1
  address-family ipv4 unicast
  address-family vpnv4 unicast
  address-family ipv6 unicast
  address-family vpnv6 unicast
  address-family ipv4 mvpn
  address-family ipv6 mvpn
  neighbor 100.0.0.3
    remote-as 100
  update-source Loopback0
  address-family ipv4 unicast
  address-family vpnv4 unicast
  address-family vpnv6 unicast
  address-family ipv4 mvpn
  address-family ipv6 mvpn

vrf p5_v46
  rd 105:1
  address-family ipv4 unicast
  address-family ipv6 unicast
  address-family ipv4 mvpn
  address-family ipv6 mvpn
  neighbor 15.0.0.2
    remote-as 200
  address-family ipv4 unicast
  neighbor 2008:15::2
    remote-as 200
  address-family ipv6 unicast
```

SAMPLE CONFIGURATIONS:

```
mpls ldp
router-id 100.0.0.1
mldp
make-before-break delay 30 0
interface TenGigE0/0/0/0

multicast-routing
address-family ipv4
mdt source Loopback0
interface all enable
address-family ipv6
interface all enable
vrf p5_v46
address-family ipv4
bgp auto-discovery mldp
mdt partitioned mldp ipv4 p2mp
interface all enable
address-family ipv6
bgp auto-discovery mldp
mdt partitioned mldp ipv4 p2mp
interface all enable

router pim
vrf p4_v46
address-family ipv4
rpf topology route-policy partition-p2mp
address-family ipv6
rpf topology route-policy partition-p2mp
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configuration task:

- 1) **Enable mLDP on all Core Routers**
- 2) **Configure MBB or MoFRR on appropriate Core Routers**
- 3) **Configure BGP to enable BGP-AD Address-Family**
- 4) **Configure route-policy**
- 5) **Configure vrf instance for customers**
- 6) **Put CFI (Customer Facing Interface) into appropriate vrf**
- 7) **Enable Multicast on PE and CE routers**
- 8) **Configure MDT Source**
- 9) **Configure Default MDT and Data MDT**
- 10) **Configure MDT for Inband Signalling Profiles**
- 11) **Configure PIM topology on PE routers**
- 12) **Other optional configurations**

Enable mLDP on all Core Routers:

Syntax:

+ mldp [disable]

```
mpls ldp
  router-id 1.1.1.1
  mldp
    logging notifications
  !
  interface GigabitEthernet0/2/0/0
  !
  interface GigabitEthernet0/2/0/1
    mldp disable
  !
  !
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) **Configure MBB or MoFRR on appropriate Core Routers**
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure MBB or MoFRR on appropriate Core Routers:

Syntax:

```
+ make-before-break delay <Forwarding delay in seconds> <Delete delay in seconds>
+ mofrr
```

```
mpls ldp
router-id 1.1.1.1
mldp
make-before-break delay 10 20
mofrr
logging notifications
!
interface GigabitEthernet0/2/0/0
!
interface GigabitEthernet0/2/0/1
mldp disable
!
!
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) **Configure BGP to enable BGP-AD Address-Family**
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure BGP to enable BGP-AD Address-Family:

Syntax:

```
+ address-family ipv4|ipv6 mvpn
router bgp 100
  address-family ipv4 mvpn
  !
  address-family ipv6 mvpn
  !
  neighbor 100.3.3.3
    remote-as 100
    address-family ipv4 mvpn
    !
    address-family ipv6 mvpn
    !
  !
  vrf pl_v46
    rd 1:1
    address-family ipv4 mvpn
    !
    address-family ipv6 mvpn
    !
  !
  !
  !
```


Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) **Configure route-policy**
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure route-policy:

Syntax:

```
+ set core-tree mldp-default | mldp-inband |  
mldp-partitioned-mp2mp | mldp-partitioned-p2mp |  
mldp-default | p2mp-te-default | pim-default  
+ set c-multicast-routing bgp | pim
```

```
route-policy provider-tree  
    set core-tree mldp-inband  
end-policy
```

```
route-policy provider-tree  
    if next-hop in (12.1.1.1) then  
        set core-tree mldp-default  
        set c-multicast-routing bgp  
    elseif next-hop in (14.1.1.1) then  
        set core-tree mldp-partitioned-p2mp  
        set c-multicast-routing pim  
    endif  
end-policy
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) **Configure vrf instance for customers**
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure vrf instance for customers:

Syntax:

```
+ vrf <vrf name>
```

```
+ vpn id <OUI VPN-index>
```

```
vrf p1_v46
```

```
  vpn id 100:1
```

```
  address-family ipv4 unicast
```

```
    import route-target
```

```
      100:1
```

```
    !
```

```
    export route-target
```

```
      100:1
```

```
    !
```

```
  !
```

```
  address-family ipv6 unicast
```

```
    import route-target
```

```
      100:1
```

```
    !
```

```
    export route-target
```

```
      100:1
```

```
    !
```

```
  !
```

```
!
```

Note: VPN-ID is mandatory configuration for Rosen mLDP Profiles, but not for others.

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Put CFI (Customer Facing Interface) into appropriate vrf:

Syntax:

+ vrf <vrf name>

```
interface TenGigE0/2/0/0
  vrf p1_v46
  ipv4 address 15.0.0.1 255.255.255.0
  ipv6 address 2008:15:100::1:1/112
!
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) **Enable Multicast on PE and CE routers**
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Enable Multicast on PE and CE routers:

Syntax:

```
+ multicast-routing
  address-family ipv4|ipv6
    interface <interface name> enable
  vrf <vrf_instance>
    address-family ipv4|ipv6
      interface <interface name> enable
```

NOTE: We can enable multicast and pim on interfaces one by one. We can also easily enable all interfaces to run multicast and pim, there is a keyword "all" followed interface.

```
multicast-routing
  address-family ipv4
    interface Loopback0
      enable
    interface TenGigE0/0/0/0
      enable
  address-family ipv6
    interface Loopback0
      enable
    interface TenGigE0/0/0/0
      enable
vrf p1_v46
  address-family ipv4
    interface all enable
  address-family ipv6
    interface all enable
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) **Configure MDT Source**
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure MDT Source:

Syntax:

```
+ multicast-routing
  address-family ipv4|ipv6
    mdt source <interface>
  vrf <vrf instance>
    address-family ipv4|ipv6
      mdt source <interface>
```

```
multicast-routing
  address-family ipv4
    mdt source Loopback0
```

```
multicast-routing
  vrf p1_v46
    address-family ipv4
      mdt source Loopback1001
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) **Configure Default MDT and Data MDT**
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure Default MDT and Data MDT:

Syntax:

```
+ mdt default mldp ipv4 <Root Address>
[This is for Rosen mLDP Profile]
+ mdt partitioned mldp ipv4 mp2mp|p2mp
[This is for Partitional mLDP Profile]
+ mdt data <maxi data MDT number> threshold
<rate>
```

NOTE: Different mLDP mVPN Profiles have different MDT definition. Default MDT and Data MDT only exist on Rosen and Partitional MDT profiles and can be configured under multicast via below CLI. Default MDT is mandatory configuration for Rosen and Partition Profiles.

NOTE: To configure Root Node Redundancy (RNR) in Rosen Profiles, just configure Multiple Root Address in multiple CLI lines.

```
multicast-routing
vrf p1_v46
  address-family ipv4
    mdt default mldp ipv4 10.2.2.2
    mdt data 255 threshold 2
  address-family ipv6
    mdt default mldp ipv4 10.2.2.2
    mdt data 255 threshold 2
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Other optional configurations

Configure MDT for Inband Signalling Profiles:

Syntax:

```
+ mdt mldp in-band-signaling ipv4
```

NOTE: There are no concepts of Default MDT and Data MDT on Inband Signalling Profiles, we can configure In-Band Signaling Core-Tree via below CLI under multicast.

```
***Option 1: Global Inband***
multicast-routing
  address-family ipv4
    mdt mldp in-band-signaling ipv4
  address-family ipv6
    mdt mldp in-band-signaling ipv4
***Option 2: VRF Inband***
multicast-routing
  vrf p1_v46
    address-family ipv4
      mdt mldp in-band-signaling ipv4
    address-family ipv6
      mdt mldp in-band-signaling ipv4
```

Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) **Configure BGP-AD route discovery mode under multicast**
- 12) Other optional configurations

Configure BGP-AD route discovery mode under multicast:

Syntax:

```
+ multicast-routing
  vrf <vrf instance>
    address-family ipv4 | ipv6
      bgp auto-discovery [mldp | pim | p2mp-te]
```

```
multicast-routing
  vrf p_1
    address-family ipv4
      bgp auto-discovery mldp
    address-family ipv6
      bgp auto-discovery mldp
```


Configuration task:

- 1) Enable mLDP on all Core Routers
- 2) Configure MBB or MoFRR on appropriate Core Routers
- 3) Configure BGP to enable BGP-AD Address-Family
- 4) Configure route-policy
- 5) Configure vrf instance for customers
- 6) Put CFI (Customer Facing Interface) into appropriate vrf
- 7) Enable Multicast on PE and CE routers
- 8) Configure MDT Source
- 9) Configure Default MDT and Data MDT
- 10) Configure MDT for Inband Signalling Profiles
- 11) Configure PIM topology on PE routers
- 12) Configure pim topology

Configure pim topology:

Syntax:

```
+ router pim
  address-family ipv4 | ipv6
    rpf topology route-policy <route-policy
    name>
```

NOTE:

❑ Configure pim rpf topology to define which core-tree will be chosen to accept and join.

```
router pim
  address-family ipv4
    rpf topology route-policy inband
  address-family ipv6
    rpf topology route-policy inband
  vrf p1_v46
    address-family ipv4
      rpf topology route-policy provider-tree
    address-family ipv6
      rpf topology route-policy provider-tree
```

- **Thank you!**
- Please complete the [post-event survey](#)
- Join us for upcoming webinars:
Register: www.cisco.com/go/techadvantage

Follow us  @GetYourBuildOn