

mVPN Deployment Models

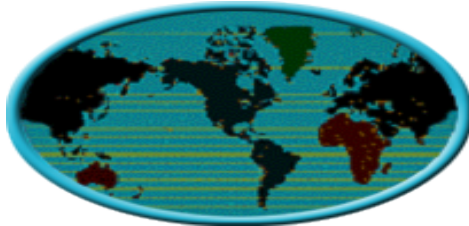
ALEF roadshow 5.11.2015, Vyhne

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Agenda

- Introduction
- Building Blocks
 - Core-tree Signaling Protocols
 - Overlay Signaling Protocols
- Deployment Models Overview
- Deployment Notes

Multicast Market Segment



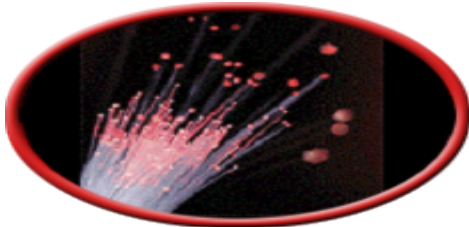
Global Enterprise



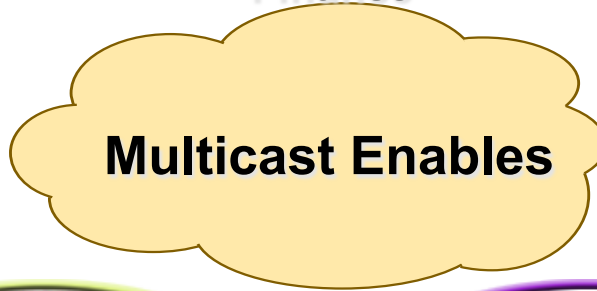
Finance



Content Providers



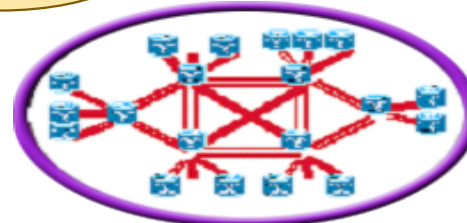
**Broadband
Entertainment**



**New Trading
Verticals
Oil & GAS
Commodities**



Education



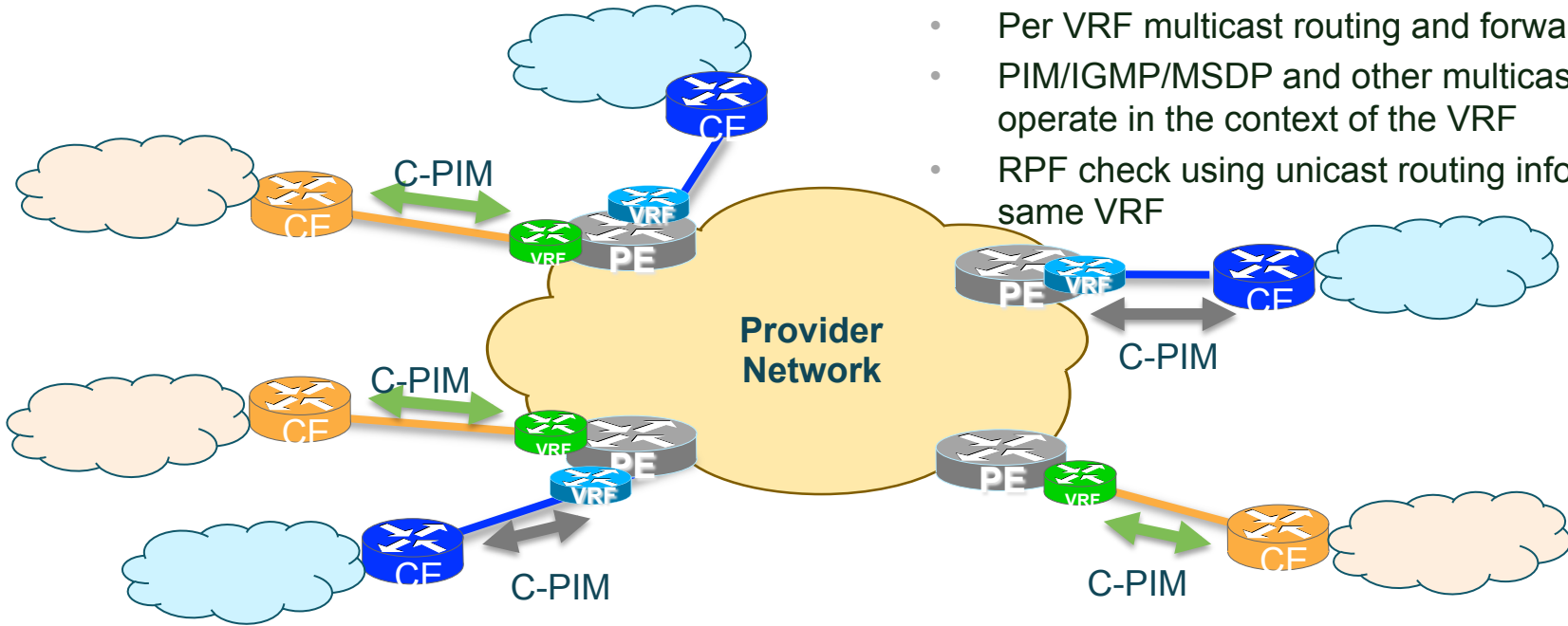
IPTV - ISP

Multicast VPN Concepts



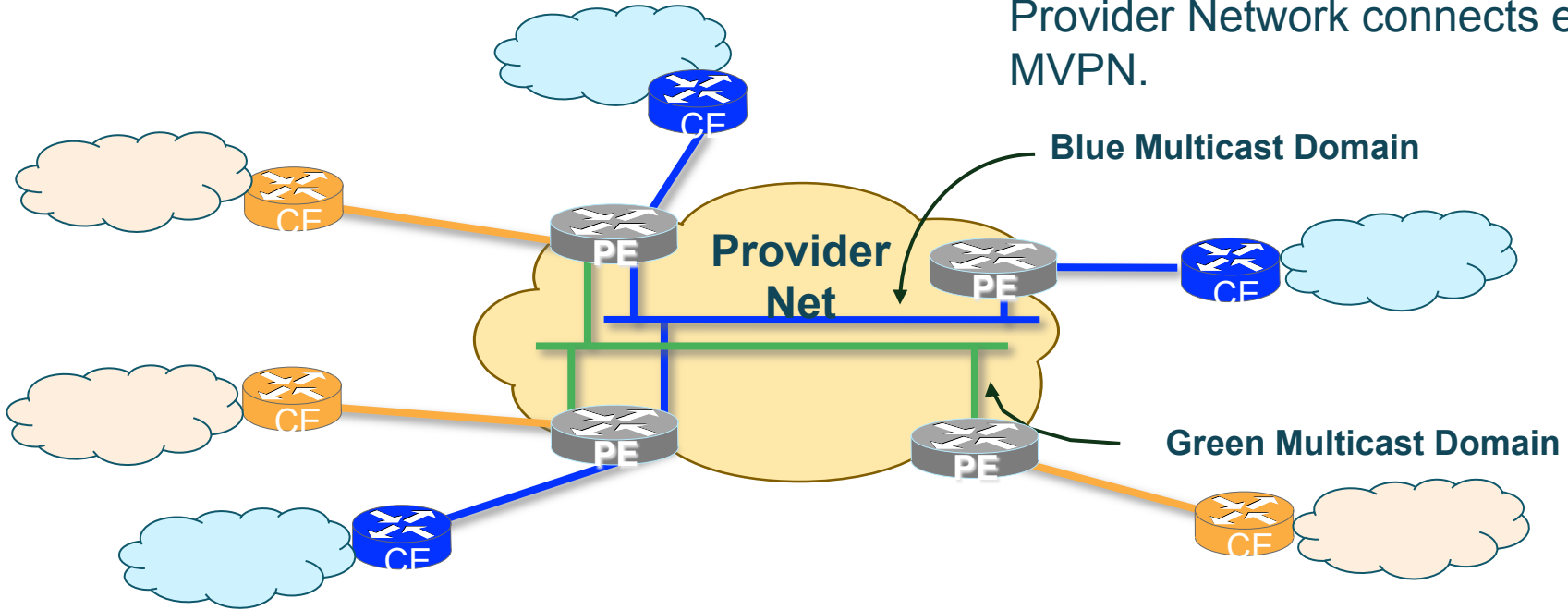
Multicast VPN – Multicast VRF

- A VRF that supports both unicast and multicast forwarding tables
- Per VRF multicast routing and forwarding
- PIM/IGMP/MSDP and other multicast protocols operate in the context of the VRF
- RPF check using unicast routing information in the same VRF



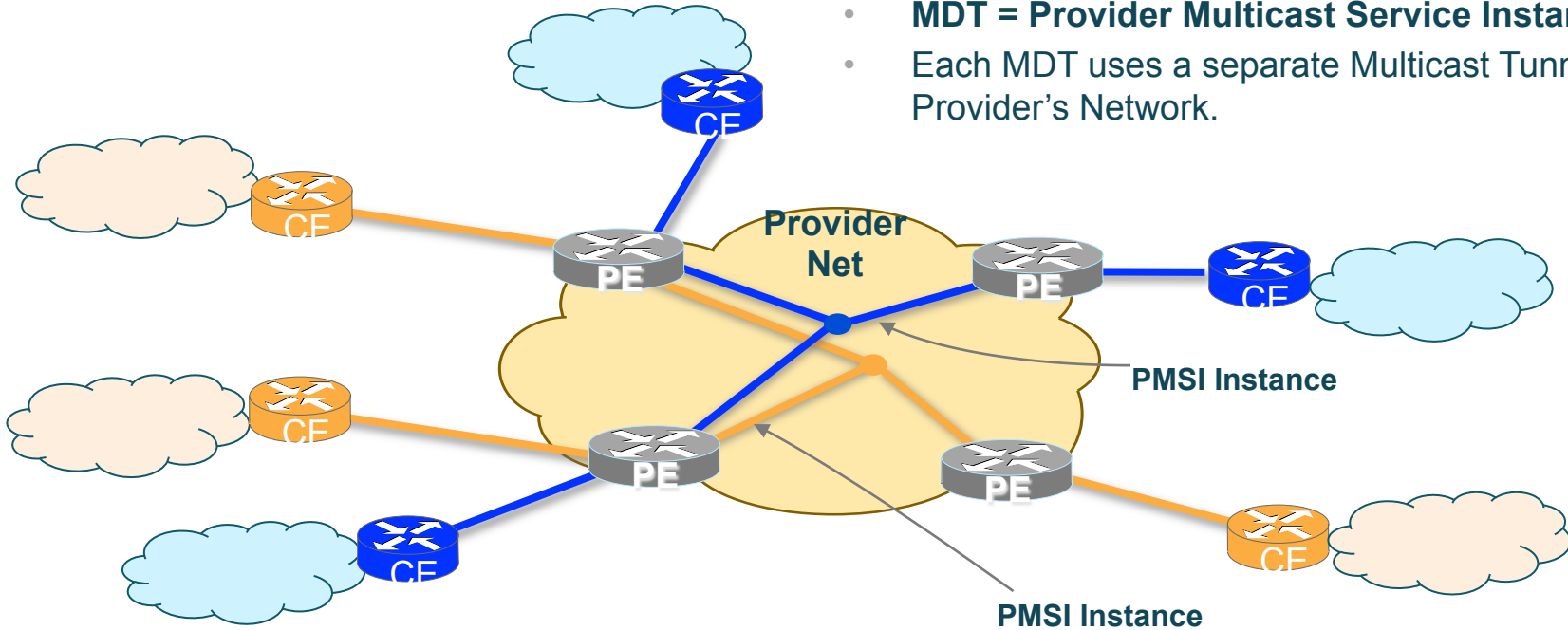
Multicast VPN – Multicast Domain

- Multicast Domain inside of Provider Network connects each MVPN.



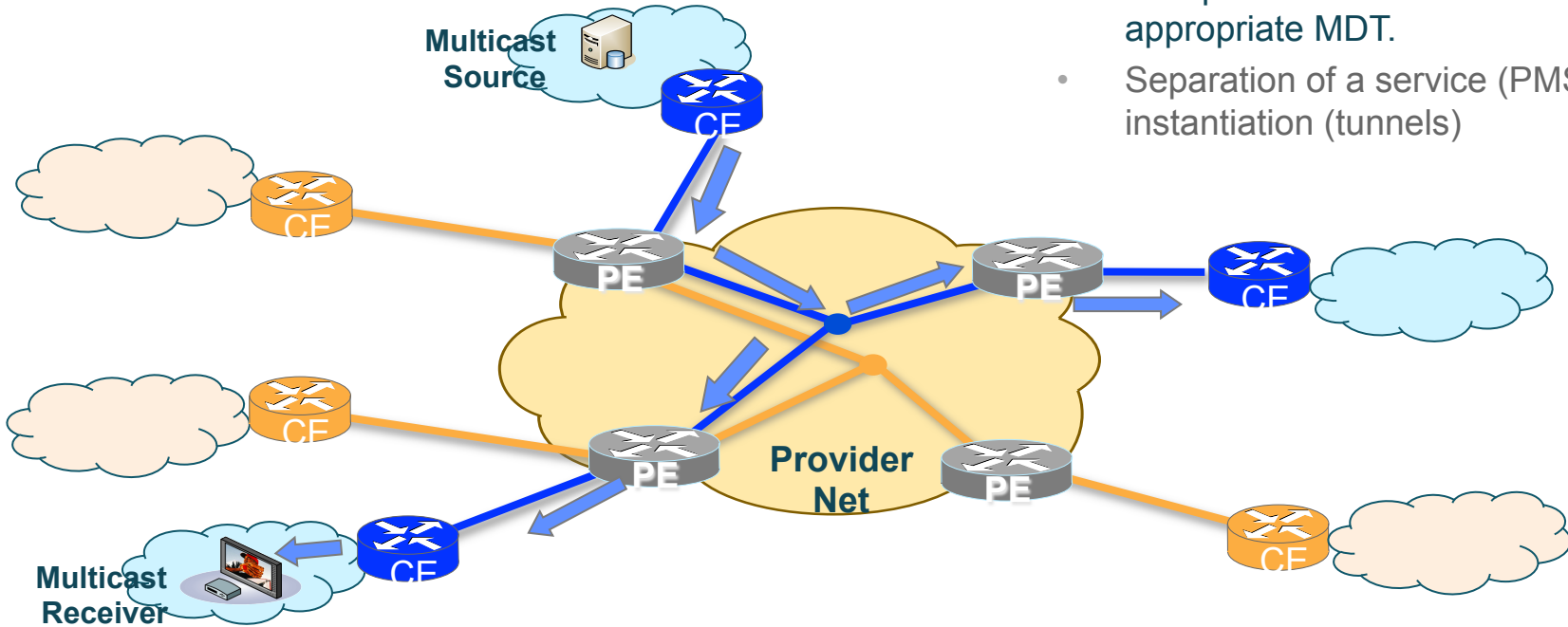
Multicast VPN – PMSI

- Each Multicast Domain consists of **Multicast Distribution Trees (MDT)**
- **MDT = Provider Multicast Service Instance (PMSI)**
- Each MDT uses a separate Multicast Tunnel inside of Provider's Network.



Multicast VPN – PMSI

- Arriving customer multicast traffic is encapsulated and flooded over appropriate MDT.
- Separation of a service (PMSI) from its instantiation (tunnels)



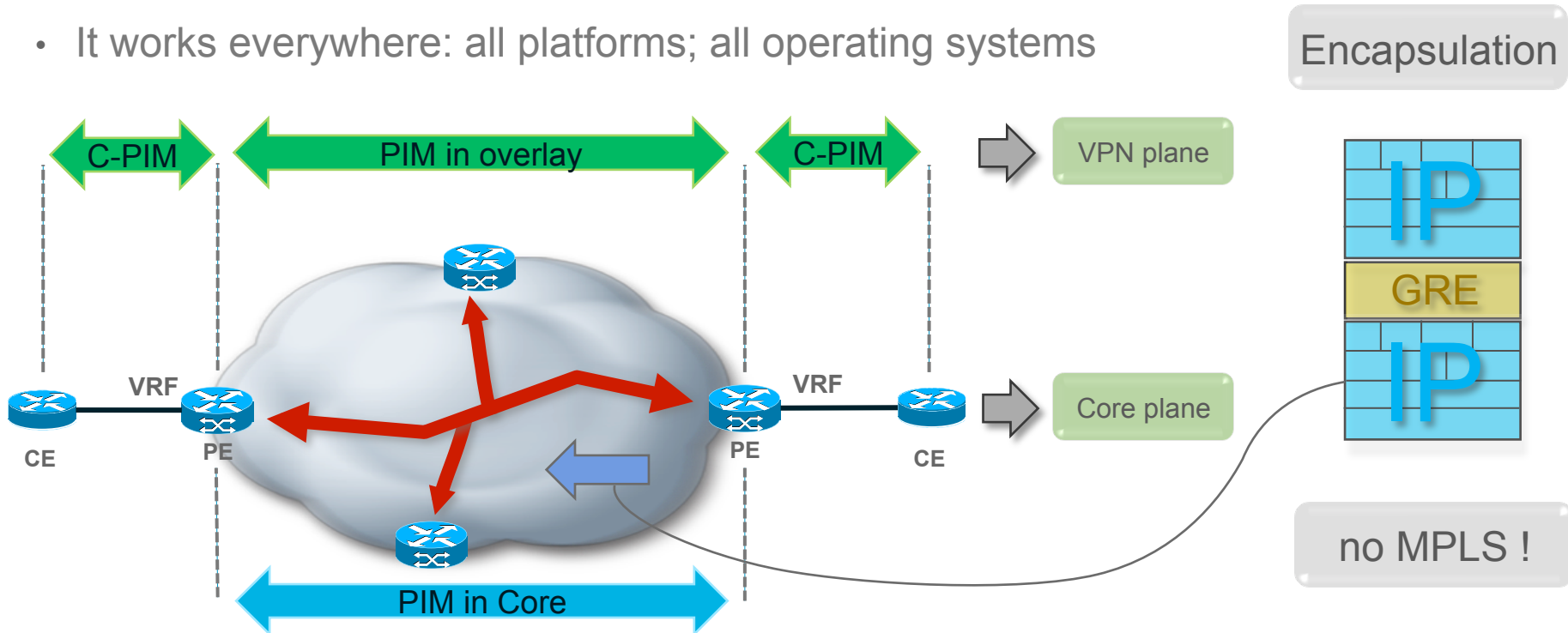
Next Gen Multicast VPN

Before We Start

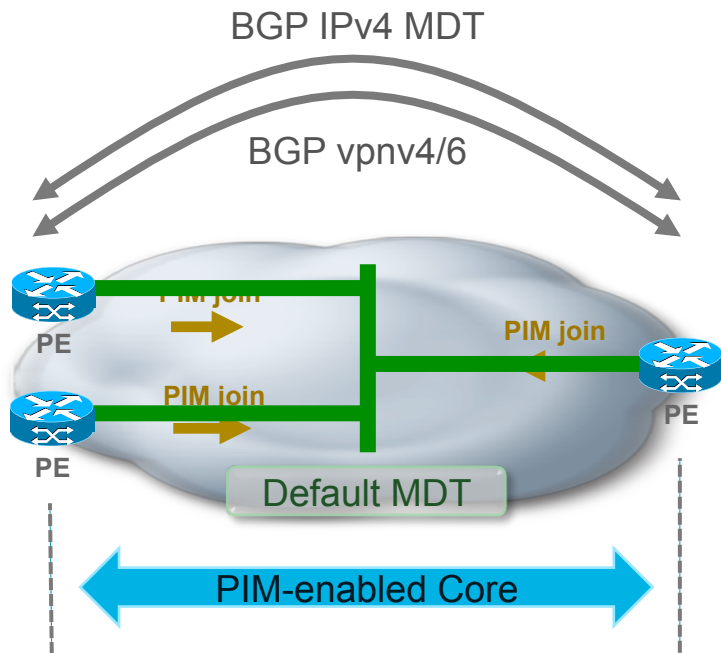
- P - is Provider
- C - is Customer
 - E.g. C-(S,G) is an (S,G) of a customer, so likely in a VRF
- Only IPv4 mentioned
 - All applies equally to IPv6
 - Similar configuration, other address family
- PMSI = Provider Multicast Service Interface = Tunnel
- Rosen renamed to “Default MDT”

mVPN Classic (aka Rosen / aka Default MDT)

- Since 2000
- It works everywhere: all platforms; all operating systems



Default MDT Recap (Multi-directional Inclusive PMSI - MI-PMSI)



1 Unicast routing (RPF)

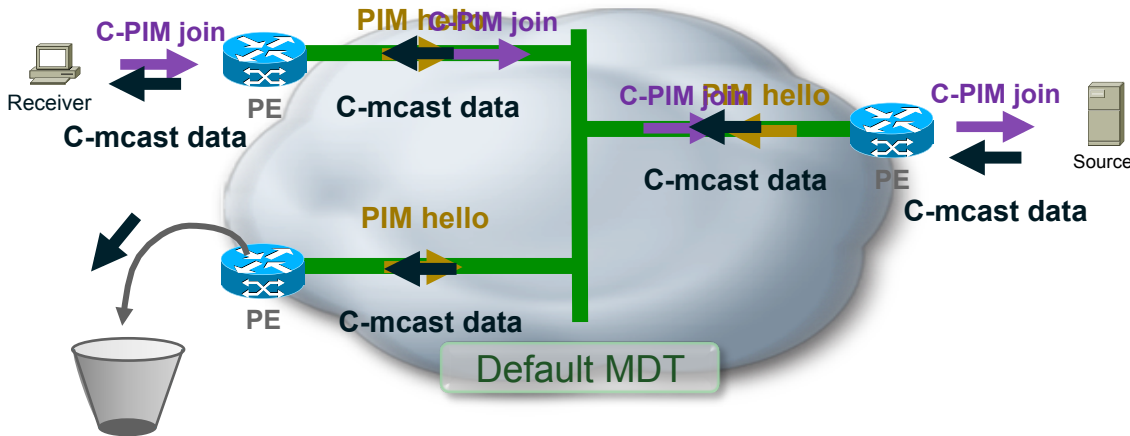
2 Build Default MDT

2.1 Advertise PE as member of mVPN by BGP IPv4 MDT

2.2 PE routers join Default MDT PIM tree

Default MDT connects all mVPN PE routers and carries all PIM signaling and all mcast traffic by default

Default MDT Recap



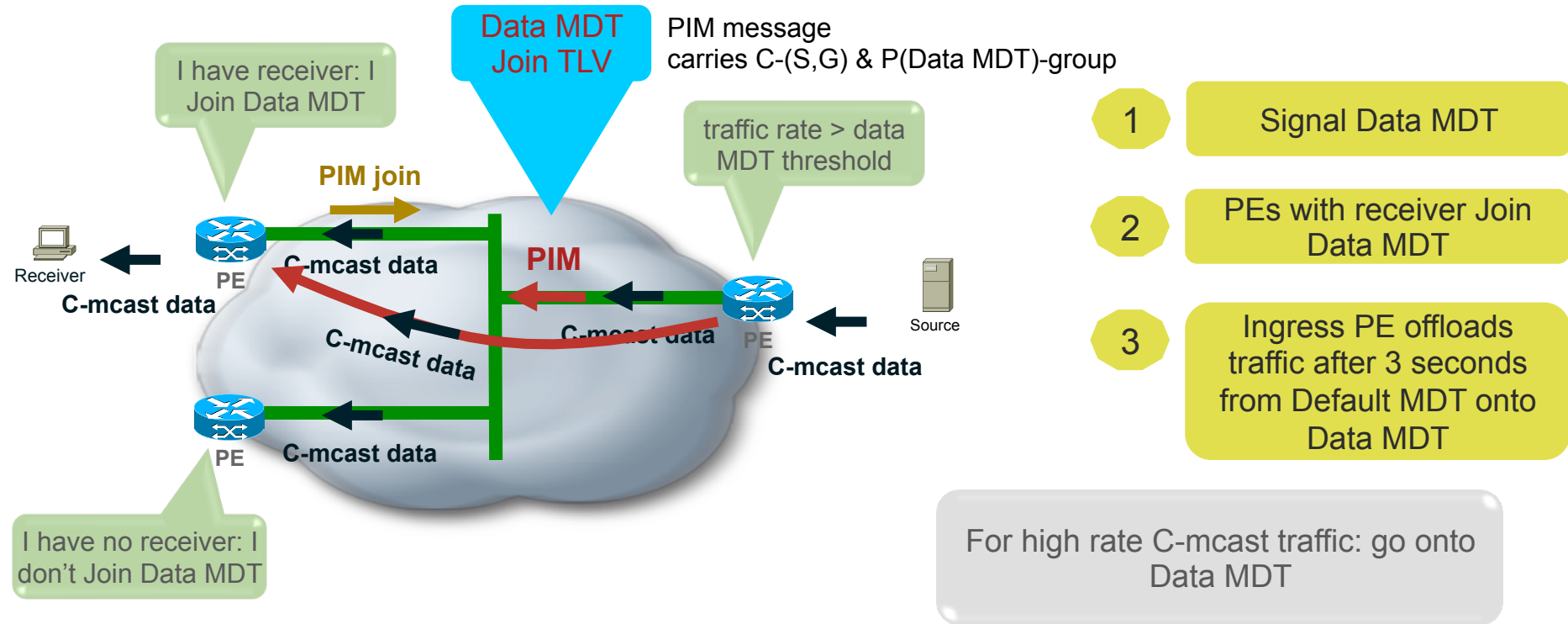
1 C-PIM neighbors across Default MDT

2 C-PIM signaling across Default MDT

3 C-multicast data

One caveat of Default MDT: drop mcast traffic on egress PE if no receiver

Data MDT Recap (Selective PMSI - S-PMSI)



Core-tree Protocols

PIM

- The oldest
- Many options, PIM SM, SSM, Bidir, Anycast, ...
- PIM SM is pretty complex, but well-known
- PIM on PIM or mVPN Default MDT GRE

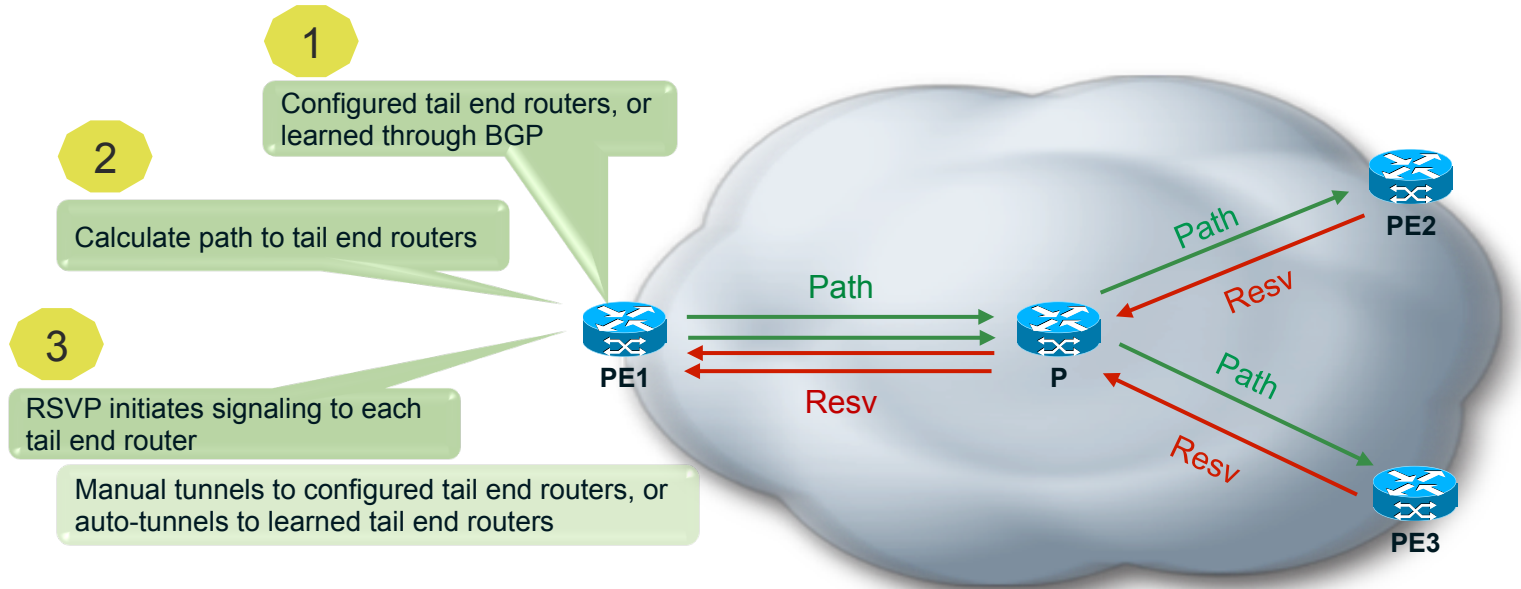
P2MP Traffic Engineering (TE)

RFC 4785

- Explicit (source) routing
- Bandwidth reservation
- Fast ReRoute (FRR) protection
- Uses RSVP for TE
- P2MP : extensions for RSVP-TE and IGP
- P2MP TE: looks and feels like P2P TE

P2MP Traffic Engineering (TE)

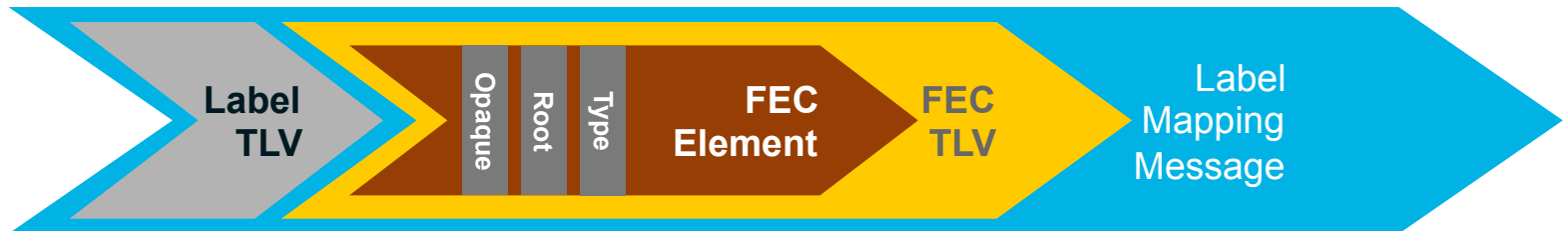
- P2MP tunnel signaled by RSVP, to multiple tail end routers



mLDP

RFC 6388.

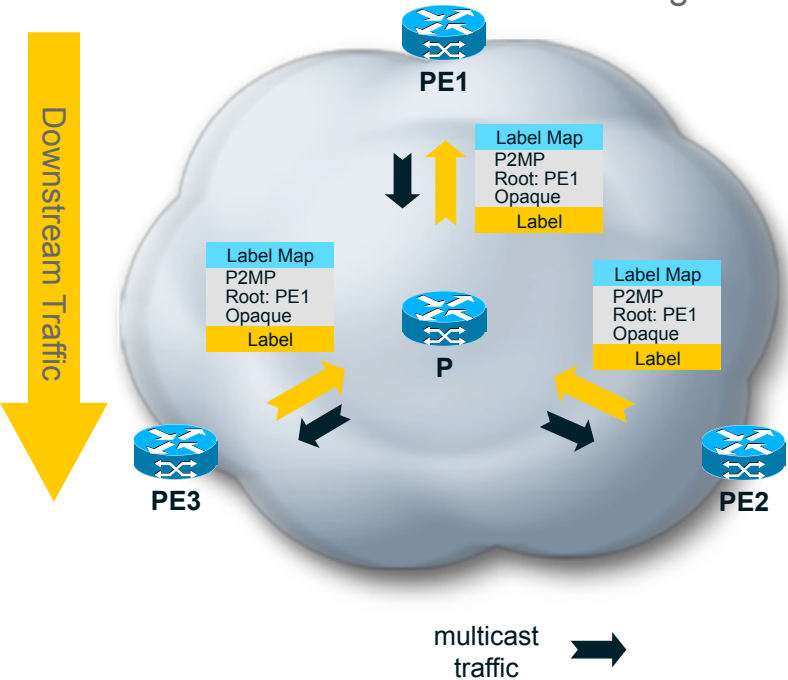
- mLDP uses LDP extensions
- P2MP tree - Receiver driven – Root learned from routing
- MP2MP tree – Configuration driven – Root configured
- Protection by MPLS TE or Loop-Free Alternate (LFA)
- No PHP – Top label identifies the tree
- FEC elements holds
 - Type of tree
 - Root
 - Opaque value: (S,G), MDT number, LSP ID



mLDP

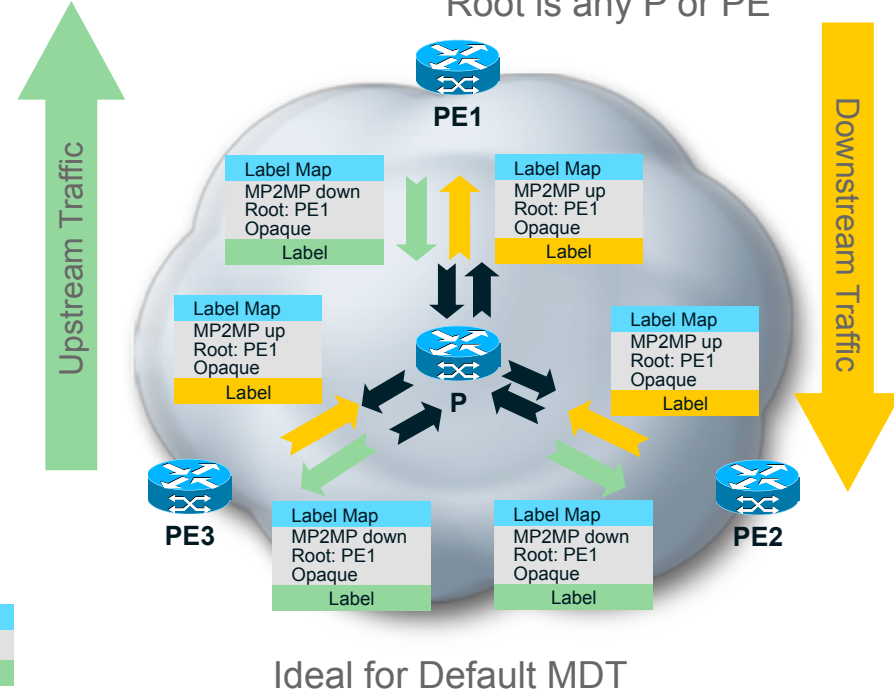
P2MP Tree

Root is ingress PE



MP2MP Tree

Root is any P or PE



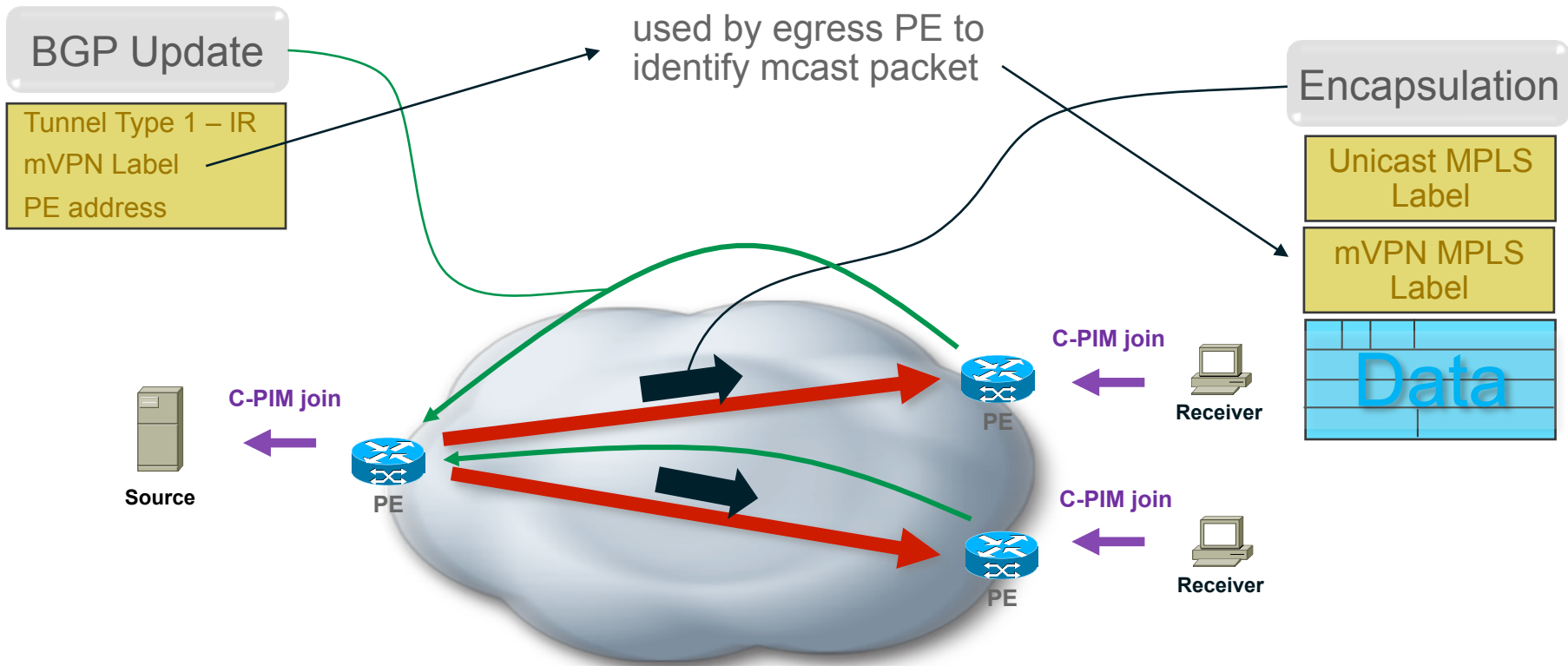
Ideal for Default MDT
Data plane is still P2MP

Ingress Replication (IR)

RFC 6513 and 6514

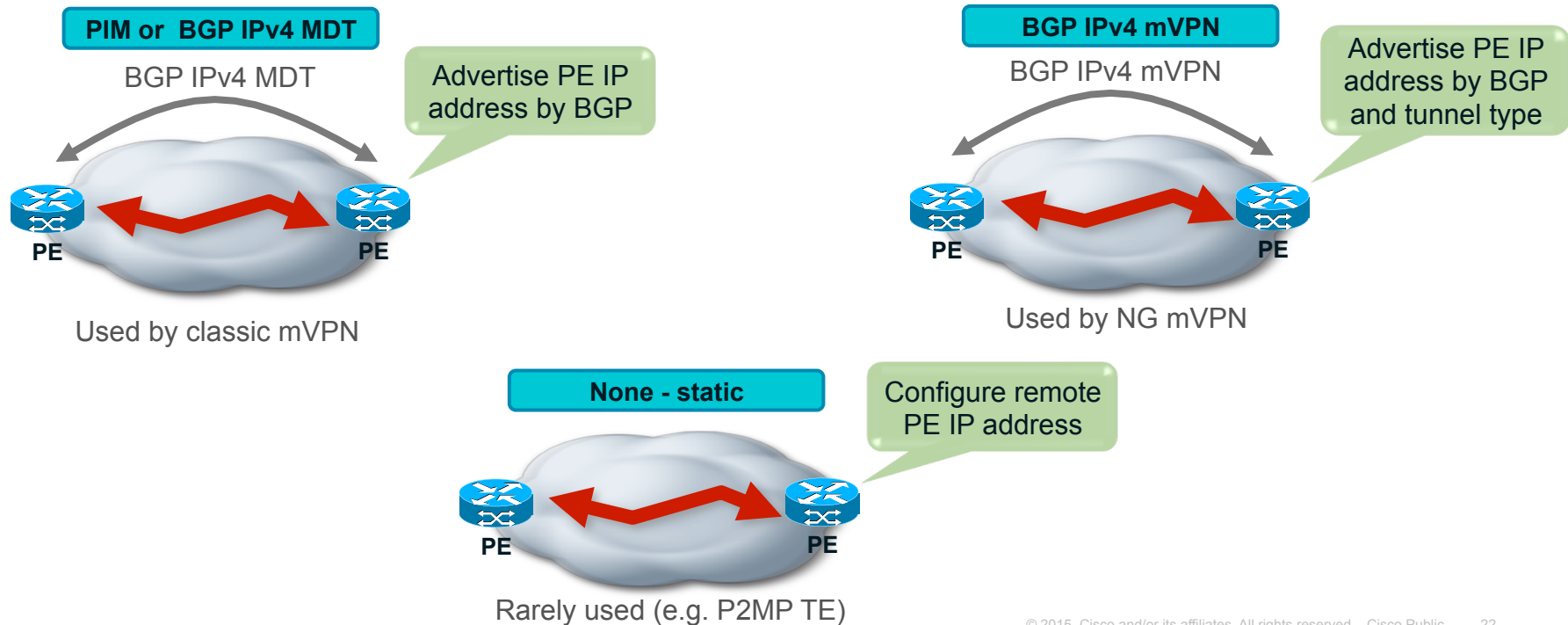
- Let's not use a P2MP tree in the core
- Let's re-use unicast MPLS Label Switched Paths (LSPs)
- Ingress replication!
- Used when
 - Routers do not understand P2MP TE, mLDP or other inter-op issues
 - Simple solution is good enough: inter-as links
 - Amount of traffic is low – certain part of the network
- Packets have extra MPLS label to differentiate unicast vs. multicast traffic on same LSP
- BGP AD is needed to transport mVPN MPLS label

Ingress Replication (IR)



Auto-Discovery

- Auto Discovery (AD)
 - The process of discovering all the PEs with members in a given mVPN
 - In order to build the MDT(Multicast Distribution Tree)

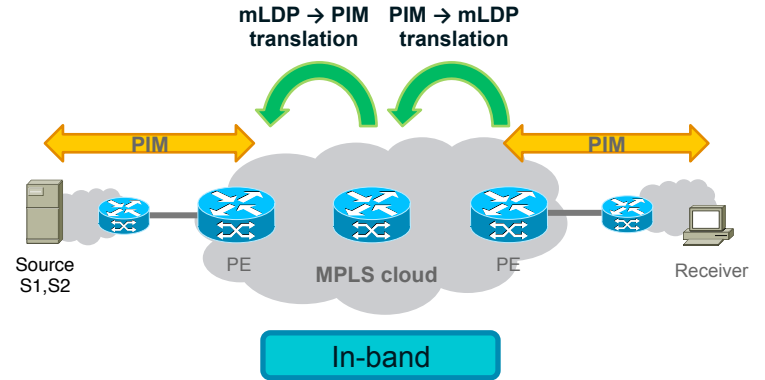
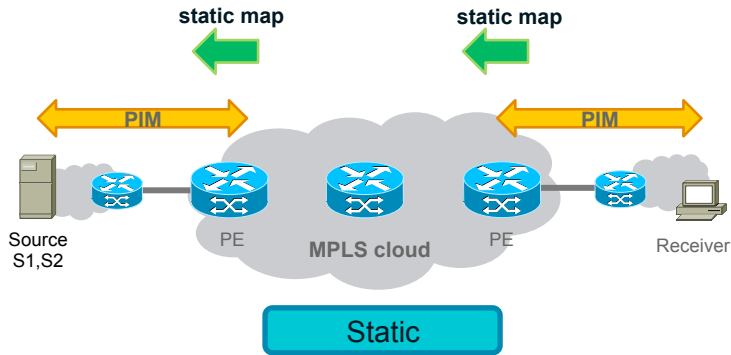
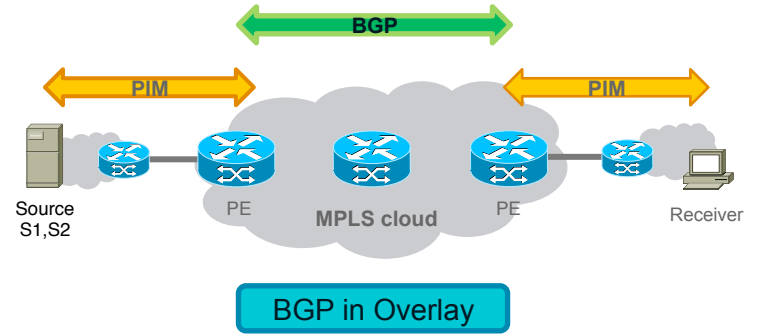
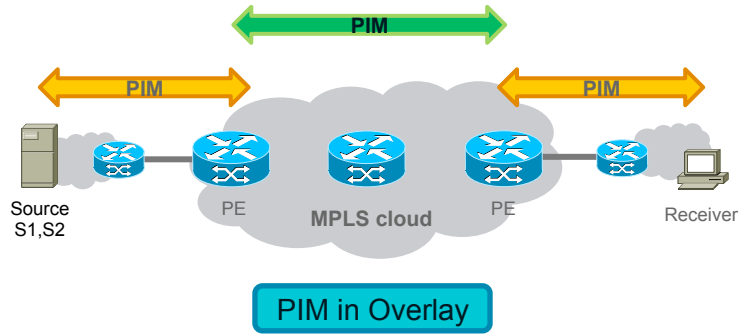


Overlay Signaling Protocols

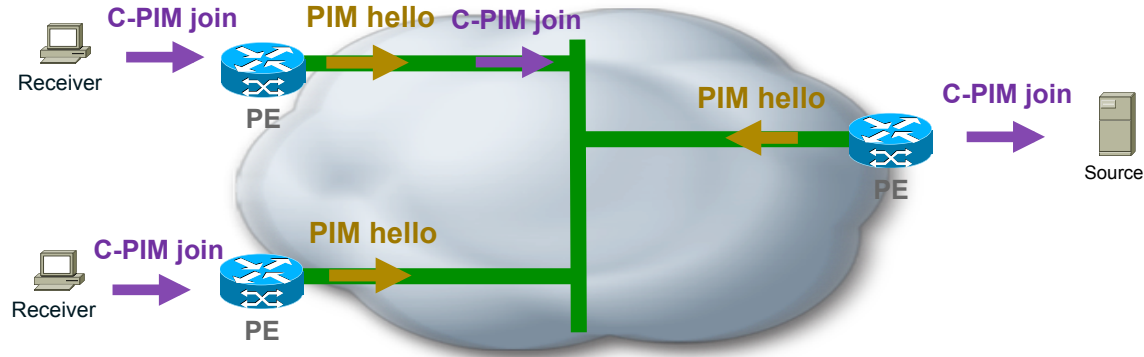
Overlay Signaling

- The purpose is to get the multicast signaling from PE-CE across the MPLS core
- The multicast signaling on PE-CE is still always PIM!
- Multiple ways
- You choose which overlay signaling can be done

Overlay Signaling Possibilities



PIM in Overlay



- PIM as we know it
 - Hello's, Joins & Prunes, RPT-bit
 - Shared to Source tree (SPT) switchover
- On the Default MDT
- Allows aggregation of multiple flows in a single LSP

Static Mapping

- Only used for mapping C-mcast onto P2MP TE tunnel
 - But, P2MP TE tunnels can also use PIM or BGP in overlay
- Allows aggregation of multiple flows in a single LSP

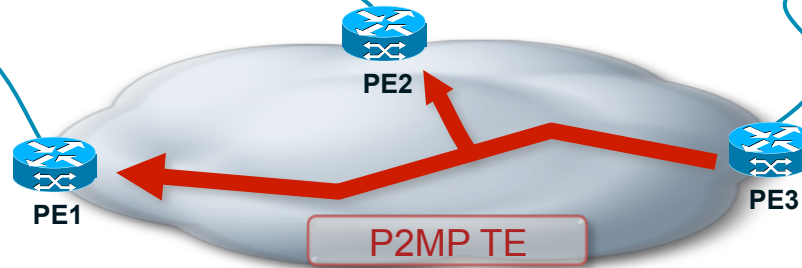
Head-end has (S,G) mapping

Tail-end has RPF statement

head-end router

```
ip mroute 10.2.3.0 255.255.255.0 10.100.1.3
```

```
interface Tunnel0
 ip unnumbered Loopback0
 ip pim passive
 ip igmp static-group 232.1.1.1 source 10.2.3.10
 tunnel mode mpls traffic-eng point-to-multipoint
 tunnel destination list mpls traffic-eng name from-PE3
```

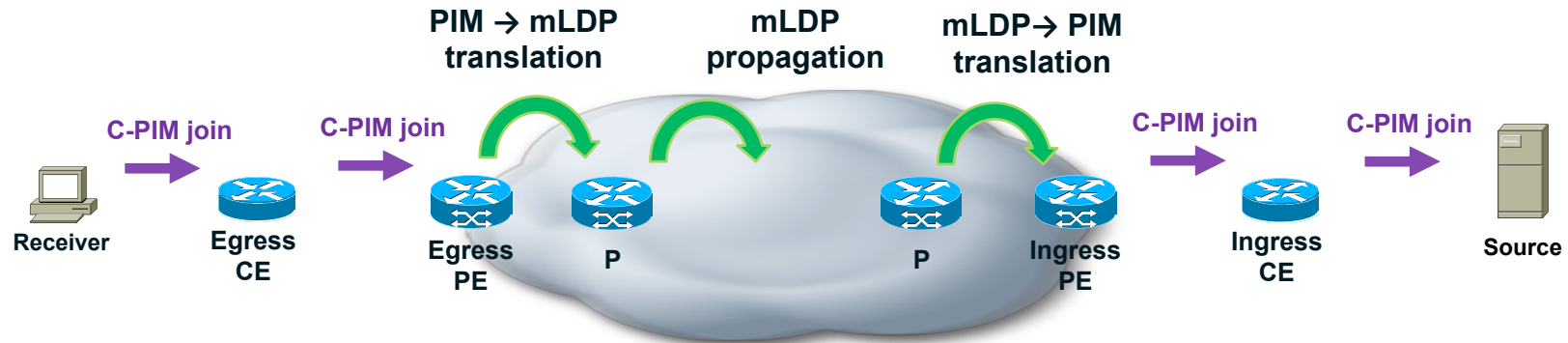


In-band Signaling

mapping

PIM Join	LDP Label Mapping Message
PIM Prune	LDP Label Withdraw Message

- No overlay signaling
- Method to stitch a PIM tree to a mLDP LSP without any additional signaling
- PIM (or IGMP) can be mapped to mLDP



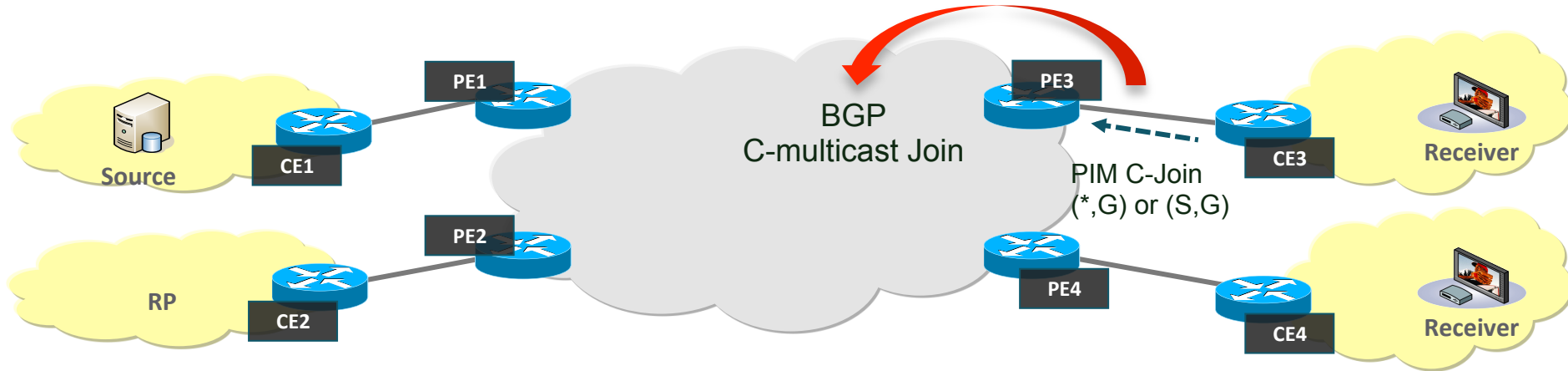
BGP Signaling

- BGP scales well
- BGP is not a multicast signaling protocol per design
 - Receiver to Source signaling ...
 - PIM Sparse Mode works differently in BGP
- New address family “IPv4 mVPN”
 - Signal auto-discovery
 - **Signal customer multicast information**
 - (*,G) or (S,G)
 - Which tunnel to use (core tree protocol and tunnel type)

```
vrf definition one
  rd 1:1
  !
  address-family ipv4
    mdt auto-discovery mldp
    mdt default mpls mldp p2mp
    mdt overlay use-bgp
    route-target export 1:1
    route-target import 1:1

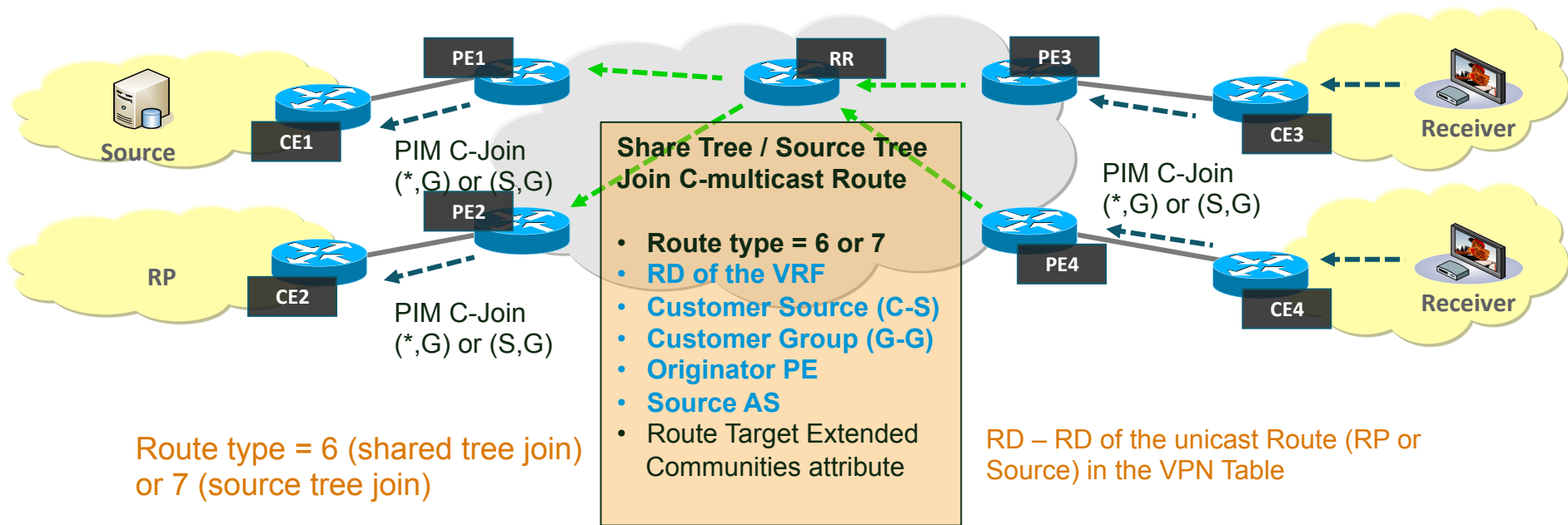
router bgp 1
  neighbor 10.100.1.7 remote-as 1
  neighbor 10.100.1.7 update-source Loopback0
  !
  address-family ipv4 mvpn
    neighbor 10.100.1.7 activate
    neighbor 10.100.1.7 send-community extended
```

Customer Multicast routes



- PIM is assumed to be the C-multicast protocol, i.e. the PE-CE multicast routing protocol
- When BGP is used for Multicast Routing, the C-Join of the C-multicast protocol is not sent over the VPN backbone.
- Instead, it is translated into a BGP C-multicast tree join route advertised through BGP.
- There are two types of C-multicast BGP routes:
 - C-multicast Shared Tree Join route
 - C-multicast Source Tree Join route

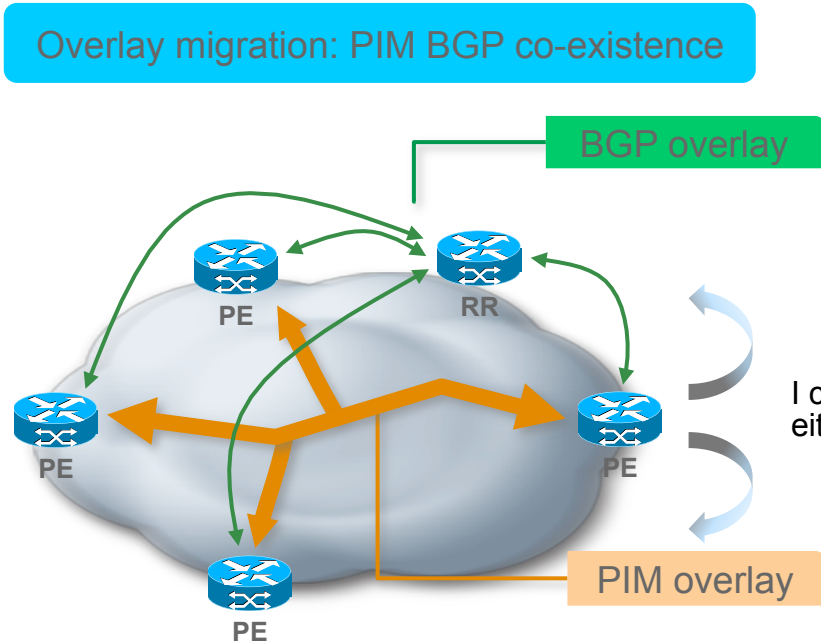
Customer Multicast Routes



- C-multicast routes are originated as a result of updates in (C-S, C-G), or (C-*, C-G) state learnt by a PE via the C-multicast protocol.
- A C-multicast shared tree join route is advertised by a PE router when it wants to propagate a C-Join for a (C-*,C-G) flow upstream.
- Similarly, a C-multicast source tree join route is advertised when a C-Join for a (C-S, C-G) flow needs to be propagated

Migration PIM to BGP Overlay Signaling

On Egress PE



Flexible policy to do overlay selection

- Per multicast Group
- Per multicast Source
- Per Source ingress router
- ...

Deployment Models (Profiles) Overview

Putting it all Together



Deployment Notes

What Profile to Chose?

- Choice is per VPN!
- If bandwidth reservation and/or traffic steering is needed : MPLS P2MP TE
- For walled garden deployments: mLDP in-band signaling
- Overlay signaling
 - PIM for familiarity
 - BGP for huge scaling
 - Easy for SSM, complex for Sparse Mode
- For backward compatibility: Classic mVPN
- Migration from Classic mVPN: mLDP Default MDT
- Anything else / default gateway : mLDP

Conclusion

- Go LSM if you do not want PIM/IP Multicast routing in the core
- Chose a model based on requirements
 - Scalability
 - Application
 - PIM mode
- All and everything is per VPN

mLDP support

- 7600 (ES+)
- ASR9000 family (all generation cards)
- ASR902, ASR903, ASR907 (RSP2, Rosen GRE from XE 3.17)
- ASR920
- ASR1000

Thank you