



Cisco Expo
2010

Networks ready for video

Multicast VPN

- live demo



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Agenda

- Multicast routing - PIM
- MVPN – PIM
- MVPN - MPLS



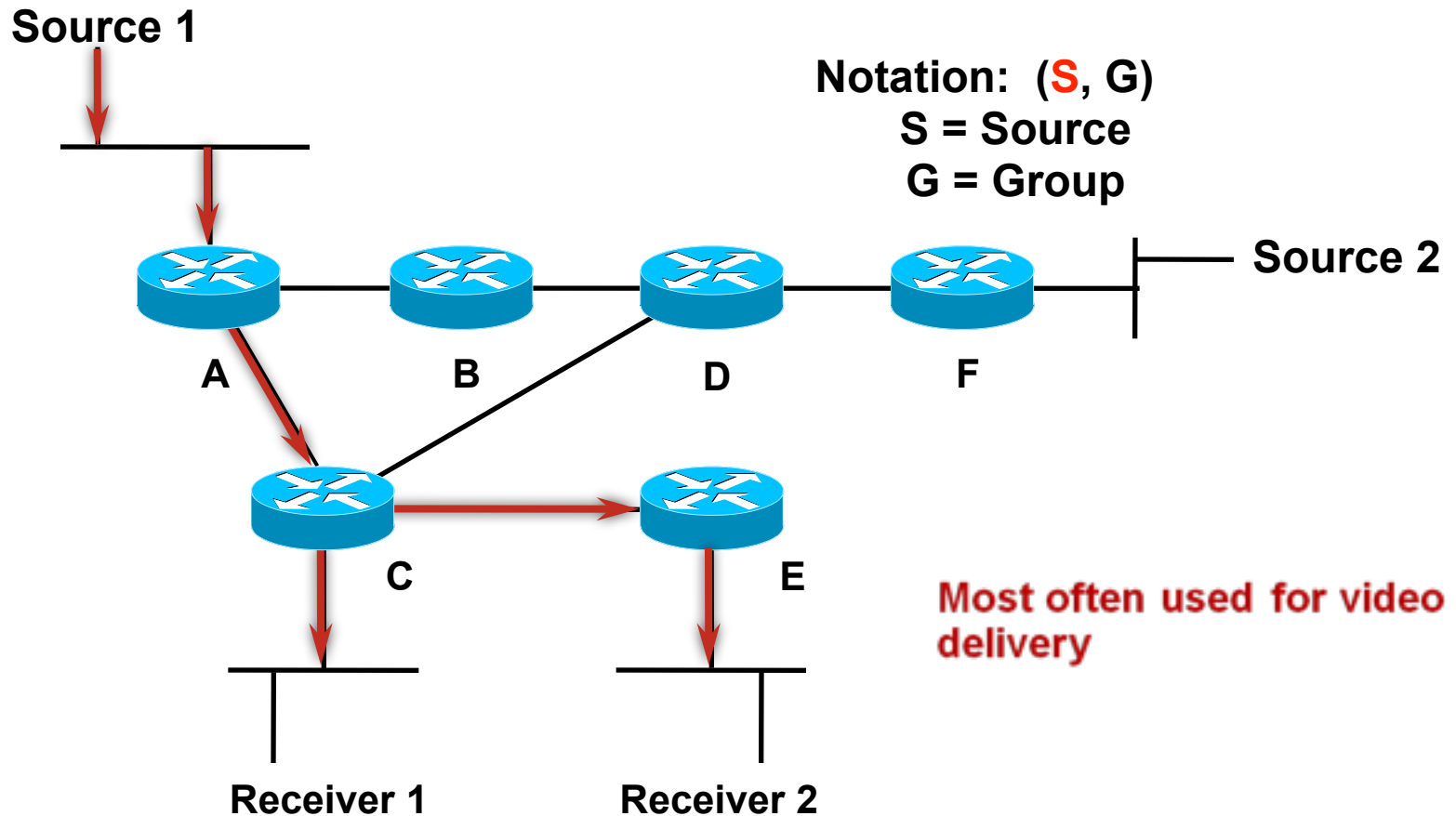


Multicast Routing - PIM



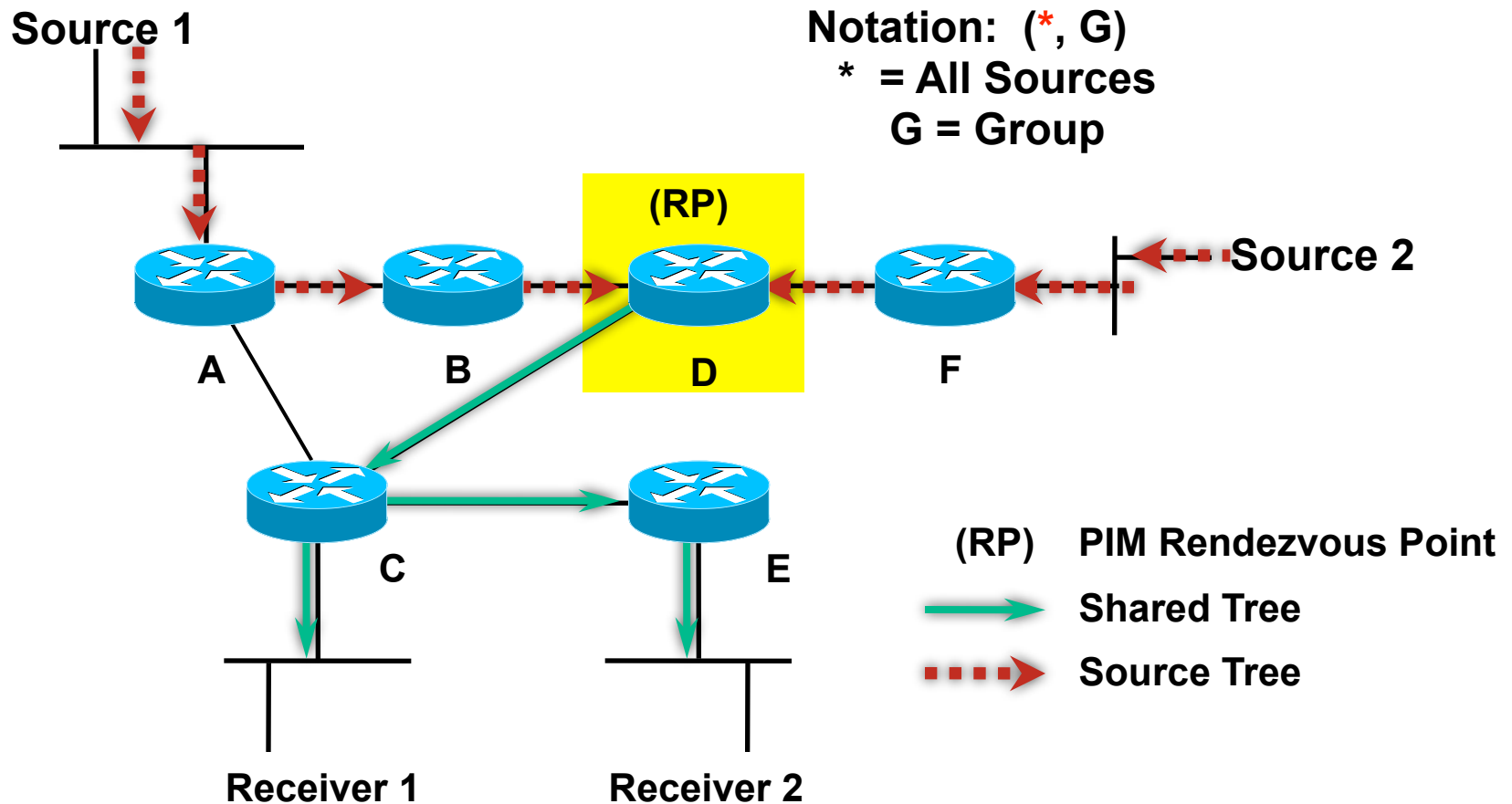
Multicast Distribution Trees

Shortest Path or Source Tree



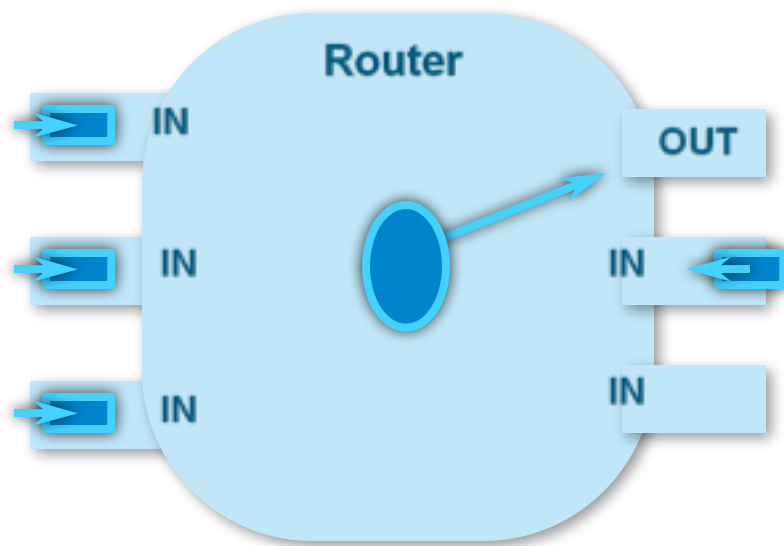
Multicast Distribution Trees

Shared Tree



Anatomy of routing

show ip route



- Where is destination?
- Look in to destination address
- If it is not on outgoing interface
- Check all polices, routemaps, filters etc..
- Send!

Destination

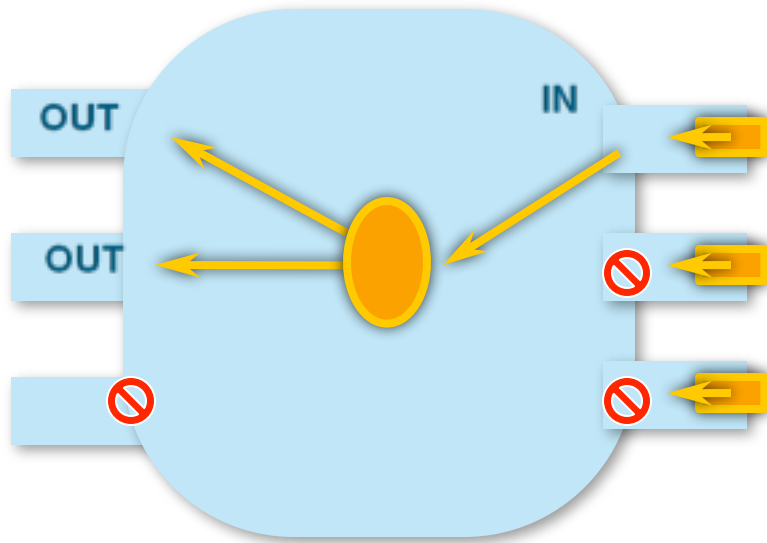
Where to send

```
R6#sh ip route
Gateway of last resort is not set

1.0.0.0/8 is variably subnetted, 14 subnets, 3 masks
O    1.1.1.0/28 [110/2] via 1.6.7.7, 00:00:01, FastEthernet1/1
```

Anatomy of multicast routing

show ip mroute



- How to replicate
- Only 1 incoming interface
- Mcast packets entering on non defined interface are dropped

Incoming packets
Identification - Destination

Router# show ip mroute
.....

Source

(10.20.1.15, 230.13.13.1), 00:14:31/00:01:40, flags:CJT
Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD

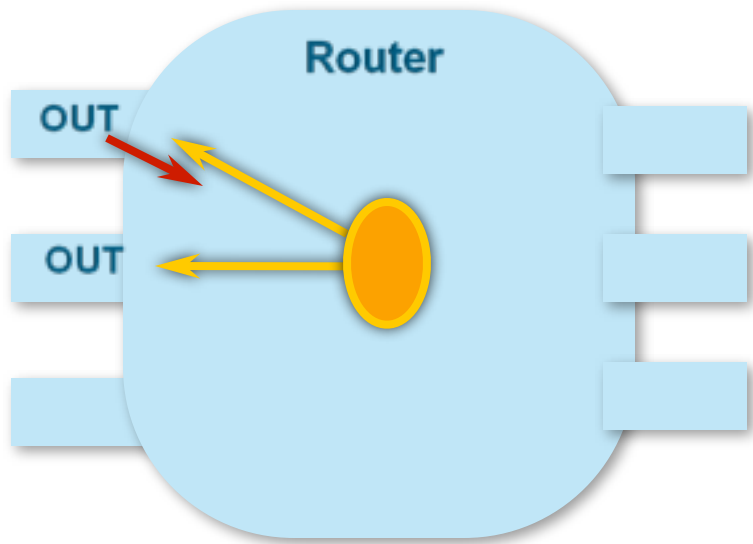
Outgoing interface list:

GigabitEthernet4/9, Forward/Sparse-Dense, 00:14:31/00:00:00, H
GigabitEthernet4/7, Forward/Sparse-Dense, 1d02h/00:02:39,H

Where to
replicate

Anatomy of multicast routing

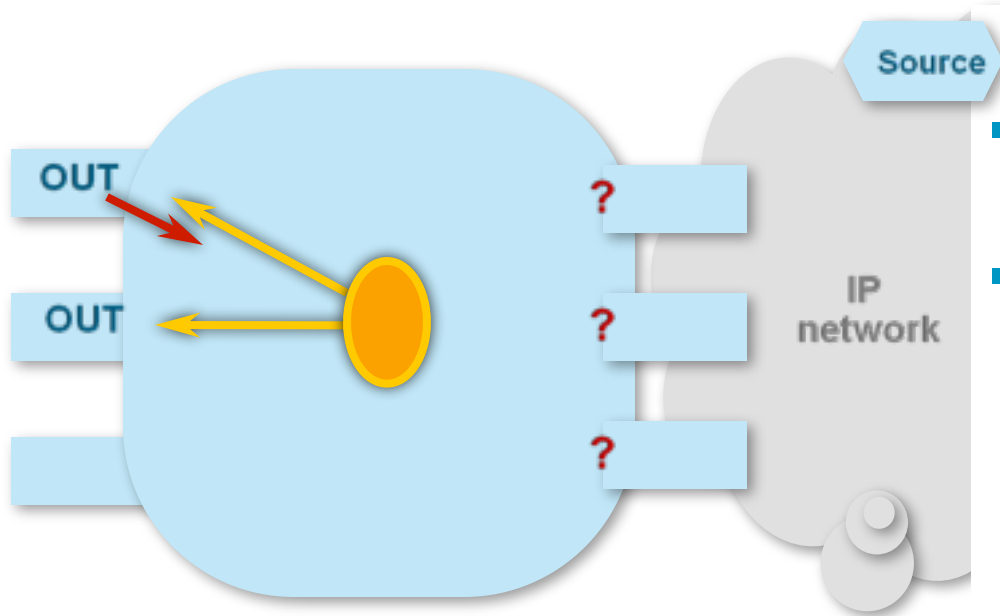
Where to replicate – Outgoing list



- How to build Outgoing list
 - Manual configuration
 - IGMP requests
 - Multicast routing requests

Anatomy of multicast routing

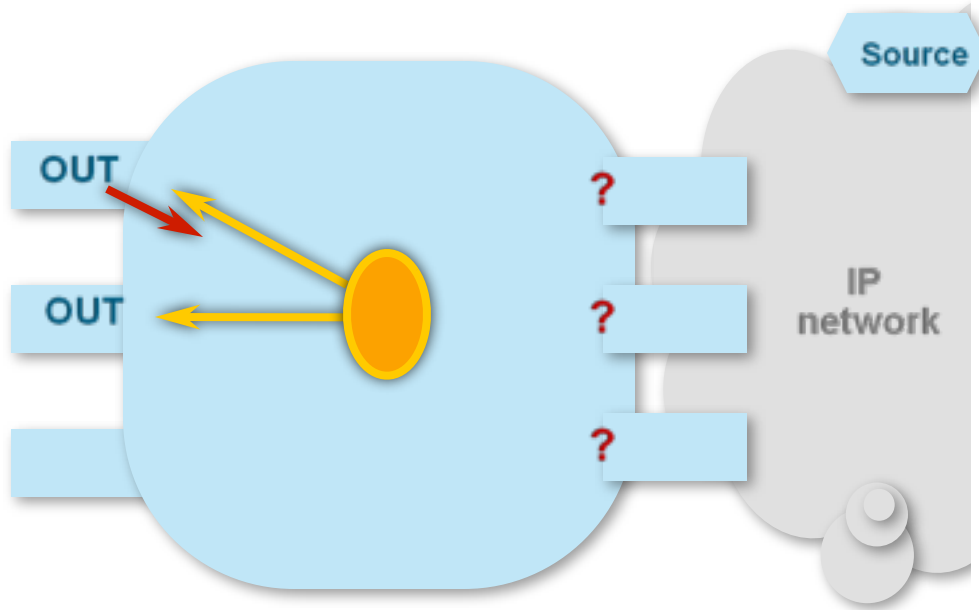
Where send request to?



- We know who is interested (list of outgoing interfaces)
- We know what they want (S,G) (Source address , mcast Group address), alternatively we should assume RP
- Where to send request?
- Which interface should be declared Incoming ?

Anatomy of multicast routing

Where send request to?



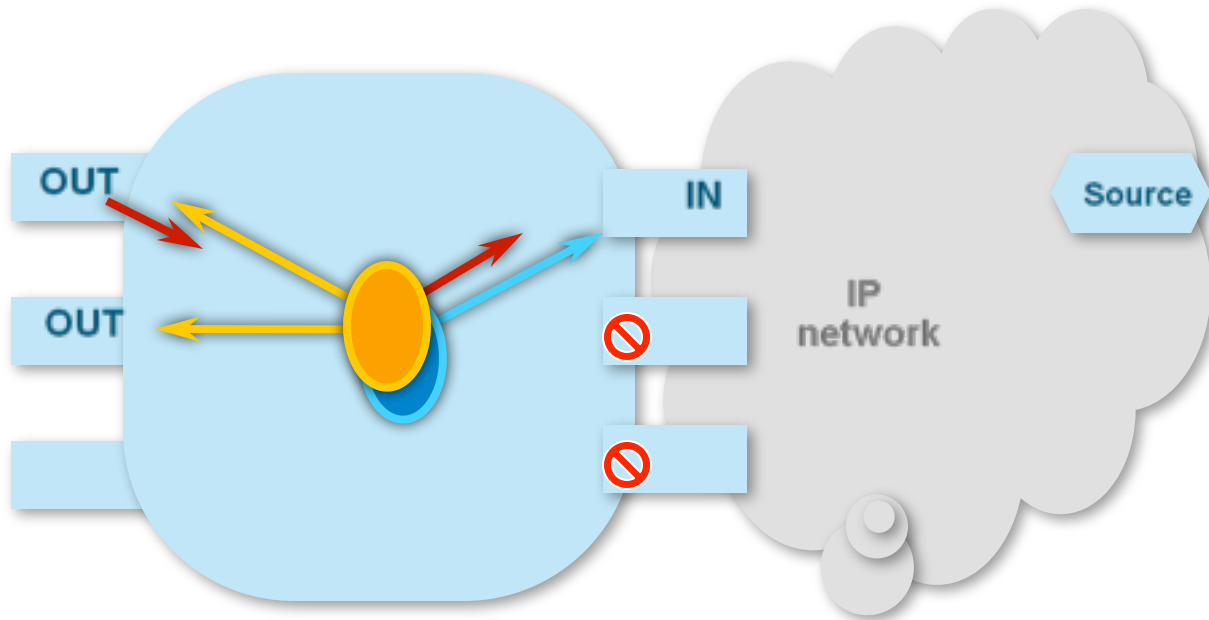
**Hint: We know Source address !
find the Source !!**

- We know who is interested (list of outgoing interfaces)
- We know what they want (S,G) (Source address , mcast Group address), alternatively we should assume RP
- Where to send request?
- Which interface should be declared Incoming ?

**Process of looking for the source in order to find incoming interface is called Reverse Path Forwarding check.
(we are looking for path from which we are expecting traffic
– reverse to unicast path forwarding**

Anatomy of multicast routing

Multicast routing protocol (PIM)



- The best way to find IP host in IP network is to use ip routing table!!
- This method is routing protocol **type** independent thus the name Protocol Independent Multicast (but it is totally dependent on routing)
- Routers are establishing peering

```
R7#sh ip pim neighbor
PIM Neighbor Table
Mode: B - Bidir Capable, DR - Designated Router, N - Default DR Priority,
      P - Proxy Capable, S - State Refresh Capable
Neighbor      Interface      Uptime/Expires    Ver    DR
Address
1.6.7.6        FastEthernet1/0  02:15:29/00:01:30 v2      1 / S P
1.5.7.5        FastEthernet1/1  02:15:39/00:01:16 v2      1 / S P
```

PIM is easy to configure

```
router ospf 1
  network x.y.0.0 area 0

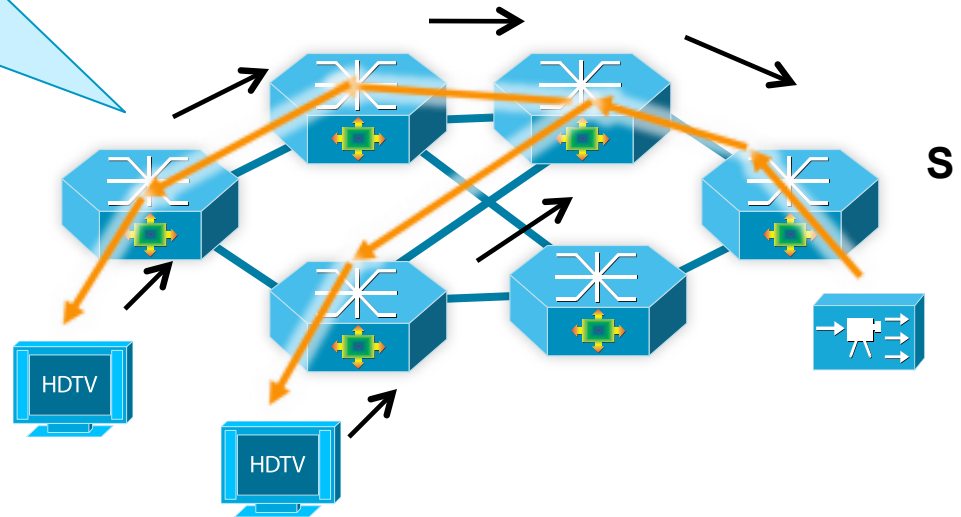
ip multicast-routing
ip igmp ssm-map ...

interface A1
  ip address x.y.z1.1 Mask
  ip pim sparse-mode

interface B1
  ip address x.y.z2.2 Mask
  ip pim sparse-mode
```

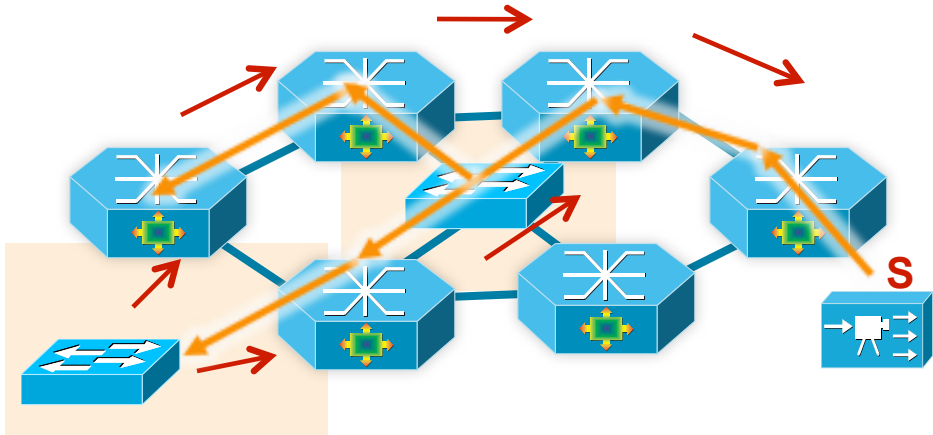
- Assignee addresses
- Start routing
- Rest is auto-magic

- If host do not know the source (*,G) requests on IGMPv2 we might need to add mapping
- Otherwise requests go to RP



PIM is easy to configure

But not trivial in operation



L2 – connection:

Designated Router (DR) selection:
Who is the router sending IGMP queries, joins?
Automatic selection based on ip address (highest wins)

- 1. Establish peering and discovery neighbours
Hello on local multicast address 224.0.0.13
- 2. Interact with IGMP
- 3. Build the tree
Many different cases, e.g common connection to L2 networks on routing side and receiver side, RP interaction, election/discovery, source registration (when RP),

RP subjects
omitted



MVPN - PIM



MPLS use cases

- High scale virtualization

Separate traffic coming from different customers or services
VPNs

- Traffic engineering

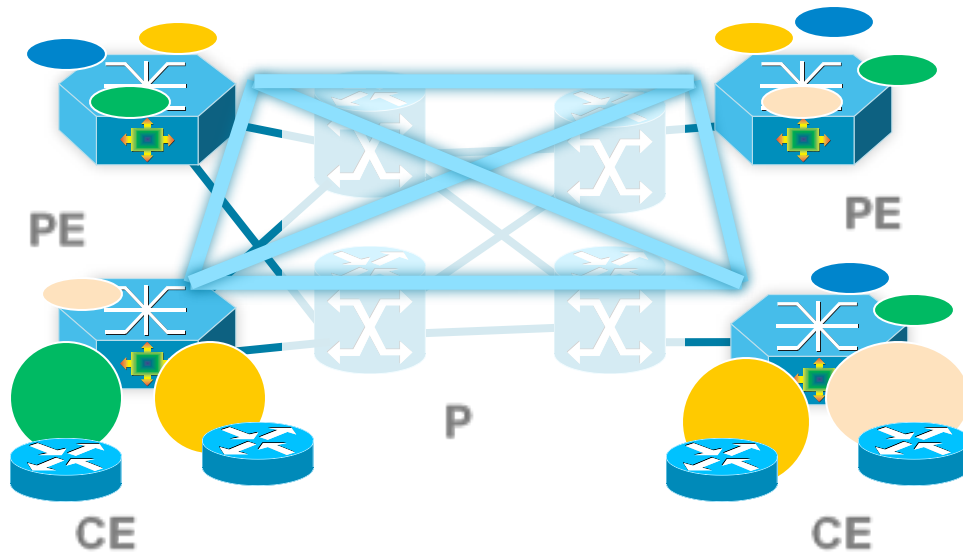
Distribute traffic in desired pattern

- High Availability

Assure fast convergence (50ms)

Virtualization VPN's Design

- Unicast VPNs



CE (Customer Edge)

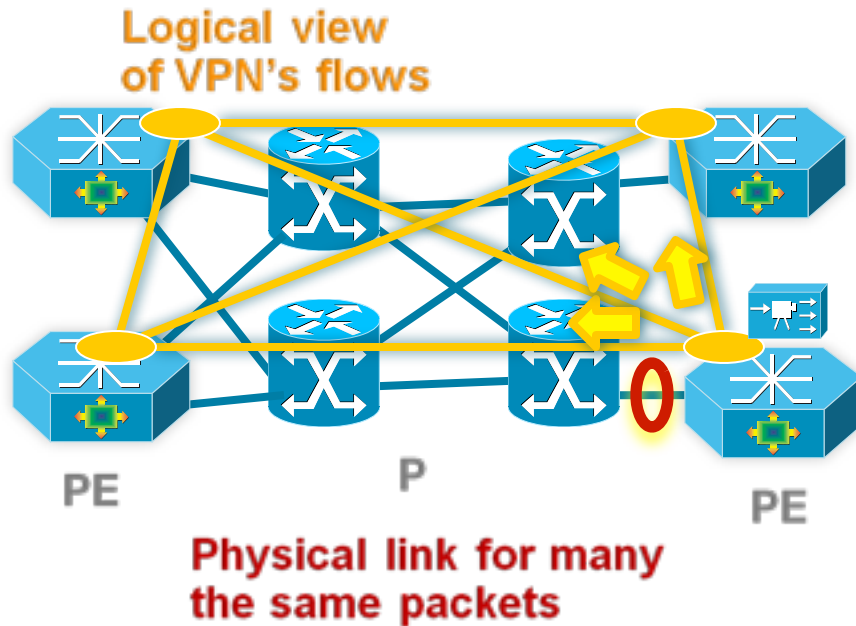
PE (Provider Edge) service creation points and interconnection for CE

P (Provider) Routers – just interconnects PE

Traffic is send in ‘full mesh’

P Routers – minimum state to maintain, critical for network stability and scalability

Virtualization VPN's Design



- Unicast VPNs

CE (Customer Edge)

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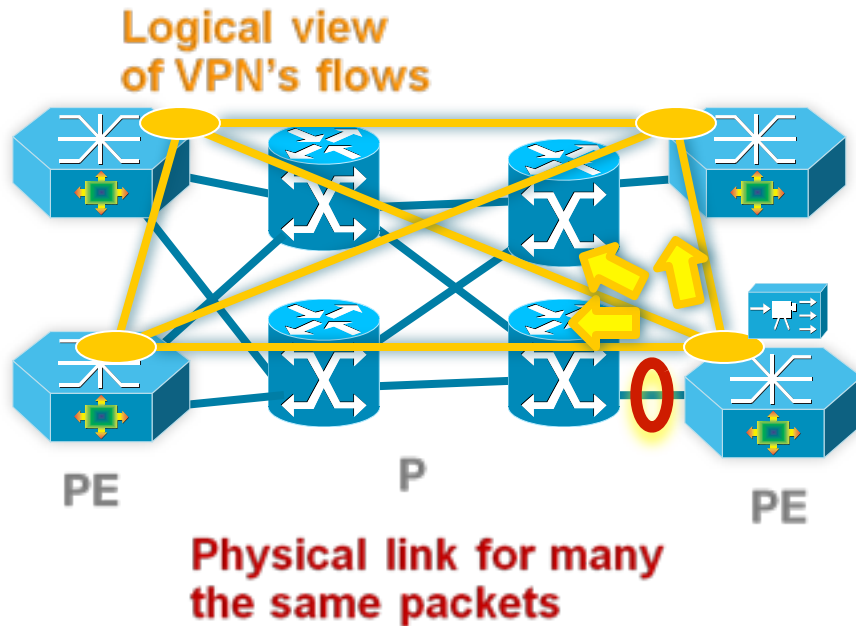
Traffic is send in 'full mesh'

P Routers – minimum state to maintain, critical for network stability and scalability

Works perfect but ...

- Send the same traffic to many neighbours (multicast)

Virtualization VPN's Design



- Unicast VPNs

- PE service creation points

- P Routers – just interconnects PE

- Traffic is send in ‘full mesh’

- P Routers – minimum state to maintain, critical for network stability and scalability

- Works perfect but ...

- Send the same traffic to many neighbours (multicast)

Option A: Replicate and send on each virtual link

L2 VPN
VPLS

😊 Easy, P – routers not engaged
😞 Waste of bandwidth – not scalable

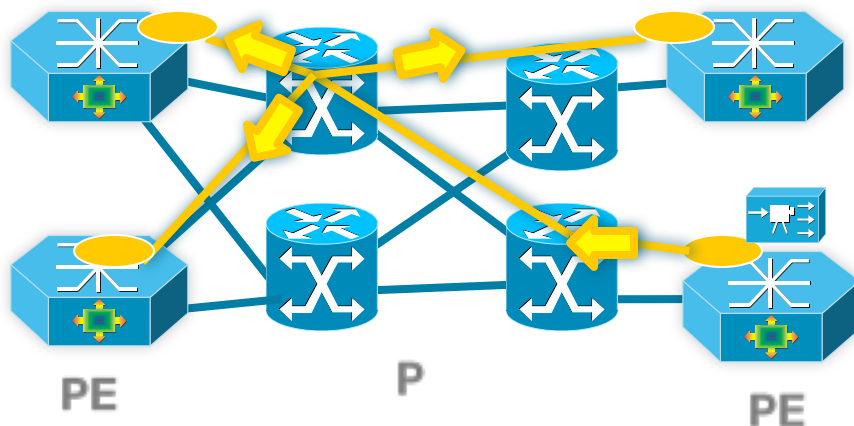
Option B: Engage P routers in multicast tree

L3 VPN

😊 Scalability and efficiency
😞 P routers participate, MPLS multicast was not ready for long time

Virtualization: VPN's Design

Core engagement:



**PE + P routers build the tree
MDT (Multicast Distribution Tree)**

- Historically MPLS lacked multicast control functions
- Workaround:
 - Control plane? Use PIM for IP
 - MPLS Encapsulation? Use GRE (IP in IP - Generic Routing Encapsulation)
- Workaround proofed to be efficient and stayed many years
 - Most of the current mVPN deployments uses GRE

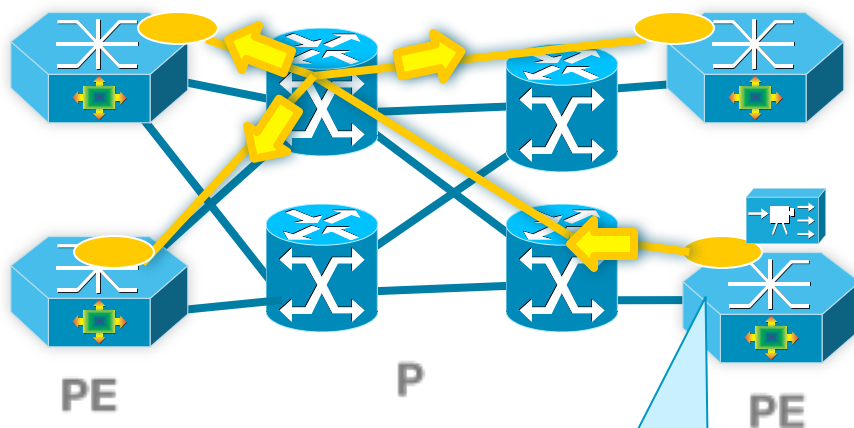
Network Working Group
Internet Draft
Intended Status: Informational
Expires: August 1, 2010

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IJsbrand Wijnands
Cisco Systems, Inc.
February 1, 2010
July 2001 (draft01 ©)

Multicast in MPLS/BGP IP VPNs
draft-rosen-vpn-mcast-13.txt

Virtualization: VPN's Design

Core engagement:



PE + P routers build the tree
MDT (Multicast Distribution Tree)

■ Types of MDT

Default MDT – always present between all PEs belonging to specific VPN

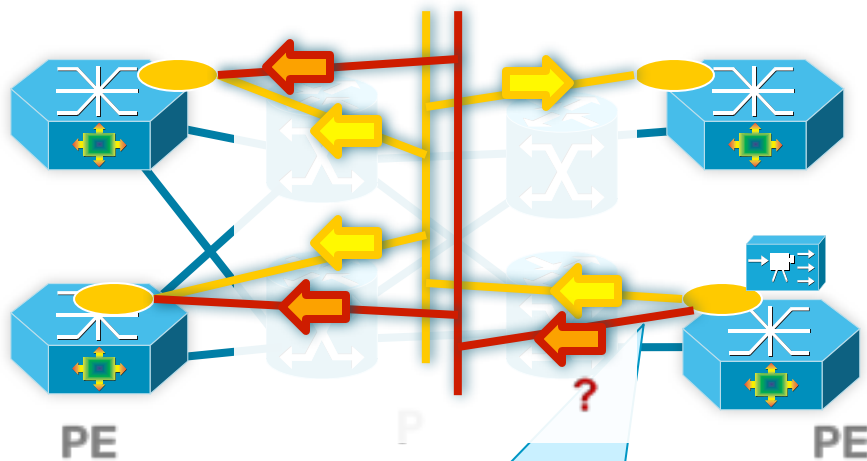
Data MDT – dynamically build between PEs sending high volume of traffic

Private addresses space

```
(config)# ip vrf cisco
...
(config-vrf)# mdt default <a.b.c.d>
...
```

Virtualization: VPN's Design

Core engagement:



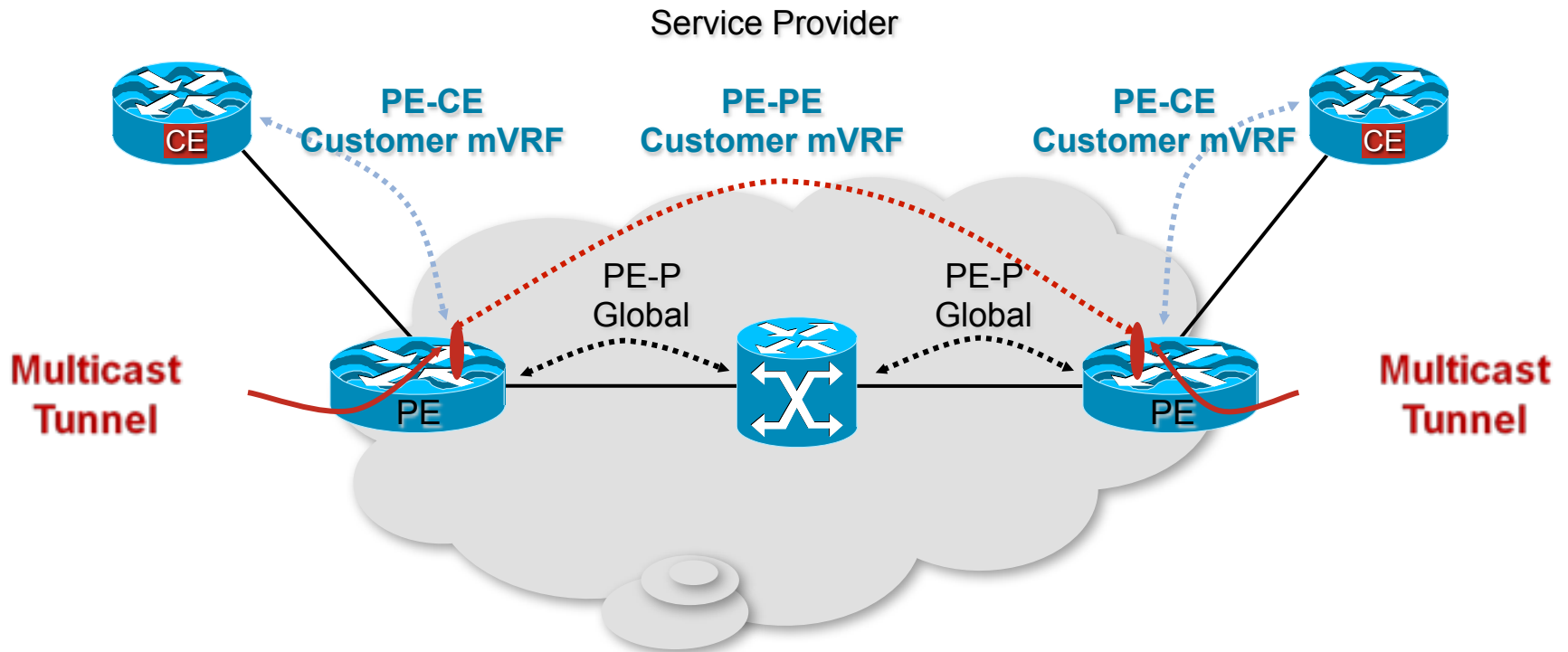
PE + P routers build the tree
MDT (Multicast Distribution Tree)

- Default MDT could be seen as 'broadcast interface' – everything is send to other PEs
- If we need high volume traffic send to limited number of nodes we need to build Data MDT

```
(config)# ip vrf cisco
...
(config-vrf)# mdt data .... threshold 1 [list <acl>]
...
```

Multicast Tunnel summary

PIM Adjacencies

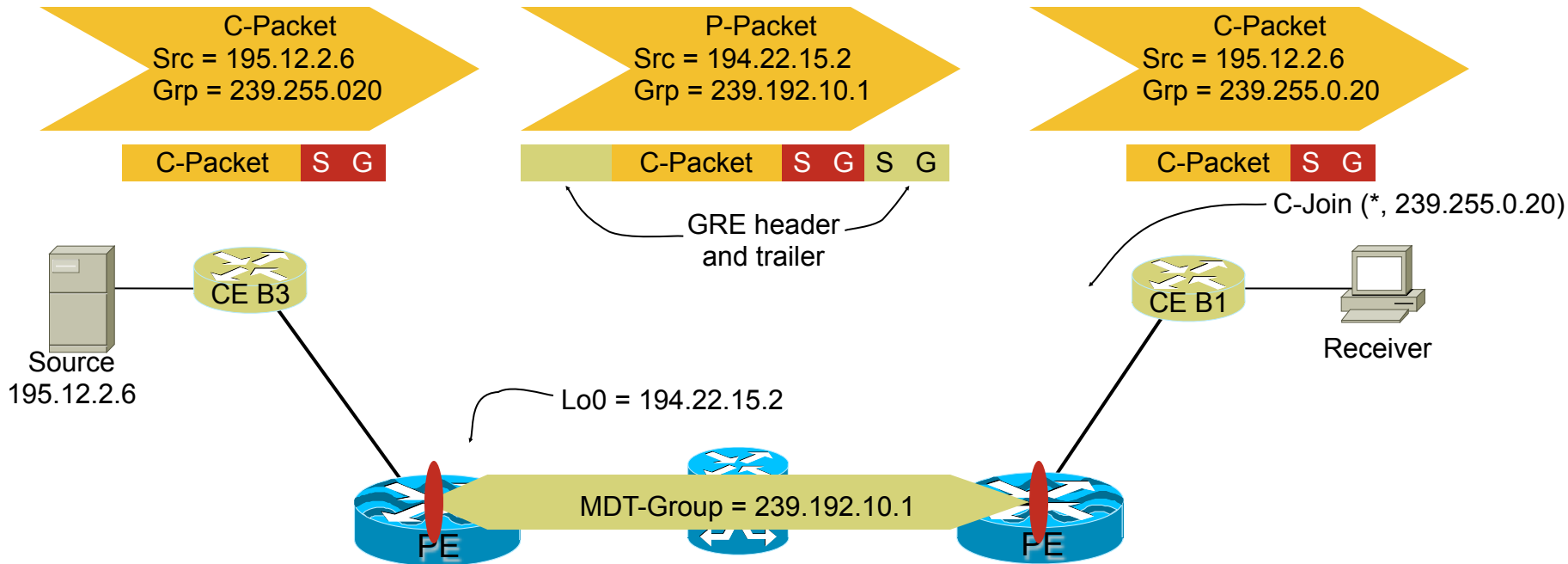


PE-P native multicast in core (Global PIM instance)

PE-CE in mVRF (Per VRF PIM instance)

PE-PE in mVRF via MT (Per VRF PIM instance)

MVPN Packet Encapsulation



Forwarding on the MDT uses GRE, C-packet becomes a P-Packet

P-Packet S address := PE's BGP peering address

G address := MDT-Group address (Default or Data)

C-Packet IP TOS will be copied to P-Packet

MPLS labels are NOT used in core, only native multicast **But it is not about MPLS.....**

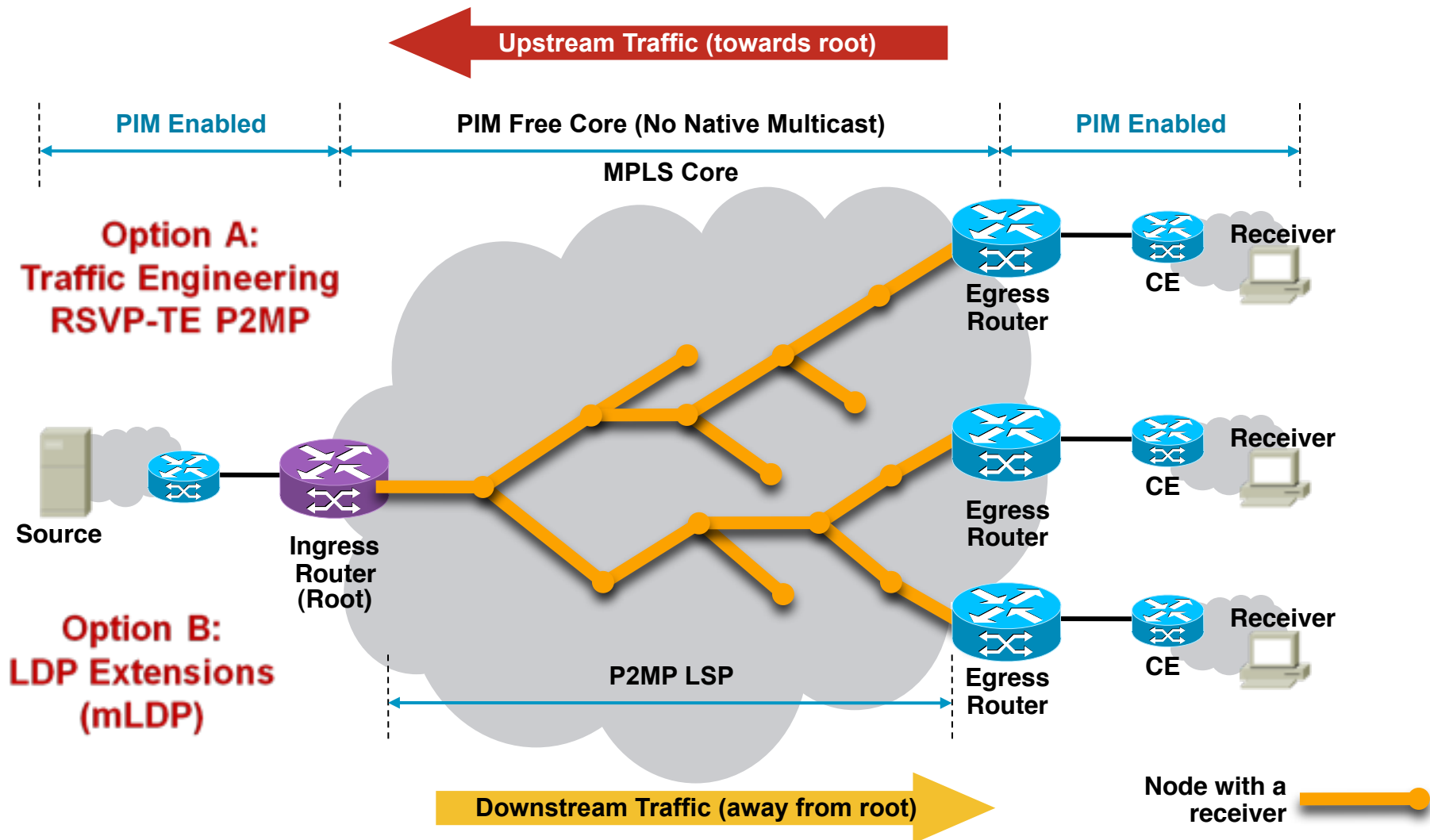


MVPN – MPLS



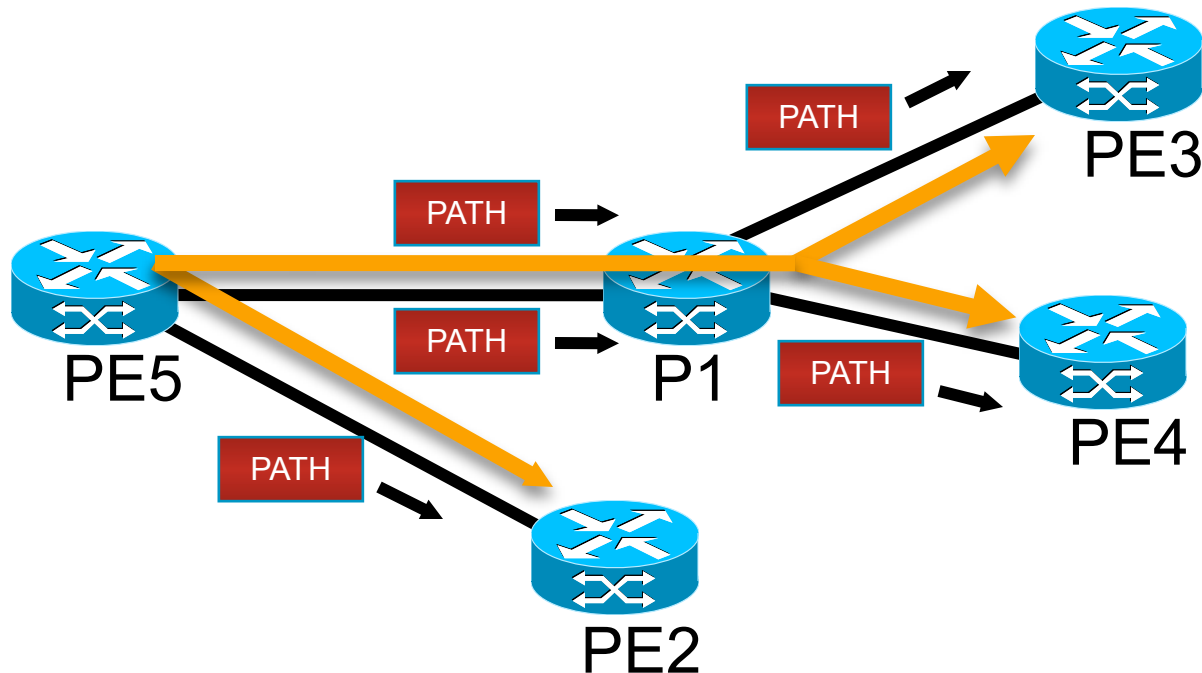
No PIM in MPLS core

But we have to assure backward compatibility



Option A: P2MP TE LSP Setup

RSVP PATH Messages



Head-end Router PE5 sends three path messages (one per destination)

First PATH message:

PE5 -> P1 -> PE3

Second PATH message:

PE5 -> P1 -> PE4

Third PATH message:

PE5 -> PE2

Configuring P2MP TE at Head End (Cisco IOS)

```
ip multicast-routing
```

```
!
```

```
mpls traffic-eng destination list name P2MP-LIST-DST1
```

```
ip 172.16.255.1 path-option 10 explicit name PATH1
```

```
ip 172.16.255.2 path-option 10 dynamic
```

```
ip 172.16.255.3 path-option 10 dynamic
```

```
ip 172.16.255.4 path-option 10 dynamic
```

```
!
```

```
interface Tunnel1
```

```
description FROM-ROUTER-TO-LIST-DST1
```

```
ip unnumbered Loopback0
```

```
ip pim passive
```

```
ip igmp static-group 232.0.0.1 source 192.168.5.1
```

```
ip igmp static-group 232.0.0.2 source 192.168.5.1
```

```
tunnel mode mpls traffic-eng point-to-multipoint
```

```
tunnel destination list mpls traffic-eng name P2MP-LIST-DST1
```

```
tunnel mpls traffic-eng priority 7 7
```

```
tunnel mpls traffic-eng bandwidth 1000
```

```
!
```

```
interface Ethernet0/0
```

```
ip address 192.168.5.1 255.255.255.252
```

```
ip pim sparse-mode
```

```
!
```

```
ip pim ssm default
```

```
!
```



Enable IPv4
multicast routing

Destination list with
path-option per
destination

Tunnel as passive
PIM interface
(historical)

Multicast groups
mapped to tunnel

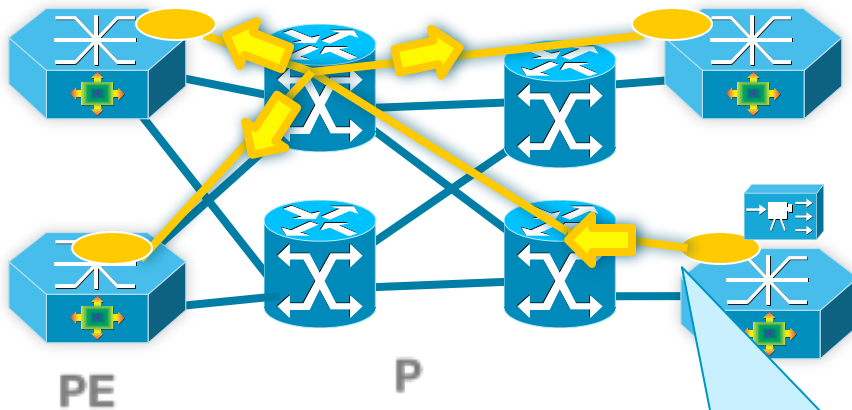
P2MP TE Tunnel

Tunnel destination
list

PIM sparse mode on
non-MPLS
interfaces

Source-specific
multicast with
default addresses
(232/8)

Option B: mLDP configuration for mVPN



- Similar to PIM based mVPN

```
(config)# ip vrf cisco
...
(config-vrf)# mdt default mldp mp2mp <a.b.c.d>
(config-vrf)# mdt data mldp 100 threshold 1
...
```



