

# IPv6 over MPLS

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# Agenda

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- **IPv6 Migration Approaches enabled by MPLS**
- **6PE Approach: IPv6 over MPLS/IPv4**
- **Conclusions**

# Key Markets where MPLS will facilitate IPv6 Migration

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- **Service Providers and ISPs**

MPLS already used (for MPLS VPN, for Layer 2 VPNs, for TE, for Guaranteed Bandwidth Services...)

IPv6 offered as yet another service over existing MPLS Multiservice platform

- **Wireless**

3G mobile phone networks, PDAs, ...

- **Academic and Research Networks**

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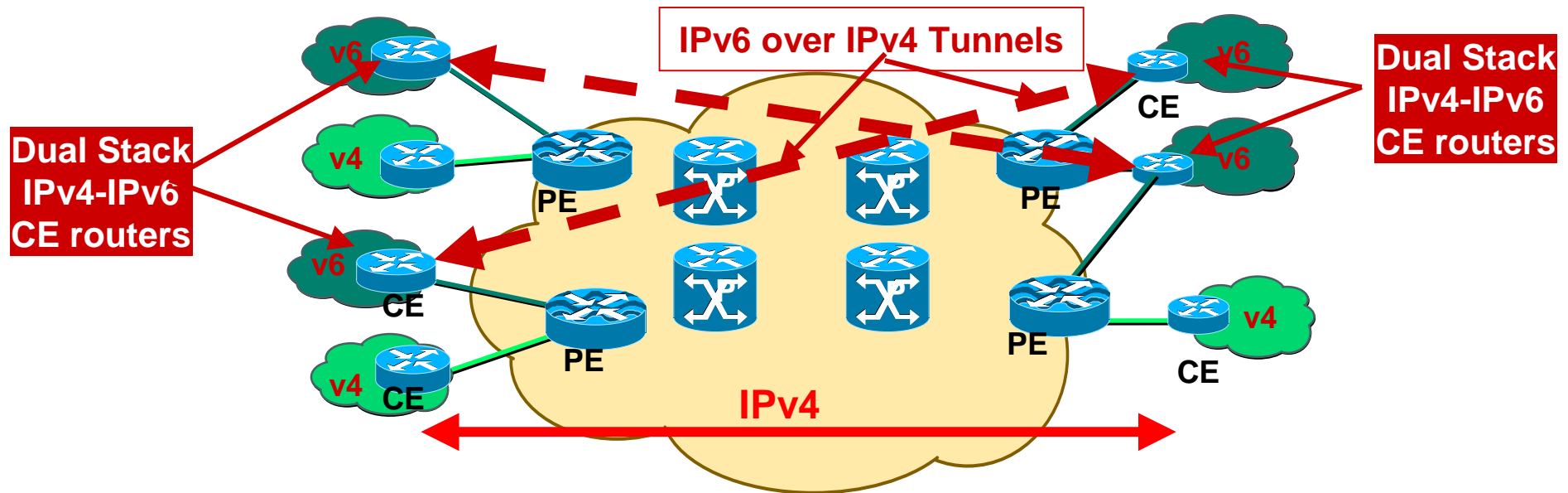


# IPv6 Migration Approaches

- **Many ways to deliver IPv6 services to End Users**
- **Many Service Providers have already deployed MPLS in their IPv4 backbone for various services**
  - MPLS/VPN, MPLS/QoS, MPLS/TE, ATM + IP switching**
- **MPLS can be used to facilitate IPv6 migration**
- **Multiple approaches for IPv6 over MPLS:**
  - IPv4 CE-to-CE Tunnels**
  - IPv6 over “Circuit\_over\_MPLS”**
  - Native IPv6 MPLS**
  - IPv6 Provider Edge Router (6PE) over MPLS**

# IPv4 CE-to-CE Tunnels

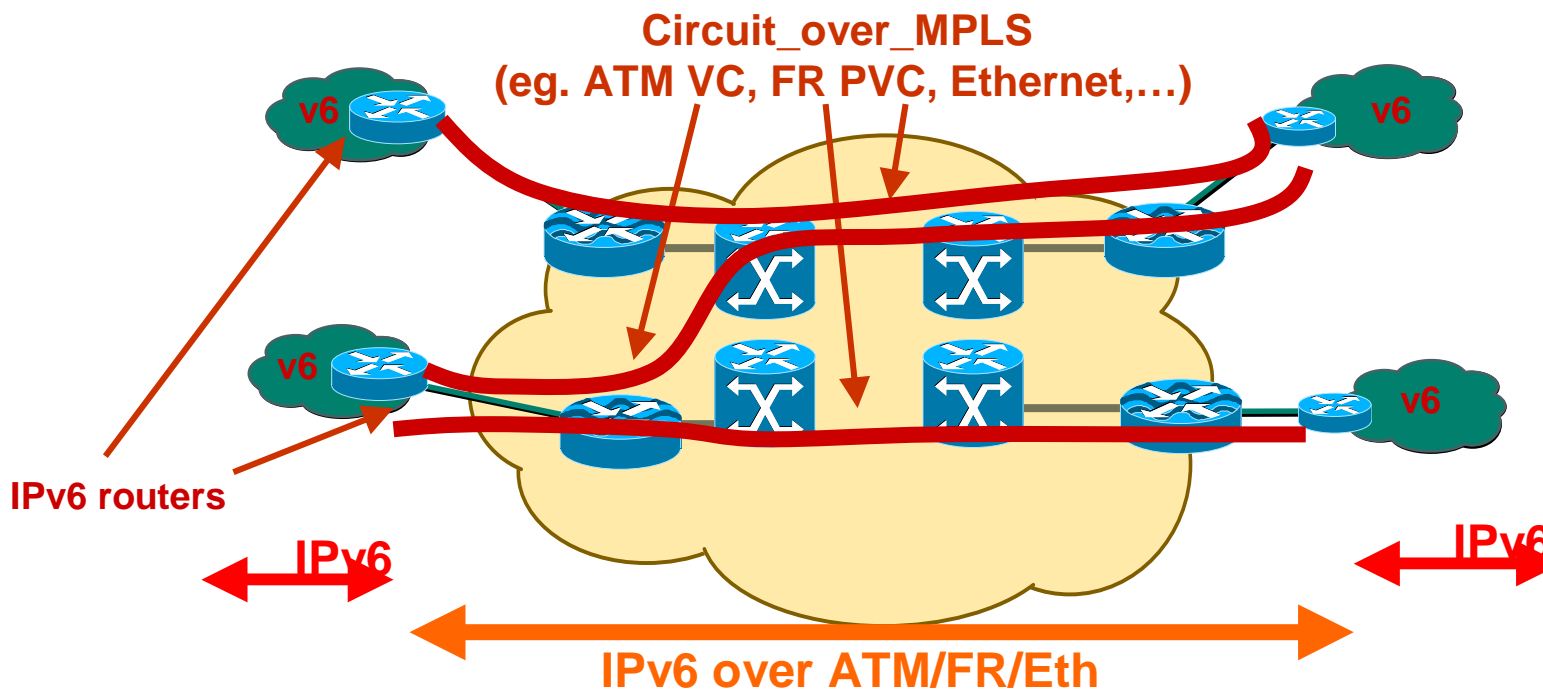
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- No impact on existing IPv4 or MPLS Core (v6 unaware)
- Only CEs are v6-aware (Dual stack)
- Mesh of IPv6 over IPv4 Tunnels CE-to-CE
- overhead: IPv4 header + MPLS header

# IPv6 over “Circuit\_over\_MPLS”

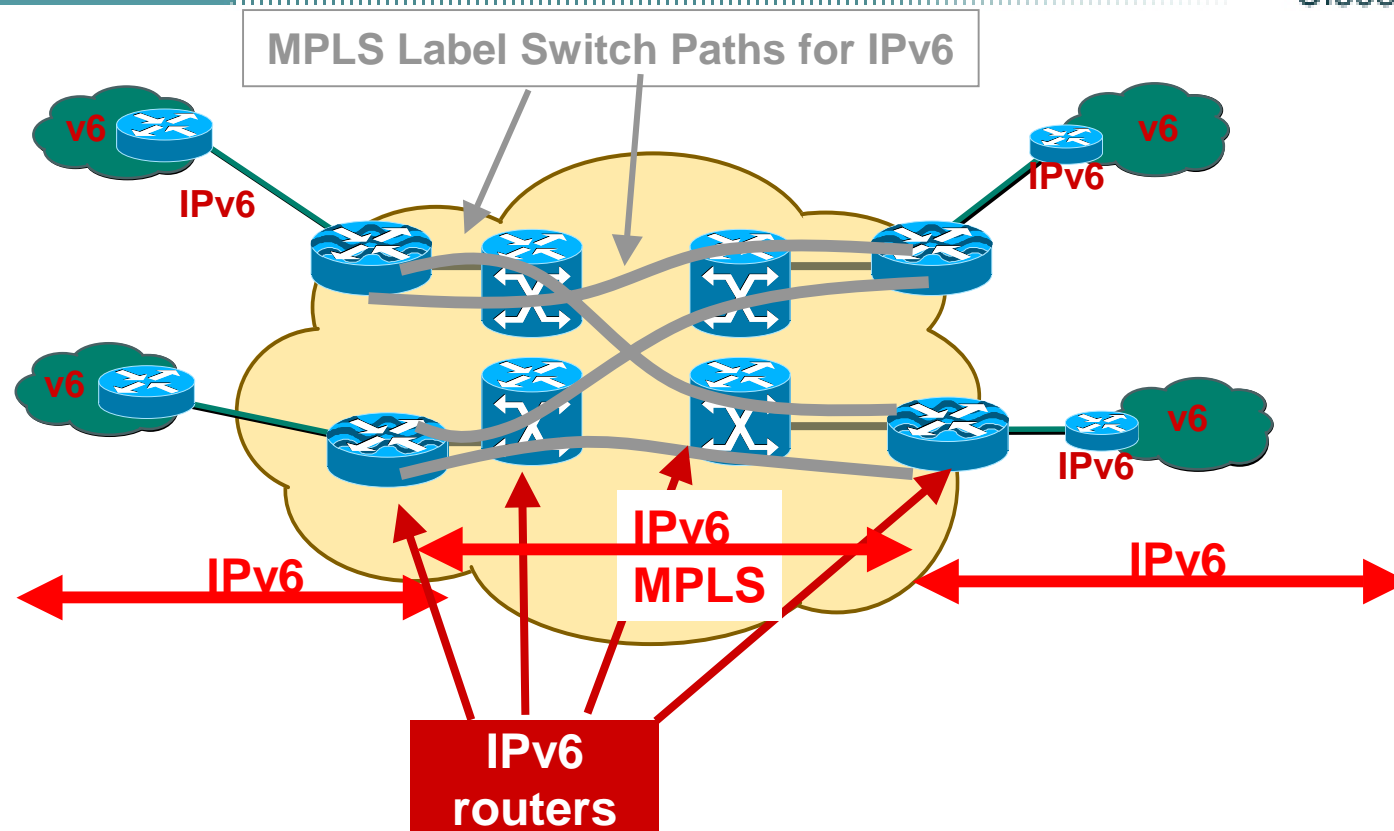
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- No impact on existing IPv4 or MPLS Core (v6 unaware)
- Edge MPLS Routers need to support “Circuit\_over\_MPLS”
- Mesh of “Circuit\_Over\_MPLS” PE-to-PE
- PE routers are regular IPv6 Routers (V6 over ATM, v6 over FR, v6 over Ethernet,...)

# Native MPLS Support of IPv6

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- Core Infrastructure requires full Control Plane upgrade to v6
- V6 Routing in core
- V6 Label Distribution Protocol in core



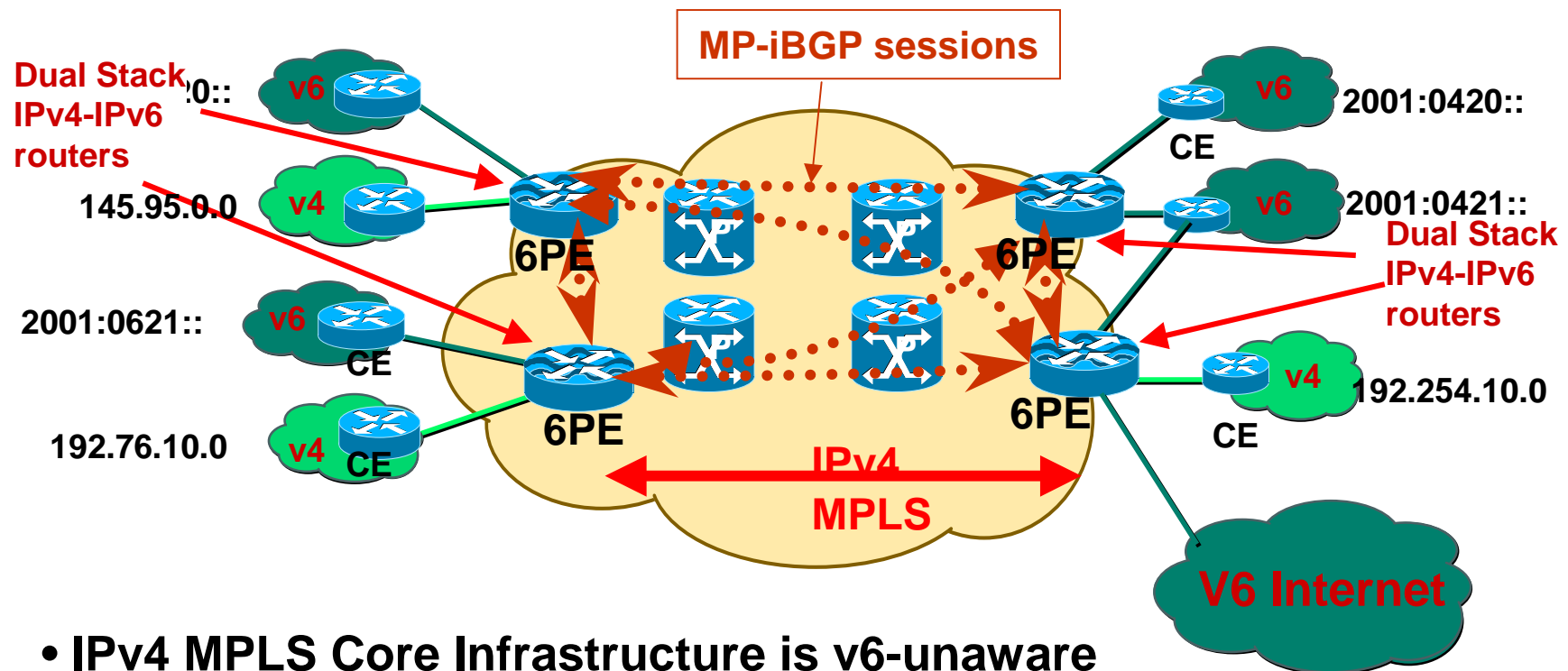
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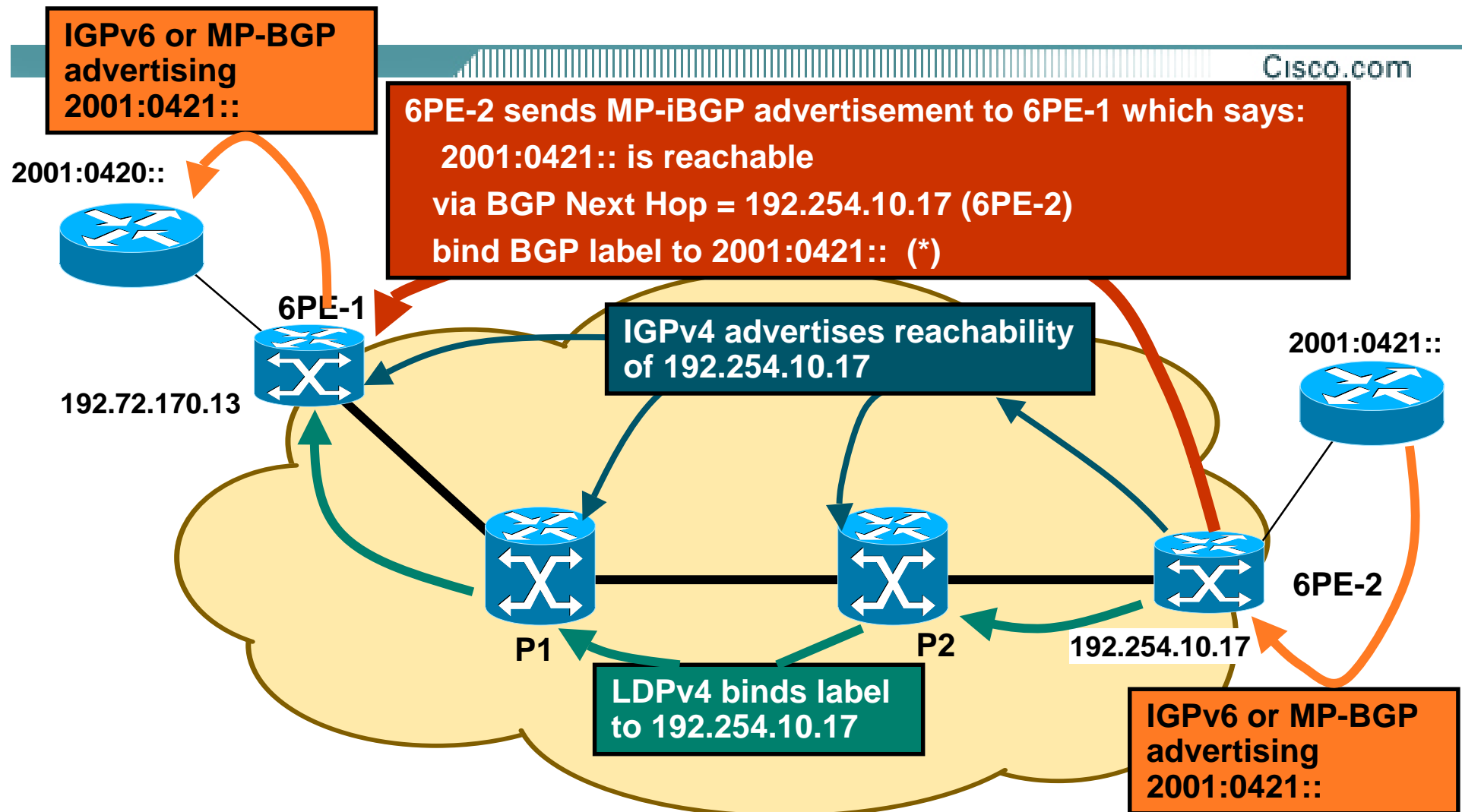
# IPv6 over MPLS Provider Edge Router (6PE)

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- IPv4 MPLS Core Infrastructure is v6-unaware
- PEs support Dual Stack/6PE
- IPv6 reachability exchanged among PEs via i-MP-BGP
- IPv6 packets transported from PE to PE inside IPv4 MPLS LSPs

# 6PE Routing/Label Distribution



(\*) The 2<sup>nd</sup> label allows operations with Penultimate Hop Popping (PHP) (which is typically used in current MPLS networks)- it is an Aggregate label

# 6PE Forwarding

2001:0420::

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2001:0421::

IPv6 packet  
to 2001:0421::

192.72.170.13

6PE-1

P1

P2

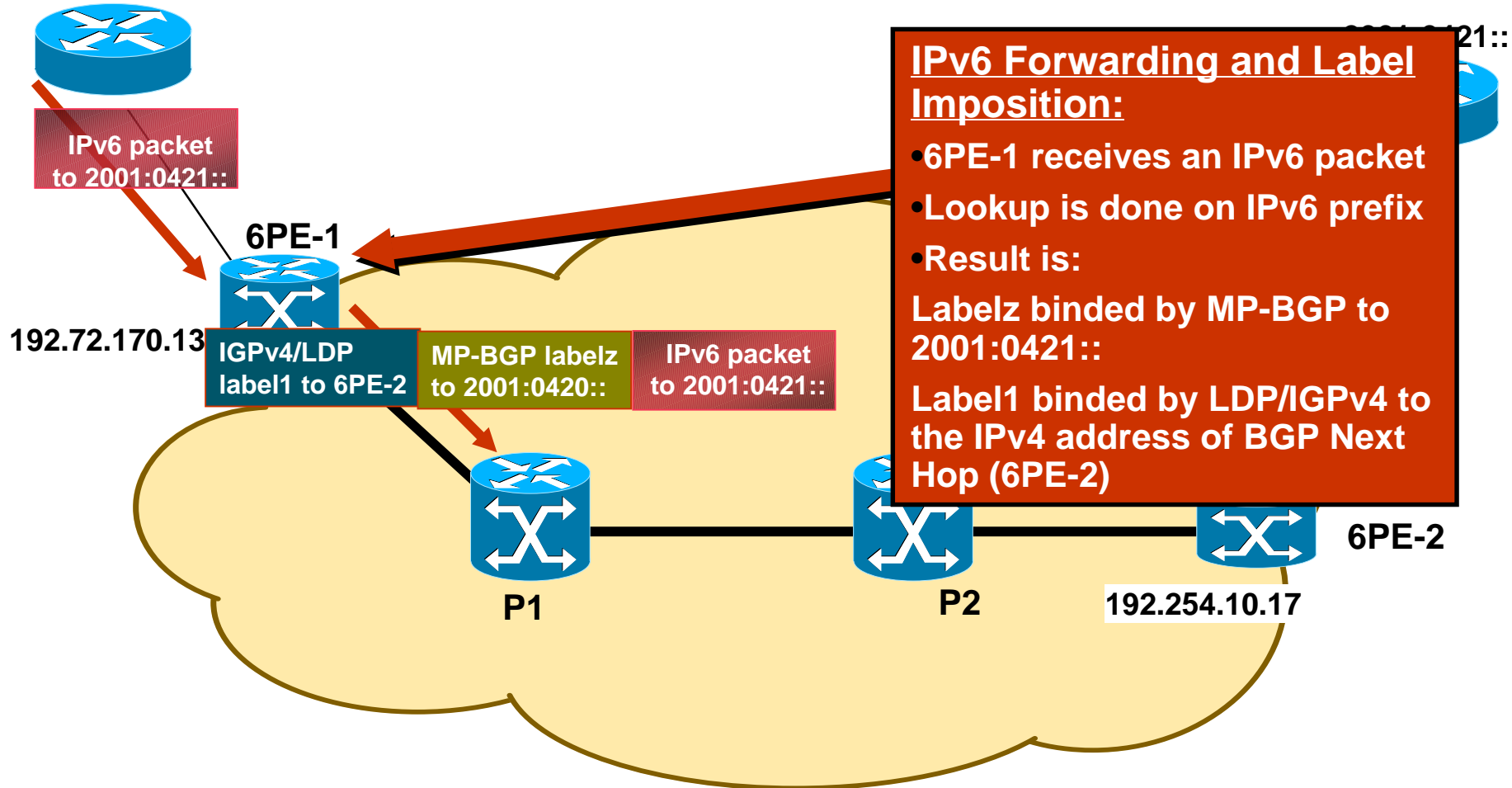
192.254.10.17

6PE-2

# 6PE Forwarding (6PE-1)

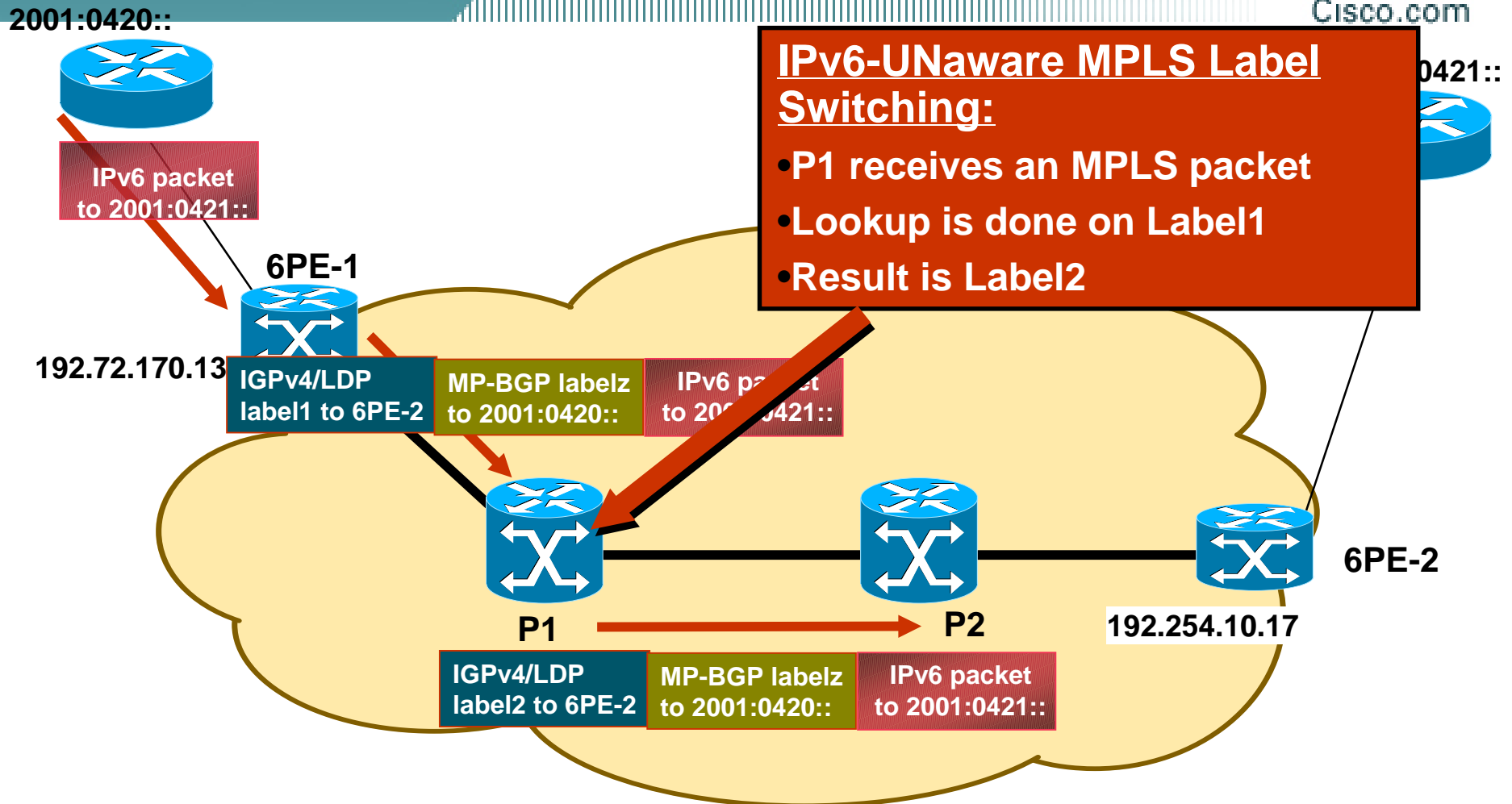
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2001:0420::



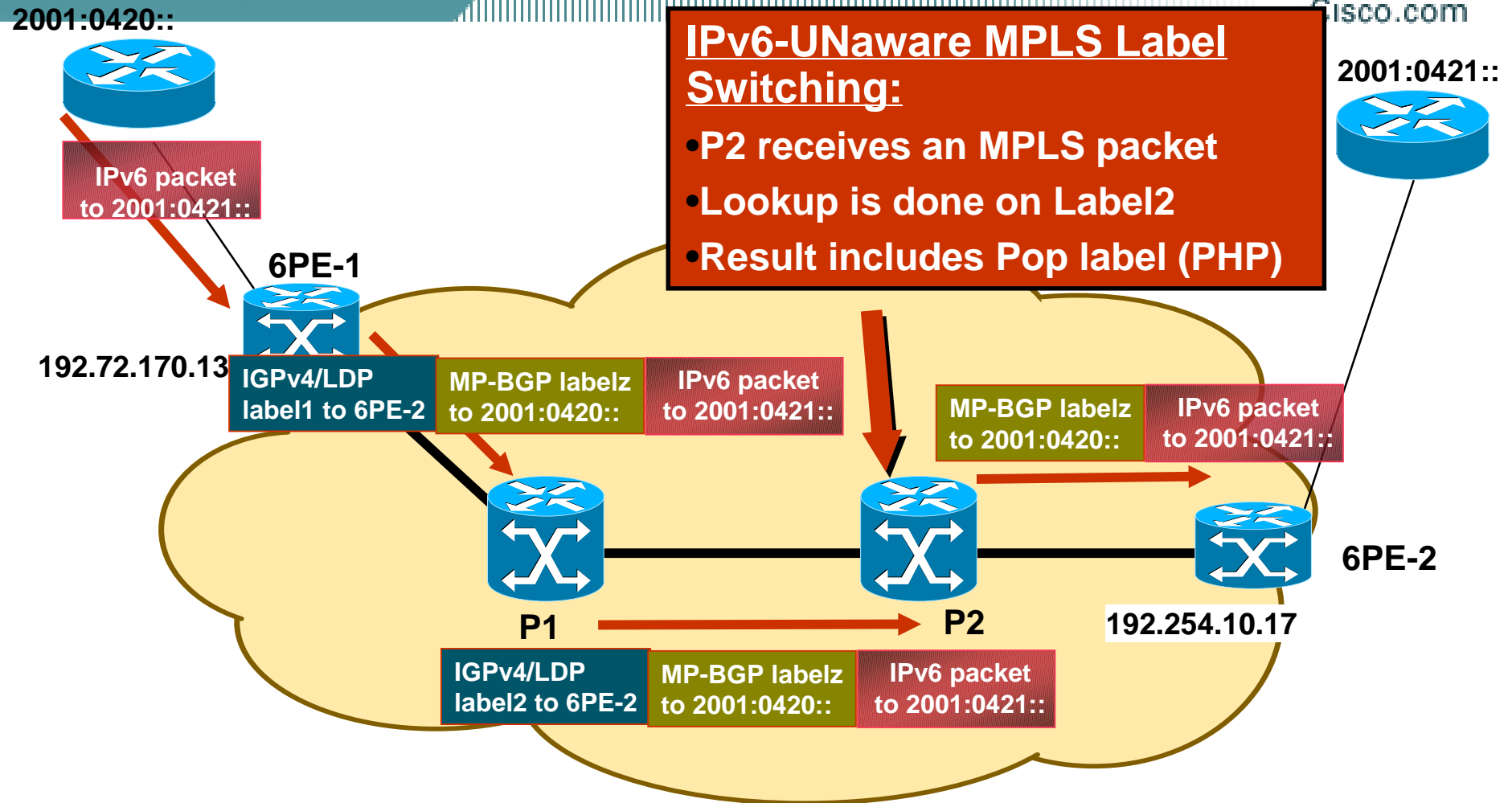
# 6PE Forwarding (P1)

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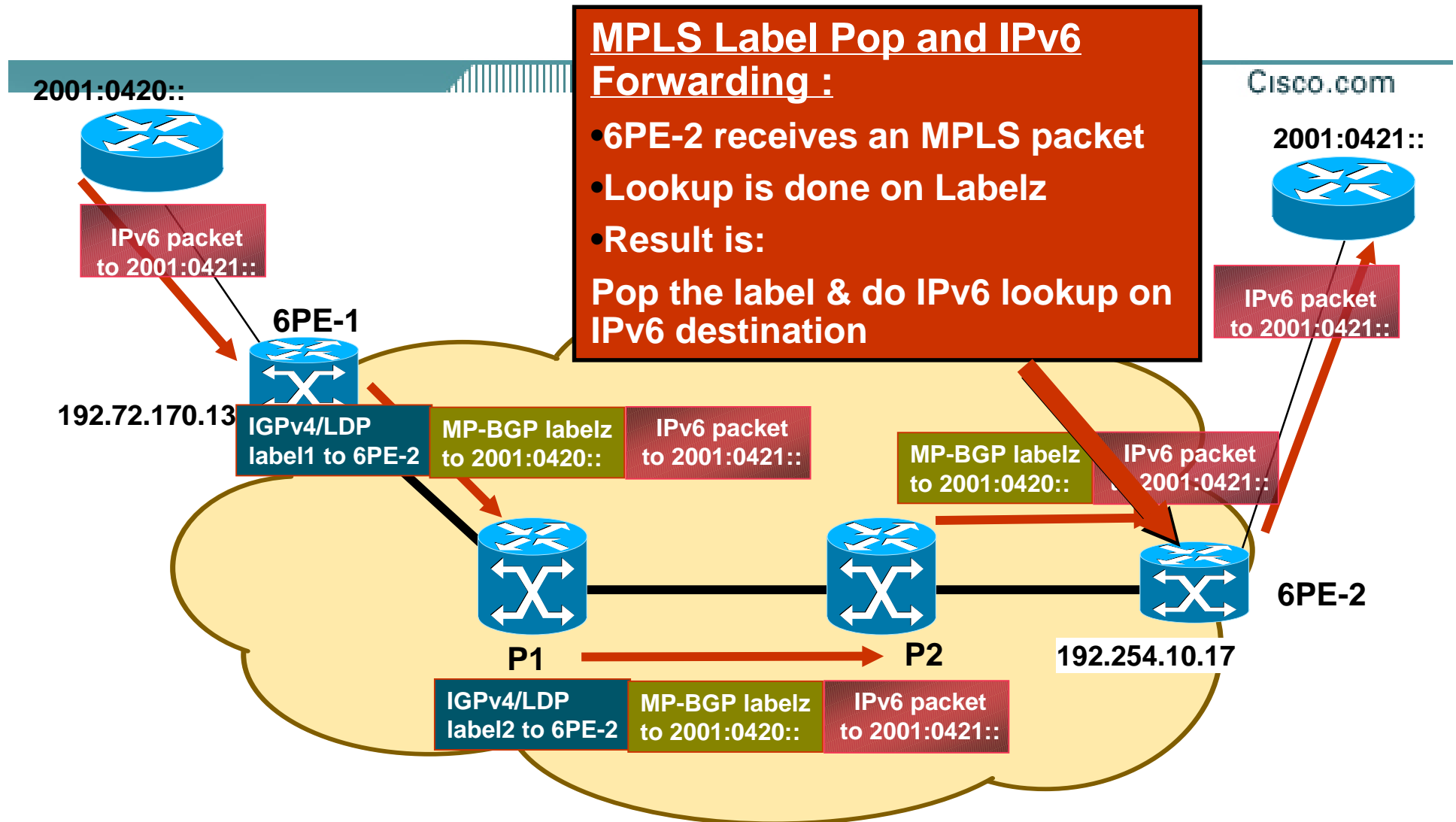


# 6PE Forwarding (P2)

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# 6PE Forwarding (6PE-2)





# 6PE Standardisation

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- **6PE approach will be an IETF standard soon**
- **See <draft-ietf-ngtrans-bgp-tunnel-04.txt>**
- **Generic solution for transport of IPv6 over any tunnelling technique (including MPLS) using MP-BGP**
- **IETF Working Group document, due for WG Last Call**

# 6PE Benefits

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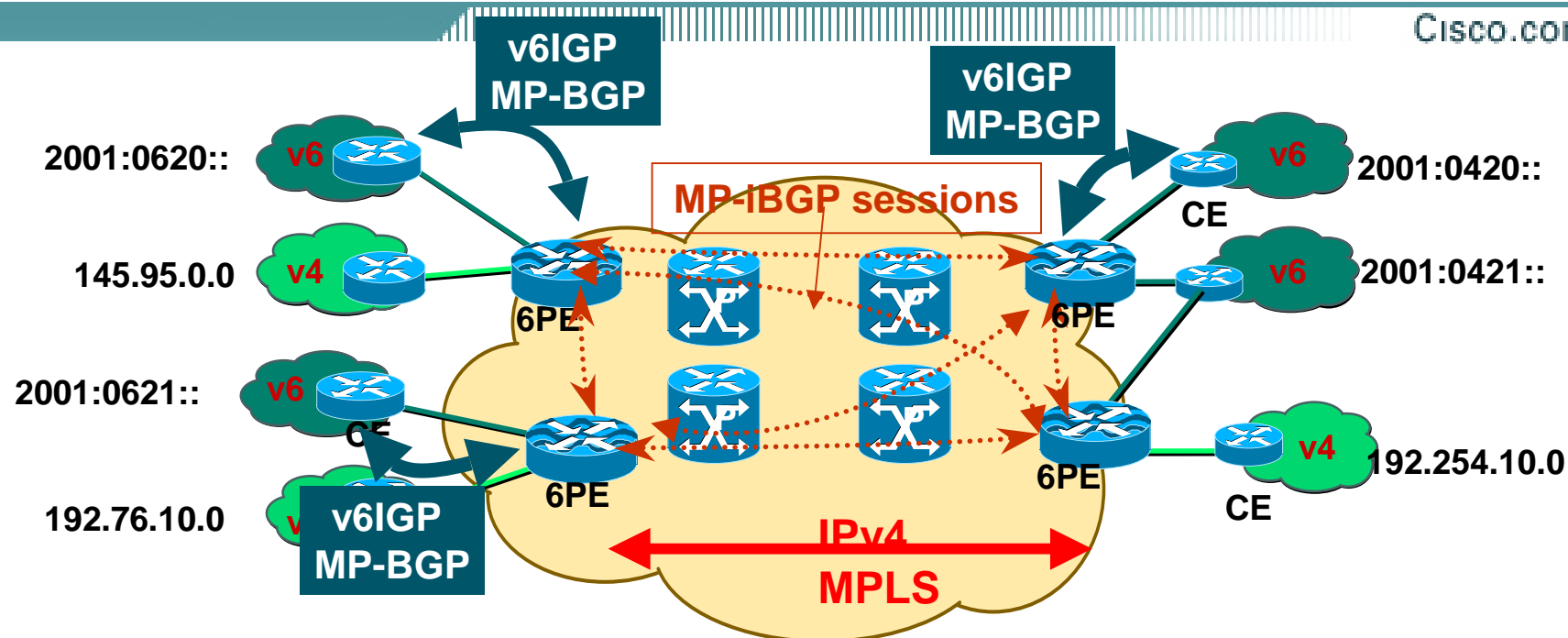
**For SPs already running MPLS, 6PE approach has many benefits:**

- **Core Infrastructure needs no upgrade and no config change**
- **Upgrade only on the edge (ie upgrade of existing PEs to 6PE, or add separate 6PEs)**
- **IPv6 supported simultaneously with existing MPLS services (MPLS v4\_VPNs, QoS, ATM, v4 Internet, ...)**

**→ 6PE allows IPv6 to be deployed over existing MPLS Multiservice infrastructure with marginal operational impact/cost /risk**

# 6PE Benefits

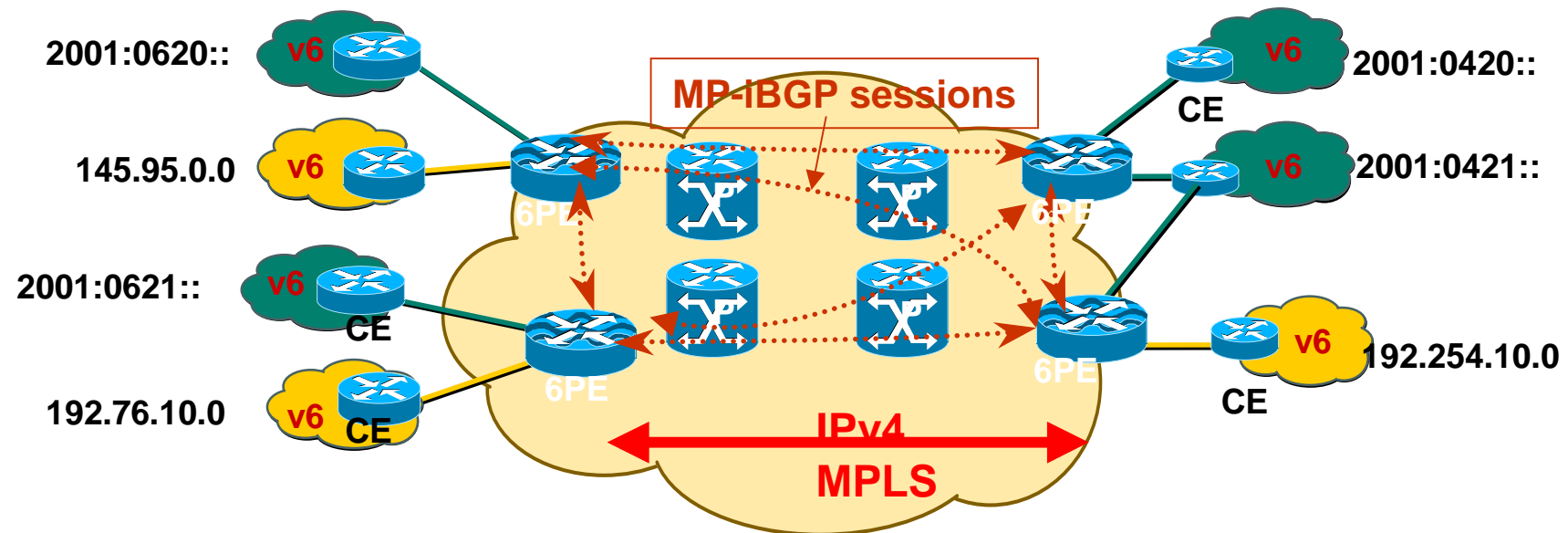
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- V6 CE only has a single Routing Peer (PE) regardless of how many remote v6 CEs it communicates with
- No change on a v6 CE when remote CEs are added/removed (reachability automatically learnt)
- No tunnel/"circuit" to be configured
- 6PE offers scalable and flexible solution (benefits are analogous to RFC2547bis layer 3 VPN solution for IPv4)

# 6PE Benefits

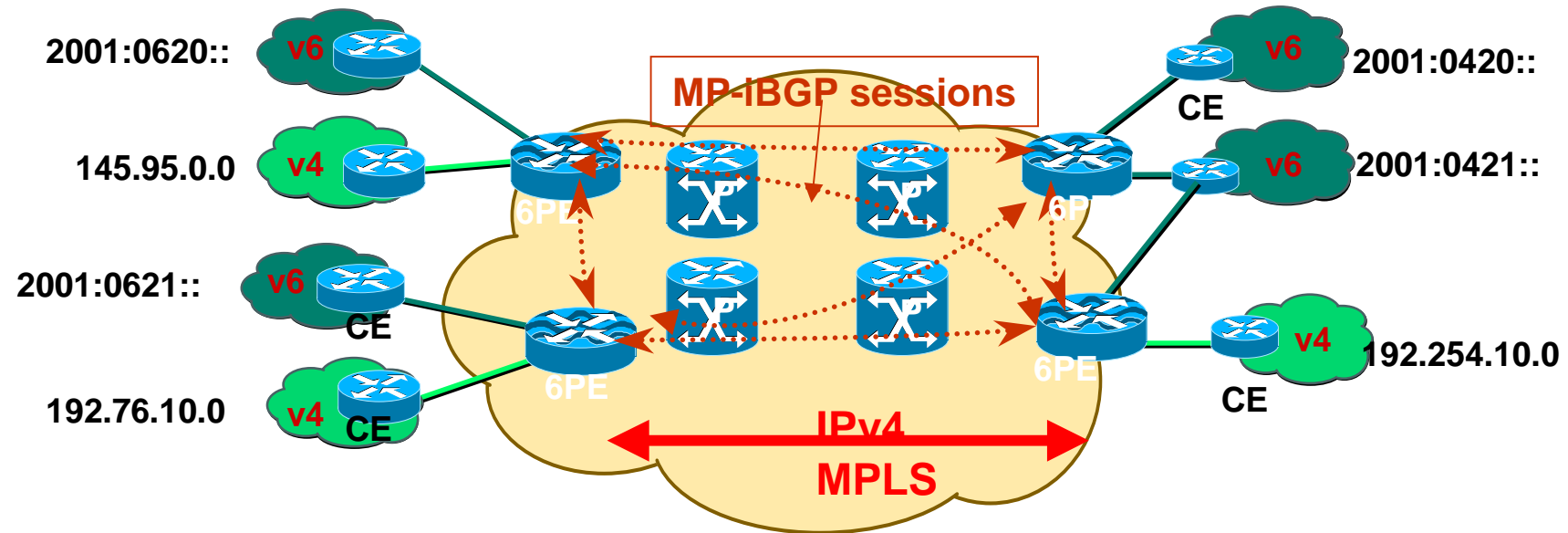
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→6PE solution can be easily extended to support same VPN services for IPv6 as currently supported for IPv4 with RFC2457bis (isolation, Internet access, QoS...)

# 6PE Cons

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- Only makes sense where network already runs MPLS
- Requires knowledge of MPLS and BGP technologies
- Requires dual-stack and software upgrade on PE (or new PE)

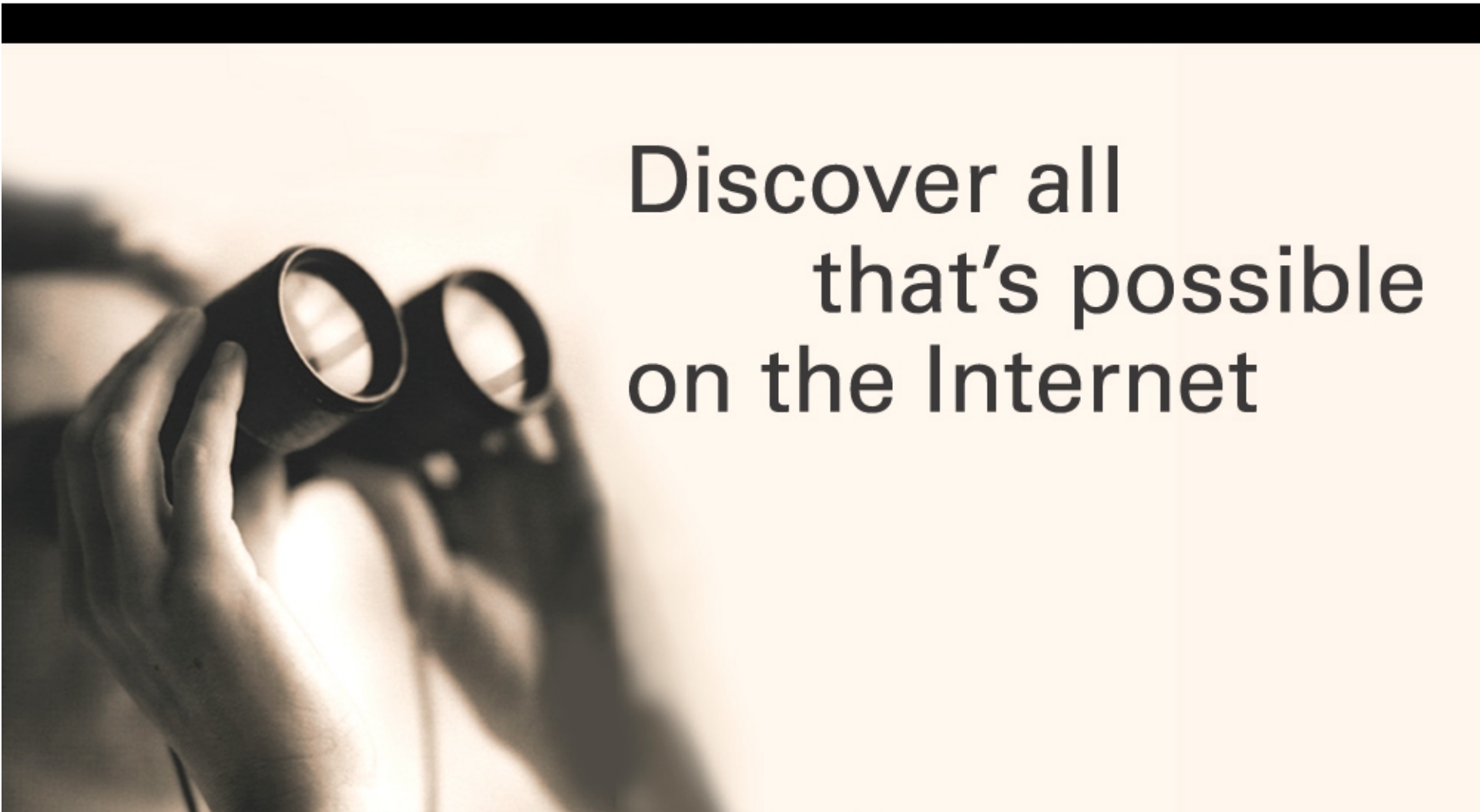
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# Conclusions

- **IPv6 migration does not “require” MPLS**
- **But, where MPLS is deployed, it enables attractive approaches for IPv6 migration**
- **6PE is one such IPv6 migration approach over MPLS which offers IPv6 deployment with marginal cost/risk**
- **IPv6 treated as “just another service” that can be supported over stable IPv4 MPLS core (in addition to IPv4 Internet, MPLS Layer 3 VPNs, ATM, FR, ...)**



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