

# Inter-AS VPN and CsC

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# Agenda

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- **Inter-AS VPN**
- **Carrier Support Carrier**

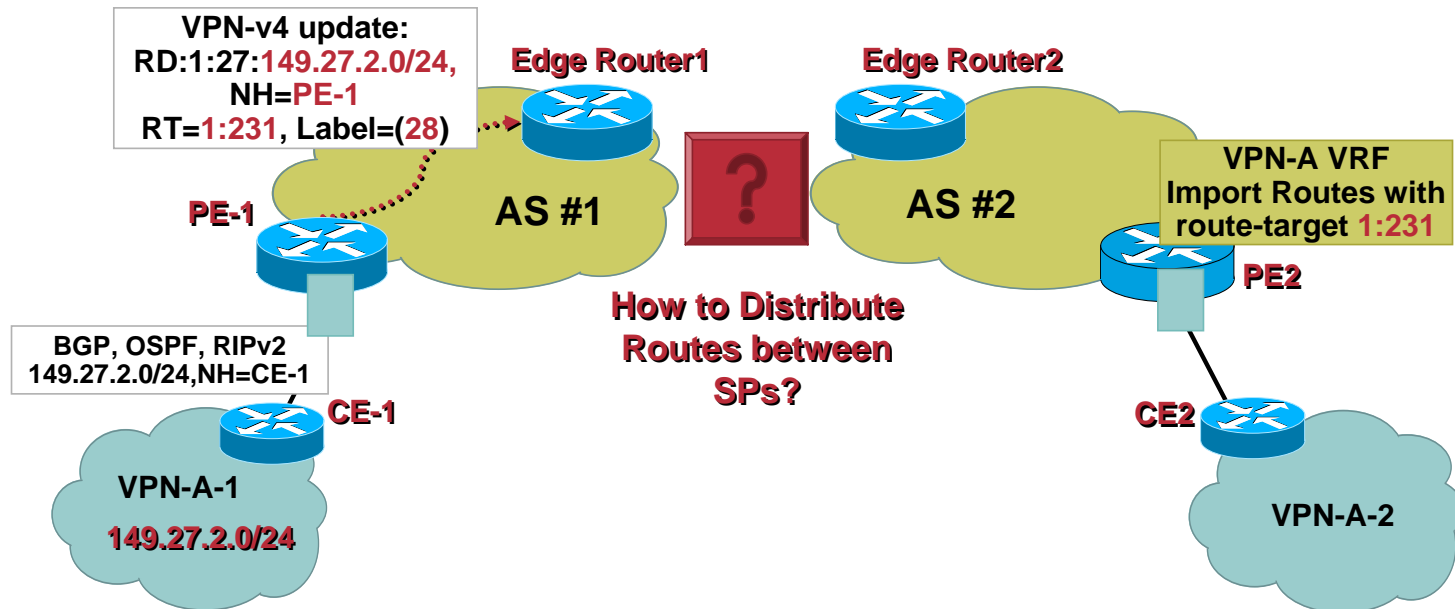
# VPN Client Connectivity

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- **VPN sites may be geographically dispersed**  
Requiring connectivity to separate MPLS VPN service providers
- **Transit between VPN sites may pass through multiple providers MPLS backbones**  
This implies exchange of VPN routing information between providers  
Provider backbones may or may not provide VPN service directly
- Referred to as **multi-provider VPN** or **inter-provider VPN** or **inter-AS VPN**

# VPN Client Connectivity

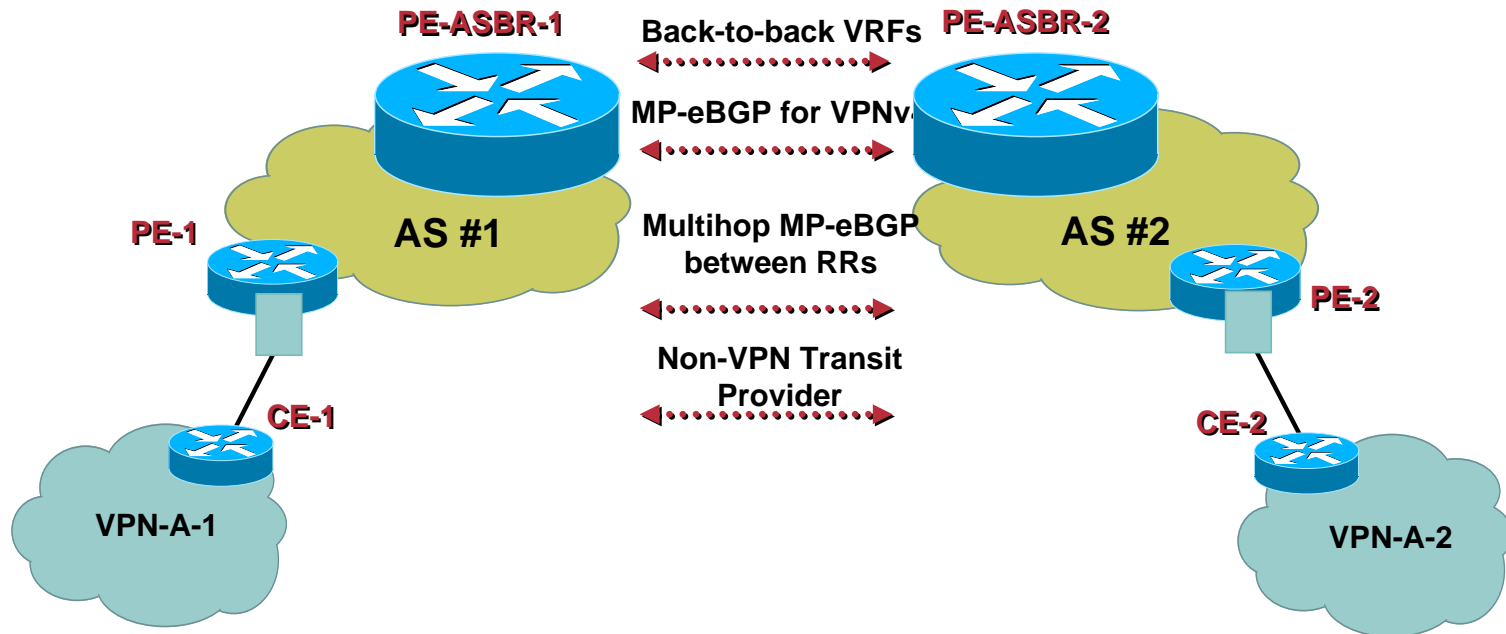
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## VPN Sites Attached to Different MPLS VPN Service Providers

# VPNv4 Distribution Options

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**Several Options Available for Distribution of VPNv4 Prefix Information**

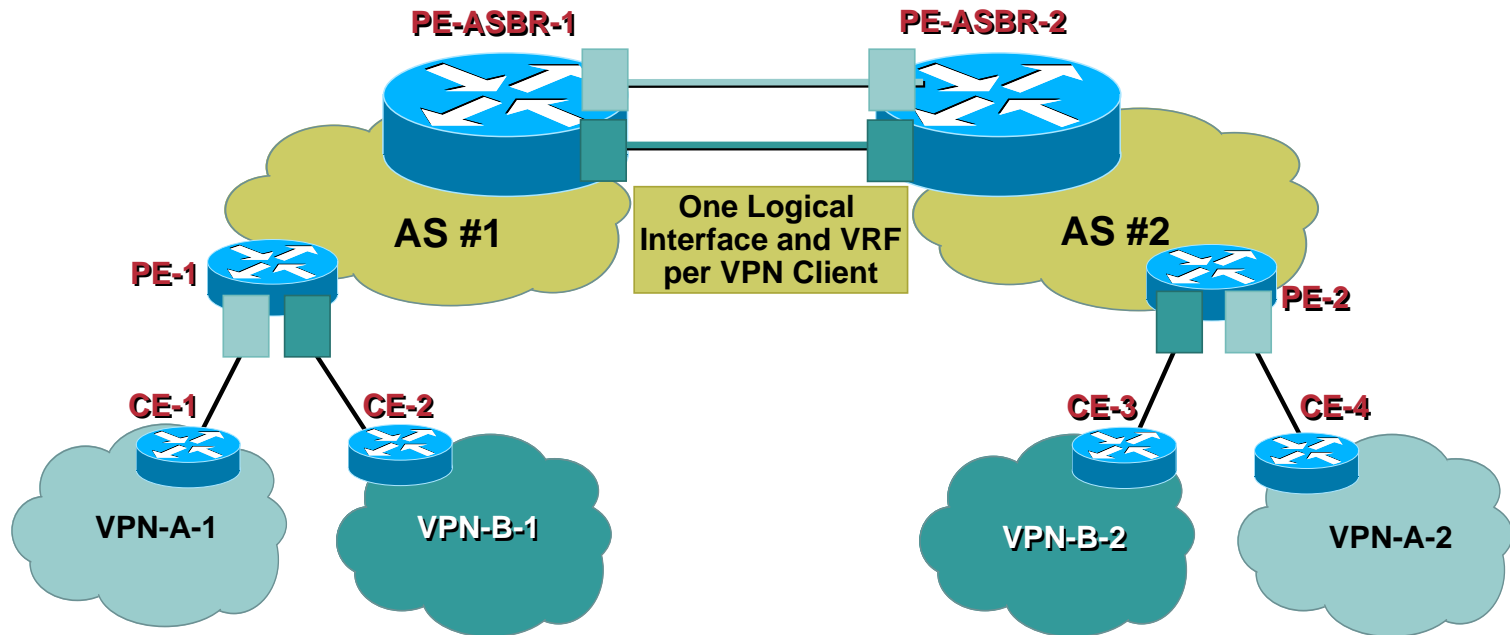
# **Option 1: Back-to-back VRF Connectivity**

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- **MPLS VPN providers exchange routes across VRF interfaces**  
VRF represents a particular VPN client
- **Each PE-ASBR router treats the other as a CE**  
Although both provider interfaces associated with a VRF
- **Provider edge routers are gateways used for VPNv4 route exchange**
- **PE-ASBR to PE-ASBR link may use any supported PE-CE routing protocol**  
Currently OSPF, BGP-4, RIPv2, and static

# Back-to-back VRF Connectivity

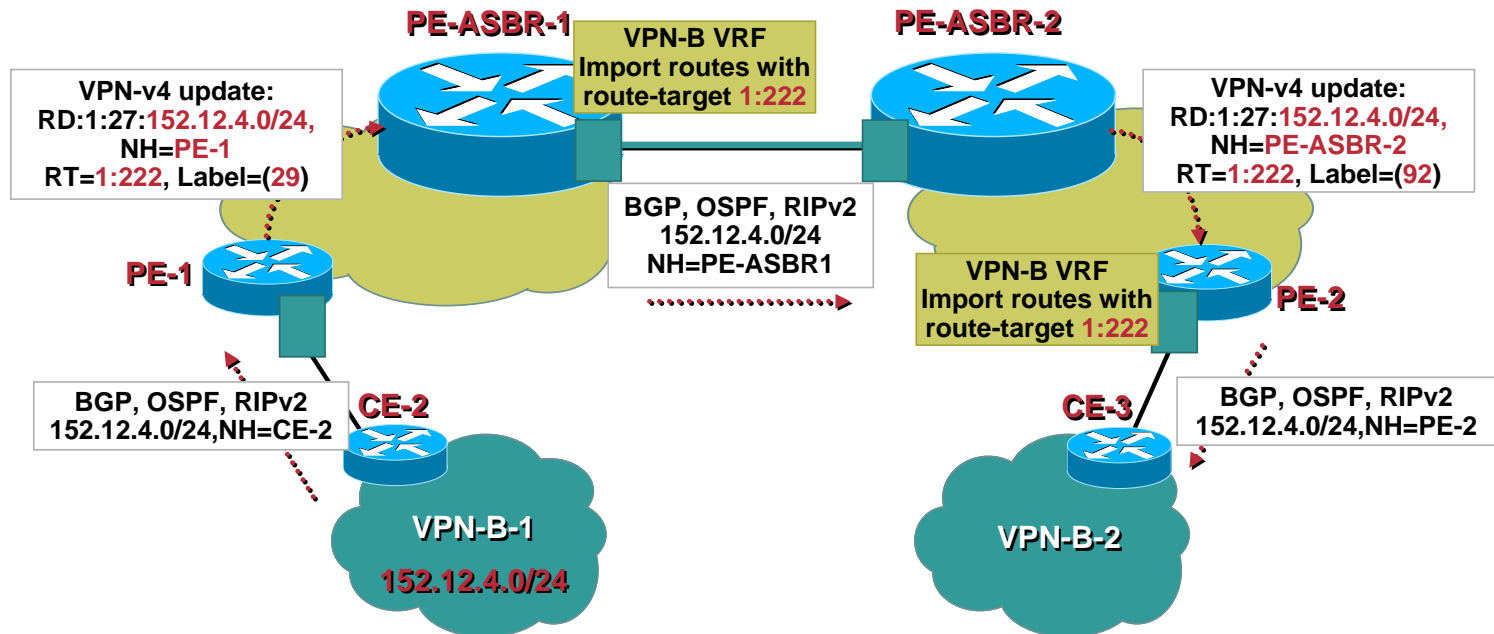
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## VRF to VRF Connectivity between PE-ASBRs

# Back-to-back VRF Connectivity

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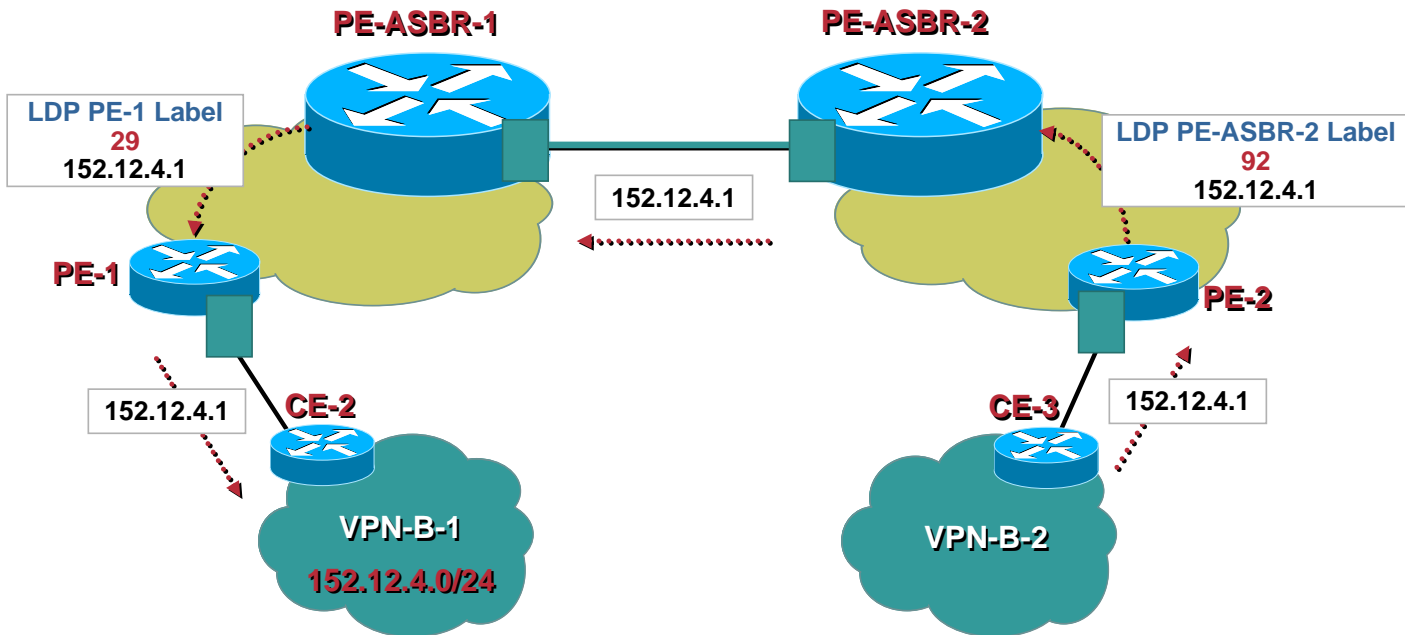


## VRF to VRF Connectivity between PE-ASBRs



# Back-to-back VRF Connectivity

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## VRF to VRF Connectivity between PE-ASBRs

## **Option 2: External MP-BGP for VPNv4 Prefix Exchange**

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- **Gateway PE-ASBRs exchange routes directly using BGP**

External MP-BGP for VPNv4 prefix exchange; no LDP or IGP

- **MP-BGP session with next-hop set to advertising PE-ASBR**

Next-hop and labels are rewritten when advertised across the inter-provider MP-BGP session

- **PE-ASBR stores all VPN routes that need to be exchanged**

But only within the BGP table

No VRFs; labels are populated into the LFIB of the PE-ASBR

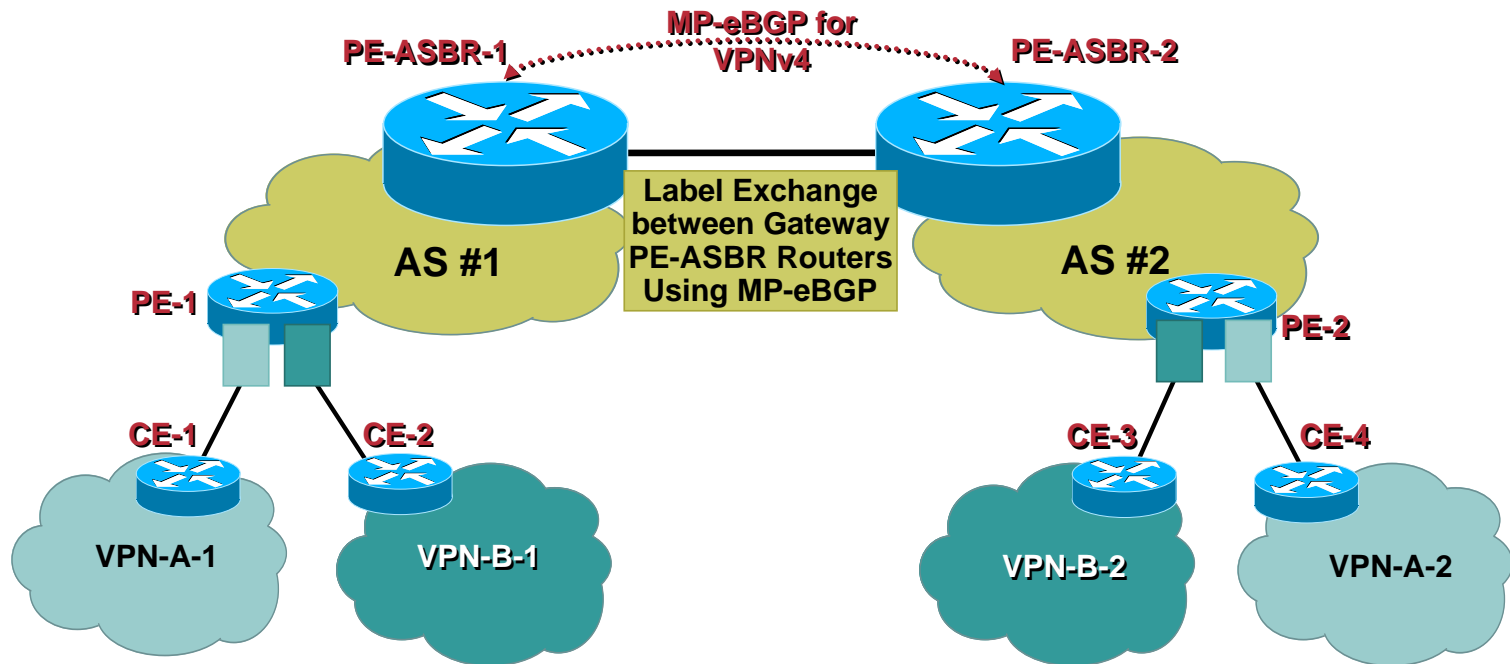
# External MP-BGP for VPNv4

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- **Receiving gateway PE-ASBRs may allocate new label if desired**  
Controlled by configuration of next-hop-self (default is off)
- **Receiving PE-ASBR will automatically create a /32 host route for its PE-ASBR neighbor**  
Which must be advertised into receiving IGP if next-hop-self is **not** in operation to maintain the LSP
- **PE-ASBRs need to hold all inter-AS VPN routes**

# External MP-BGP for VPNv4

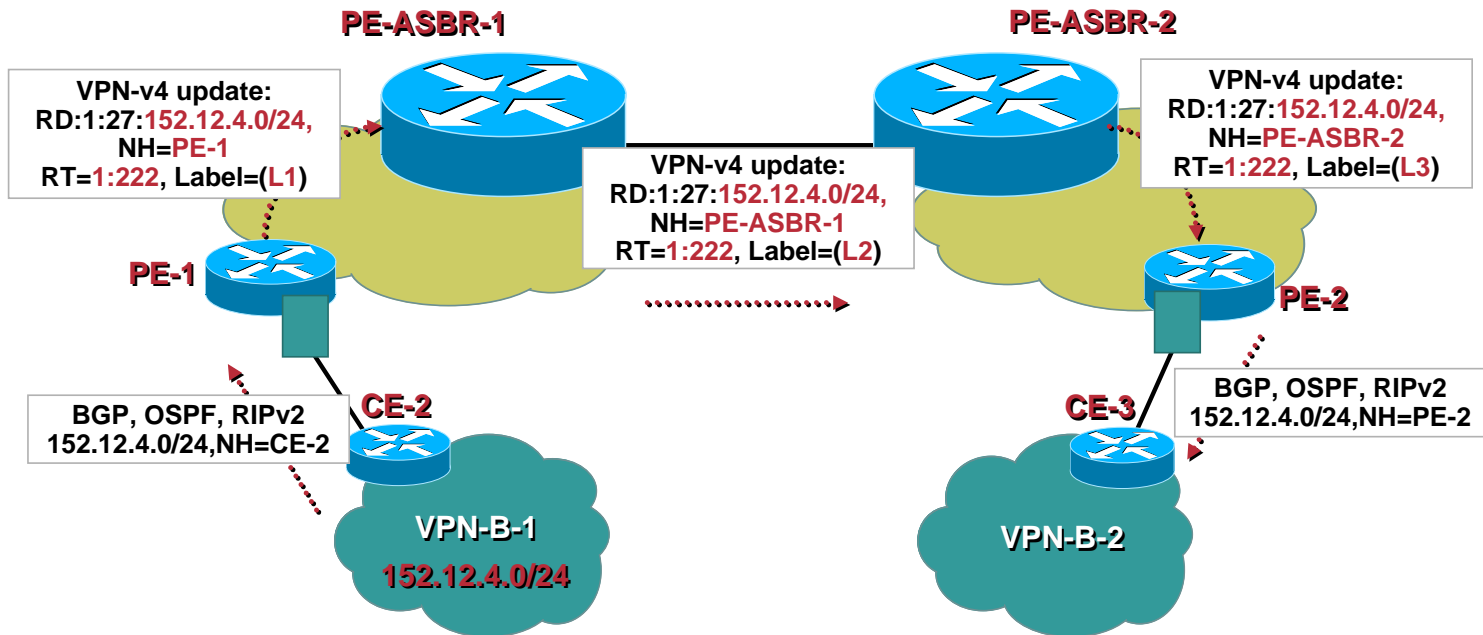
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**MP-BGP VPNv4 Prefix Exchange between Gateway PE-ASBRs**

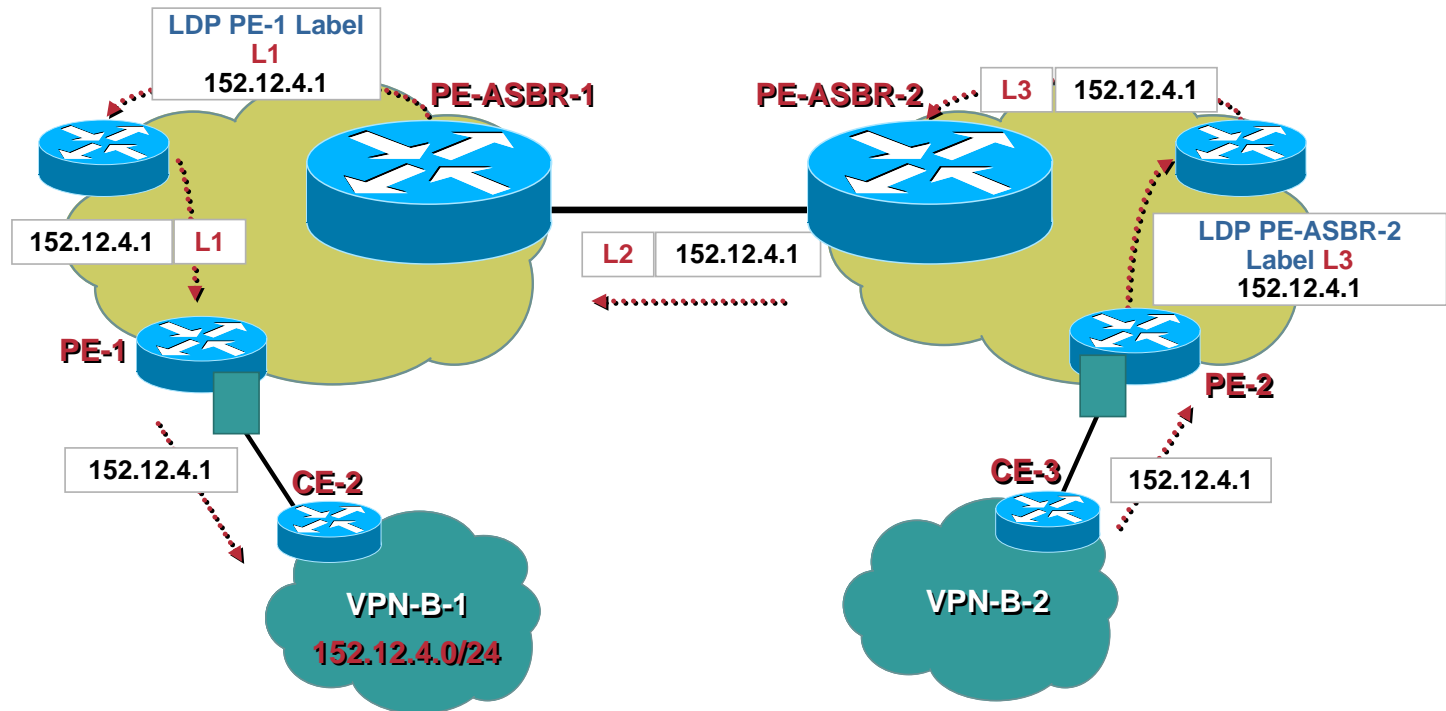
# External MP-BGP for VPNv4

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# External MP-BGP for VPNv4

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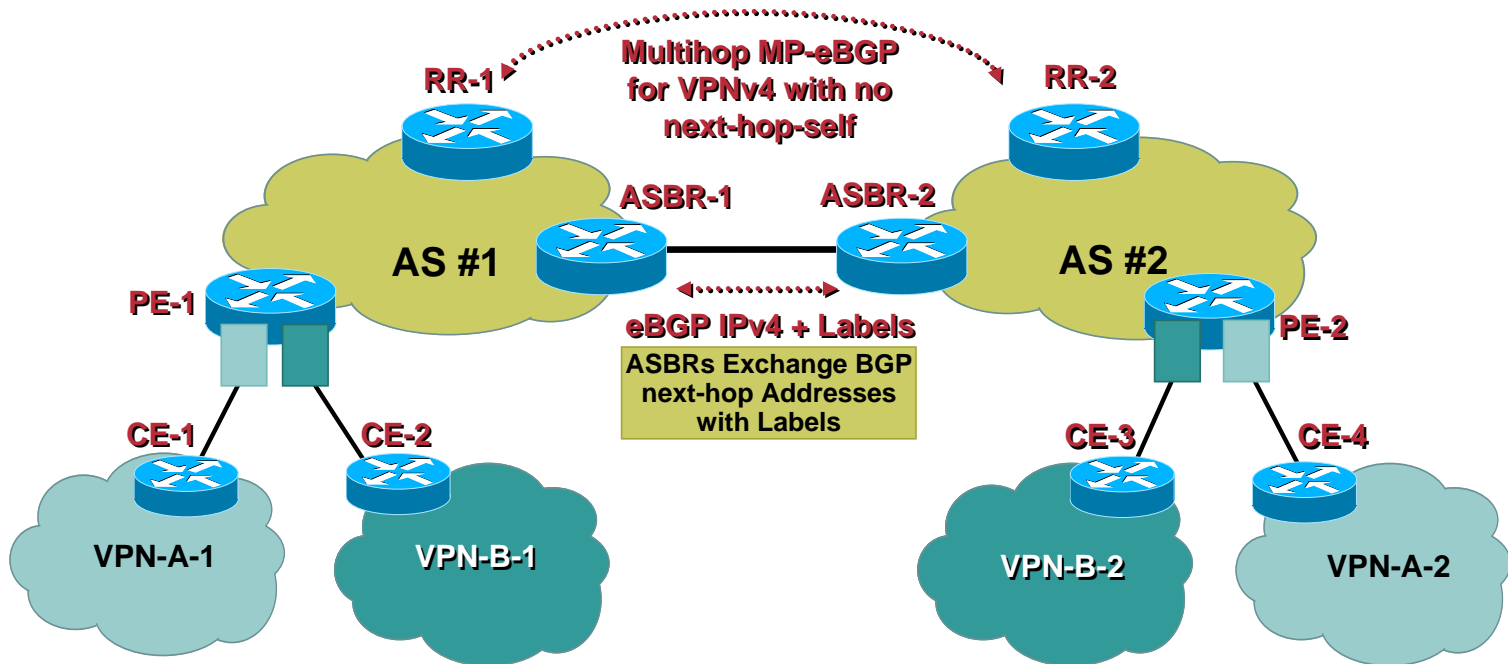
## Option 3: Multihop MP-eBGP for VPNv4 between RRs

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- **MPLS VPN providers exchange VPNv4 prefixes via their route reflectors**  
Requires Multihop MP-eBGP (VPNv4 routes)
- **Next-hop-self **must** be disabled on route reflector**  
Preserves next-hop and label as allocated by the originating PE router
- **Providers exchange IPv4 routes with labels between directly connected ASBRs using eBGP**  
Only PE loopback addresses exchanged as these are BGP next-hop addresses

# Multihop MP-eBGP for VPNv4 between RRs

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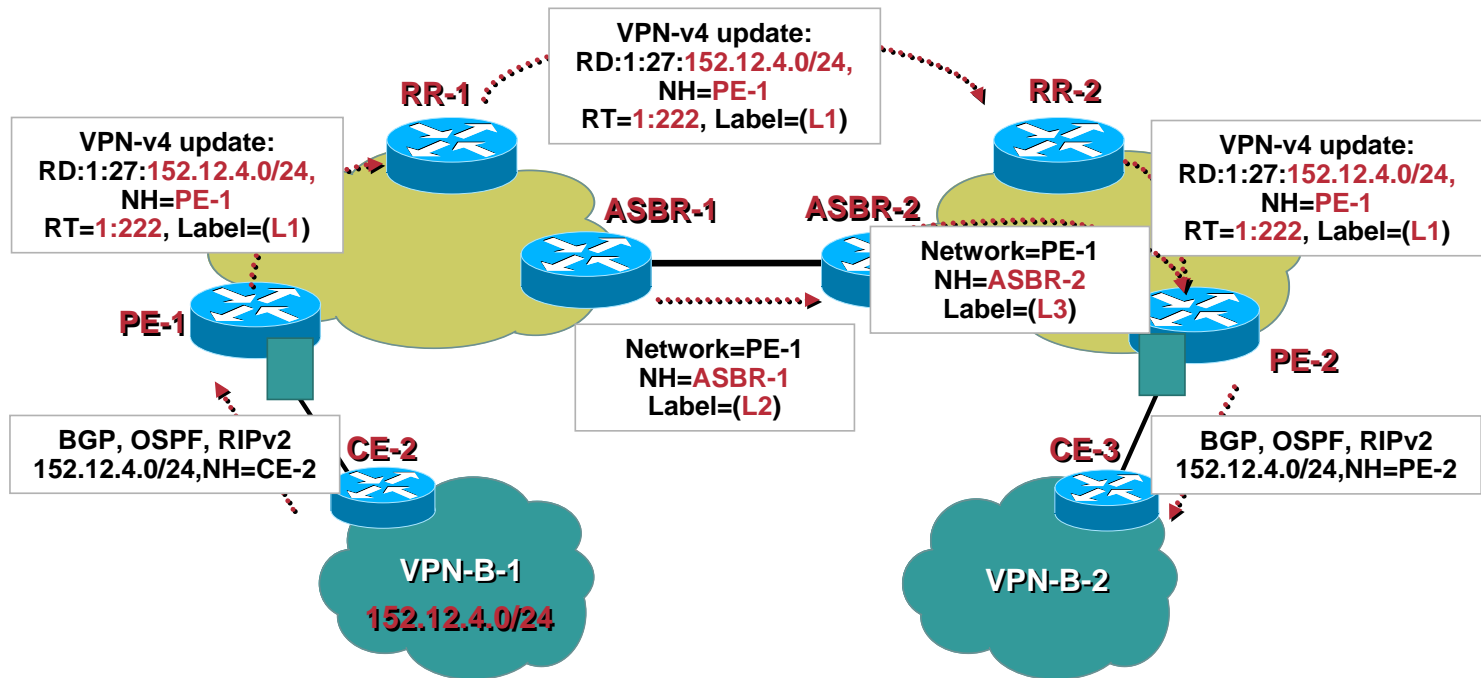


**Multihop MP-eBGP VPNv4 prefix Exchange between Route Reflectors**



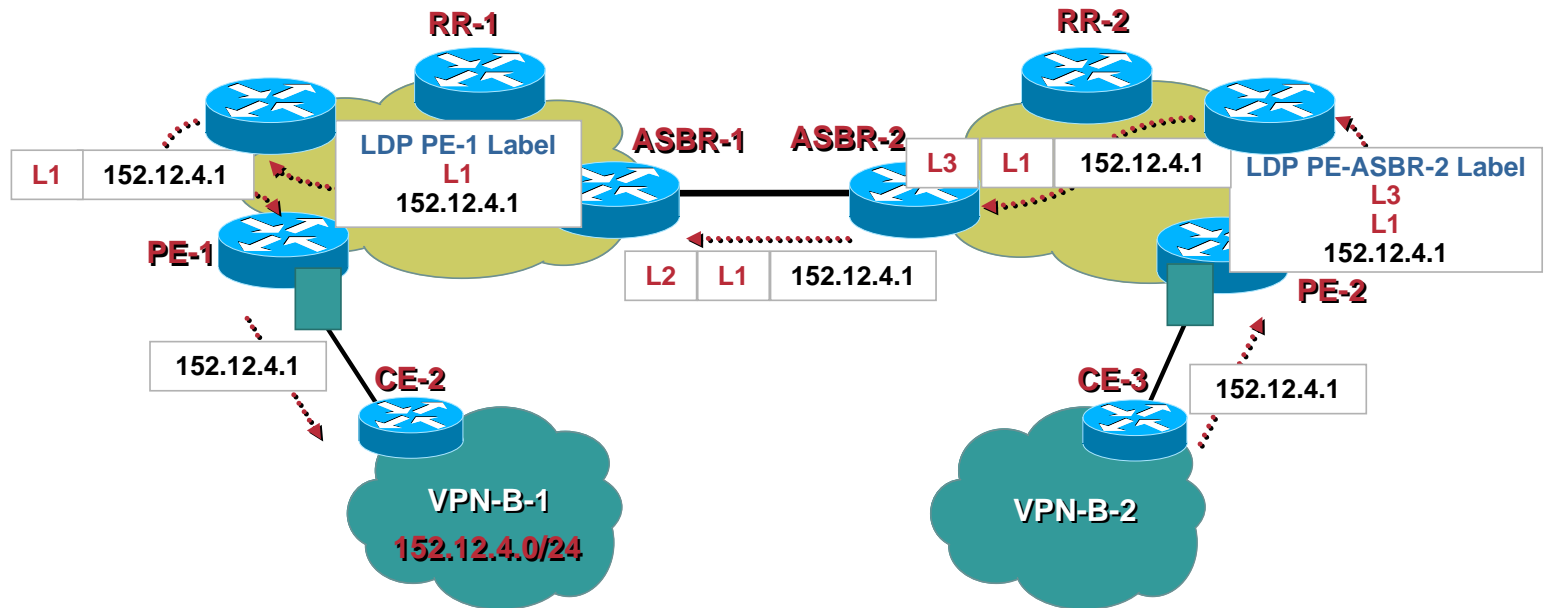
# Multihop MP-eBGP for VPNv4 between RRs

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# Multihop MP-eBGP for VPNv4 between RRs

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## Option 4: Non-VPN Transit Provider

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- **Two MPLS VPN providers may exchange routes via one or more third parties**

Which are non-VPN transit backbones running MPLS

- **Multihop MP-eBGP deployed between edge providers**

With the exchange of BGP next-hops via the transit provider

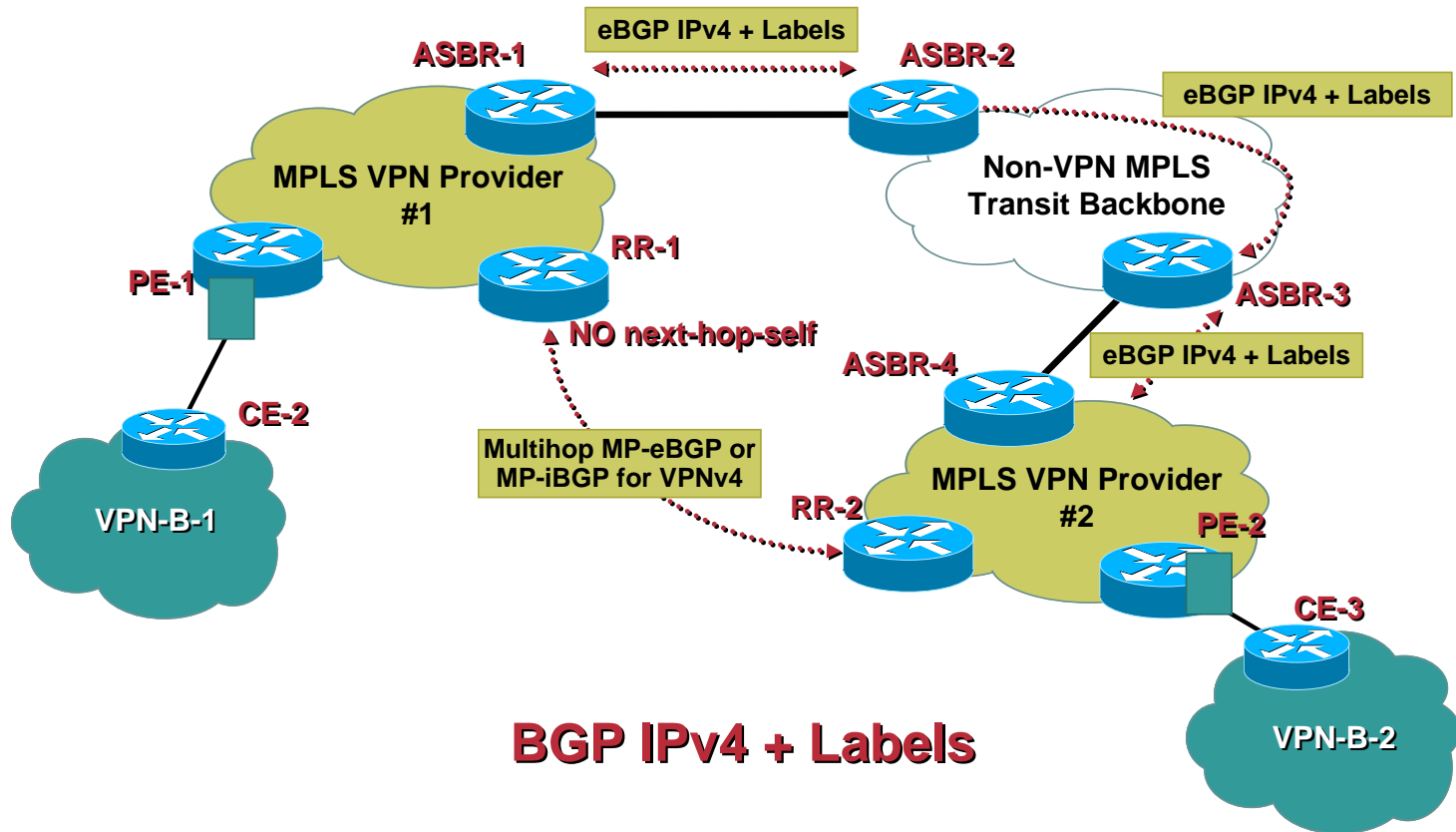
- **Providers may use the same AS# within each region or different AS#**

Transit network is **not** part of the AS path

# Non-VPN Transit Provider

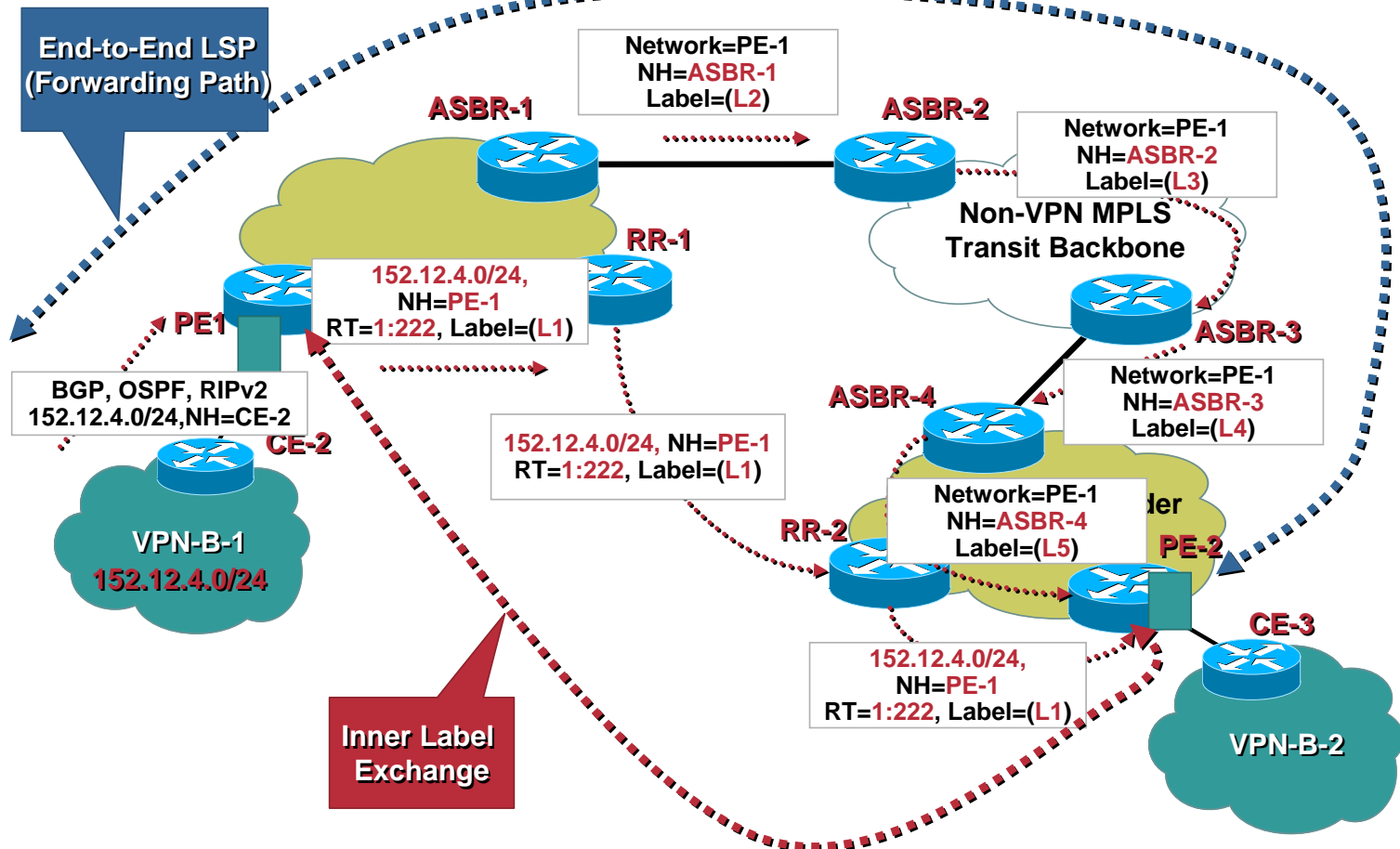
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*(using IPv4 + BGP Label Distribution)*



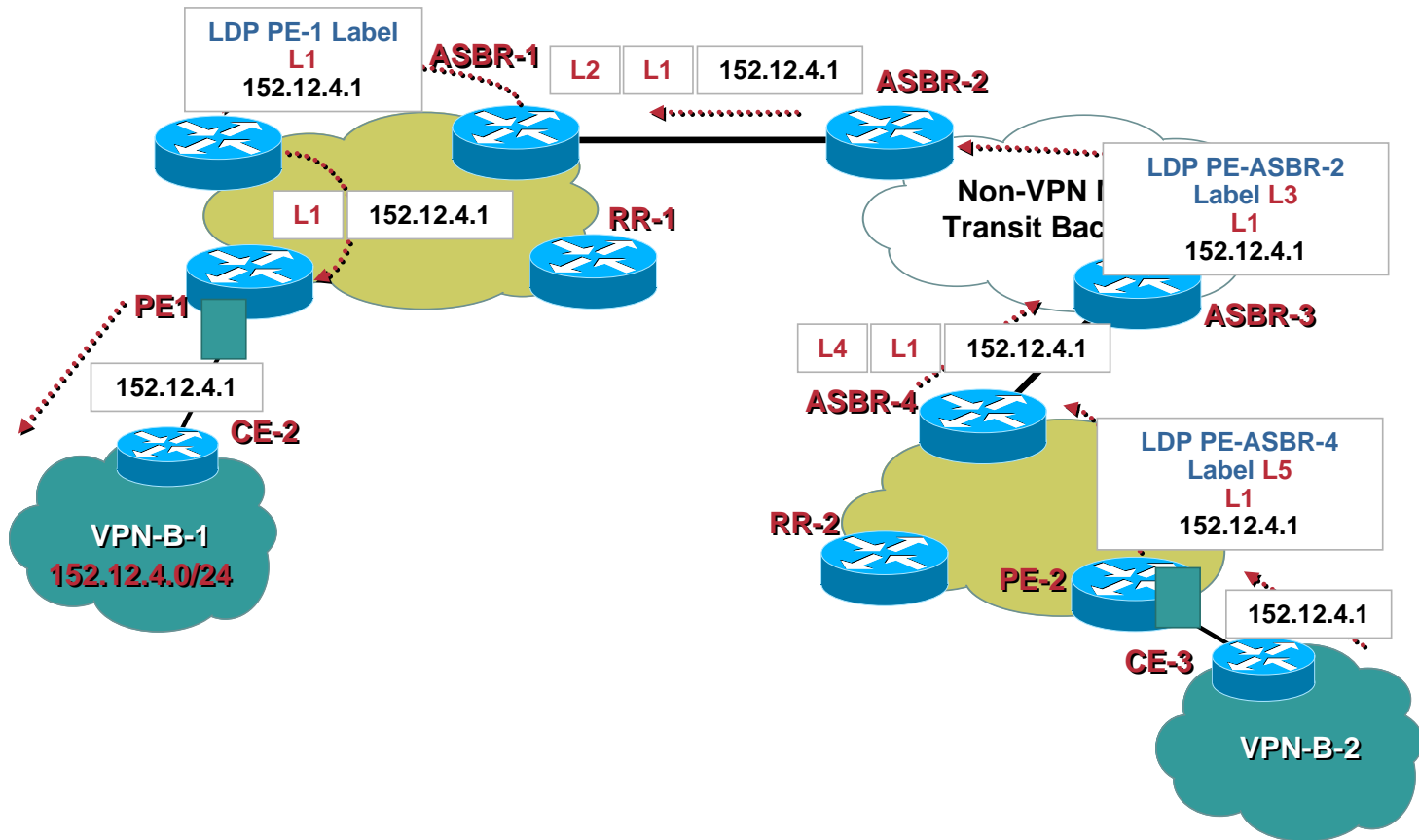
# Non-VPN Transit Provider

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# Non-VPN Transit Provider

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# Agenda

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- **Inter-AS VPN**
- **Carrier Support Carrier**

# Carrier's Carrier

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- **A MPLS-VPN backbone may deliver VPN services to ISPs**
- **Customer sites are in fact ISP PoPs**
- **High volume of routing information on each PoP**

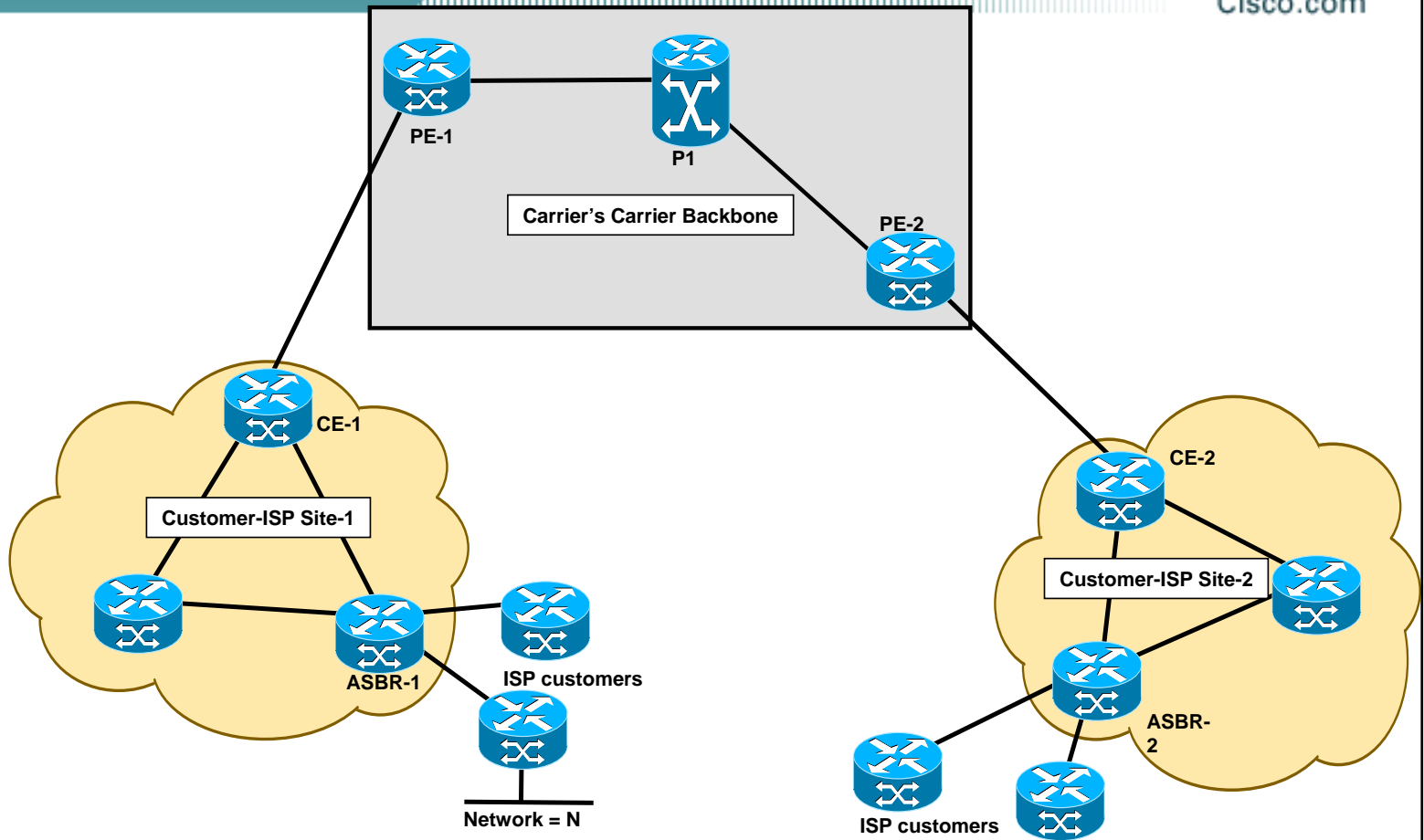
**Possible full Internet table**

- **Scalability issue if these routes have to be translated in VPN-IPv4 routes and injected into the Carrier's backbone**



# Carrier's Carrier

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# Carrier's Carrier

- **Differentiation between routes**

## **Internal routes**

**Routes belonging to the customer-ISP sites IGP**

**Includes all site routes**

**Internal routes will have to be distributed to all sites through the MPLS-VPN (Carrier) backbone**

## **External routes**

**Routes learned by the customer-ISP, as external routes**

**Typically BGP external routes learned from peering point by the customer-ISP**

**External routes need to be advertised to all ISP sites but NOT through the MPLS-VPN (carrier) backbone**

# Carrier's Carrier

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- **Customer-ISP may NOT run MPLS and being a VPN customer of the Carrier**
- **Customer-ISP may use MPLS on each site and request end to end label swapping**
- **Customer-ISP may use MPLS-VPN on each site and provide VPN services to final customers**
  - Hierarchical VPNs**
- **In all cases Carrier backbone need not to know ISP external routes**

# Carrier's Carrier

- **In all cases MPLS is used between PE and CE routers**
- **One label distribution protocol is needed between PE and CE routers**

**IGP (RIPv2, OSPF, ...) between PE and CE in conjunction with TDP/LDP**

**Static routing with LDP/TDP (or static labels)**

# Carrier's Carrier

- **PE needs a security mechanism to accept (or not) labels used by the CE**

**The PE must control that labels used by the CE are associated to IP routes present in the PE/CE VRF**

- **Label security in order to prevent label “spoofing”**

**PE will keep the knowledge of which label bindings have been advertised to which interface**

- **iBGP sessions between sites**

**Route reflectors to improve scalability**

# Carrier's Carrier

## Labels and BGP-4 routes

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- **Each customer-ISP site advertises internal routes only**

ISP-CE routers announces site routes

Site routes are in fact AS exit points

Equivalent to BGP next-hop addresses

- **PE routers propagate sites routes to other PEs**

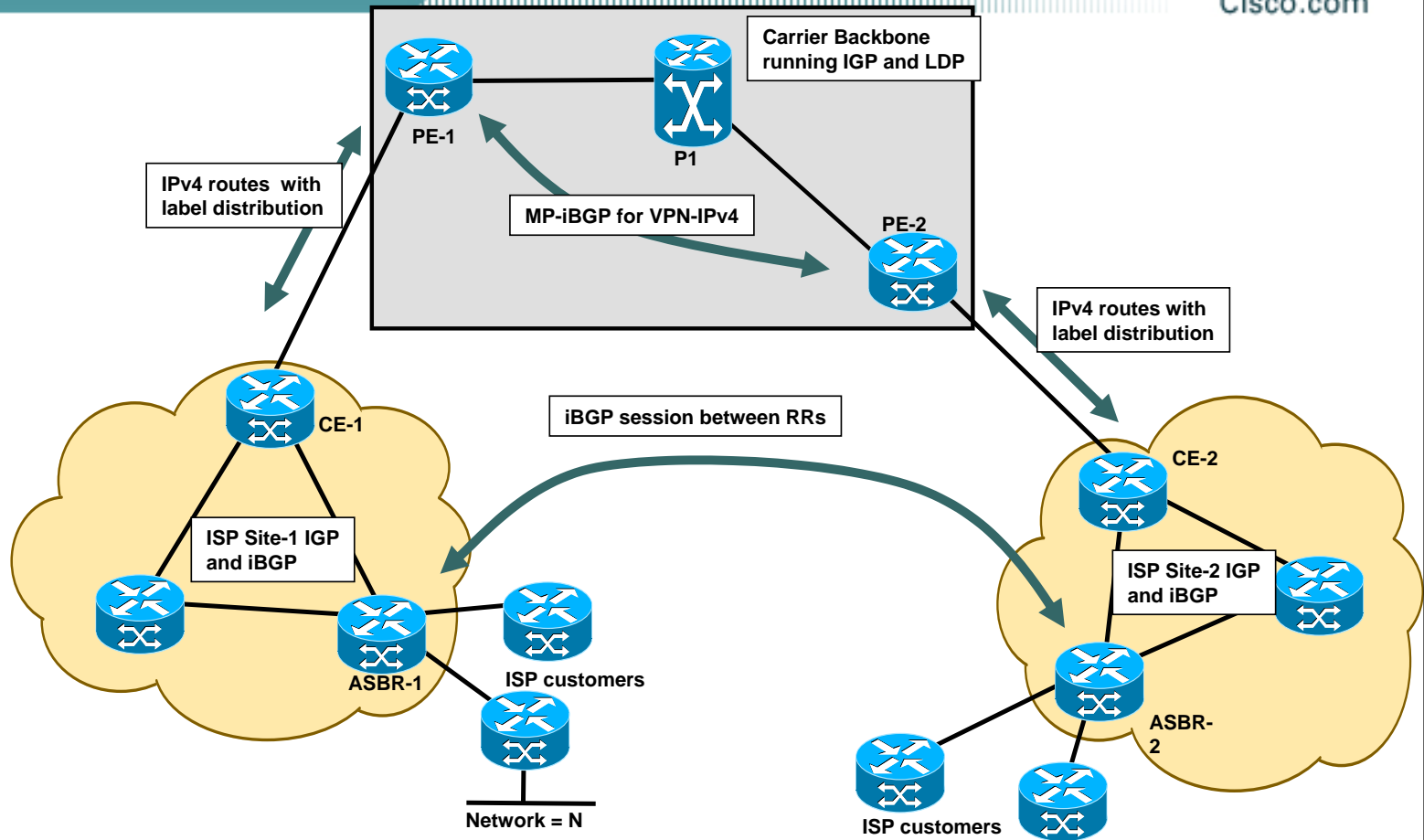
VPN-IPv4 addresses through MP-iBGP

- **PE routers advertise to CEs routes learned from internal PE neighbors**

IPv4 addresses and **labels**

# Carrier's Carrier Customer-ISP not running MPLS

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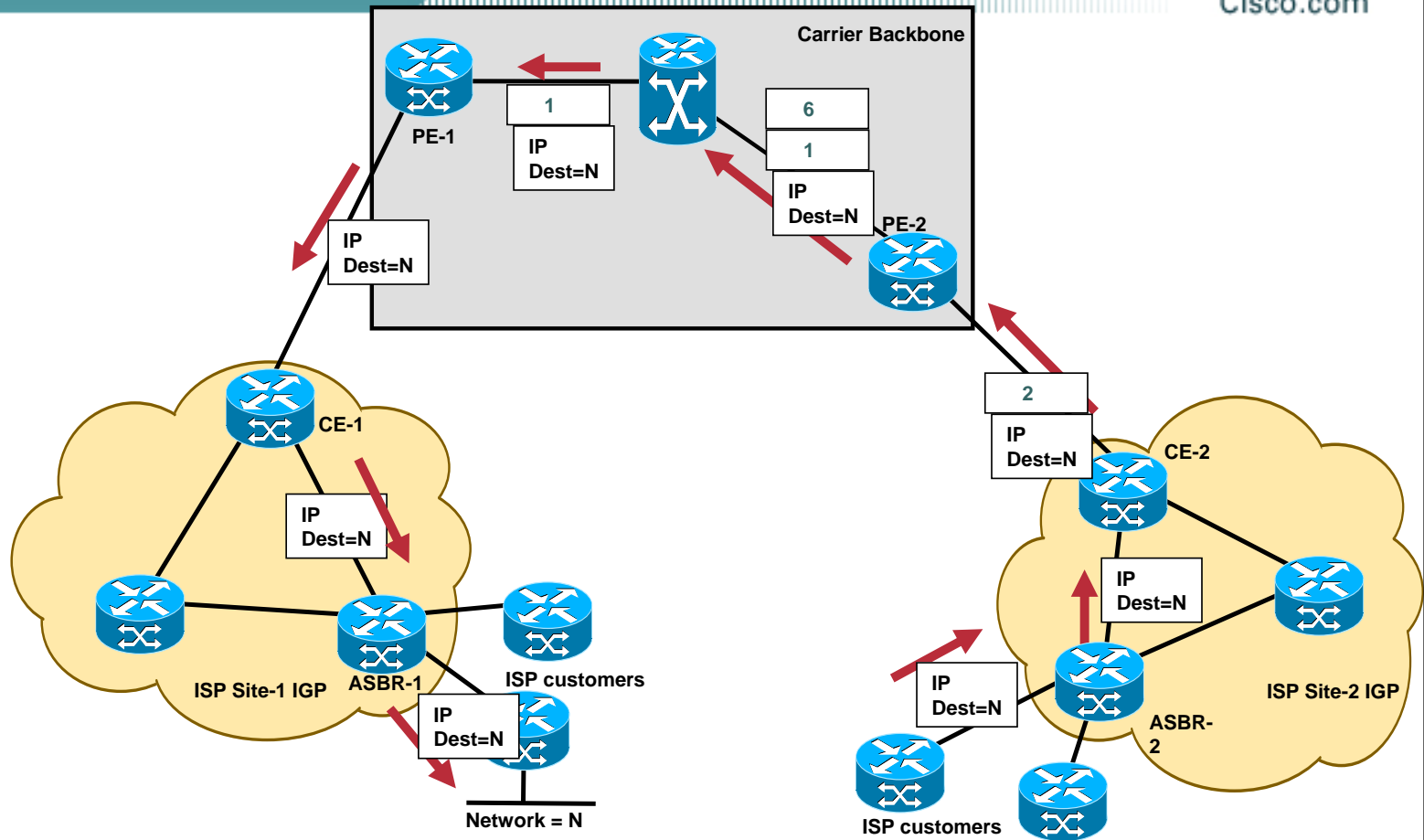
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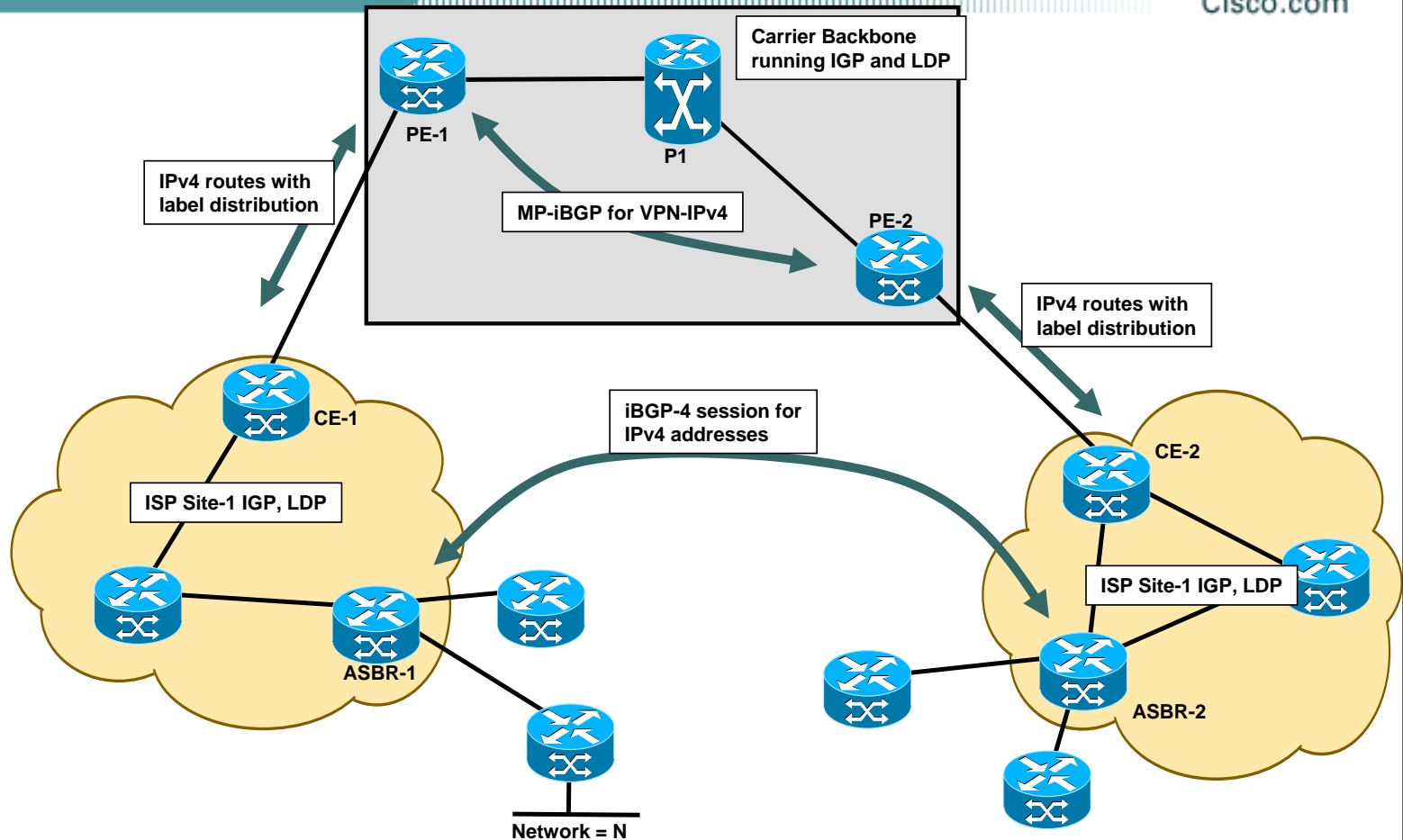
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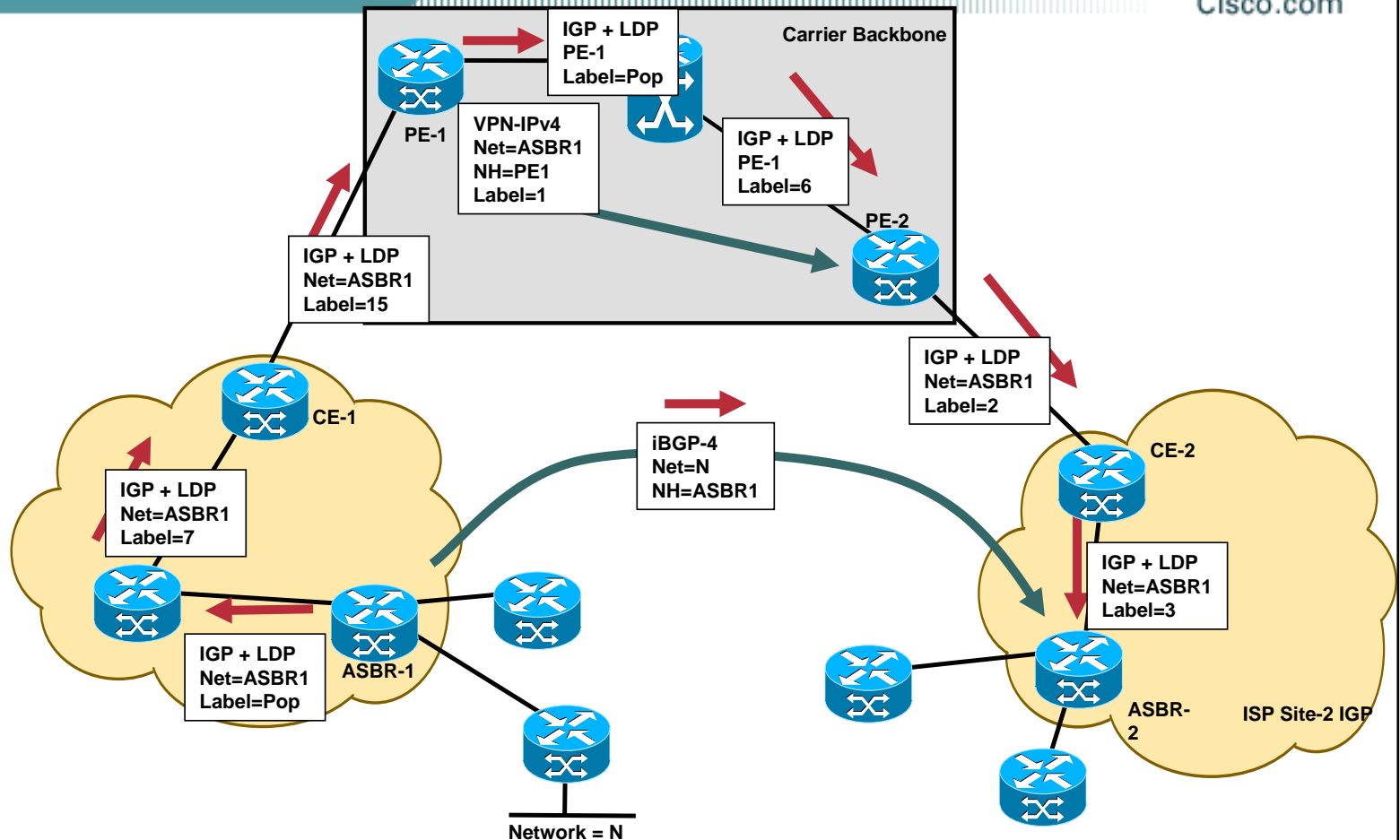
# Carrier's Carrier Customer-ISP running MPLS

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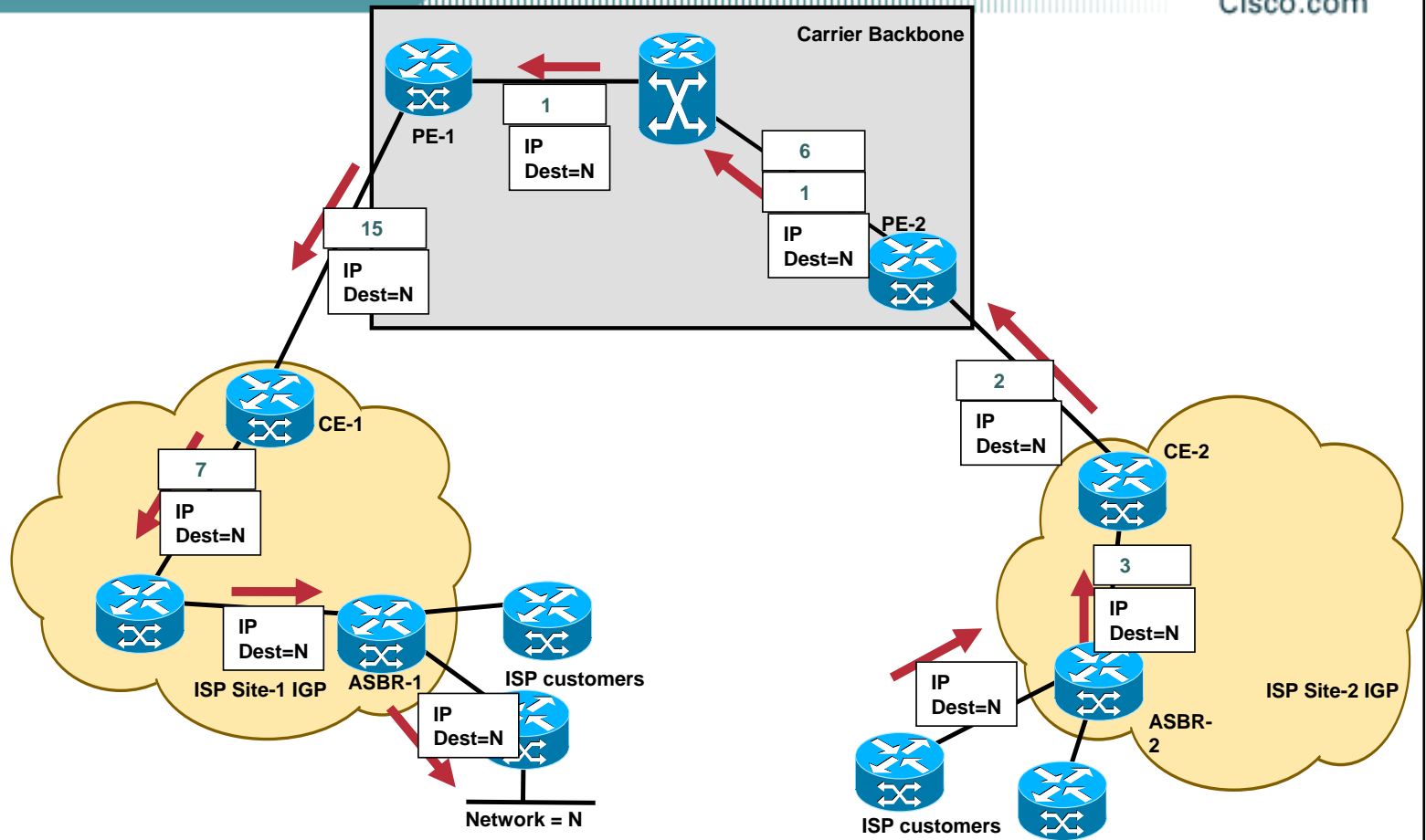
# Carrier's Carrier Customer-ISP running MPLS

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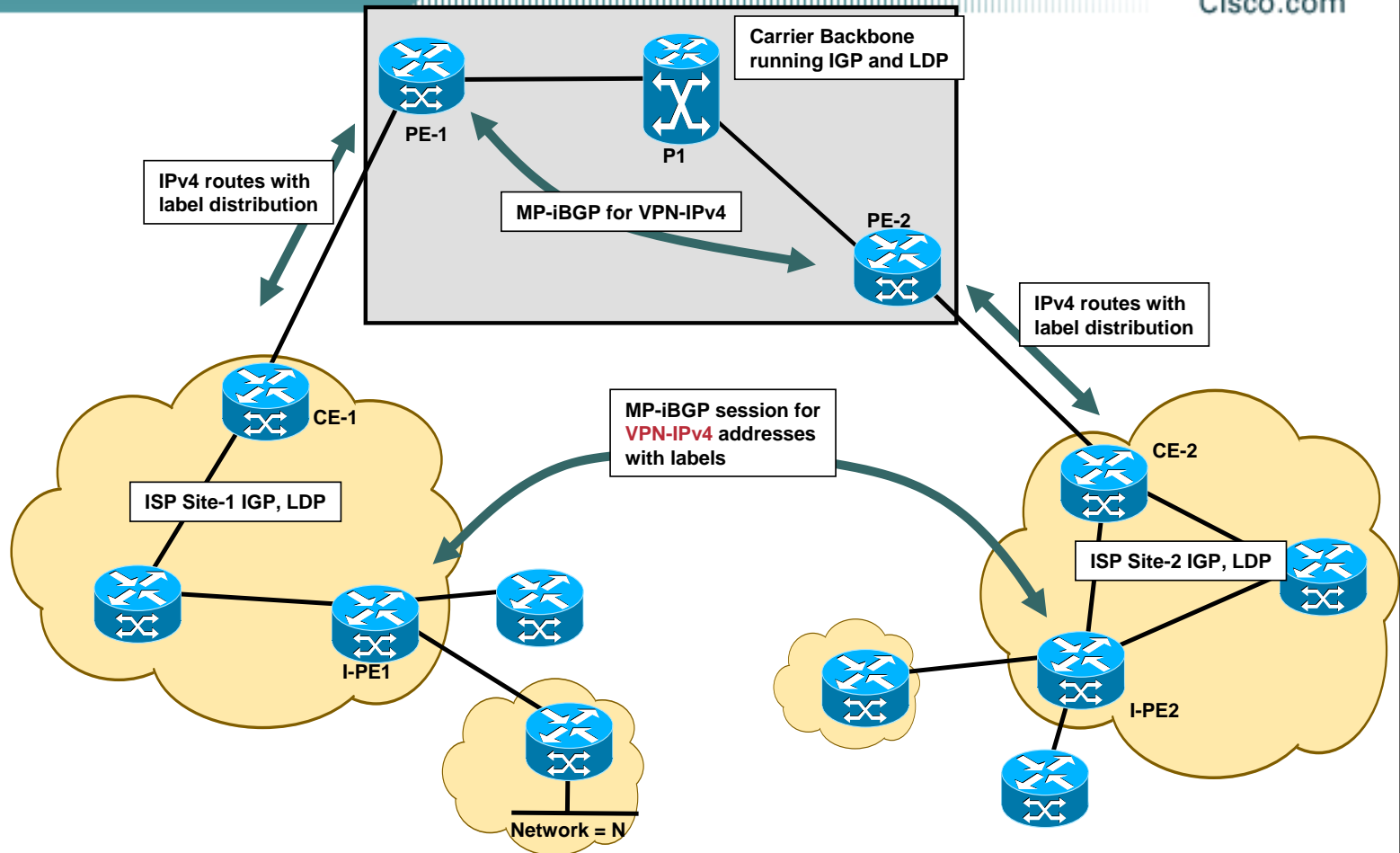
# Carrier's Carrier Customer-ISP running MPLS

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# Carrier's Carrier Customer-ISP running MPLS-VPN

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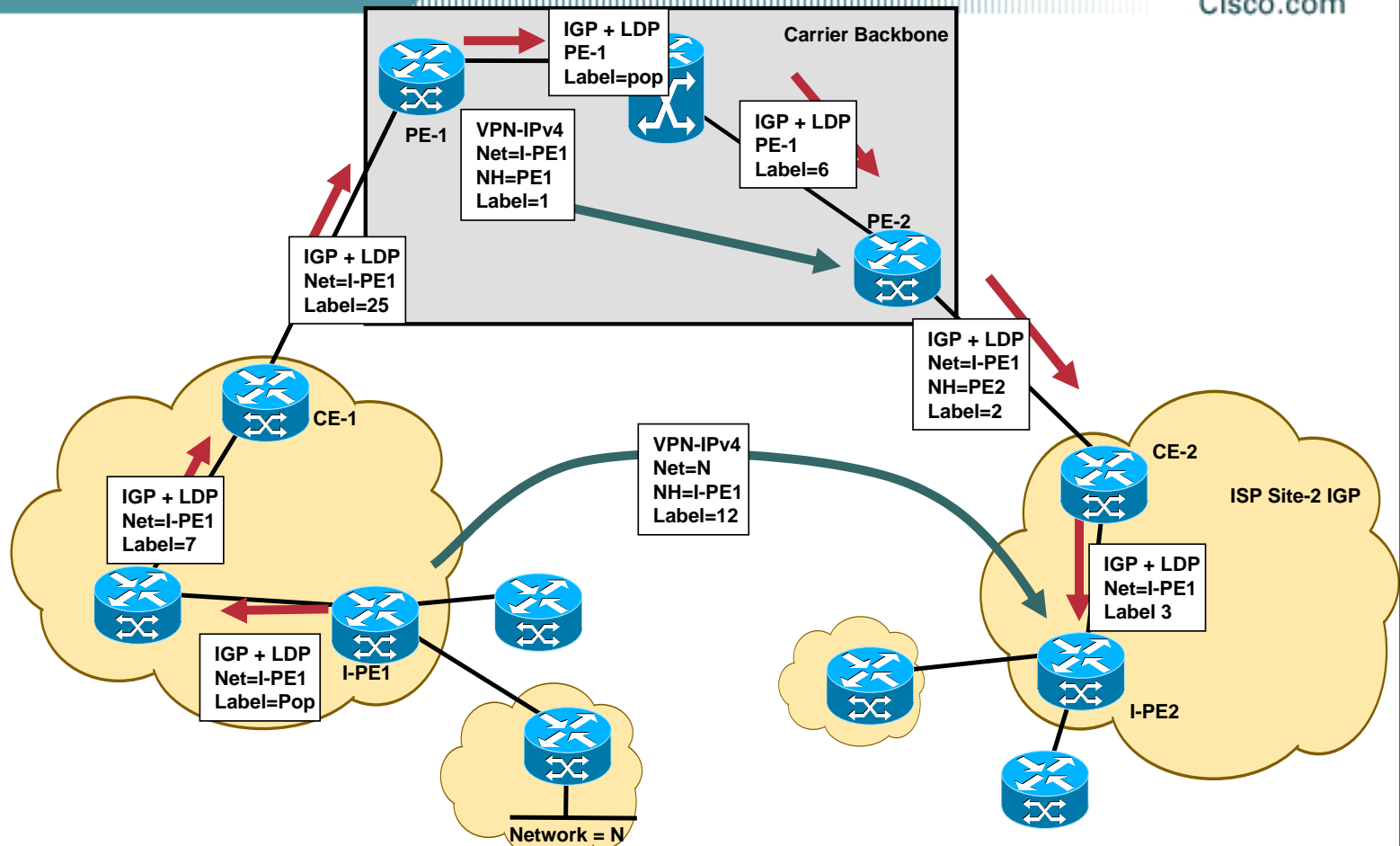
# **Carrier's Carrier Customer-ISP running MPLS-VPN**

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- **Hierarchical VPNs**
- **A VPN customer can run MPLS-VPN in order to offer VPN services to other customers**
- **MPLS-VPN backbone with MPLS-VPN backbones as clients**
- **ISP VPN backbone emulated over Carrier backbone**

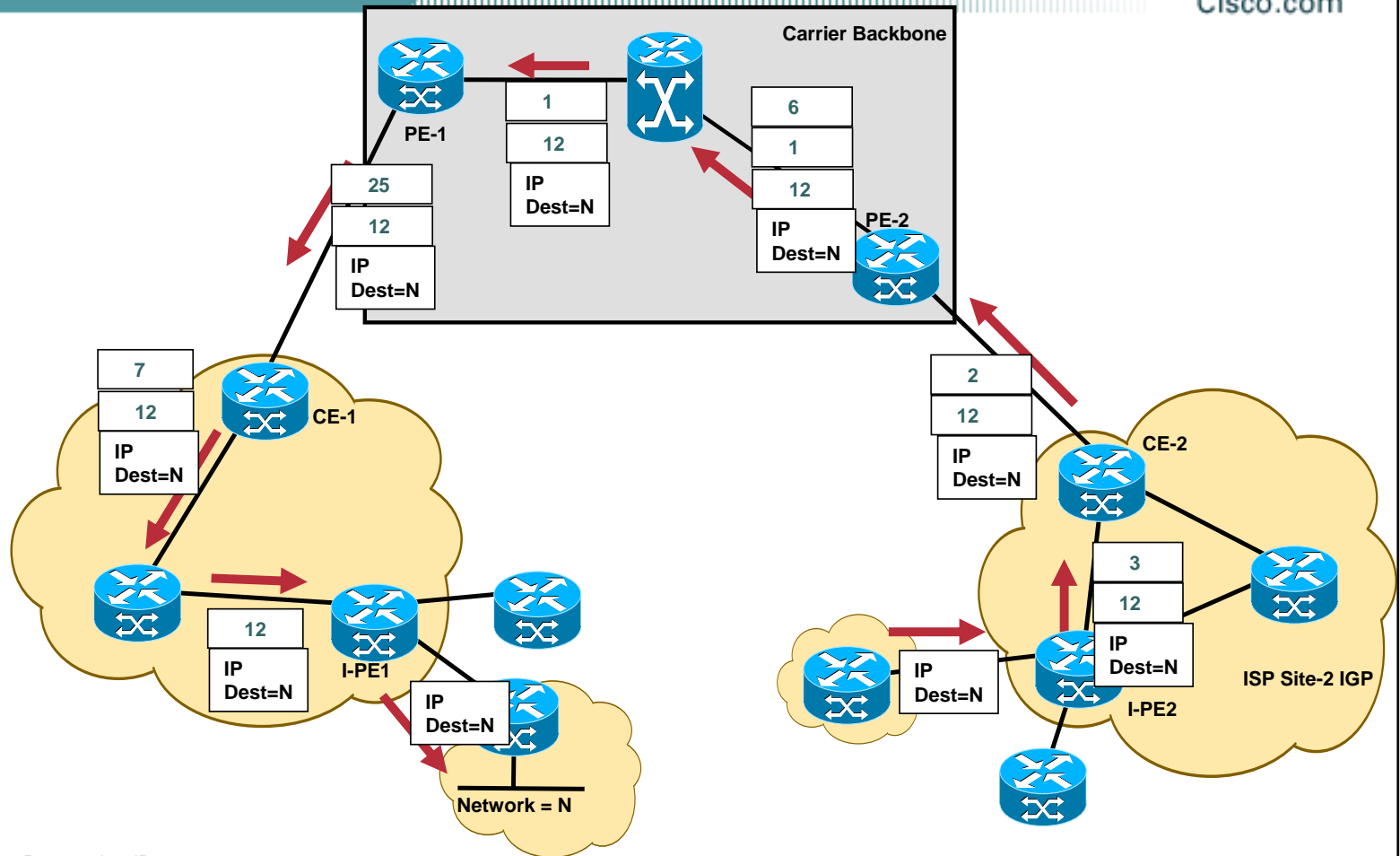
# Carrier's Carrier Customer-ISP running MPLS-VPN

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# Carrier's Carrier Customer-ISP running MPLS-VPN

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