MPLS labs for CCS

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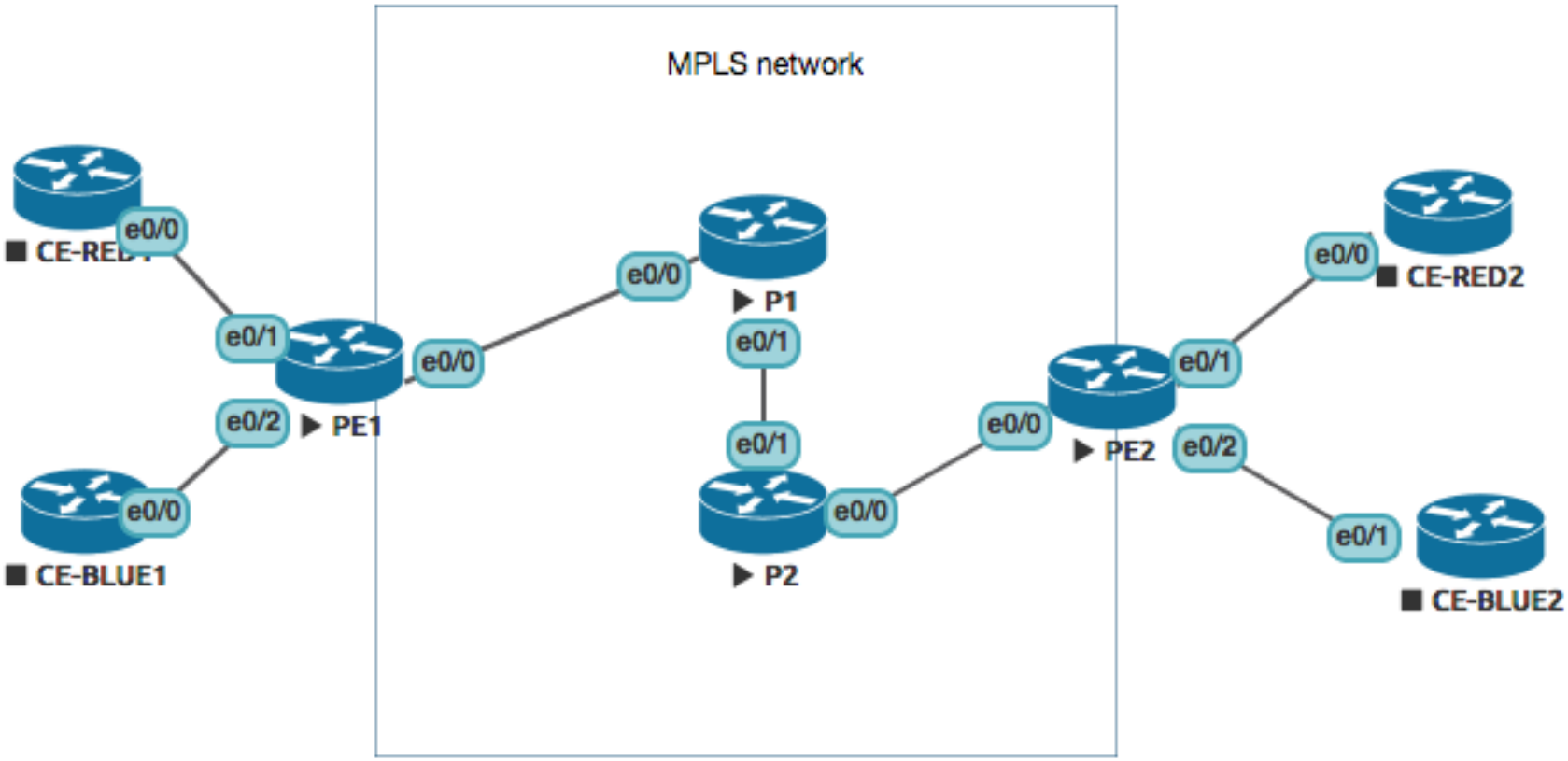
Topology


MPLS network
e0/0
e0/1
e0/2
PE1
P1
P2
PE2
CE-BLUE1
CE-RED2
CE-BLUE2

Address plan

- Customers: RED (AS 65100), BLUE (AS 65200) – overlapping prefixes on purpose

Router	interface	IP addresses
CE-RED1	Loopback1	192.168.1.1/24, 2001:db8:face:A::1/64
CE-RED2	Loopback1	192.168.2.1/24, 2001:db8:face:B::1/64
CE-BLUE1	Loopback1	192.168.1.1/24, 2001:db8:cafe:A::1/64
CE-BLUE2	Loopback1	192.168.2.1/24, 2001:db8:cafe:B::1/64
PE1	Loopback1	1.1.1.1/32
PE2	Loopback1	1.1.1.2/32

- Infrastructure: 10.10.10.0/24 – PE1–P1 .0/30, P1–P2 .4/30, P2–PE2 .8/30; P1/P2 Loopback1 1.1.1.3/32, 1.1.1.4/32; EIGRP named mode, AS 65300

Link	IP addresses
PE1 – RED1	10.10.1.0/30, 2001:db8:ffff:a::/64
PE1 – BLUE1	10.10.1.4/30, 2001:db8:ffff:b::/64
PE2 – RED2	10.10.2.0/30, 2001:db8:ffff:c::/64
PE2 – BLUE2	10.10.2.4/30, 2001:db8:ffff:d::/64

Tasks

- Enable MPLS on the provider backbone.
- Create VRFs and assign routed interfaces to them.
- Configure MP-BGP between the PE routers.
- Configure BGP or IGP between each PE router and its attached CE routers.
- Enable route redistribution between the customer sites and the backbone.
- Verify: CE-RED1 reaches CE-RED2 Loopback1 (IPv4 and IPv6); RED cannot reach BLUE.

Enable MPLS

- mpls ip

```
P1(config)# mpls ldp router-id Loopback1 force
P1(config)# interface ether 0/1
P1(config-if)# mpls ip
P1(config-if)# do show mpls interfaces
Interface     IP            Tunnel   BGP Static Operational
Ethernet0/1   Yes (ldp)     No       No  No     Yes
```

- Show commands
  - show mpls ldp neighbor
  - show mpls ldp bindings
  - show mpls ldp discovery
  - show mpls interfaces
  - show mpls forwarding-table

VRF

- Create VRF for each customer
  - Use vrf definition to support both address families
  - Configure route distinguisher and route target from the provider ASN (RED 65300:1, BLUE 65300:2)

```
vrf definition RED
  rd 65300:1
  address-family ipv4 ! repeat for ipv6, incl. route-target
  route-target both 65300:1
  exit-address-family
```

  - Assign interfaces to VRF

```
interface e0/1
  vrf forwarding RED  ! clears IP addresses
  ip address …
```

Configure MP-BGP between PE routers

- BGP AS 65300
- Use PE1/PE2 loopback addresses
- VPNv4, VPNv6 address family
  - Route targets are sent as extended communities (IOS adds send-community extended automatically)

```
PE1(config)# router bgp 65300
PE1(config-router)# neighbor x.x.x.x remote-as 65300
PE1(config-router)# neighbor x.x.x.x update-source Loopback1
PE1(config-router)# address-family vpnv4
PE1(config-router-af)# neighbor x.x.x.x activate
PE1(config-router-af)# address-family vpnv6
PE1(config-router-af)# neighbor x.x.x.x activate
```

Configure redistribution between PE/CE

- If BGP is used between CE/PE
  - as-override – both sites use the same AS (alternative: allowas-in on the CE)
  - E.g. configuration on PE2

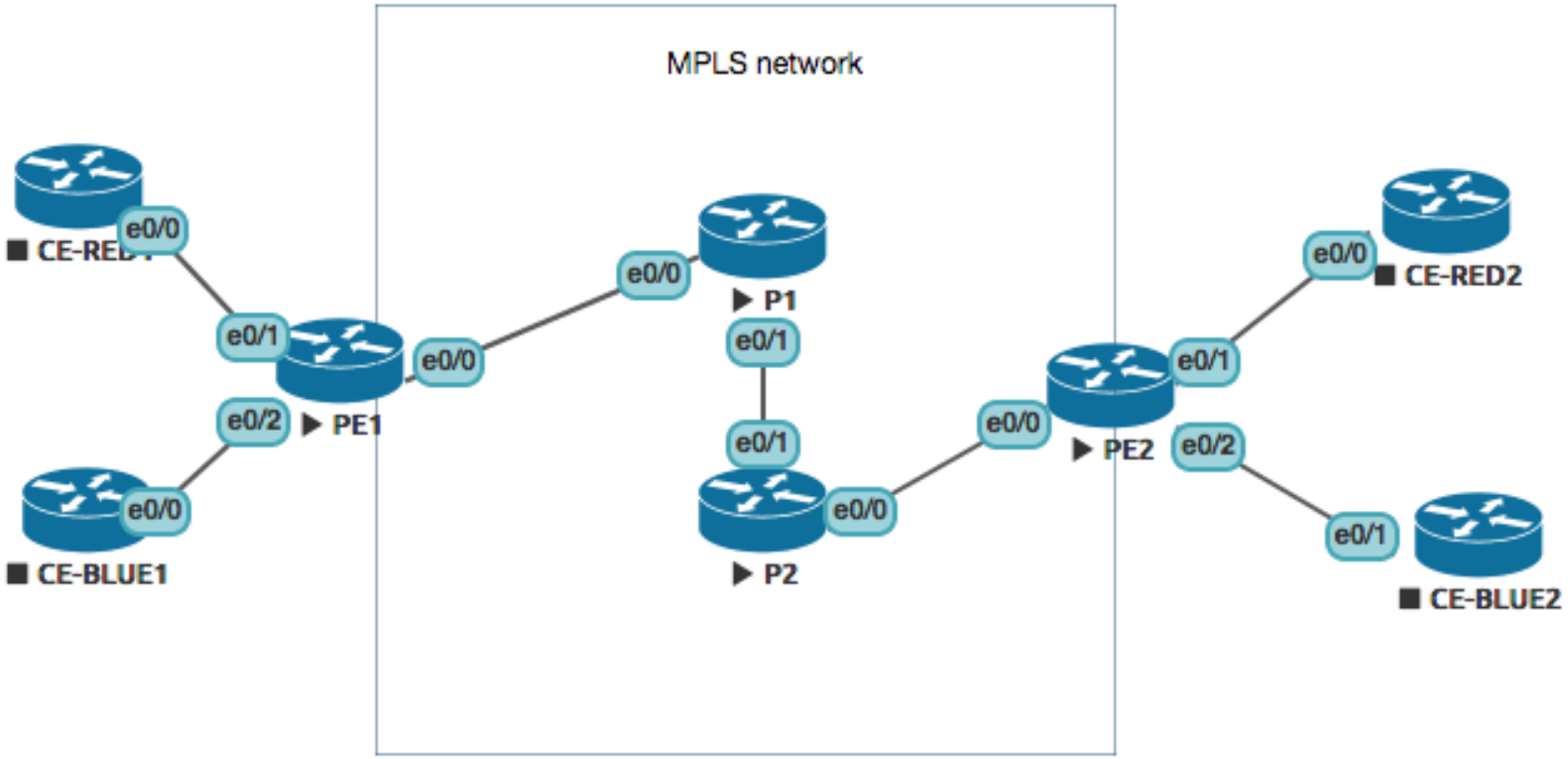
```
address-family ipv4 vrf RED
 neighbor 10.10.2.2 remote-as 65100
 neighbor 10.10.2.2 activate
 neighbor 10.10.2.2 as-override
exit-address-family
```

- If IGP is used between CE/PE
  - Redistribute in both directions: IGP → BGP under address-family ipv4/ipv6 vrf XXX, BGP → IGP in the VRF IGP process

Verification

- Transport
  - show mpls ldp neighbor
  - show mpls forwarding-table
  - ping mpls ipv4 1.1.1.2/32
- L3VPN control plane
  - show bgp vpnv4 unicast all
  - show bgp vpnv4 unicast all labels
  - show bgp vpnv6 unicast all
- L3VPN forwarding
  - show ip route vrf RED
  - show ip cef vrf RED 192.168.2.0 detail
  - ping vrf RED 192.168.2.1 / traceroute vrf RED 192.168.2.1

MPLS L2VPN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e0/1
P2
e0/0
e0/0
PE2
e0/1
e0/2
e0/0
CE-RED2
e0/1
CE-BLUE2
e0/0
CE-BLUE1

Address plan

- Customers: RED (AS 65100) and BLUE (AS 65200)

Router	interface	IP addresses
CE-RED1	Eth0/0	`192.168.1.1/24, 2001:db8:face:A::1/64`
CE-RED2	Eth0/0	`192.168.1.2/24, 2001:db8:face:A::2/64`
CE-BLUE1	Eth0/0	`192.168.1.1/24, 2001:db8:cafe:A::1/64`
CE-BLUE2	Eth0/1	`192.168.1.2/24, 2001:db8:cafe:A::2/64`
PE1	Loopback1	`1.1.1.1/32`
PE2	Loopback1	`1.1.1.2/32`

- Infrastructure: 10.10.10.0/24 inside MPLS cloud, EIGRP – named mode

PE–CE links carry no IP addresses: each CE pair is L2-adjacent over its pseudowire and shares 192.168.1.0/24.

MPLS L2VPN

- Create pseudowire class

```
PE1(config)# pseudowire-class inter-ether
PE1(config-pw-class)# encapsulation mpls
```

- Create an LDP-signalled pseudowire (targeted LDP)

```
PE1(config)# interface e0/1   ! no IP config on the CE-facing port
PE1(config-if)# xconnect 1.1.1.2 100 encapsulation mpls pw-class inter-ether
```

- VC ID 100 must match on PE2; BLUE: interface e0/2, VC ID 200
- Verify: show mpls l2transport vc detail



Labs created by Matěj Grégr for CCS practice.

Last update: 24-11-2026