

# MPLS VPN

version 1.0

## Terminology

- PE-router:** a provider router connected to customer networks
- P-router:** a provider router with no customer links
- CE-router:** a customer router connected to the Service Provider network
- VRF:** Virtual routing and forwarding table
- MP-BGP:** Multi-protocol BGP
- VPNv4:** 96-bit address composed of 64-bit RD and 32-bit IP address
- RD (Route Distinguisher):** 64-bit value that makes customer IP addresses globally unique. Usually written in the AS:NN notation.
- RT (Route Target):** 64-bit BGP community that controls route import/export between VPNv4 BGP table and customer VRF

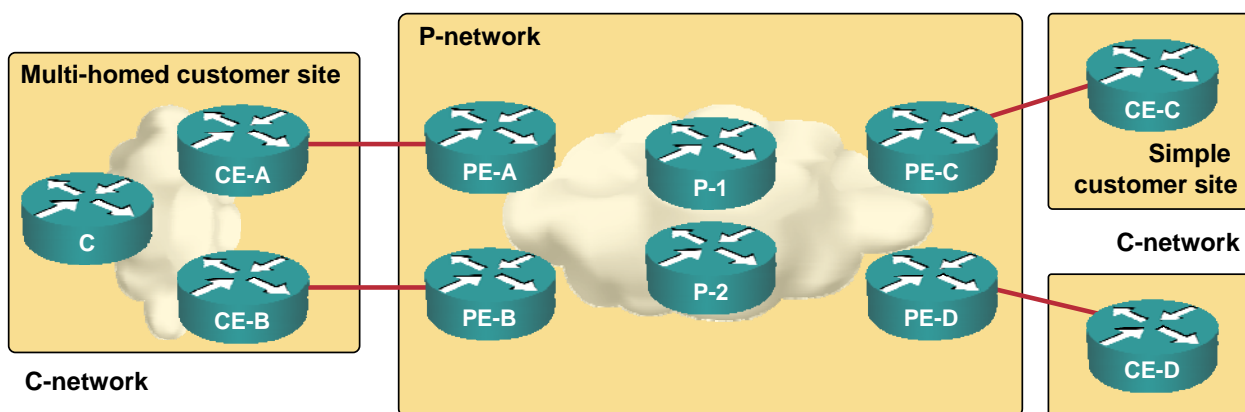
## Route Distinguisher formats

0x0000	AS num	local	AS number + 4-byte local identifier (AS:NN)
0x0001	IP address	local	IP address + 2-byte local identifier (A.B.C.D:NN)
0x0002	AS num (4 byte)	local	4-byte AS number + 2-byte local identifier (AS:NN)

## Route Target formats

0x00	0x03	AS num	local	AS number + 4-byte local identifier (AS:NN)
0x01	0x03	IP address	local	IP address + 2-byte local identifier (A.B.C.D:NN)

## Reference diagram



## Simple Core Design Rules

- Configure IBGP sessions between PE-routers. Use BGP route reflectors for scalability.
- Run IBGP sessions between loopback interfaces.
- Advertise PE loopback interface with correct mask
- Do not summarize loopback addresses
- Establish end-to-end MPLS paths between PE-routers. Use LDP in simple networks.

## Simple VPN Design Rules

- Create one VRF for each customer connected to a PE-router.
- Use the same VRF name on all PE-routers (not required)
- Use unique RD and RT values for each customer. Make RD equal to RT. Use the same RD and RT on all PE routers.

## Simple PE-CE Design Rules

- Use numbered PE-CE interfaces (private IP addresses are OK)
- Use BGP as PE-CE routing protocol if possible
- When using BGP, use a unique AS number for each customer site
- Do not mix different non-BGP PE-CE routing protocols in the same VPN. Mixing BGP with other PE-CE routing protocols is acceptable
- Redistribute PE-CE routing protocol into MP-BGP.
- Redistribute connected interfaces and static routes into MP-BGP
- If possible, do not redistribute MP-BGP into PE-CE routing protocols. Default route advertisement is simpler.

## MPLS VPN resources

- MPLS VPN training <http://www.nil.com/ls/mpls>
- MPLS VPN remote labs <http://www.nil.com/go/remote+labs>
- MPLS VPN articles [http://wiki.nil.com/Category:MPLS\\_VPN](http://wiki.nil.com/Category:MPLS_VPN)
- MPLS VPN tips & tricks <http://blog.ioshints.info/search/label/MPLS%20VPN>

## MPLS VPN books

- MPLS and VPN Architectures
- MPLS and VPN Architectures, Volume II
- Definitive MPLS Network Designs
- MPLS Fundamentals

## PE-router configuration

```
ip cef
!
ip bgp-community new-format
!
mpls ip
!
interface loopback 0
 ip address loopback-IP-address 255.255.255.255
!
interface POS1/0
 description core link
 mpls ip
!
router bgp AS-number
 neighbor remote-PE-loopback remote-as AS-number
 neighbor remote-PE-loopback update-source loopback 0
!
address-family vpnv4
 neighbor remote-PE-loopback activate
 neighbor remote-PE-loopback send-community both
```

## P-router configuration

```
ip cef
!
mpls ip
!
interface POS1/0
 description core link
 mpls ip
```

## Route reflector configuration

```
router bgp AS-number
 neighbor remote-PE-loopback remote-as AS-number
 neighbor remote-PE-loopback update-source loopback 0
 neighbor remote-PE-loopback route-reflector-client
!
address-family vpnv4
 neighbor remote-PE-loopback activate
 neighbor remote-PE-loopback send-community both
 neighbor remote-PE-loopback route-reflector-client
```

## VRF configuration for a simple VPN

```
ip vrf vrf-name
 rd AS:NN
 route-target both AS:NN
!
interface serial1/0
 ip vrf forwarding vrf-name
 ip address address mask
!
router bgp AS
 address-family ipv4 vrf vrf-name
 redistribute connected
```

## Static routes

```
ip route vrf vrf-name addr mask [interface] [next-hop]
!
router bgp AS
!
address-family ipv4 vrf vrf-name
 redistribute static
 neighbor customer-IP remote-as customer-AS
```

## Running BGP with the customer

```
router bgp AS
 address-family ipv4 vrf vrf-name
```

## Running OSPF with the customer

```
router ospf process vrf vrf-name
 network address mask area ospf-area
 redistribute bgp AS subnets
!
router bgp AS
!
address-family ipv4 vrf vrf-name
 redistribute ospf process match internal external
```

## Running EIGRP with the customer

```
router eigrp provider-EIGRP-AS
!
address-family ipv4 vrf vrf-name
 autonomous-system customer-EIGRP-AS
 network customer-IP-network
 no auto-summary
 redistribute bgp AS metric bw delay rel load mtu
!
router bgp AS
 address-family ipv4 vrf vrf-name
 redistribute eigrp customer-EIGRP-AS
```

## Running RIP with the customer

```
router rip
 version 2
 no auto-summary
!
address-family ipv4 vrf vrf-name
 network customer-IP-network
 redistribute bgp AS metric transparent
!
router bgp AS
!
address-family ipv4 vrf vrf-name
 redistribute rip
```

## MPLS VPN troubleshooting

```
ping vrf name ip address [size len] [repeat count]
trace vrf name ip address [ttl min max]
telnet address /vrf name [/source interface]
trace mpls ipv4 remote-PE-address/32

show ip vrf [detail|interfaces]
show ip protocol vrf name
show ip route vrf name
show ip cef vrf name

show ip bgp vpnv4 all summary
show ip bgp vpnv4 vrf name
show ip bgp vpnv4 vrf name prefix

show ip bgp vpnv4 rd rd-value
show ip bgp vpnv4 rd rd-value prefix
```