

## Module 11b – MPLS VPLS Configuration Lab (LDP Manual)

**Objective:** All the routers are pre-configured with basic interface, OSPF, BGP, MPLS Label Distribution Protocol (LDP) configuration according the following topology diagram. Required LSPs are already built among the loopback interfaces of all the infrastructure routers. Need to configure MPLS VPLS from one side CPE routers to the other side CPE routers. This LAB module is using LDP as VPLS signal protocol and PE neighbours are configured manually. After finishing the MPLS VPLS configuration you can ping from one CE router to all the other 3 CE routers in the same VPLS domain. **Please notice CPE side LAN IP address and it has been changed from the previous lab exercises.**

**Prerequisites:** Knowledge of IGP, EGP, MPLS, LDP and MPLS VPWS are required.

The following will be the common topology and IP address plan used for the labs.

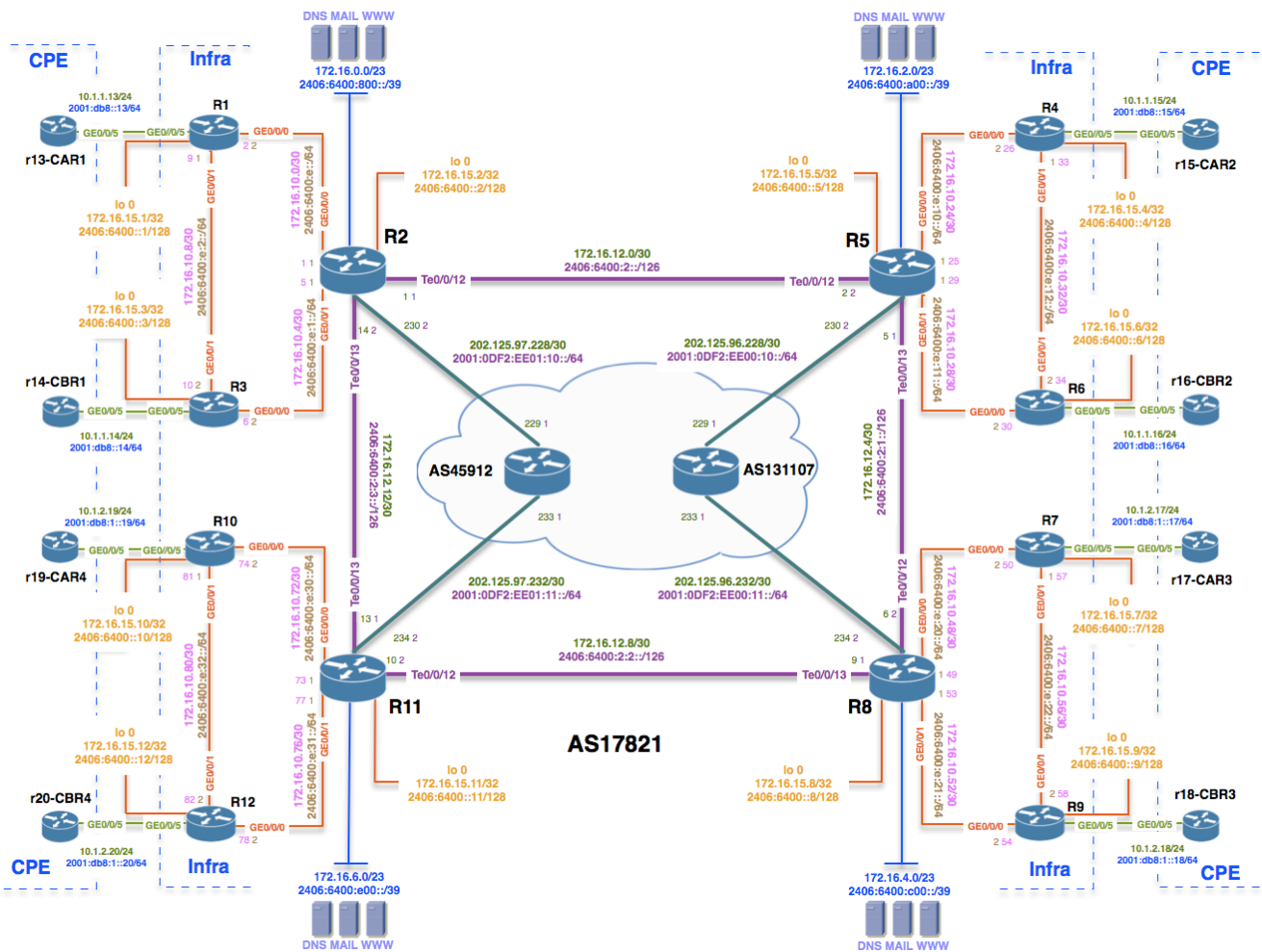


Figure 1 – ISP Lab Basic Configuration

### Lab Notes

Out of all 20 routers on the above lab topology R1, R3, R4, R6, R7, R9, R10, R12 are PE (LER) routers. R2, R5, R8, R11 are P (LSR) routers and R13-20 are CE routers.

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Please spend some time to be familiar with the network topology and addressing plan before you start building the configuration on the routers.

In this module, R13, R14, R15, R16 belong to one VPLS domain, PE routers R1, R3, R4 and R6 will be full meshed with each other manually; R17, R18, R19, R20 belong to another VPLS domain, PE routers R7, R9, R10 and R12 will be full meshed with each other manually.

## **Lab Exercise**

### **1. Configure a VFI on PE routers:**

Here is an example of VFI configuration for R1

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
```

Enable the Layer 2 VFI manual configuration mode. The name of the VFI is VPLS-CUST1-ETHERNET. Neighbors will be set up manually.

The virtual forwarding interface (VFI) specifies the VPN ID of a VPLS domain, the addresses of other PE devices in the domain, and the type of tunnel signaling and encapsulation mechanism for each peer.

```
vpn id 1
```

Configure a VPN ID for a VPLS domain. The emulated VCs bound to this Layer 2 VRF use this VPN ID for signaling. This number is the VC ID when you verify the results, this number for the PEs in the same VPN should be identical.

```
bridge-domain 1
```

Specify a bridge domain, ID is 1.

```
neighbor 172.16.15.3 encapsulation mpls
```

Specify the remote peering router ID manually and the tunnel encapsulation type or the pseudo-wire property to be used to set up the emulated VC.

```
neighbor 172.16.15.4 encapsulation mpls
neighbor 172.16.15.6 encapsulation mpls
exit
```

### **2. Configure the Access Port on PE routers:**

Here is an example of configuring an access port on R1 for untagged traffic from a CE Device.

```
interface GigabitEthernet0/0/5
no ip address
```

Delete configured IP address

```
negotiation auto
no cdp enable
service instance 10 ethernet
```



Configure Ethernet service instance, specifies the service instance ID and enters service instance configuration mode.

```
encapsulation untagged
```

Defines the matching criteria to map untagged ingress Ethernet frames on an interface to the appropriate service instance.

```
bridge-domain 1
```

Binds the service instance 10 to a bridge domain 1.

### 3. Interface IP Configuration on CE Routers:

Here is an example of interface IP address configuration for router R13:

```
config t
interface GigabitEthernet0/0/5
description Upstream WAN r13-CAR1-R1
no ip redirects
no ip directed-broadcast
no ip unreachable
no ip address
no ipv6 address
ip address 10.1.1.13 255.255.255.0
ipv6 address 2001:db8::13/64
no shutdown
exit
exit
wr
```

### 4. Verification commands for your VPLS configuration:

Show the VFI state on PE routers:

```
show l2vpn vfi name VPLS-CUST1-ETHERNET
```

```
Router1#show l2vpn vfi name VPLS-CUST1-ETHERNET
Legend: RT=Route-target, S=Split-horizon, Y=Yes, N=No

VFI name: VPLS-CUST1-ETHERNET, state: up, type: multipoint, signaling: LDP
VPN ID: 1
Bridge-Domain 1 attachment circuits:
Pseudo-port interface: pseudowire100040
Interface      Peer Address    VC ID    S
pseudowire100043 172.16.15.6    1        Y
pseudowire100042 172.16.15.4    1        Y
pseudowire100041 172.16.15.3    1        Y
```

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Check L2VPN service:

show l2vpn service all detail

```
Router1#show l2vpn service all detail
Legend: St=State      XC St=State in the L2VPN Service      Prio=Priority
        UP=Up        DN=Down          AD=Admin Down      IA=Inactive
        SB=Standby   HS=Hot Standby  RV=Recovering    NH=No Hardware
        m=manually selected

Interface          Group          Encapsulation          Prio  St  XC St
-----          -
VPLS name: VPLS-CUST1-ETHERNET, State: UP
pw100040          VPLS-CUST1-ETHERNET(VFI)          0    UP  UP
pw100043          core_pw       172.16.15.6:1(MPLS)          0    UP  UP
                  Local VC label 113
                  Remote VC label 605
pw100042          core_pw       172.16.15.4:1(MPLS)          0    UP  UP
                  Local VC label 108
                  Remote VC label 402
pw100041          core_pw       172.16.15.3:1(MPLS)          0    UP  UP
                  Local VC label 110
                  Remote VC label 303

BD name: 1, State: --
-                  1(BD)          0    UP  --
-                  VPLS-CUST1-ETHERNET(VFI)          0    UP  UP
```

Display detailed information related to the virtual connection:

show mpls l2transport vc 1

```
Router1#show mpls l2transport vc 1

Local intf      Local circuit      Dest address      VC ID      Status
-----
VFI VPLS-CUST1-ETHERNET \
                vfi                172.16.15.3      1          UP
VFI VPLS-CUST1-ETHERNET \
                vfi                172.16.15.4      1          UP
VFI VPLS-CUST1-ETHERNET \
                vfi                172.16.15.6      1          UP
```

Check the MAC address table learned in VPLS domain on PE routers:

show mac-address-table dynamic bdomain 1

```
Router1#show mac-address-table dynamic bdomain 1

Nile Mac Address Entries

BD      mac addr          type      ports
-----
1       0042.6856.3805   DYNAMIC  Gi0/0/5.Efp10
1       0078.88f7.0f85   DYNAMIC  172.16.15.6, 1
1       0078.88f7.1405   DYNAMIC  172.16.15.3, 1
1       0078.88f8.fb85   DYNAMIC  172.16.15.4, 1
```



Check the ARP table on CE routers to compare the MAC addresses:

show arp

```
r13-CAR1#show arp
```

Protocol	Address	Age (min)	Hardware Addr	Type	Interface
Internet	10.1.1.13	-	0042.6856.3805	ARPA	GigabitEthernet0/0/5
Internet	10.1.1.14	30	0078.88f7.1405	ARPA	GigabitEthernet0/0/5
Internet	10.1.1.15	0	0078.88f8.fb85	ARPA	GigabitEthernet0/0/5
Internet	10.1.1.16	11	0078.88f7.0f85	ARPA	GigabitEthernet0/0/5

Check the connectivity between CE routers in the same VPLS domain:

R13, R14, R15, R16 should be able to ping each other.

R17, R18, R19, R20 should be able to ping each other.

## Workshop templates for reference purpose only:

### Virtual Switch between R13 R14 R15 R16

#### R1

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.3 encapsulation mpls
neighbor 172.16.15.4 encapsulation mpls
neighbor 172.16.15.6 encapsulation mpls
exit
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

#### R3

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.1 encapsulation mpls
neighbor 172.16.15.4 encapsulation mpls
neighbor 172.16.15.6 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

#### R4

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.1 encapsulation mpls
```



```
neighbor 172.16.15.3 encapsulation mpls
neighbor 172.16.15.6 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

### R6

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.1 encapsulation mpls
neighbor 172.16.15.3 encapsulation mpls
neighbor 172.16.15.4 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

### R13

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI1
no ip redirects
no ip directed-broadcast
no ip unreachable
no ip address
no ipv6 address
ip address 10.1.1.13 255.255.255.0
ipv6 address 2001:db8::13/64
no shutdown
exit
exit
wr
```

### R14

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```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI1
no ip redirects
no ip directed-broadcast
no ip unreachablees
no ip address
no ipv6 address
ip address 10.1.1.14 255.255.255.0
ipv6 address 2001:db8::14/64
no shutdown
exit
exit
wr
```

### **R15**

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI1
no ip redirects
no ip directed-broadcast
no ip unreachablees
no ip address
no ipv6 address
ip address 10.1.1.15 255.255.255.0
ipv6 address 2001:db8::15/64
no shutdown
exit
exit
wr
```

### **R16**

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI1
no ip redirects
no ip directed-broadcast
no ip unreachablees
no ip address
no ipv6 address
ip address 10.1.1.16 255.255.255.0
ipv6 address 2001:db8::16/64
no shutdown
exit
exit
wr
```



## Virtual Switch between R17 R18 R19 R20

### R7

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.9 encapsulation mpls
neighbor 172.16.15.10 encapsulation mpls
neighbor 172.16.15.12 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

### R9

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.7 encapsulation mpls
neighbor 172.16.15.10 encapsulation mpls
neighbor 172.16.15.12 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

### R10

```
config t
l2 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.7 encapsulation mpls
neighbor 172.16.15.9 encapsulation mpls
neighbor 172.16.15.12 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
```

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```
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

### **R12**

```
config t
12 vfi VPLS-CUST1-ETHERNET manual
vpn id 1
bridge-domain 1
neighbor 172.16.15.7 encapsulation mpls
neighbor 172.16.15.9 encapsulation mpls
neighbor 172.16.15.10 encapsulation mpls
interface GigabitEthernet0/0/5
no ip address
negotiation auto
no cdp enable
service instance 10 ethernet
encapsulation untagged
bridge-domain 1
end
wr
```

### **R17**

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI2
no ip redirects
no ip directed-broadcast
no ip unreachable
no ip address
no ipv6 address
ip address 10.1.2.17 255.255.255.0
ipv6 address 2001:db8:1::17/64
no shutdown
exit
exit
wr
```

### **R18**

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI2
no ip redirects
no ip directed-broadcast
no ip unreachable
```



```
no ip address
no ipv6 address
ip address 10.1.2.18 255.255.255.0
ipv6 address 2001:db8:1::18/64
no shutdown
exit
exit
wr
```

### R19

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI2
no ip redirects
no ip directed-broadcast
no ip unreachable
no ip address
no ipv6 address
ip address 10.1.2.19 255.255.255.0
ipv6 address 2001:db8:1::19/64
no shutdown
exit
exit
wr
```

### R20

```
config t
interface GigabitEthernet0/0/5
description Upstream VPLS-VSI2
no ip redirects
no ip directed-broadcast
no ip unreachable
no ip address
no ipv6 address
ip address 10.1.2.20 255.255.255.0
ipv6 address 2001:db8:1::20/64
no shutdown
exit
exit
wr
```