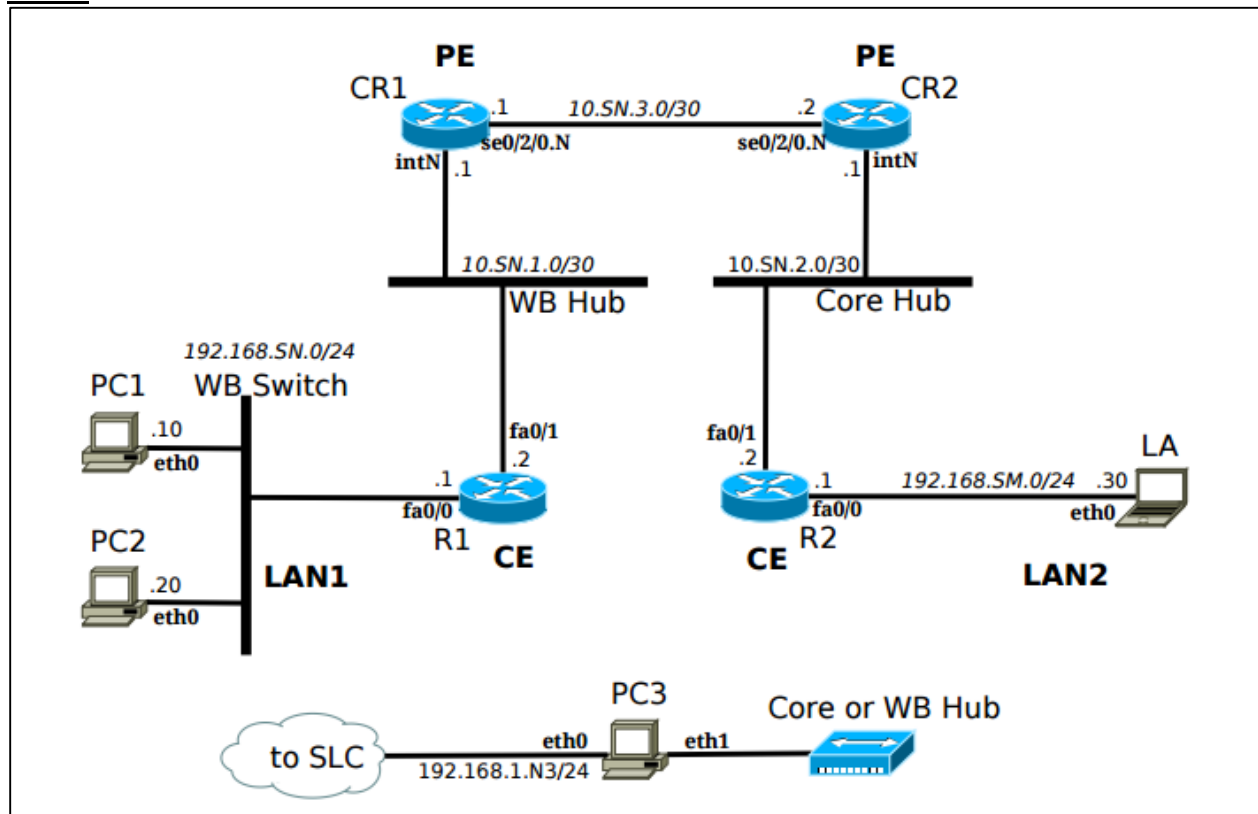


## MPLS



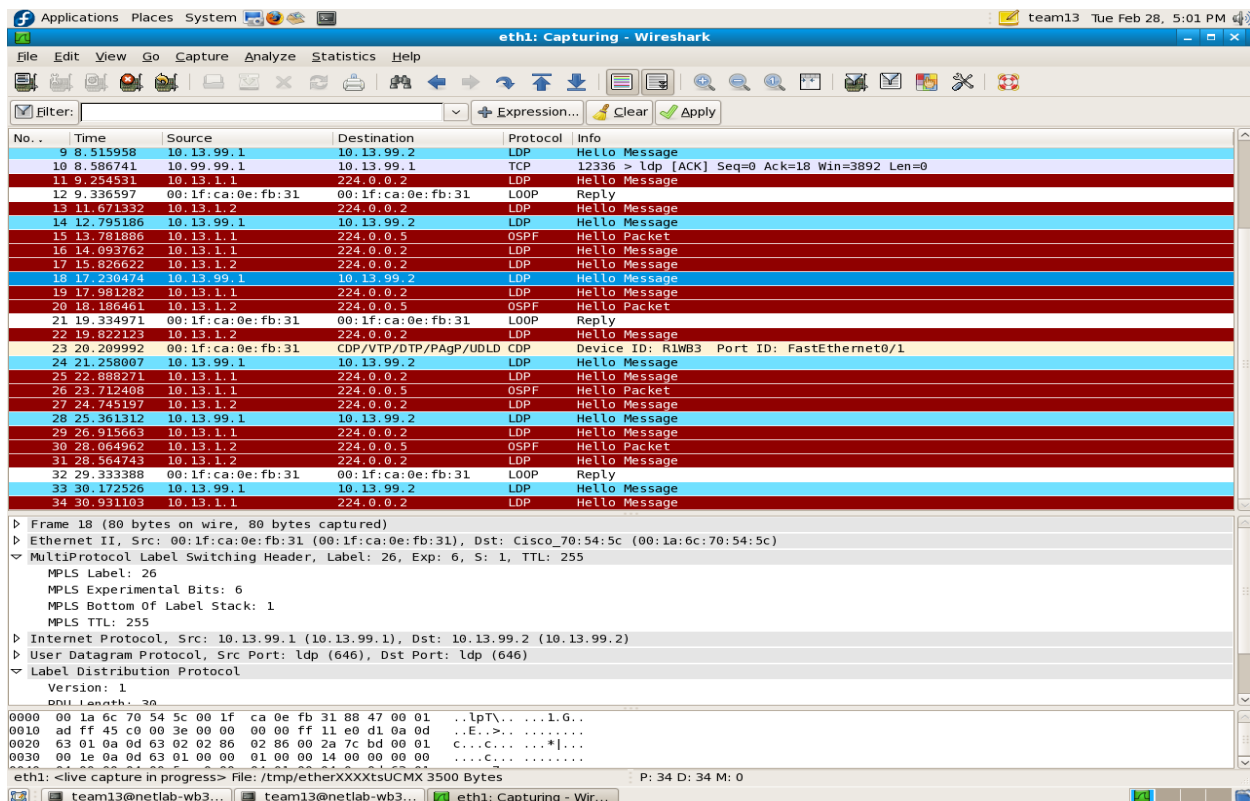
- The computers and the routers were connected as shown in the figure above.
- Loopback interface was created on each WB router.  
R1 – 10.13.99.1      R2 – 10.13.99.2
- PC3 was used as a monitoring and a management station.
- OSPF was configured on all the 4 routers using area 0. Loopback interfaces were also included in the OSPF configuration.
- The loopback interfaces were pingable from the router and the PC's.

### Experiment 4.1: Basic LDP configuration

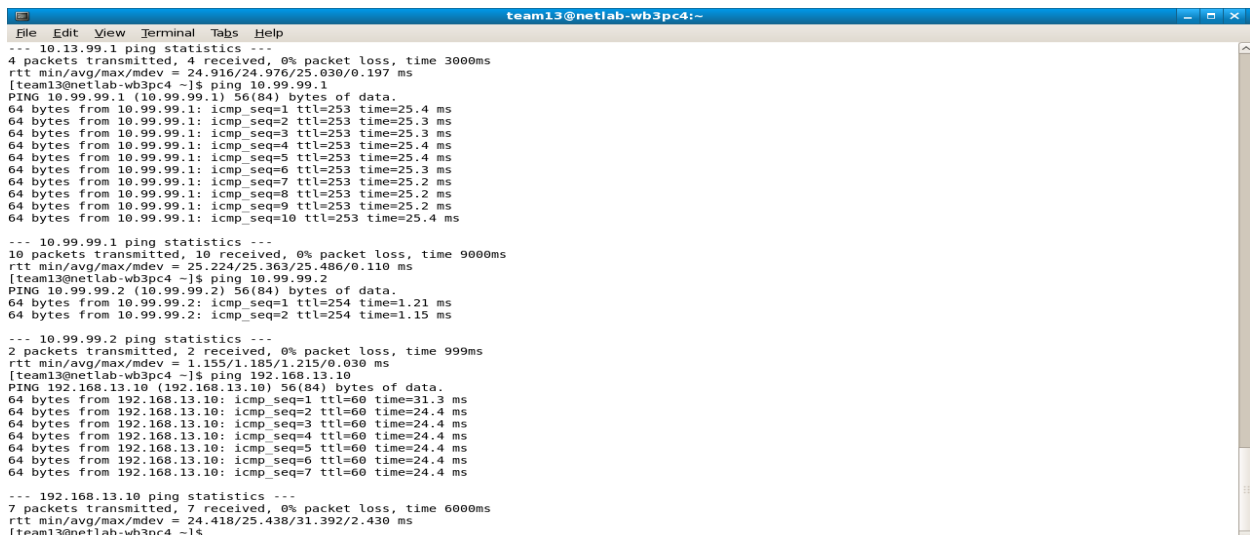
- Wireshark was started on PC3 to monitor the WB hub.
- The following commands were entered on the workbench routers.

```
ip cef
mpls ip
mpls label protocol ldp
mpls ldp router-id loopback0 force
```

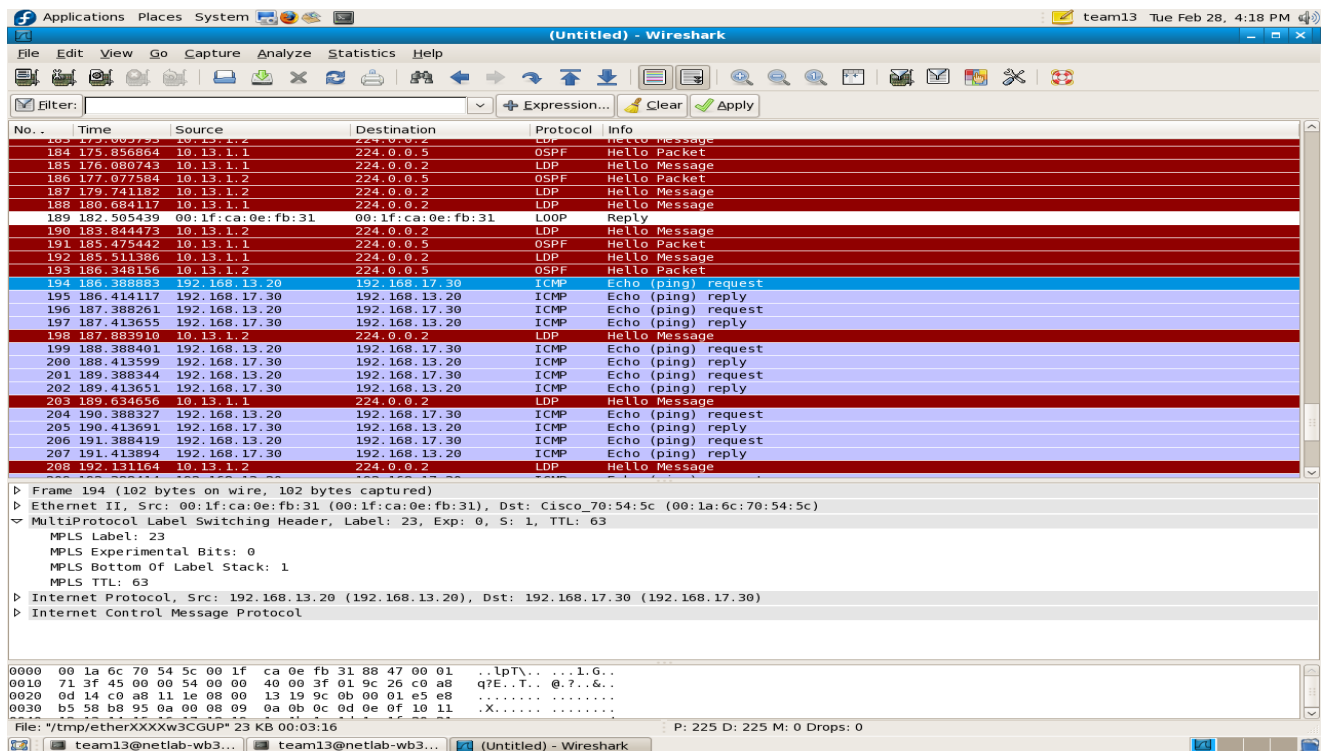
- MPLS was enabled on each interface to be used by MPLS on each router using the command “**mpls ip**”.
- LDP packets were captured between the WB routers and the core routers. We see the LDP initialization and once the neighborhood is established, the hello packets are exchanged.



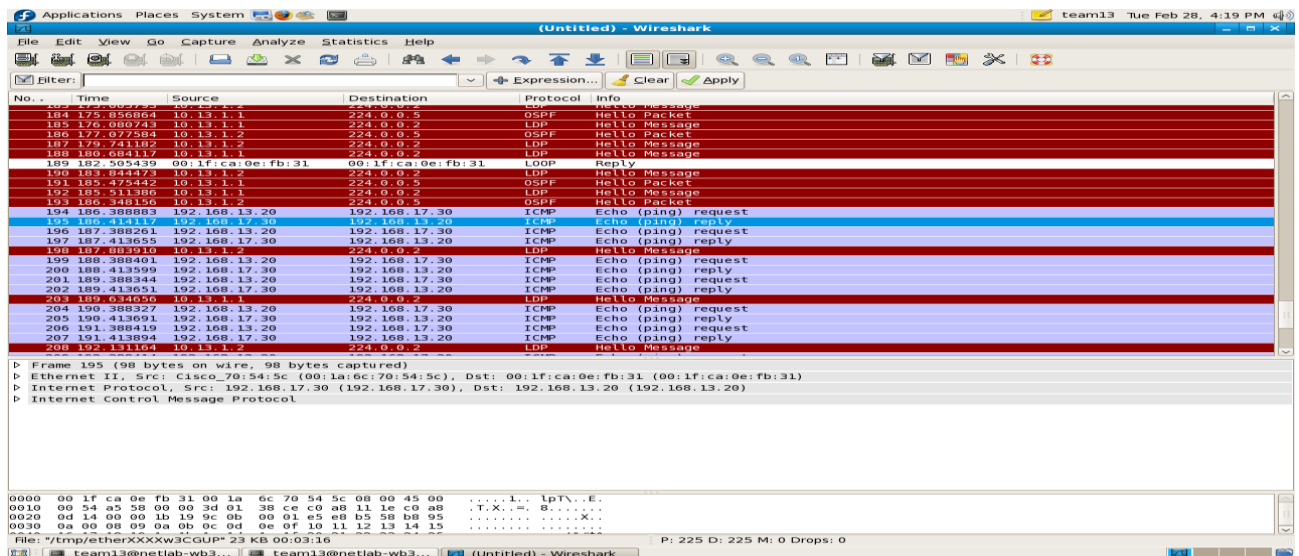
- Using ping and traceroute the connectivity between the PC's and the laptop was verified.



- In the ICMP echo request packets we see the MPLS label before the IP header.



- However as expected the reply packets from the PE to the CE did not have any MPLS label because the reply packets were leaving the MPLS network and there is no need for label processing.



- Output of “**show ip mpls binding**” from R1 and CR1 is provided below.

```
R1WB3#show mpls ip binding
10.11.1.0/30
  in label: 16
  out label: imp-null lsr: 10.99.99.1:0 inuse
10.11.2.0/30
  in label: 17
  out label: 27 lsr: 10.99.99.1:0 inuse
10.11.3.0/30
  in label: 18
  out label: imp-null lsr: 10.99.99.1:0 inuse
10.11.99.2/32
  in label: 19
  out label: 28 lsr: 10.99.99.1:0 inuse
10.13.1.0/30
  in label: imp-null
  out label: imp-null lsr: 10.99.99.1:0
10.13.2.0/30
  in label: 20
  out label: 16 lsr: 10.99.99.1:0 inuse
10.13.3.0/30
  in label: 21
  out label: imp-null lsr: 10.99.99.1:0 inuse
10.13.99.1/32
  in label: imp-null
  out label: 30 lsr: 10.99.99.1:0
10.13.99.2/32
  in label: 22
  out label: 26 lsr: 10.99.99.1:0 inuse
10.14.1.0/30
  in label: 23
  out label: imp-null lsr: 10.99.99.1:0 inuse
10.14.2.0/30
  in label: 24
  out label: 17 lsr: 10.99.99.1:0 inuse
10.14.3.0/30
  in label: 25
  out label: imp-null lsr: 10.99.99.1:0 inuse
10.14.99.1/32
  in label: 26
  out label: 18 lsr: 10.99.99.1:0 inuse
10.14.99.2/32
  in label: 27
  out label: 19 lsr: 10.99.99.1:0 inuse
10.99.99.1/32
  in label: 28
  out label: imp-null lsr: 10.99.99.1:0 inuse
10.99.99.2/32
  in label: 29
  out label: 20 lsr: 10.99.99.1:0 inuse
```

```

10.255.255.252/30
    out label:  imp-null lsr: 10.99.99.1:0
192.168.11.0/24
    in label:   30
    out label:  25    lsr: 10.99.99.1:0    inuse
192.168.13.0/24
    in label:   imp-null
    out label:  21    lsr: 10.99.99.1:0
192.168.14.0/24
    in label:   31
    out label:  22    lsr: 10.99.99.1:0    inuse
192.168.15.0/24
    in label:   32
    out label:  29    lsr: 10.99.99.1:0    inuse
192.168.17.0/24
    in label:   33
    out label:  23    lsr: 10.99.99.1:0    inuse
192.168.18.0/24
    in label:   34
    out label:  24    lsr: 10.99.99.1:0    inuse

```

This is the MPLS IP binding table for R1

R1C#show mpls ip binding

```

10.11.1.0/30
    in label:   imp-null
    out label:  27    lsr: 10.14.99.1:0
    out label:  25    lsr: 10.99.99.2:0
    out label:  16    lsr: 10.13.99.1:0
10.11.2.0/30
    in label:   27
    out label:  imp-null lsr: 10.99.99.2:0    inuse
    out label:  31    lsr: 10.14.99.1:0
    out label:  17    lsr: 10.13.99.1:0
10.11.3.0/30
    in label:   imp-null
    out label:  imp-null lsr: 10.99.99.2:0
    out label:  30    lsr: 10.14.99.1:0
    out label:  18    lsr: 10.13.99.1:0
10.11.99.2/32
    in label:   28
    out label:  28    lsr: 10.99.99.2:0    inuse
    out label:  32    lsr: 10.14.99.1:0
    out label:  19    lsr: 10.13.99.1:0
10.13.1.0/30
    in label:   imp-null
    out label:  16    lsr: 10.14.99.1:0
    out label:  16    lsr: 10.99.99.2:0
    out label:  imp-null lsr: 10.13.99.1:0

```

10.13.2.0/30  
   in label: 16  
   out label: 17   lsr: 10.14.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0   inuse  
   out label: 20   lsr: 10.13.99.1:0  
 10.13.3.0/30  
   in label: imp-null  
   out label: 18   lsr: 10.14.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0  
   out label: 21   lsr: 10.13.99.1:0  
 10.13.99.1/32  
   in label: 30  
   out label: 30   lsr: 10.99.99.2:0  
   out label: 34   lsr: 10.14.99.1:0  
   out label: imp-null lsr: 10.13.99.1:0   inuse  
 10.13.99.2/32  
   in label: 26  
   out label: 27   lsr: 10.99.99.2:0   inuse  
   out label: 29   lsr: 10.14.99.1:0  
   out label: 22   lsr: 10.13.99.1:0  
 10.14.1.0/30  
   in label: imp-null  
   out label: imp-null lsr: 10.14.99.1:0  
   out label: 17   lsr: 10.99.99.2:0  
   out label: 23   lsr: 10.13.99.1:0  
 10.14.2.0/30  
   in label: 17  
   out label: 19   lsr: 10.14.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0   inuse  
   out label: 24   lsr: 10.13.99.1:0  
 10.14.3.0/30  
   in label: imp-null  
   out label: 20   lsr: 10.14.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0  
   out label: 25   lsr: 10.13.99.1:0  
 10.14.99.1/32  
   in label: 18  
   out label: imp-null lsr: 10.14.99.1:0   inuse  
   out label: 18   lsr: 10.99.99.2:0  
   out label: 26   lsr: 10.13.99.1:0  
 10.14.99.2/32  
   in label: 19  
   out label: 21   lsr: 10.14.99.1:0  
   out label: 19   lsr: 10.99.99.2:0   inuse  
   out label: 27   lsr: 10.13.99.1:0  
 10.99.99.1/32  
   in label: imp-null  
   out label: 22   lsr: 10.14.99.1:0  
   out label: 20   lsr: 10.99.99.2:0  
   out label: 28   lsr: 10.13.99.1:0  
 10.99.99.2/32

```

    in label: 20
    out label: 23    lsr: 10.14.99.1:0
    out label: imp-null lsr: 10.99.99.2:0    inuse
    out label: 29    lsr: 10.13.99.1:0
10.255.255.252/30
    in label: imp-null
    out label: imp-null lsr: 10.99.99.2:0
192.168.11.0/24
    in label: 25
    out label: 28    lsr: 10.14.99.1:0
    out label: 26    lsr: 10.99.99.2:0
    out label: 30    lsr: 10.13.99.1:0
192.168.13.0/24
    in label: 21
    out label: 24    lsr: 10.14.99.1:0
    out label: 21    lsr: 10.99.99.2:0
    out label: imp-null lsr: 10.13.99.1:0    inuse
192.168.14.0/24
    in label: 22
    out label: imp-null lsr: 10.14.99.1:0    inuse
    out label: 22    lsr: 10.99.99.2:0
    out label: 31    lsr: 10.13.99.1:0
192.168.15.0/24
    in label: 29
    out label: 29    lsr: 10.99.99.2:0    inuse
    out label: 33    lsr: 10.14.99.1:0
    out label: 32    lsr: 10.13.99.1:0
192.168.17.0/24
    in label: 23
    out label: 25    lsr: 10.14.99.1:0
    out label: 23    lsr: 10.99.99.2:0    inuse
    out label: 33    lsr: 10.13.99.1:0
192.168.18.0/24 (no route)
    in label: 24
    out label: 26    lsr: 10.14.99.1:0
    out label: 24    lsr: 10.99.99.2:0
    out label: 34    lsr: 10.13.99.1:0
R1C#

```

This is the MPLS IP binding table of CR1.

The output of “**show mpls forwarding-table**” of both R1 and CR1 is given below.

```

Applications Places System team13 Tue Feb 28, 4:26 PM
team13@netlab-wb3pc3:~
File Edit View Terminal Tabs Help
in Label: 26
out Label: 18 lsr: 10.99.99.1:0 inuse
10.14.99.2/32
in Label: 27
out Label: 19 lsr: 10.99.99.1:0 inuse
10.99.99.1/32
in Label: 28
out Label: imp-null lsr: 10.99.99.1:0 inuse
10.99.99.2/32
in Label: 29
out Label: 20 lsr: 10.99.99.1:0 inuse
10.255.255.252/30
out Label: imp-null lsr: 10.99.99.1:0
192.168.11.0/24
in Label: 30
out Label: 25 lsr: 10.99.99.1:0 inuse
192.168.13.0/24
in Label: 31
out Label: 21 lsr: 10.99.99.1:0 inuse
192.168.14.0/24
in Label: 32
out Label: 22 lsr: 10.99.99.1:0 inuse
192.168.15.0/24
in Label: 33
out Label: 29 lsr: 10.99.99.1:0 inuse
192.168.17.0/24
in Label: 34
out Label: 23 lsr: 10.99.99.1:0 inuse
192.168.18.0/24
in Label: 34
out Label: 24 lsr: 10.99.99.1:0 inuse
R1WB3#show mpls forwarding-table
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or VC or Tunnel Id Switched interface
16 Pop Label 10.11.1.0/30 0 Fa0/1 10.13.1.1
17 Pop Label 10.11.2.0/30 0 Fa0/1 10.13.1.1
18 Pop Label 10.11.3.0/30 0 Fa0/1 10.13.1.1
19 Pop Label 10.11.99.2/32 0 Fa0/1 10.13.1.1
20 Pop Label 10.13.2.0/30 0 Fa0/1 10.13.1.1
21 Pop Label 10.13.3.0/30 0 Fa0/1 10.13.1.1
22 Pop Label 10.13.99.2/32 0 Fa0/1 10.13.1.1
23 Pop Label 10.11.0/30 0 Fa0/1 10.13.1.1
24 Pop Label 10.14.2.0/30 0 Fa0/1 10.13.1.1
25 Pop Label 10.14.3.0/30 0 Fa0/1 10.13.1.1
26 Pop Label 10.14.99.1/32 0 Fa0/1 10.13.1.1
27 Pop Label 10.14.99.2/32 0 Fa0/1 10.13.1.1
28 Pop Label 10.99.99.1/32 0 Fa0/1 10.13.1.1
29 Pop Label 10.99.99.2/32 0 Fa0/1 10.13.1.1
30 Pop Label 192.168.11.0/24 0 Fa0/1 10.13.1.1
31 Pop Label 192.168.13.0/24 0 Fa0/1 10.13.1.1
32 Pop Label 192.168.14.0/24 0 Fa0/1 10.13.1.1
33 Pop Label 192.168.15.0/24 0 Fa0/1 10.13.1.1
34 Pop Label 192.168.17.0/24 0 Fa0/1 10.13.1.1
34 Pop Label 192.168.18.0/24 0 Fa0/1 10.13.1.1
R1WB3#

```

```

Applications Places System team13 Tue Feb 28, 4:47 PM
team13@netlab-wb3pc3:~
File Edit View Terminal Tabs Help
R1C>ping 10.11.99.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.11.99.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R1C>
R1C>
R1C>enable
R1C#show mpls forwarding-table
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or VC or Tunnel Id Switched interface
16 Pop Label 10.13.2.0/30 0 Se0/2/0.3 point2point
17 Pop Label 10.13.2.0/30 0 Se0/2/0.4 point2point
18 Pop Label 10.14.2.0/30 0 Se0/2/0.1 point2point
19 Pop Label 10.14.2.0/30 0 Se0/2/0.3 point2point
20 Pop Label 10.14.2.0/30 0 Se0/2/0.4 point2point
21 Pop Label 10.14.2.0/30 0 Se0/2/0.1 point2point
22 Pop Label 10.14.99.1/32 0 Fa0/1/0 10.14.1.2
23 Pop Label 10.14.99.2/32 0 Se0/2/0.3 point2point
24 Pop Label 10.14.99.2/32 0 Se0/2/0.4 point2point
25 Pop Label 10.14.99.2/32 0 Se0/2/0.1 point2point
26 Pop Label 10.99.99.2/32 0 Se0/2/0.3 point2point
27 Pop Label 10.99.99.2/32 0 Se0/2/0.4 point2point
28 Pop Label 10.99.99.2/32 0 Se0/2/0.1 point2point
29 Pop Label 10.99.99.2/32 0 Se0/2/0.3 point2point
30 Pop Label 10.99.99.2/32 0 Se0/2/0.4 point2point
31 Pop Label 192.168.13.0/24 60172 Fa0/0/0 10.13.1.2
32 Pop Label 192.168.14.0/24 0 Fa0/1/0 10.14.1.2
33 Pop Label 192.168.17.0/24 56488 Se0/2/0.3 point2point
34 Pop Label 192.168.17.0/24 0 Se0/2/0.4 point2point
35 Pop Label 192.168.17.0/24 27808 Se0/2/0.1 point2point
36 Pop Label 10.13.99.2/32 0 Se0/2/0.3 point2point
37 Pop Label 10.13.99.2/32 0 Se0/2/0.4 point2point
38 Pop Label 10.13.99.2/32 0 Se0/2/0.1 point2point
39 Pop Label 10.13.99.2/32 0 Se0/2/0.3 point2point
40 Pop Label 10.13.99.2/32 0 Se0/2/0.4 point2point
41 Pop Label 192.168.15.0/24 0 Se0/2/0.1 point2point
42 Pop Label 192.168.15.0/24 0 Se0/2/0.3 point2point
43 Pop Label 192.168.15.0/24 0 Se0/2/0.4 point2point
44 Pop Label 192.168.15.0/24 0 Se0/2/0.1 point2point
45 Pop Label 10.13.99.1/32 0 Fa0/0/0 10.13.1.2
R1C#
*Feb 28 22:30:25.500: %OSPF-5-ADJCHG: Process 10, Nbr 10.11.99.1 on FastEthernet0/0 from FULL to DOWN, Neighbor Down: Dead timer expired

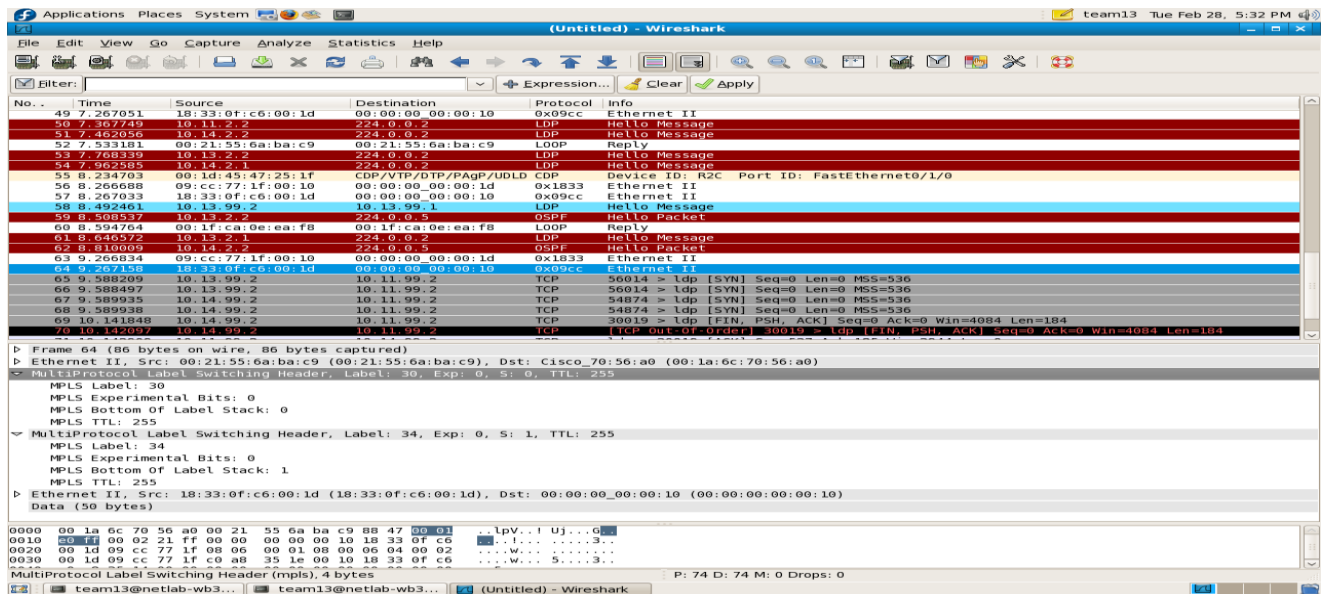
```

- The MPLS label of 23 in the ICMP packets is shown in the MPLS forwarding tables. Looking at the core router 1's forwarding table, there is a label 17 coming from CR2 and this is removed before sending the label 23 to R1. Since the interfaces are connected to the core routers, the IP addresses of the interfaces in the forwarding tables might be different than our workstation.

## Experiment 4.2: Layer-2 VPN Ethernet over MPLS







R1WB3#show mpls ip binding

```

10.11.1.0/30
  in label: 16
  out label: imp-null lsr: 10.99.99.1:0 inuse
  out label: 16 lsr: 10.13.99.2:0

10.11.2.0/30
  in label: 17
  out label: 27 lsr: 10.99.99.1:0 inuse
  out label: 17 lsr: 10.13.99.2:0

10.11.3.0/30
  in label: 18
  out label: imp-null lsr: 10.99.99.1:0 inuse
  out label: 18 lsr: 10.13.99.2:0

10.11.99.1/32
  in label: 30
  out label: 24 lsr: 10.99.99.1:0 inuse
  out label: 30 lsr: 10.13.99.2:0

10.11.99.2/32
  in label: 19
  out label: 28 lsr: 10.99.99.1:0 inuse
  out label: 19 lsr: 10.13.99.2:0

10.13.1.0/30
  in label: imp-null
  out label: imp-null lsr: 10.99.99.1:0
  out label: 20 lsr: 10.13.99.2:0

10.13.2.0/30
  in label: 20
  out label: 16 lsr: 10.99.99.1:0 inuse
  out label: imp-null lsr: 10.13.99.2:0

10.13.3.0/30
  in label: 21

```

```

    out label:  imp-null lsr: 10.99.99.1:0  inuse
    out label:  21      lsr: 10.13.99.2:0
10.13.99.1/32
    in label:  imp-null
    out label:  30      lsr: 10.99.99.1:0
    out label:  22      lsr: 10.13.99.2:0
10.13.99.2/32
    in label:  22
    out label:  26      lsr: 10.99.99.1:0  inuse
    out label:  imp-null lsr: 10.13.99.2:0
10.14.1.0/30
    in label:  23
    out label:  imp-null lsr: 10.99.99.1:0  inuse
    out label:  23      lsr: 10.13.99.2:0
10.14.2.0/30
    in label:  24
    out label:  17      lsr: 10.99.99.1:0  inuse
    out label:  24      lsr: 10.13.99.2:0
10.14.3.0/30
    in label:  25
    out label:  imp-null lsr: 10.99.99.1:0  inuse
    out label:  25      lsr: 10.13.99.2:0
10.14.99.1/32
    in label:  26
    out label:  18      lsr: 10.99.99.1:0  inuse
    out label:  26      lsr: 10.13.99.2:0
10.14.99.2/32
    in label:  27
    out label:  19      lsr: 10.99.99.1:0  inuse
    out label:  27      lsr: 10.13.99.2:0
10.99.99.1/32
    in label:  28
    out label:  imp-null lsr: 10.99.99.1:0  inuse
    out label:  28      lsr: 10.13.99.2:0
10.99.99.2/32
    in label:  29
    out label:  20      lsr: 10.99.99.1:0  inuse
    out label:  29      lsr: 10.13.99.2:0
10.255.255.252/30
    out label:  imp-null lsr: 10.99.99.1:0
192.168.11.0/24
    in label:  33
    out label:  25      lsr: 10.99.99.1:0  inuse
    out label:  35      lsr: 10.13.99.2:0
192.168.13.0/24
    in label:  imp-null
    out label:  21      lsr: 10.99.99.1:0
    out label:  31      lsr: 10.13.99.2:0
192.168.14.0/24
    in label:  31
    out label:  22      lsr: 10.99.99.1:0  inuse

```

```

    out label: 32    lsr: 10.13.99.2:0
192.168.15.0/24
    in label: 32
    out label: 29    lsr: 10.99.99.1:0    inuse
    out label: 33    lsr: 10.13.99.2:0

```

This is the MPLS IP binding table from R1.

R1C#show mpls ip binding

```

10.11.1.0/30
    in label:  imp-null
    out label: 16    lsr: 10.13.99.1:0
    out label: 25    lsr: 10.99.99.2:0
    out label:  imp-null lsr: 10.11.99.1:0
10.11.2.0/30
    in label: 27
    out label:  imp-null lsr: 10.99.99.2:0    inuse
    out label: 17    lsr: 10.13.99.1:0
    out label: 16    lsr: 10.11.99.1:0
10.11.3.0/30
    in label:  imp-null
    out label:  imp-null lsr: 10.99.99.2:0
    out label: 18    lsr: 10.13.99.1:0
    out label: 17    lsr: 10.11.99.1:0
10.11.99.1/32
    in label: 24
    out label: 30    lsr: 10.13.99.1:0
    out label: 24    lsr: 10.99.99.2:0
    out label:  imp-null lsr: 10.11.99.1:0    inuse
10.11.99.2/32
    in label: 28
    out label: 28    lsr: 10.99.99.2:0    inuse
    out label: 19    lsr: 10.13.99.1:0
    out label: 18    lsr: 10.11.99.1:0
10.13.1.0/30
    in label:  imp-null
    out label:  imp-null lsr: 10.13.99.1:0
    out label: 16    lsr: 10.99.99.2:0
    out label: 19    lsr: 10.11.99.1:0
10.13.2.0/30
    in label: 16
    out label: 20    lsr: 10.13.99.1:0
    out label:  imp-null lsr: 10.99.99.2:0    inuse
    out label: 20    lsr: 10.11.99.1:0
10.13.3.0/30
    in label:  imp-null
    out label: 21    lsr: 10.13.99.1:0
    out label:  imp-null lsr: 10.99.99.2:0
    out label: 21    lsr: 10.11.99.1:0

```

10.13.99.1/32  
   in label: 30  
   out label: 30   lsr: 10.99.99.2:0  
   out label: imp-null lsr: 10.13.99.1:0   inuse  
   out label: 22   lsr: 10.11.99.1:0  
 10.13.99.2/32  
   in label: 26  
   out label: 27   lsr: 10.99.99.2:0   inuse  
   out label: 22   lsr: 10.13.99.1:0  
   out label: 23   lsr: 10.11.99.1:0  
 10.14.1.0/30  
   in label: imp-null  
   out label: 23   lsr: 10.13.99.1:0  
   out label: 17   lsr: 10.99.99.2:0  
   out label: 24   lsr: 10.11.99.1:0  
 10.14.2.0/30  
   in label: 17  
   out label: 24   lsr: 10.13.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0   inuse  
   out label: 25   lsr: 10.11.99.1:0  
 10.14.3.0/30  
   in label: imp-null  
   out label: 25   lsr: 10.13.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0  
   out label: 26   lsr: 10.11.99.1:0  
 10.14.99.1/32 (no route)  
   in label: 18  
   out label: 26   lsr: 10.13.99.1:0  
   out label: 18   lsr: 10.99.99.2:0  
   out label: 27   lsr: 10.11.99.1:0  
 10.14.99.2/32 (no route)  
   in label: 19  
   out label: 27   lsr: 10.13.99.1:0  
   out label: 19   lsr: 10.99.99.2:0  
   out label: 28   lsr: 10.11.99.1:0  
 10.99.99.1/32  
   in label: imp-null  
   out label: 28   lsr: 10.13.99.1:0  
   out label: 20   lsr: 10.99.99.2:0  
   out label: 29   lsr: 10.11.99.1:0  
 10.99.99.2/32  
   in label: 20  
   out label: 29   lsr: 10.13.99.1:0  
   out label: imp-null lsr: 10.99.99.2:0   inuse  
   out label: 30   lsr: 10.11.99.1:0  
 10.255.255.252/30  
   in label: imp-null  
   out label: imp-null lsr: 10.99.99.2:0  
 192.168.11.0/24  
   in label: 25  
   out label: 33   lsr: 10.13.99.1:0

```

out label: 26    lsr: 10.99.99.2:0
out label: imp-null lsr: 10.11.99.1:0    inuse
192.168.13.0/24
in label: 21
out label: imp-null lsr: 10.13.99.1:0    inuse
out label: 21    lsr: 10.99.99.2:0
out label: 31    lsr: 10.11.99.1:0
192.168.14.0/24 (no route)
in label: 22
out label: 31    lsr: 10.13.99.1:0
out label: 22    lsr: 10.99.99.2:0
out label: 32    lsr: 10.11.99.1:0
192.168.15.0/24
in label: 29
out label: 29    lsr: 10.99.99.2:0    inuse
out label: 32    lsr: 10.13.99.1:0
out label: 33    lsr: 10.11.99.1:0

```

R1C#

➤ Corresponding output of “sh mpls forwarding-table”

```

R1WB3#show mpls forwarding-table
% Invalid input detected at '^' marker.

R1WB3#show mpls forwarding-table
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or VC or Tunnel Id Switched Interface
16 Pop Label 10.13.2.0/30 0 Fa0/1 10.13.1.1
17 27 10.11.2.0/30 0 Fa0/1 10.13.1.1
18 Pop Label 10.11.99.2/32 0 Fa0/1 10.13.1.1
20 16 10.13.2.0/30 0 Fa0/1 10.13.1.1
21 Pop Label 10.13.3.0/30 0 Fa0/1 10.13.1.1
22 26 10.13.99.2/32 0 Fa0/1 10.13.1.1
23 Pop Label 10.14.1.0/30 0 Fa0/1 10.13.1.1
24 17 10.14.2.0/30 0 Fa0/1 10.13.1.1
25 Pop Label 10.14.3.0/30 0 Fa0/1 10.13.1.1
26 Pop Label 10.99.99.1/32 0 Fa0/1 10.13.1.1
29 29 10.99.99.2/32 0 Fa0/1 10.13.1.1
30 24 10.11.99.1/32 0 Fa0/1 10.13.1.1
32 192.168.13.0/24 0 Fa0/1 10.13.1.1
33 25 192.168.11.0/24 0 Fa0/1 10.13.1.1
34 No Label Lckct(3) 28316 Fa0/0/0 point2point

```

```

R1C#
Feb 28 23:24:11.012: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1/0, changed state to down
R1C#show mpls forwarding-table
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or VC or Tunnel Id Switched Interface
16 Pop Label 10.13.2.0/30 520 Ser0/2/0.1 point2point
17 Pop Label 10.13.2.0/30 0 Ser0/2/0.4 point2point
18 Pop Label 10.14.2.0/30 0 Ser0/2/0.1 point2point
20 Pop Label 10.14.2.0/30 0 Ser0/2/0.4 point2point
21 Pop Label 10.99.99.2/32 0 Ser0/2/0.1 point2point
22 Pop Label 10.99.99.2/32 0 Ser0/2/0.3 point2point
23 Pop Label 10.99.99.2/32 0 Ser0/2/0.4 point2point
24 Pop Label 192.168.13.0/24 7474 Fa0/0 10.13.1.2
25 Pop Label 192.168.11.0/24 392 Fa0/0 10.13.1.2
26 27 10.13.99.2/32 37316 Ser0/2/0.1 point2point
27 Pop Label 10.11.2.0/30 0 Ser0/2/0.3 point2point
28 Pop Label 10.11.2.0/30 0 Ser0/2/0.4 point2point
29 Pop Label 10.11.2.0/30 0 Ser0/2/0.1 point2point
30 28 10.11.99.2/32 0 Ser0/2/0.4 point2point
31 28 10.11.99.2/32 0 Ser0/2/0.3 point2point
32 28 10.11.99.2/32 0 Ser0/2/0.4 point2point
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or VC or Tunnel Id Switched Interface
29 29 192.168.15.0/24 0 Ser0/2/0.1 point2point
28 28 192.168.15.0/24 0 Ser0/2/0.3 point2point
30 29 192.168.15.0/24 0 Ser0/2/0.4 point2point
31 28 10.13.99.1/32 64382 Fa0/0/0 10.13.1.2

```

- The traceroute from PC2 to Laptop will consist of only hop because this Ethernet over VPN and we are connecting to a machine on the same network. We see the same behavior in the traceroute.

```

team13@netlab-wb3pc2:~
File Edit View Terminal Tabs Help
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.073ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.135ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.083ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 21.995ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.114ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.056ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.106ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.162ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.071ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.178ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.046ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.119ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.106ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.081ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.081ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.147ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.198ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.175ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.236ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.149ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.142ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.186ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.094ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.169ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.161ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.213ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.056ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.119ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.072ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.210ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.076ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.150ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.178ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.229ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.112ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.055ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.198ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.071ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.162ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.087ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.028ms
Unicast reply from 192.168.53.30 [00:1D:09:CC:77:1F] 22.022ms
Sent 274 probes (1 broadcast(s))
Received 274 response(s)
[team13@netlab-wb3pc2 ~]$ sudo traceroute 192.168.53.30
traceroute to 192.168.53.30 (192.168.53.30): 30 hops max, 40 byte packets
 1 (192.168.53.30) 52.665 ms 68.843 ms 85.038 ms
[team13@netlab-wb3pc2 ~]$ sudo traceroute 192.168.13.10
traceroute to 192.168.13.10 (192.168.13.10): 30 hops max, 40 byte packets
connect: Network is unreachable
[team13@netlab-wb3pc2 ~]$ sudo traceroute 192.168.53.30
traceroute to 192.168.53.30 (192.168.53.30): 30 hops max, 40 byte packets
 1 (192.168.53.30) 30.784 ms 46.957 ms 63.175 ms
[team13@netlab-wb3pc2 ~]$

```

## Exit Procedures

- Ensured there is one cable connecting each PCx21 port to the DELL switch (ports 1-20).
- Ensured there is one cable connecting port LA111 to the DELL switch (ports 1-20).
- The LNET port is connected to port 19 of the DELL switch.
- The MGT port is connected to port 23 of the DELL switch.
- Nothing else is connected to the switch, hub or router ports.
- Unused cables were put on the cabling rack and all computers were shut down.