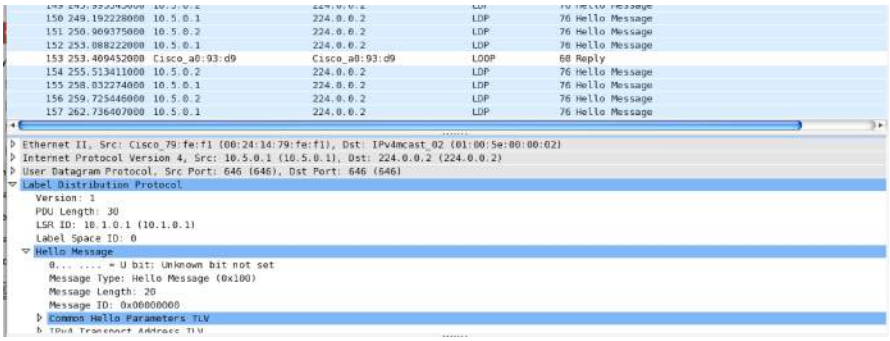
Lab 7: MPLS, LDP, & RSVP

1. Obj 1: Understanding LDP operation
    a. Step2: Enable MPLS and LDP
        i. global conf
            1. mpls label protocol ldp
            2. ip cef
        ii. interface conf
            1. mpls ip
    b. Questions
        i. Explain command in step2
        ii. Did any routers form neighbors?
            1. Yes, R2,R5 became neighbors and R1,R6.
        iii. Other routers did not form neighbors because the ldp routers they were connected to did not have the the same ldp identifier as they subnet they were connected on.
        iv. The routers send out udp hellos through port 646 to discover each other. When neighbors form they create a tcp session.
            1. 

        v. You may be able to use an ldp targeted session and extended discovery to establish a connection to a neighbor more than one hop away.

c. Step 4: Loopbacks and MD5 authentication
    i. global conf
        1. mpls ldp router-id _____ (interface) force (change ldp identifier) ***** or write mem and reload ****
        2. mpls ldp neighbor _____ (ip address) password _____ (md5 authentication)
d. Step 5: Enable ospf and end-to-end connectivity
    i. global conf
        1. router ospf ____ (number)
            a. network _____ (network address) _____ (reverse mask) area ____ (number)
    ii. to confirm use ‘sh mpls forwarding-table’ and ping
e. Questions:
    i. show mpls ldp bindings

1.

```
R1#sh mpls ldp bindings
  tib entry: 10.0.0.0/16, rev 8
        local binding:  tag: imp-null
        remote binding: tsr: 30.0.0.2:0, tag: imp-null
        remote binding: tsr: 30.0.0.3:0, tag: 16
        remote binding: tsr: 30.0.0.6:0, tag: 17
  tib entry: 10.1.0.0/16, rev 6
        local binding:  tag: imp-null
        remote binding: tsr: 30.0.0.2:0, tag: 18
        remote binding: tsr: 30.0.0.3:0, tag: imp-null
        remote binding: tsr: 30.0.0.6:0, tag: 16
  tib entry: 10.2.0.0/16, rev 17
        local binding:  tag: 19
        remote binding: tsr: 30.0.0.2:0, tag: 19
        remote binding: tsr: 30.0.0.3:0, tag: imp-null
        remote binding: tsr: 30.0.0.6:0, tag: 20
  tib entry: 10.3.0.0/16, rev 10
        local binding:  tag: 16
        remote binding: tsr: 30.0.0.2:0, tag: imp-null
        remote binding: tsr: 30.0.0.3:0, tag: 17
        remote binding: tsr: 30.0.0.6:0, tag: 18
  tib entry: 10.5.0.0/16, rev 2
        local binding:  tag: imp-null
        remote binding: tsr: 30.0.0.2:0, tag: 17
        remote binding: tsr: 30.0.0.3:0, tag: 18
        remote binding: tsr: 30.0.0.6:0, tag: imp-null
  tib entry: 10.6.0.0/16, rev 12
        local binding:  tag: 17
        remote binding: tsr: 30.0.0.2:0, tag: imp-null
        remote binding: tsr: 30.0.0.3:0, tag: 19
        remote binding: tsr: 30.0.0.6:0, tag: 19
  tib entry: 30.0.0.0/29, rev 4
        local binding:  tag: imp-null
        remote binding: tsr: 30.0.0.2:0, tag: imp-null
        remote binding: tsr: 30.0.0.3:0, tag: imp-null
        remote binding: tsr: 30.0.0.6:0, tag: imp-null
  tib entry: 30.0.0.1/32, rev 15
        remote binding: tsr: 30.0.0.2:0, tag: 16
        remote binding: tsr: 30.0.0.3:0, tag: 20
        remote binding: tsr: 30.0.0.6:0, tag: 21
  tib entry: 30.0.0.2/32, rev 14
        local binding:  tag: 18
        remote binding: tsr: 30.0.0.3:0, tag: 21
        remote binding: tsr: 30.0.0.6:0, tag: 22
  tib entry: 30.0.0.3/32, rev 19
        local binding:  tag: 20
        remote binding: tsr: 30.0.0.2:0, tag: 20
  --More--
```

ii.

```
  tib entry: 30.0.0.1/32, rev 16
        local binding:  tag: 20
        remote binding: tsr: 30.0.0.4:0, tag: 20
```

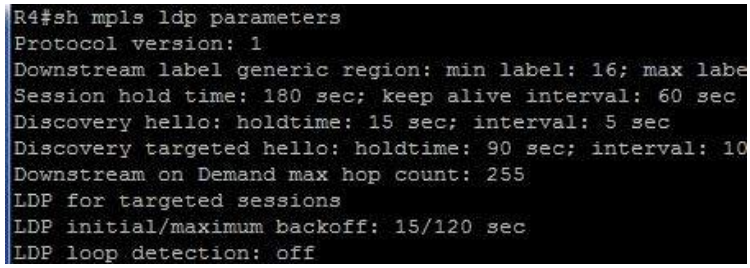
iii.

```
R2#sh mpls fo
R2#sh mpls forwarding-table
Local      Outgoing   Prefix           Bytes Label   Outgoing    Next Hop
Label      Label      or Tunnel Id     Switched      interface
16         No Label   30.0.0.1/32      0             Gi0/1       10.0.0.1
```

iv.

```
  tib entry: 30.0.0.1/32, rev 16
        local binding:  tag: 20
        remote binding: tsr: 30.0.0.2:0, tag: 16
        remote binding: tsr: 30.0.0.3:0, tag: 20
```

v. No, not all LIB bindings go into LFIB.

vi.


vii. Yes, it uses both paths. A different one for each icmp packet. The penultimate router pops.

viii. No, LDP neighbors can be formed before routing protocol convergence.

2. Obj 2: MPLS Traffic Engineering Tunnels
    a. All routers
        i. global conf
            1. ip cef
            2. mpls traffic-eng tunnels
            3. router ospf ____ (number)
                a. mpls traffic-eng area ___ (number)
                b. mpls traffic eng router-id _____ (interface type) _____ (number)
        ii. interface conf
            1. mpls traffic-eng tunnels
    b. On Head router
        i. global conf
            1. ip explicit-path name _____ (name) enable
                a. next-address _____ (ip of next hop)
            2. interface tunnel ____ (number)
                a. tunnel destination _____ (ip address)

b. ip unnumbered loopback ____ (number)

c. tunnel mode mpls traffic-eng

d. description _____ (line)

e. *** set tunnel path priorities***

i. traffic-eng path-option ___ (number) explicit name _____

ii. tunnel mpls traffic-eng path-option ___ (number) dynamic

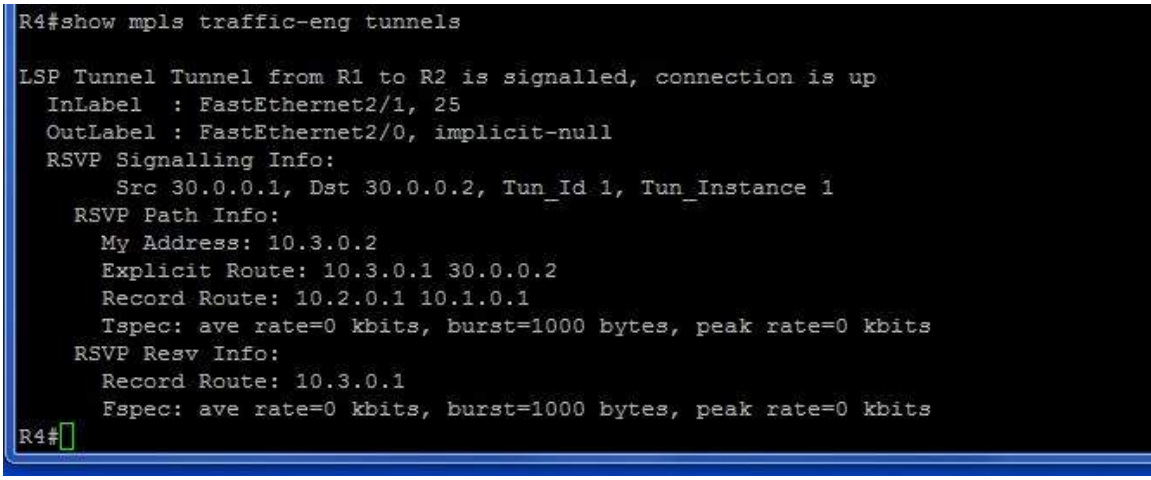
f. tunnel mpls traffic-eng autoroute announce

g. tunnel mpls traffic-eng record-route

c. Questions:

i. ?

ii.



iii.

```
R1#show mpls traffic-eng tunnels tunnel 1

Name: Tunnel from R1 to R2                (Tunnel1) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R1-R3-R4-R2(south) (Basis for Setup, path weigh

  Config Parameters:
    Bandwidth: 0        kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 0        bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/0, 25
```

iv.

```
R1#traceroute 30.0.0.5

Type escape sequence to abort.
Tracing the route to 30.0.0.5

  1 10.1.0.2 [MPLS: Label 25 Exp 0] 0 msec 0 msec 0 msec
  2 10.2.0.2 [MPLS: Label 25 Exp 0] 0 msec 0 msec 0 msec
  3 10.3.0.1 0 msec 0 msec 0 msec
  4 10.6.0.2 0 msec 0 msec *
```

v.

```
R1#sh mpls traffic-eng tunnels tunnel 1

Name: Tunnel from R1 to R2                (Tunnel1) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 2, type dynamic (Basis for Setup, path weight 1)
    path option 1, type explicit R1-R3-R4-R2(south)

  Config Parameters:
    Bandwidth: 0        kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 0        bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/1, implicit-null
  RSVP Signalling Info:
```

vi.

```
R1#traceroute 30.0.0.5

Type escape sequence to abort.
Tracing the route to 30.0.0.5

  1 10.0.0.2 [MPLS: Label 22 Exp 0] 0 msec 0 msec 0 msec
  2 10.6.0.2 0 msec 0 msec *
R1#
```

vii. question 7: global conf of head router

1. ‘mpls traffic-eng reoptimize timers frequency 30’

3. Obj 3: Bandwidth reservation and tunnel priorities

   a. interface conf

      i. ip rsvp bandwidth _____

b. tunnel interface
    i. tunnel mpls traffic-eng bandwidth ____
c. Question 5:
    i. Tunnel one must use it's dynamic route because tunnel 10 uses the southern route.
d. Global pool and subpool
    i. interface conf
        1. ip rsvp bandwidth _____ sub-pool _____
    ii. tunnel interface
        1. tunnel mpls traffic-eng bandwidth sub-pool ____ (use sub-pool bandwidth)
        2. tunnel mpls traffic-end bandwidth _____ (global pool bandwidth)
e. Question 11:
    i.

```
R1#conf t
*Oct 22 04:12:33.647: %SYS-5-CONFIG_I: Configured from console by csh mpls traffic-eng tunnels tunnel 1

Name: Tunnel from R1 to R2               (Tunnel1) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R1-R3-R4-R2(south) (Basis for Setup, path weight 3)
    path option 2, type dynamic

  Config Parameters:
    Bandwidth: 10000    kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 10000    bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/0, 25
  RSVP Signalling Info:
       Src 30.0.0.1, Dst 30.0.0.2, Tun_Id 1, Tun_Instance 26
    RSVP Path Info:
      My Address: 10.1.0.1
      Explicit Route: 10.1.0.2 10.2.0.1 10.2.0.2 10.3.0.2
                      10.3.0.1 30.0.0.2
      Record Route:
      Tspec: ave rate=10000 kbits, burst=1000 bytes, peak rate=10000 kbits
    RSVP Resv Info:
```

ii.

```
R1#sh mpls traffic-eng tunnels tunnel 1

Name: Tunnel from R1 to R2                (Tunnel1) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R1-R3-R4-R2(south) (Basis for Setup, path weight 3)
    path option 2, type dynamic

  Config Parameters:
    Bandwidth: 12000    kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 12000    bw-based
    auto-bw: disabled
```

iii.

```
R6#sh mpls traffic-eng tunnels tunnel 10
*Oct 22 05:12:00.302: %SYS-5-CONFIG_I: Configured from console by console

Name: R6_t10                              (Tunnel10) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R6-R1-R3-R4-R2 (Basis for Setup, path weight 4)

  Config Parameters:
    Bandwidth: 13000    kbps (Sub)  Priority: 6  6   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  disabled  LockDown: disabled  Loadshare: 13000    bw-based
    auto-bw: disabled
```

iv.

```
R1#sh mpls traffic-eng tunnels tunnel 1

Name: Tunnel from R1 to R2                (Tunnel1) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R1-R3-R4-R2(south) (Basis for Setup, path weight 3)
    path option 2, type dynamic

  Config Parameters:
    Bandwidth: 12000    kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 12000    bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/0, 27
  RSVP Signalling Info:
       Src 30.0.0.1, Dst 30.0.0.2, Tun_Id 1, Tun_Instance 89
    RSVP Path Info:
      My Address: 10.1.0.1
      Explicit Route: 10.1.0.2 10.2.0.1 10.2.0.2 10.3.0.2
                      10.3.0.1 30.0.0.2

R1#tra
R1#tra
R1#traceroute 30.0.0.5

Type escape sequence to abort.
Tracing the route to 30.0.0.5

  1 10.1.0.2 [MPLS: Label 27 Exp 0] 0 msec 0 msec 0 msec
  2 10.2.0.2 [MPLS: Label 27 Exp 0] 0 msec 0 msec 0 msec
```

v.

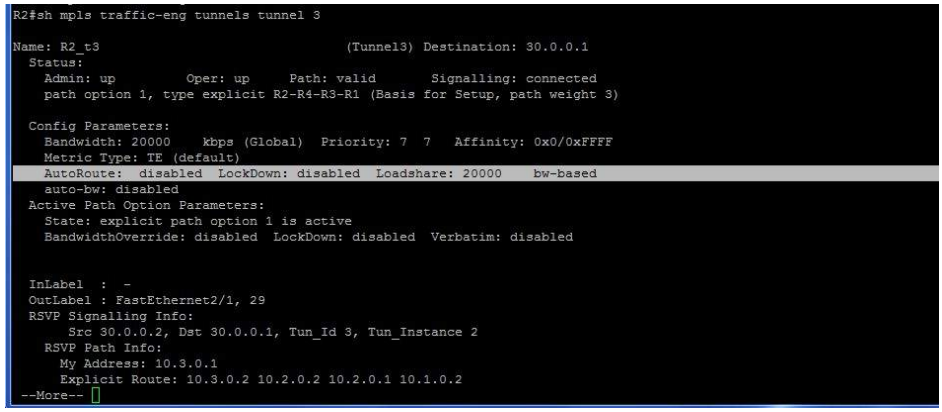
```
R1#traceroute 30.0.0.2

Type escape sequence to abort.
Tracing the route to 30.0.0.2

  1 10.1.0.2 [MPLS: Label 27 Exp 0] 0 msec 0 msec 0 msec
  2 10.2.0.2 [MPLS: Label 27 Exp 0] 0 msec 0 msec 0 msec
```

f. Question 12:

i.



```
R2#sh mpls traffic-eng tunnels tunnel 3

Name: R2_t3                               (Tunnel3) Destination: 30.0.0.1
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected
    path option 1, type explicit R2-R4-R3-R1 (Basis for Setup, path weight 3)

  Config Parameters:
    Bandwidth: 20000    kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  disabled  LockDown: disabled  Loadshare: 20000    bw-based
    auto-bw: disabled
  Active Path Option Parameters:
    State: explicit path option 1 is active
    BandwidthOverride: disabled  LockDown: disabled  Verbatim: disabled


  InLabel  :  -
  OutLabel : FastEthernet2/1, 29
  RSVP Signalling Info:
       Src 30.0.0.2, Dst 30.0.0.1, Tun_Id 3, Tun_Instance 2
    RSVP Path Info:
      My Address: 10.3.0.1
      Explicit Route: 10.3.0.2 10.2.0.2 10.2.0.1 10.1.0.2
 --More--
```

ii.

```
R1#sh mpls traffic-eng tunnels tunnel 1

Name: Tunnel from R1 to R2                (Tunnel1) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R1-R3-R4-R2(south) (Basis for Setup, path weight 3)
    path option 2, type dynamic

  Config Parameters:
    Bandwidth: 12000    kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 12000    bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/0, 27
  RSVP Signalling Info:
       Src 30.0.0.1, Dst 30.0.0.2, Tun_Id 1, Tun_Instance 89
    RSVP Path Info:
      My Address: 10.1.0.1
      Explicit Route: 10.1.0.2 10.2.0.1 10.2.0.2 10.3.0.2
                      10.3.0.1 30.0.0.2
```

iii.

```
R1#sh mpls traffic-eng tunnels tunnel 2

Name: R1_t2                               (Tunnel2) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R1-R3-R4-R2(south) (Basis for Setup, path weight 3)

  Config Parameters:
    Bandwidth: 8000     kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  disabled  LockDown: disabled  Loadshare: 8000     bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/0, 26
  RSVP Signalling Info:
       Src 30.0.0.1, Dst 30.0.0.2, Tun_Id 2, Tun_Instance 9
    RSVP Path Info:
      My Address: 10.1.0.1
      Explicit Route: 10.1.0.2 10.2.0.1 10.2.0.2 10.3.0.2
```

iv.

```
R6#sh mpls traffic-eng tunnels tunnel 10

Name: R6_t10                              (Tunnel10) Destination: 30.0.0.2
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 1, type explicit R6-R1-R3-R4-R2 (Basis for Setup, path weight 4)

  Config Parameters:
    Bandwidth: 13000    kbps (Sub)  Priority: 6  6   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute:  disabled  LockDown: disabled  Loadshare: 13000    bw-based
    auto-bw: disabled

  InLabel  :  -
  OutLabel : FastEthernet2/0, 24
  RSVP Signalling Info:
       Src 30.0.0.6, Dst 30.0.0.2, Tun_Id 10, Tun_Instance 29
    RSVP Path Info:
      My Address: 10.5.0.2
      Explicit Route: 10.5.0.1 10.1.0.1 10.1.0.2 10.2.0.1
                      10.2.0.2 10.3.0.2 10.3.0.1 30.0.0.2
      Record Route:  NONE
      Tspec: ave rate=13000 kbits, burst=1000 bytes, peak rate=13000 kbits
  --More--
```