

Chapter 8

Checking the Data Link Layer

This chapter describes how to investigate a problem at the data link layer of the Multiprotocol Label Switching (MPLS) network. (See Table 14.)

Table 14: Checklist for Checking the Data Link Layer

Checking the Data Link Layer Tasks	Command or Action
Checking the Data Link Layer on page 102	
1. Verify the LSP on page 104	show mpls lsp extensive
2. Verify Interfaces on page 105	show interfaces <i>type-fpc/pic/port</i> extensive show interfaces <i>type-fpc/pic/port</i>
3. Take Appropriate Action on page 108	The following sequence of commands addresses the specific problem described in this section: [edit interfaces <i>type-fpc/pic/port</i>] show delete encapsulation show commit
4. Verify the LSP Again on page 109	show mpls lsp extensive

Checking the Data Link Layer

Purpose After you have configured the label-switched path (LSP), issued the `show mpls lsp extensive` command, and determined that there is an error, you might find that the error is not in the physical layer. Continue investigating the problem at the data link layer of the network.

Figure 12 illustrates the data link layer of the layered MPLS model.

Figure 12: Checking the Data Link Layer

BGP Layer	traceroute <i>host-name</i> show bgp summary show configuration protocols bgp show route <i>destination-prefix</i> detail show route receive protocol bgp <i>neighbor-address</i>	
MPLS Layer	show mpls lsp show mpls lsp extensive show route table mpls.0 show route <i>address</i> traceroute <i>address</i> ping mpls rsvp <i>lsp-name</i> detail	
RSVP Layer	show rsvp session show rsvp neighbor show rsvp interface	
↙ IGP and IP Layers Functioning ↘		
OSPF Layer show ospf neighbor show configuration protocols ospf show ospf interface	IS-IS Layer show isis adjacency show configuration protocols isis show isis interface	
IP Layer show ospf neighbor extensive show interfaces terse	IP Layer show isis adjacency extensive show interfaces terse	
Data Link Layer show interfaces extensive <i>JUNOS Interfaces Network Operations Guide</i>		
Physical Layer	show interfaces show interfaces terse ping <i>host</i>	

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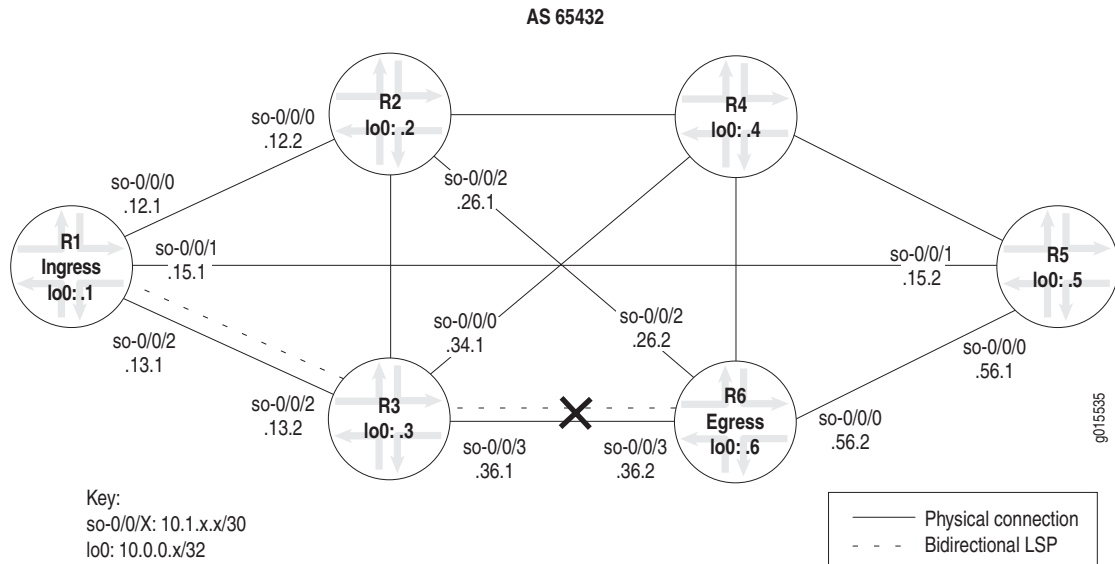
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With this layer, you must check the encapsulation mode, for example, Point-to-Point Protocol (PPP) or Cisco High-level Data Link Control (HDLC); PPP options, for example, header encapsulation; frame check sequence (FCS) size; and whether keepalive frames are enabled or disabled. Also, check the ingress, egress, and transit routers.

If the network is not functioning at this layer, the LSP does not work as configured.

Figure 13 illustrates the MPLS network used in this chapter.

Figure 13: MPLS Network Broken at the Data Link Layer



The network shown in Figure 13 is a fully meshed configuration where every directly connected interface can receive and send packets to every other similar interface. The LSP in this network is configured to run from ingress router **R1**, through transit router **R3**, to egress router **R6**. In addition, a reverse LSP is configured to run from **R6** through **R3** to **R1**, creating bidirectional traffic.

However, in this example, the LSP is down without a path in either direction, from **R1** to **R6** or from **R6** to **R1**.

When you verify that the data link layer is not functioning correctly, you might find a mismatch with PPP or Cisco HDLC encapsulation, PPP options, or keepalive frames.

The cross shown in Figure 13 indicates where the LSP is broken because of a configuration error on ingress router **R1** that prevents the LSP from traversing the network as expected.

Steps To Take To check the data link layer, follow these steps:

1. Verify the LSP on page 104
2. Verify Interfaces on page 105
3. Take Appropriate Action on page 108
4. Verify the LSP Again on page 109

Step 1: Verify the LSP

Purpose Typically, you use the `show mpls lsp extensive` command to verify the LSP. However for quick verification of the LSP state, use the `show mpls lsp` command. If the LSP is down, use the `extensive` option (`show mpls lsp extensive`) as a follow-up. If your network has numerous LSPs, you might consider specifying the name of the LSP, using the `name` option (`show mpls lsp name name` or `show mpls lsp name name extensive`).

Action To determine whether the LSP is up, enter the following command from the ingress router:

```
user@host> show mpls lsp extensive
```

Sample Output 1

```
user@R1> show mpls lsp extensive
Ingress LSP: 1 sessions

10.0.0.6
  From: 10.0.0.1, State: Dn, ActiveRoute: 0, LSPname: R1-to-R6
  ActivePath: (none)
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
  Primary                               State: Dn
    Will be enqueued for recomputation in 15 second(s).
  140 Sep 30 12:01:12 CSPF failed: no route toward 10.0.0.6[26 times]
  139 Sep 30 11:48:57 Deselected as active
  138 Sep 30 11:48:56 CSPF failed: no route toward 10.0.0.6
  137 Sep 30 11:48:56 Clear Call
  136 Sep 30 11:48:56 CSPF: link down/deleted
  10.1.36.1(R3.00/10.0.0.3)->10.1.36.2(R6.00/10.0.0.6)
  135 Sep 30 11:48:56 ResvTear received
  134 Sep 30 11:48:56 Down
  133 Sep 30 11:48:56 CSPF failed: no route toward 10.0.0.6
  132 Sep 30 11:48:56 10.1.13.2: No Route toward dest
  [...Output truncated...]
  Created: Sat Jul 10 18:18:44 2004
Total 1 displayed, Up 0, Down 1

Egress LSP: 0 sessions
Total 0 displayed, Up 0, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

What It Means The sample output from ingress router R1 shows the LSPs within which it participates. The ingress LSP is down, without a path from R1 to R6. Because a reverse LSP is configured in the network shown in Figure 13 on page 103, we would expect an egress LSP session to be up. However, R1 does not have any egress LSPs, indicating that the LSP from R6 to R1 is not functioning.

Step 2: Verify Interfaces



NOTE: Before you proceed with this step, check the physical layer to ensure that the problem is not in the physical layer.

Purpose From your network topology, determine the adjacent interfaces through which the LSP is meant to traverse, and examine the output for the encapsulation type, PPP options, FCS size, and whether keepalive frames are enabled or disabled.

Action To verify the functioning of adjacent interfaces, enter the following commands from the relevant routers:

```
user@host> show interfaces type-fpc/pic/port extensive
user@host> show interfaces type-fpc/pic/port
```

Sample Output 1

```
user@R6> show interfaces so-0/0/3 extensive
Physical interface: so-0/0/3, Enabled, Physical link is Up
  Interface index: 131, SNMP ifIndex: 27, Generation: 14
  Link-level type: Cisco-HDLC, MTU: 4474, Clocking: Internal, SONET mode, Speed:
OC3, Loopback: None,
  FCS: 16, Payload scrambler: Enabled
  Device flags   : Present Running
  Interface flags: Link-Layer-Down Point-To-Point SNMP-Traps 16384
  Link flags     : Keepalives
  Hold-times    : Up 0 ms, Down 0 ms
  Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
  Keepalive statistics:
    Input : 0 (last seen: never)
    Output: 357 (last sent 00:00:04 ago)
  CoS queues    : 4 supported
  Last flapped  : 2004-07-21 16:03:49 PDT (10w0d 07:01 ago)
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   :          203368873          0 bps
    Output bytes  :          186714992         88 bps
    Input packets :          3641808          0 pps
    Output packets:          3297569          0 pps
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Bucket drops:
0,
    Policed discards: 1770, L3 incompletes: 0, L2 channel errors: 0, L2 mismatch
timeouts: 0,
    HS link CRC errors: 0, HS link FIFO overflows: 0
  Output errors:
    Carrier transitions: 1, Errors: 0, Drops: 0, Aged packets: 0, HS link FIFO
underflows: 0,
    MTU errors: 0
  Queue counters:
    Queued packets  Transmitted packets  Dropped packets
    0 best-effort   197012          197012          0
    1 expedited-fo         0              0          0
    2 assured-forw         0              0          0
    3 network-cont  3100557        3100557          0
  SONET alarms   : None
  SONET defects  : None
  SONET PHY:
    Seconds      Count  State
    PLL Lock     0      0  OK
    PHY Light    0      0  OK
  SONET section:
    BIP-B1       0      0
```

```

SEF                1                3  OK
LOS                1                1  OK
LOF                1                1  OK
ES-S               1
SES-S              1
SEFS-S             1
SONET line:
BIP-B2             0                0
REI-L              0                0
RDI-L              0                0  OK
AIS-L              0                0  OK
BERR-SF            0                0  OK
BERR-SD            0                0  OK
ES-L               1
SES-L              1
UAS-L              0
ES-LFE             0
SES-LFE            0
UAS-LFE            0
SONET path:
BIP-B3             0                0
REI-P              0                0
LOP-P              0                0  OK
AIS-P              0                0  OK
RDI-P              0                0  OK
UNEQ-P             0                0  OK
PLM-P              0                0  OK
ES-P               1
SES-P              1
UAS-P              0
ES-PFE             0
SES-PFE            0
UAS-PFE            0
Received SONET overhead:
F1      : 0x00, J0      : 0x00, K1      : 0x00, K2      : 0x00
S1      : 0x00, C2      : 0xcf, C2(cmp) : 0xcf, F2      : 0x00
Z3      : 0x00, Z4      : 0x00, S1(cmp) : 0x00
Transmitted SONET overhead:
F1      : 0x00, J0      : 0x01, K1      : 0x00, K2      : 0x00
S1      : 0x00, C2      : 0xcf, F2      : 0x00, Z3      : 0x00
Z4      : 0x00
Received path trace: R3 so-0/0/3
52 33 20 73 6f 2d 30 2f 30 2f 33 00 00 00 00 00  R3 so-0/0/3.....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 0d 0a .....
Transmitted path trace: R6 so-0/0/3
52 36 20 73 6f 2d 30 2f 30 2f 33 00 00 00 00 00  R6 so-0/0/3.....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
HDLC configuration:
  Policing bucket: Disabled
  Shaping bucket : Disabled
  Giant threshold: 4484, Runt threshold: 3
Packet Forwarding Engine configuration:
  Destination slot: 0, PLP byte: 1 (0x00)
  CoS transmit queue      Bandwidth      Buffer Priority  Limit
                           %      bps      %      bytes
0 best-effort             95    147744000 95         0      low   none
3 network-control         5     7776000  5         0      low   none

Logical interface so-0/0/3.0 (Index 71) (SNMP ifIndex 28) (Generation 16)

```

```

Flags: Device-Down Point-To-Point SNMP-Traps Encapsulation: Cisco-HDLC
Traffic statistics:
  Input bytes :          406737746
  Output bytes :         186714992
  Input packets:          7283616
  Output packets:        3297569
Local statistics:
  Input bytes :          203368873
  Output bytes :         186714992
  Input packets:          3641808
  Output packets:        3297569
Transit statistics:
  Input bytes :          203368873          0 bps
  Output bytes :              0          0 bps
  Input packets:          3641808          0 pps
  Output packets:              0          0 pps
Protocol inet, MTU: 4470, Generation: 46, Route table: 0
  Flags: None
Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
Destination: 10.1.36.0/30, Local: 10.1.36.2, Broadcast: 10.1.36.3,
Generation: 38
Protocol iso, MTU: 4469, Generation: 47, Route table: 0
  Flags: None
Protocol mp1s, MTU: 4458, Generation: 48, Route table: 0
  Flags: None

```

Sample Output 2 user@R3> **show interfaces so-0/0/3**

```

Physical interface: so-0/0/3, Enabled, Physical link is Up
  Interface index: 131, SNMP ifIndex: 24
Link-level type: PPP, MTU: 4474, Clocking: Internal, SONET mode, Speed: OC3,
Loopback: None, FCS: 16,
  Payload scrambler: Enabled
Device flags : Present Running
Interface flags: Point-To-Point SNMP-Traps
Link flags : Keepalives
Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
Keepalive: Input: 736827 (00:00:03 ago), Output: 736972 (00:00:05 ago)
LCP state: Opened
NCP state: inet: Opened, inet6: Not-configured, iso: Opened, mp1s: Opened
CHAP state: Not-configured
CoS queues : 4 supported
Last flapped : 2004-07-21 16:08:01 PDT (10w5d 19:57 ago)
Input rate : 40 bps (0 pps)
Output rate : 48 bps (0 pps)
SONET alarms : None
SONET defects : None

Logical interface so-0/0/3.0 (Index 70) (SNMP ifIndex 51)
  Flags: Point-To-Point SNMP-Traps Encapsulation: PPP
  Protocol inet, MTU: 4470
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
    Destination: 10.1.36.0/30, Local: 10.1.36.1, Broadcast: 10.1.36.3
  Protocol iso, MTU: 4470
    Flags: None
  Protocol mp1s, MTU: 4458
    Flags: None

```

What It Means Sample Output 1 from egress router **R6** shows that there are no SONET alarms or defects (**none**), the states are all **OK**, and the path trace shows the distant end (**R3 so-0.0.0**), indicating that the physical link is up. However, the logical link is down, and the link-level type is Cisco HDLC.

Sample Output 2 from transit router **R3** shows that the link-level type is PPP, indicating that the encapsulation types are mismatched, resulting in the LSP going down.

Step 3: Take Appropriate Action

Purpose Depending on the error you encountered in your investigation, you must take the appropriate action to correct the problem. In the example below, the encapsulation types are mismatched.

Action To correct the error in this example, enter the following commands:

```
[edit interfaces so-0/0/3]
user@R1# show
user@R1# delete encapsulation
user@R1# show
user@R1# commit
```

Sample Output

```
[edit interfaces so-0/0/3]
user@R6# show
encapsulation cisco-hdlc;
unit 0 {
    family inet {
        address 10.1.36.2/30;
    }
    family iso;
    family mpls;
}

[edit interfaces so-0/0/3]
user@R6# delete encapsulation

[edit interfaces so-0/0/3]
user@R6# show
unit 0 {
    family inet {
        address 10.1.36.2/30;
    }
    family iso;
    family mpls;
}

[edit interfaces so-0/0/3]
user@R6# commit
commit complete
```

What It Means The sample output from egress router **R6** shows that the Cisco HDLC was incorrectly configured on interface **so-0/0/3** which prevented the LSP from using the intended path. The problem was corrected when the **encapsulation** statement was deleted and the configuration committed.

Step 4: Verify the LSP Again

Action From the ingress, egress, and transit routers, verify that the LSP is up and traversing the network as expected:

```
user@host> show mpls lsp extensive
```

Sample Output 1 user@R1> show mpls lsp extensive

```
Ingress LSP: 1 sessions

10.0.0.6
  From: 10.0.0.1, State: Up, ActiveRoute: 1, LSPname: R1-to-R6
  ActivePath: (primary)
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
  *Primary State: Up
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 20)
  10.1.13.2 S 10.1.36.2 S
    Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node
10=SoftPreempt):
      10.1.13.2 10.1.36.2
      145 Sep 30 12:25:01 Selected as active path
      144 Sep 30 12:25:01 Record Route: 10.1.13.2 10.1.36.2
      143 Sep 30 12:25:01 Up
      142 Sep 30 12:25:01 Originate Call
      141 Sep 30 12:25:01 CSPF: computation result accepted
      140 Sep 30 12:24:32 CSPF failed: no route toward 10.0.0.6[74 times]
      139 Sep 30 11:48:57 Deselected as active
      138 Sep 30 11:48:56 CSPF failed: no route toward 10.0.0.6
      137 Sep 30 11:48:56 Clear Call
      136 Sep 30 11:48:56 CSPF: link down/deleted
10.1.36.1(R3.00/10.0.0.3)->10.1.36.2(R6.00/10.0.0.6)
  [...Output truncated...]
  Created: Sat Jul 10 18:18:43 2004
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions

10.0.0.1
  From: 10.0.0.6, LSPstate: Up, ActiveRoute: 0
  LSPname: R6-to-R1, LSPpath: Primary
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: -
  Resv style: 1 FF, Label in: 3, Label out: -
  Time left: 134, Since: Thu Sep 30 12:24:56 2004
  Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
  Port number: sender 6 receiver 39024 protocol 0
  PATH rcvfrom: 10.1.13.2 (so-0/0/2.0) 7 pkts
  Adspec: received MTU 1500
  PATH sentto: localclient
  RESV rcvfrom: localclient
  Record route: 10.1.36.2 10.1.13.2 <self>
Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

Sample Output 2 user@R6> show mpls lsp extensive

Ingress LSP: 1 sessions

10.0.0.1**From: 10.0.0.6, State: Up, ActiveRoute: 1, LSPname: R6-to-R1**

ActivePath: (primary)

LoadBalance: Random

Encoding type: Packet, Switching type: Packet, GPID: IPv4

*Primary State: Up

Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 20)

10.1.36.1 S 10.1.13.1 SReceived RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node
10=SoftPreempt):

10.1.36.1 10.1.13.1

50 Sep 30 12:24:12 Selected as active path

49 Sep 30 12:24:12 Record Route: 10.1.36.1 10.1.13.1

48 Sep 30 12:24:12 Up

47 Sep 30 12:24:12 Originate Call

46 Sep 30 12:24:12 CSPF: computation result accepted

45 Sep 30 12:23:43 CSPF failed: no route toward 10.0.0.1[73 times]

44 Sep 30 11:48:12 Deselected as active

43 Sep 30 11:48:12 CSPF failed: no route toward 10.0.0.1

42 Sep 30 11:48:12 CSPF: link down/deleted

10.1.36.2(R6.00/10.0.0.6)->10.1.36.1(R3.00/10.0.0.3)

[...Output truncated...]

Created: Tue Aug 17 12:18:34 2004

Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions

10.0.0.6**From: 10.0.0.1, LSPstate: Up, ActiveRoute: 0**

LSPname: R1-to-R6, LSPpath: Primary

Suggested label received: -, Suggested label sent: -

Recovery label received: -, Recovery label sent: -

Resv style: 1 FF, Label in: 3, Label out: -

Time left: 159, Since: Thu Sep 30 12:24:16 2004

Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500

Port number: sender 19 receiver 44251 protocol 0

PATH rcvfrom: 10.1.36.1 (so-0/0/3.0) 4 pkts

Adspec: received MTU 1500

PATH sentto: localclient

RESV rcvfrom: localclient

Record route: 10.1.13.1 10.1.36.1 <self>

Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions

Total 0 displayed, Up 0, Down 0

Sample Output 3 user@R3> show mpls lsp extensive

Ingress LSP: 0 sessions

Total 0 displayed, Up 0, Down 0

Egress LSP: 0 sessions

Total 0 displayed, Up 0, Down 0

Transit LSP: 2 sessions

10.0.0.1

From: 10.0.0.6, LSPstate: Up, ActiveRoute: 1
 LSPname: R6-to-R1, LSPpath: Primary
 Suggested label received: -, Suggested label sent: -
 Recovery label received: -, Recovery label sent: 3
 Resv style: 1 FF, Label in: 100176, Label out: 3
 Time left: 143, Since: Thu Sep 30 12:21:25 2004
 Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
 Port number: sender 6 receiver 39024 protocol 0
 PATH rcvfrom: 10.1.36.2 (so-0/0/3.0) 10 pkts
 Adspec: received MTU 1500 sent MTU 1500
 PATH sentto: 10.1.13.1 (so-0/0/2.0) 9 pkts
 RESV rcvfrom: 10.1.13.1 (so-0/0/2.0) 9 pkts
 Explct route: 10.1.13.1
Record route: 10.1.36.2 <self> 10.1.13.1

10.0.0.6

From: 10.0.0.1, LSPstate: Up, ActiveRoute: 1
 LSPname: R1-to-R6, LSPpath: Primary
 Suggested label received: -, Suggested label sent: -
 Recovery label received: -, Recovery label sent: 3
 Resv style: 1 FF, Label in: 100192, Label out: 3
 Time left: 148, Since: Thu Sep 30 12:21:30 2004
 Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
 Port number: sender 19 receiver 44251 protocol 0
 PATH rcvfrom: 10.1.13.1 (so-0/0/2.0) 9 pkts
 Adspec: received MTU 1500 sent MTU 1500
 PATH sentto: 10.1.36.2 (so-0/0/3.0) 9 pkts
 RESV rcvfrom: 10.1.36.2 (so-0/0/3.0) 9 pkts
 Explct route: 10.1.36.2
Record route: 10.1.13.1 <self> 10.1.36.2

Total 2 displayed, Up 2, Down 0

Sample Output 4

```

user@R1> show configuration protocols mpls
label-switched-path R1-to-R6 {
    to 10.0.0.6;
}
inactive: interface so-0/0/0.0;
inactive: interface so-0/0/1.0;
interface so-0/0/2.0;

user@R6> show configuration protocols mpls
label-switched-path R6-to-R1 {
    to 10.0.0.1;
}
inactive: interface so-0/0/0.0;
inactive: interface so-0/0/1.0;
inactive: interface so-0/0/2.0;
interface so-0/0/3.0;

user@R3> show configuration protocols mpls
interface fxp0.0 {
    disable;
}
inactive: interface so-0/0/0.0;
inactive: interface so-0/0/1.0;
interface so-0/0/2.0;
interface so-0/0/3.0;
  
```

What It Means Sample Outputs 1 and 2 from ingress router **R1** and egress router **R6**, respectively, show that the LSP is now traversing the network along the expected path, from **R1** through **R3** to **R6**, and the reverse LSP, from **R6** through **R3** to **R1**.

Sample Output 3 from transit router **R3** shows that there are two transit LSP sessions, one from **R1** to **R6** and the other from **R6** to **R1**.

Sample Output 4 shows the interfaces that were deactivated on the ingress, egress, and transit routers, forcing the LSP to take the intended path. If these interfaces were not deactivated, even though the configuration is now correct, the LSP would still traverse the network through the alternate path.