

Chapter 6

Working with the Layered MPLS Troubleshooting Model

This chapter describes the different layers that you must verify when troubleshooting a Multiprotocol Label Switching (MPLS) network. (See Table 12.) The chapter also includes the example network used throughout the book to illustrate various problems that can occur in an MPLS network.

Table 12: Checklist for Working with the Layered MPLS Troubleshooting Model

Working with the Layered MPLS Troubleshooting Model Tasks	Command or Action
Understanding the Layered MPLS Troubleshooting Model on page 86	show mpls lsp show mpls lsp extensive show mpls lsp name <i>name</i> show mpls lsp name <i>name</i> extensive

Understanding the Layered MPLS Troubleshooting Model

Purpose The layered MPLS troubleshooting model is a disciplined approach to investigating problems with an MPLS network. Figure 8 illustrates the layers in the model, and the commands you can use to structure your investigation. Because of the complexity of the MPLS network, you can obtain much better results from your investigations if you progress through the layers and verify the functioning of each layer on the ingress, egress, and transit routers before moving on to the next layer.

Figure 8: Layered MPLS Network Troubleshooting Model

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
<div>↙ IGP and IP Layers Functioning ↘</div>	
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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As you move from one layer of the model to the next, you verify the correct functioning of a different component of the MPLS network and eliminate that layer as the source of the problem.

Physical Layer When you investigate the physical layer, you check that the routers are connected, and the interfaces are up and configured correctly. To check the physical layer, enter the `show interfaces`, `show interfaces terse`, and `ping` commands. If there is a problem in the physical layer, take appropriate action to fix it; then check that the LSP is operating as expected using the `show mpls lsp extensive` command. For more information on checking the physical layer, see “Verifying the Physical Layer” on page 93.

- Data Link Layer** When you investigate the data link layer, you 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. To check the data link layer, enter the **show interfaces extensive** command. If there is a problem in the data link layer, take appropriate action to fix it; then check that the LSP is operating as expected using the **show mpls lsp extensive** command. For more information on checking the data link layer, see “Checking the Data Link Layer” on page 102 and the *JUNOS Interfaces Operations Guide*.
- IP Layer** When you investigate the IP layer, you verify that interfaces have correct IP addressing, and that the interior gateway protocol (IGP) neighbor adjacencies are established. To check the IP layer, enter the **show interfaces terse**, **show ospf neighbor extensive**, and **show isis adjacency extensive** commands. If there is a problem in the IP layer, take appropriate action to fix it; then check that the LSP is operating as expected using the **show mpls lsp extensive** command.
- IGP Layer** When you investigate the IGP layer, you verify that the the Open Shortest Path First (OSPF) or Intermediate System-to-Intermediate System (IS-IS) protocols are configured and running correctly. For more information about configuring OSPF and IS-IS, see “Configuring MPLS on Your Network” on page 6.
- If you have the OSPF protocol configured, you must check the IP layer first, and then the OSPF configuration. When you investigate the OSPF layer, you check that the protocol, interfaces, and traffic engineering are configured correctly. To check the OSPF layer, enter the **show configuration protocols ospf** and **show ospf interface** commands. If the problem exists in the OSPF layer, take appropriate action to fix it; then check that the LSP is operating as expected using the **show mpls lsp extensive** command. For more information about checking the OSPF layer, see “Verifying the IP and IGP Layers” on page 113.
 - If you have the IS-IS protocol configured, because IS-IS and IP are independent of each other, it doesn’t matter which one you check first. When you check the IS-IS configuration, you verify that IS-IS adjacencies are up, and the interfaces and IS-IS protocol are configured correctly. To check the IS-IS layer, enter the **show isis adjacency**, **show configuration protocols isis**, and **show isis interfaces** commands. If the problem exists in the IS-IS layer, take appropriate action to fix it; then check that the LSP is operating as expected using the **show mpls lsp extensive** command. For more information about checking the IS-IS layer, see “Verifying the IP and IGP Layers” on page 113.



NOTE: The IS-IS protocol has traffic engineering enabled by default.

RSVP and MPLS Layers After you have both the IP and IGP layers functioning and the problem is still not solved, you can begin to check the Resource Reservation Protocol (RSVP) and MPLS layers to determine if the problem is in one of these layers.

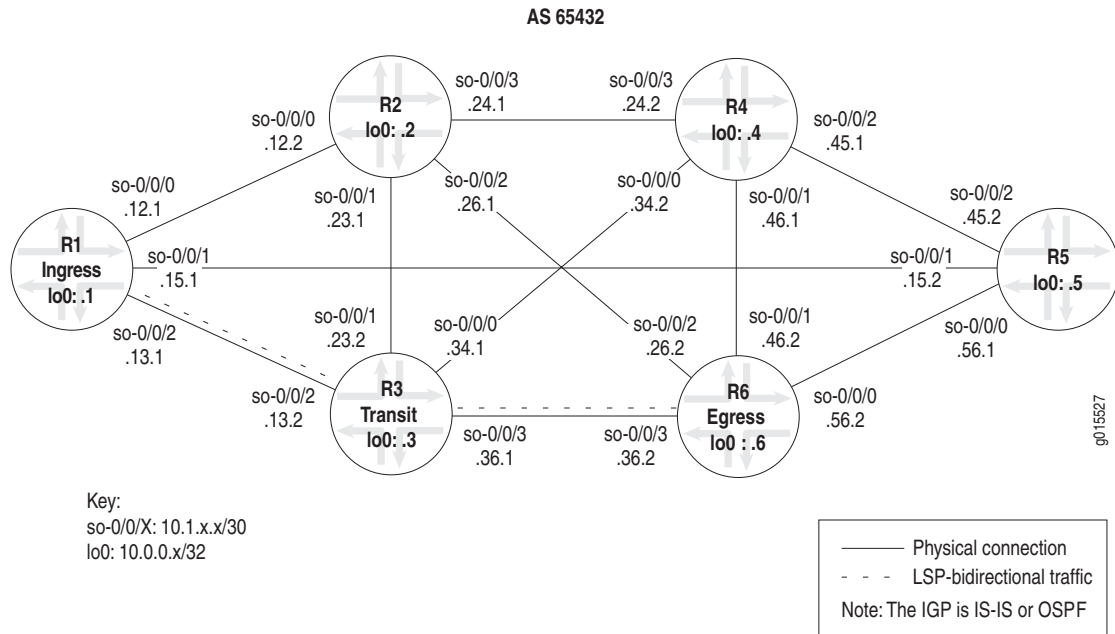
- When you investigate the RSVP layer, you are checking that dynamic RSVP signaling is occurring as expected, neighbors are connected, and interfaces are configured correctly for RSVP. To check the RSVP layer, enter the **show rsvp session**, **show rsvp neighbor**, and **show rsvp interface** commands. If there is a problem in the RSVP layer, take appropriate action to fix it; then check that the LSP is operating as expected using the **show mpls lsp extensive** command.
- When you investigate the MPLS layer, you are checking whether the LSP is up and functioning correctly. To check the MPLS layer, enter the **show mpls lsp**, **show mpls lsp extensive**, **show route table mpls.0**, **show route address**, **traceroute address**, and **ping mpls rsvp lsp-name detail** commands. If there is a problem in the MPLS layer, take appropriate action to fix it; then check that the LSP is operating as expected using the **show mpls lsp extensive** command.

BGP Layer If the problem persists after you have checked the RSVP and MPLS layers, you must verify that the Border Gateway Protocol (BGP) is working correctly. There is no point in checking the BGP layer unless the LSP is established because BGP uses the MPLS LSP to forward traffic. When you check the BGP layer, you verify that the route is present and active, and more importantly, you ensure that the next hop is the LSP. To check the BGP layer, enter the **traceroute host-name**, **show bgp summary**, **show configuration protocols bgp**, **show route destination-prefix detail**, and **show route receive protocol bgp neighbor-address** commands. For more information on checking the BGP layer, see “Checking the BGP Layer” on page 179.

In reality, you could start at any level of the MPLS model to investigate a problem with your MPLS network. However, a disciplined approach, as the one described here, produces more consistent and reliable results.

Figure 9 illustrates the basic network topology used in all the chapters in Part 2.

Figure 9: MPLS Basic Network Topology Example



The MPLS network consists of the following components:

- Router-only network with SONET interfaces
- MPLS protocol enabled on all routers, with interfaces selectively deactivated to illustrate a particular problem scenario
- All interfaces configured with MPLS
- A full-mesh IBGP topology, using AS 65432
- IS-IS or OSPF as the underlying IGP, using one level (IS-IS Level 2) or one area (OSPF area 0.0.0.0)
- A **send-statics** policy on routers R1 and R6, allowing a new route to be advertised into the network
- Two LSPs between routers R1 and R6, allowing for bidirectional traffic.

After you have configured an LSP, it is considered best practice to issue the **show mpls lsp** command to verify that the LSP is up, and to investigate further if you find an error message in the output. The error message can indicate a problem at any layer of the MPLS network.

The LSPs can be ingress, transit, or egress. Use the `show mpls lsp` command for quick verification of the LSP state, with the `extensive` option (`show mpls lsp extensive`) as a follow-up if the LSP is down. 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 begin the investigation of an error in your MPLS network, from the ingress router, enter some or all of the following JUNOS command-line interface (CLI) operational mode commands:

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

Sample Output 1

```
user@R1> show mpls lsp
Ingress LSP: 1 sessions
To          From          State Rt ActivePath      P      LSPName
10.0.0.6    10.0.0.1      Up    1
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions
To          From          State Rt Style Labelin Labelout LSPName
10.0.0.1    10.0.0.6      Up    0 1 FF      3      - R6-to-R1
Total 1 displayed, Up 1, Down 0

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

Sample Output 2

```
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 RR0 (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node
10=SoftPreempt):
        10.1.13.2 10.1.36.2
30 Dec 28 13:47:29 Selected as active path
29 Dec 28 13:47:29 Record Route: 10.1.13.2 10.1.36.2
28 Dec 28 13:47:29 Up
27 Dec 28 13:47:29 Originate Call
26 Dec 28 13:47:29 CSPF: computation result accepted
25 Dec 28 13:46:59 CSPF failed: no route toward 10.0.0.6
24 Dec 28 13:46:39 Deselected as active
23 Dec 28 13:46:39 CSPF failed: no route toward 10.0.0.6
22 Dec 28 13:46:39 Clear Call
21 Dec 28 13:46:39 ResvTear received
20 Dec 28 13:46:39 Down
19 Dec 28 13:46:39 10.1.13.2: Session preempted
18 Dec 28 13:42:07 Selected as active path
17 Dec 28 13:42:07 Record Route: 10.1.13.2 10.1.36.2
16 Dec 28 13:42:07 Up
15 Dec 28 13:42:07 Originate Call
14 Dec 28 13:42:07 CSPF: computation result accepted
13 Dec 28 13:41:37 CSPF failed: no route toward 10.0.0.6
```

```

12 Dec 28 13:41:16 Deselected as active
11 Dec 28 13:41:16 CSPF failed: no route toward 10.0.0.6
10 Dec 28 13:41:16 Clear Call
9 Dec 28 13:41:16 ResvTear received
8 Dec 28 13:41:16 Down
7 Dec 28 13:41:16 10.1.13.2: Session preempted
6 Dec 13 11:50:15 Selected as active path
5 Dec 13 11:50:15 Record Route: 10.1.13.2 10.1.36.2
4 Dec 13 11:50:15 Up
3 Dec 13 11:50:15 Originate Call
2 Dec 13 11:50:15 CSPF: computation result accepted
1 Dec 13 11:49:45 CSPF failed: no route toward 10.0.0.6[6 times]
---(more)---[abort]

```

Sample Output 3

```

user@R1> show mpls lsp name R1-to-R6
Ingress LSP: 1 sessions
To          From          State Rt ActivePath      P    LSPname
10.0.0.6    10.0.0.1      Up    1
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions
Total 0 displayed, Up 0, Down 0

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

```

Sample Output 4

```

user@R1> show mpls lsp name R1-to-R6 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
30 Dec 28 13:47:29 Selected as active path
29 Dec 28 13:47:29 Record Route: 10.1.13.2 10.1.36.2
28 Dec 28 13:47:29 Up
27 Dec 28 13:47:29 Originate Call
26 Dec 28 13:47:29 CSPF: computation result accepted
25 Dec 28 13:46:59 CSPF failed: no route toward 10.0.0.6
24 Dec 28 13:46:39 Deselected as active
23 Dec 28 13:46:39 CSPF failed: no route toward 10.0.0.6
22 Dec 28 13:46:39 Clear Call
21 Dec 28 13:46:39 ResvTear received
20 Dec 28 13:46:39 Down
19 Dec 28 13:46:39 10.1.13.2: Session preempted
18 Dec 28 13:42:07 Selected as active path
17 Dec 28 13:42:07 Record Route: 10.1.13.2 10.1.36.2
16 Dec 28 13:42:07 Up
15 Dec 28 13:42:07 Originate Call
14 Dec 28 13:42:07 CSPF: computation result accepted
13 Dec 28 13:41:37 CSPF failed: no route toward 10.0.0.6
12 Dec 28 13:41:16 Deselected as active
11 Dec 28 13:41:16 CSPF failed: no route toward 10.0.0.6
10 Dec 28 13:41:16 Clear Call
9 Dec 28 13:41:16 ResvTear received

```

```

      8 Dec 28 13:41:16 Down
      7 Dec 28 13:41:16 10.1.13.2: Session preempted
      6 Dec 13 11:50:15 Selected as active path
      5 Dec 13 11:50:15 Record Route: 10.1.13.2 10.1.36.2
      4 Dec 13 11:50:15 Up
      3 Dec 13 11:50:15 Originate Call
      2 Dec 13 11:50:15 CSPF: computation result accepted
      1 Dec 13 11:49:45 CSPF failed: no route toward 10.0.0.6[6 times]
Created: Mon Dec 13 11:47:19 2004
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 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 the ingress router R1 shows that the label-switched path is traversing the network as intended, from R1 through R3 to R6, and another LSP in the reverse direction, from R6 through R3 to R1.

If your network has numerous LSPs, you might consider using the `show mpls lsp` command for quick verification of the LSP state. and the `show mpls lsp name name extensive` command to continue your investigation if you find that the LSP is down.

For more information about the status and statistics of the `show mpls lsp` command, see “Determining the LSP State” on page 59. For more information on the availability and valid use of an LSP, see “Verifying LSP Use” on page 77.

In the chapters from “Verifying the Physical Layer” on page 93 through “Checking the MPLS Layer” on page 161, the network topology is broken at different layers of the network to investigate various MPLS network problems. The problems presented are not inclusive. Instead, the problems serve to illustrate one possible process of investigation into the different model layers.