Chapter 11

Verify the IS-IS Protocol and Adjacencies

This chapter describes how to check whether the Intermediate System-to-Intermediate System (IS-IS) protocol is configured correctly on a Juniper Networks router and that the proper adjacencies are formed in a network. (See Table 31.)

Table 31: Checklist for Verifying the IS-IS Protocol and Adjacencies

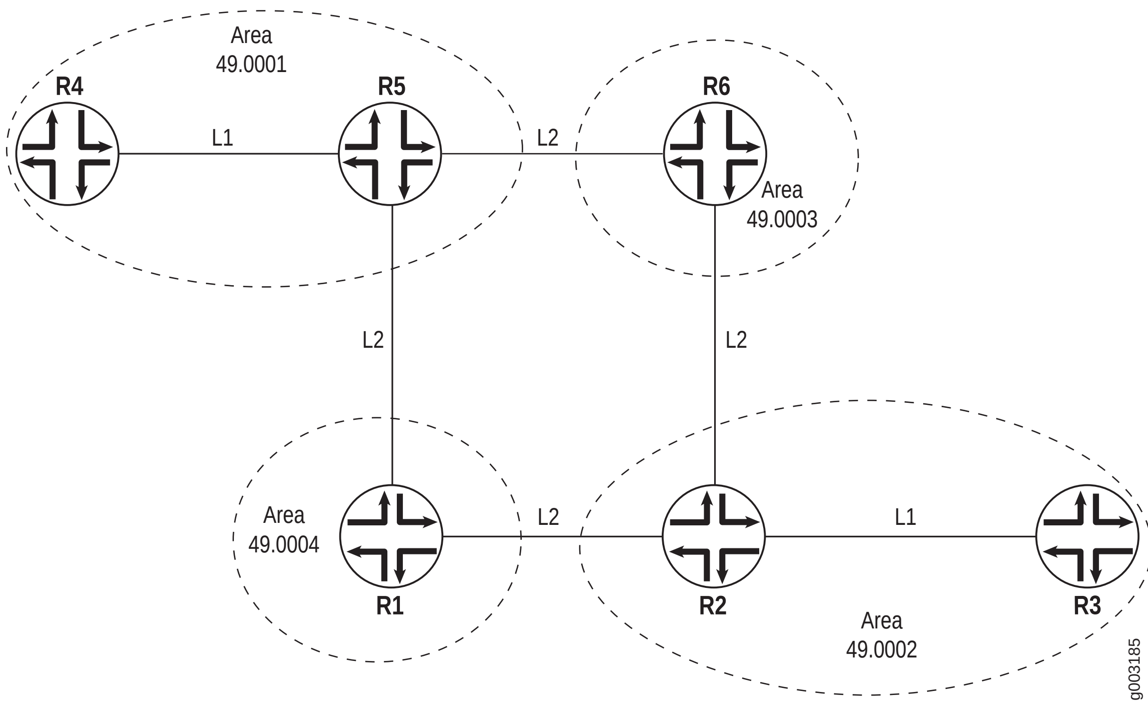
Verify the IS–IS Protocol and Adjacencies Tasks	Command or Action
Verify the IS-IS Configuration on a Router in a Network on page 112	
1. Check the Configuration of a Level 1/Level 2 Router on page 114	[edit protocols isis] show [edit protocols isis] run show isis interface [edit] edit interfaces [edit interfaces] show
2. Check the Configuration of a Level 1 Router on page 116	[edit protocols isis] show [edit protocols isis] run show isis interface [edit] edit interfaces [edit interfaces] show
3. Check the Configuration of a Level 2 Router on page 117	[edit protocols isis] show [edit protocols isis] run show isis interface [edit] edit interfaces [edit interfaces] show
Display the Status of IS-IS Adjacencies on page 119	
1. Verify Adjacent Routers on page 120	show isis adjacency
2. Examine a Route on page 121	show route *destination-prefix* show route detail *destination-prefix* show isis route *destination-prefix*
3. Examine the Forwarding Table on page 123	show route forwarding-table destination *destination-prefix*
4. Examine the Link-State Database on page 124	show isis database
5. Examine a Link-State Protocol Data Unit Header on page 126	show isis database extensive

Verify the IS-IS Configuration on a Router in a Network

Purpose For IS-IS to run on a router (intermediate system) in your network, you must enable IS-IS on the router, configure a network entity title (NET) on the loopback interface (lo0), and configure family iso on all interfaces on which you want to run IS-IS. When you enable IS-IS on a router, Level 1 and Level 2 are enabled by default.

Figure 7 illustrates an example of routers at different levels in an IS-IS topology.

Figure 7: Levels in an IS-IS Network Topology

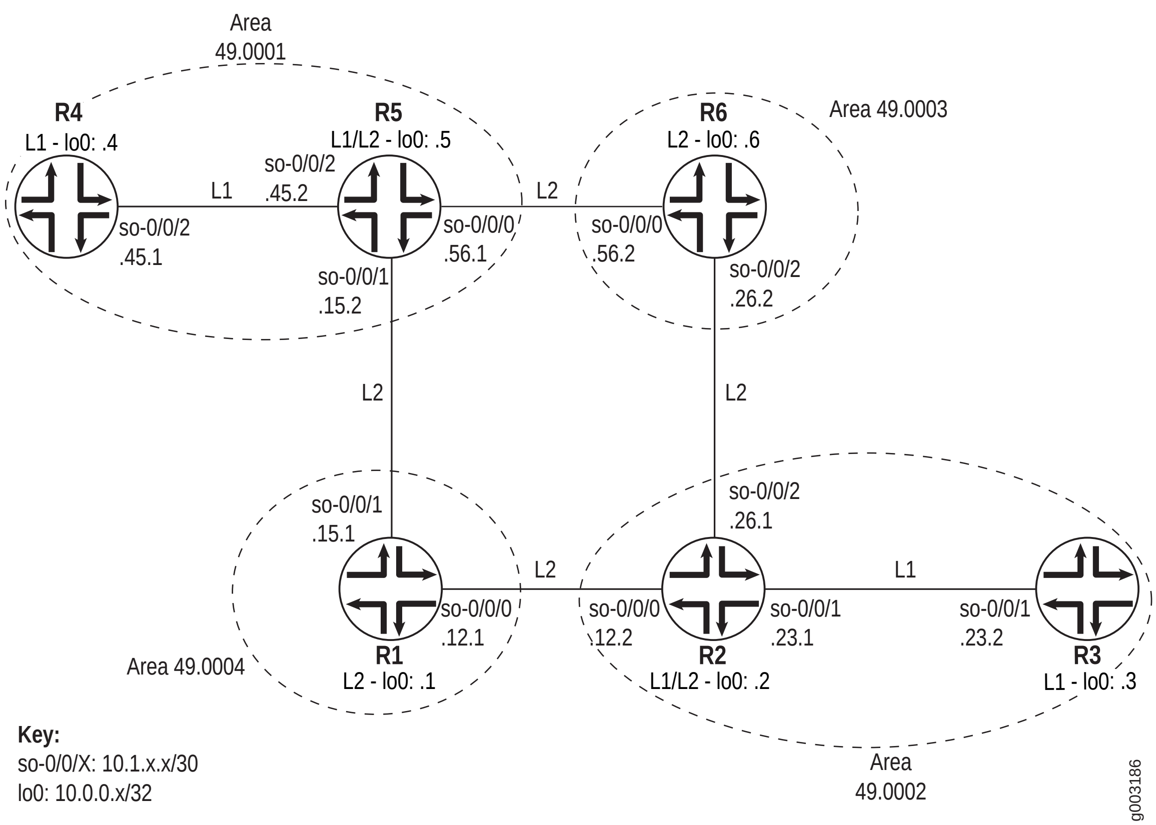


The network in Figure 7 is organized hierarchically and consists of Level 2, Level 1/Level 2, and Level 1 routers in one autonomous system (AS) divided into four areas: 49.0001, 49.0002, 49.0003, and 49.0004. The Level 2 routers route toward other autonomous systems. The Level 1/Level 2 routers route between areas and to other autonomous systems. The Level 1 routers route within an area, and when the destination is outside the local area, they route toward a Level1/Level2 system.

In the following steps, the configuration of the various types of routers is examined.

Figure 8 provides more details about the IS-IS network topology on page 112 so that you can verify the configuration output of the various routers.

Figure 8: IS-IS Network Topology with Details



Steps To Take To verify that IS-IS is configured correctly on routers at different levels, follow these steps:

1. Check the Configuration of a Level 1/Level 2 Router on page 114
2. Check the Configuration of a Level 1 Router on page 116
3. Check the Configuration of a Level 2 Router on page 117

Step 1: Check the Configuration of a Level 1/Level 2 Router

Action To verify the IS-IS configuration of a Level 1/Level 2 router in your network, enter the following JUNOS command-line interface (CLI) commands:

user@host# [edit protocols isis] **show**
user@host# [edit protocols isis] **run show isis interface**
user@host# [edit] **edit interfaces**
user@host# [edit interfaces] **show**

Sample output The following output is for an IS-IS configuration on R2, a Level 1/Level 2 router in the network shown in Figure 7:

```
[edit protocols isis]
user@R2# show
interface so-0/0/0.0 {
    level 2 metric 10;
    level 1 disable;
}
interface so-0/0/1.0 {
    level 2 disable;
    level 1 metric 10;
}
interface so-0/0/2.0 {
    level 2 metric 10;
    level 1 disable;
}
interface fxp0.0 {
    disable;
}
interface lo0.0;

[edit protocols isis]
user@R2# run show isis interface
IS-IS interface database:
Interface             L CirID Level 1 DR        Level 2 DR        L1/L2 Metric
lo0.0                 0   0x1 Passive           Passive                  0/0
so-0/0/0.0            2   0x1 Disabled          Point to Point         10/10
so-0/0/1.0            3   0x1 Point to Point    Point to Point         10/10
so-0/0/2.0            2   0x1 Disabled          Point to Point         10/10

[edit interfaces]
user@R2# show
so-0/0/0 {
    unit 0 {
        family inet {
            address 10.1.12.2/30;
        }
        family iso;
    }
}
so-0/0/1 {
    unit 0 {
        family inet {
            address 10.1.23.1/30;
        }
        family iso;
    }
}
```

```
so-0/0/2 {
    unit 0 {
        family inet {
            address 10.1.26.1/30;
        }
        family iso;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.2/32;
        }
        family iso {
            address 49.0002.1000.0000.0002.00;
        }
    }
}
```

What It Means

The sample output shows a basic configuration of IS-IS on R2, a Level 1/Level 2 router. The basic configuration is at the [edit protocols isis] and [edit interfaces] hierarchy levels.

At the [edit protocols isis] level, five interfaces are included: so-0/0/0, so-0/0/1, so-0/0/2, fxp0, and the loopback (lo0) interface. Two interfaces, so-0/0/0.0 and so-0/0/2.0, have Level 1 disabled, making them Level 2 interfaces. One interface, so-0/0/1.0, has Level 2 disabled, making it a Level 1 interface. The management interface (fxp0) is disabled so that IS-IS packets are not sent over it, and the loopback interface (lo0) is included because it becomes a point of connection from the router to the IS-IS network.

At the [edit interfaces] hierarchy level, all of the interfaces included in the [edit protocols isis] hierarchy level are configured with family iso, and the loopback (lo0) interface is configured with the NET address 49.0002.1000.0000.0002.00. Every router in an IS-IS network must have at least one NET address that identifies a point of connection to the IS-IS network. The NET address is generally configured on the loopback (lo0) interface. Routers that participate in multiple areas can have multiple NET addresses.

See the *JUNOS Routing Protocols Configuration Guide* for more information on configuring IS-IS on a router.

Step 2: Check the Configuration of a Level 1 Router

Action To check the configuration of a Level 1 router, enter the following CLI commands:

user@host# [edit protocols isis] **show**
user@host# [edit protocols isis] **run show isis interface**
user@host# [edit] **edit interfaces**
user@host# [edit interfaces] **show**

Sample Output: The following sample output is for R4, a Level 1 router in the network shown in Figure 7:

```
[edit protocols isis]
user@R4# show
level 2 disable;
interface so-0/0/2.0 {
    level 1 metric 10;
}
interface fxp0.0 {
    disable;
}
interface lo0.0;

[edit protocols isis]
user@R4# run show isis interface
IS-IS interface database:
Interface            L CirID Level 1 DR        Level 2 DR        L1/L2 Metric
lo0.0                0   0x1 Passive           Passive                  0/0
so-0/0/2.0           1   0x1 Point to Point    Disabled               10/10

[edit interfaces]
user@R4# show
so-0/0/2 {
    unit 0 {
        family inet {
            address 10.1.45.1/30;
        }
        family iso;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.4/32;
        }
        family iso {
            address 49.0001.1000.0000.0004.00;
        }
    }
}
```

What It Means The sample output shows a basic configuration of IS-IS on R4, a Level 1 router. The basic configuration is at the [edit protocols isis] and [edit interfaces] hierarchy levels.

At the [edit protocols isis] hierarchy level, three interfaces are included: so-0/0/2.0, fxp0, and the loopback (lo0) interface. Level 2 is disabled on the router, making it a Level 1 router that sends packets within its local area, 49.0001. When a packet destination is outside the local area, R4 establishes an adjacency with the nearest Level 1/Level 2 router (R5) that forwards the packets. For more information on adjacencies, see "Display the Status of IS-IS Adjacencies" on page 119.

One interface, so-0/0/2.0, is configured for IS-IS. The management interface (fxp0) is disabled so that IS-IS packets are not sent over it, and the loopback interface (lo0) is included because it becomes a point of connection from the router to the IS-IS network.

At the [edit interfaces] hierarchy level, the interface included in the [edit protocols isis] hierarchy level is also configured with family iso, and the loopback (lo0) interface is configured with the NET address of 49.0001.1000.0000.0004.00. Every router in an IS-IS network must have at least one NET address that identifies a point of connection to the IS-IS network. The NET address is generally configured on the loopback (lo0) interface. Routers that participate in multiple areas can have multiple NET addresses.

See the *JUNOS Routing Protocols Configuration Guide* for more information on configuring IS-IS on a router.

Step 3: Check the Configuration of a Level 2 Router

Action To check the configuration of a Level 2 router, enter the following CLI commands:

user@host# [edit protocols isis] **show**
user@host# [edit protocols isis] **run show isis interface**
user@host# [edit] **edit interfaces**
user@host# [edit interfaces] **show**

Sample Output: The following sample output is for R6, a Level 2 router in the network shown in Figure 7:

```
[edit protocols isis]
user@R6# show
level 1 disable;
interface so-0/0/0.0 {
    level 2 metric 10;
}
interface so-0/0/2.0 {
    level 2 metric 10;
}
interface fxp0.0 {
    disable;
}
interface lo0.0;

[edit protocols isis]
user@R6# run show isis interface
IS-IS interface database:
Interface             L CirID Level 1 DR        Level 2 DR        L1/L2 Metric
lo0.0                 0   0x1 Passive           Passive                0/0
so-0/0/0.0            2   0x1 Disabled          Point to Point       10/10
so-0/0/2.0            2   0x1 Disabled          Point to Point       10/10
```

```
[edit interfaces]
user@R6# show
so-0/0/0 {
    unit 0 {
        family inet {
            address 10.1.56.2/30;
        }
        family iso;
    }
}
so-0/0/2 {
    unit 0 {
        family inet {
            address 10.1.26.2/30;
        }
        family iso;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.6/32;
        }
        family iso {
            address 49.0003.1000.0000.0006.00;
        }
    }
}
```

What It Means The sample output shows a basic configuration of IS-IS on R6, a Level 2 router. The basic configuration is at the [edit protocols isis] and [edit interfaces] hierarchy levels.

At the [edit protocols isis] level, four interfaces are included: so-0/0/0.0, so-0/0/2.0, fxp0, and the loopback (lo0) interface. Level 1 is disabled on the two SONET interfaces, making this a Level 2 router that routes between areas and towards other ASs. The management interface (fxp0) is disabled so that IS-IS packets are not sent over it, and the loopback interface (lo0) is included because it becomes a point of connection from the router to the IS-IS network.

At the [edit interfaces] hierarchy level, the interfaces included in the [edit protocols isis] hierarchy level are also configured with family iso, and the loopback (lo0) interface is configured with the NET address of 49.0003.1000.0000.0006.00. Every router in an IS-IS network must have at least one NET address that identifies a point of connection to the IS-IS network. The NET address is generally configured on the loopback (lo0) interface. Routers that participate in multiple areas can have multiple NET addresses.

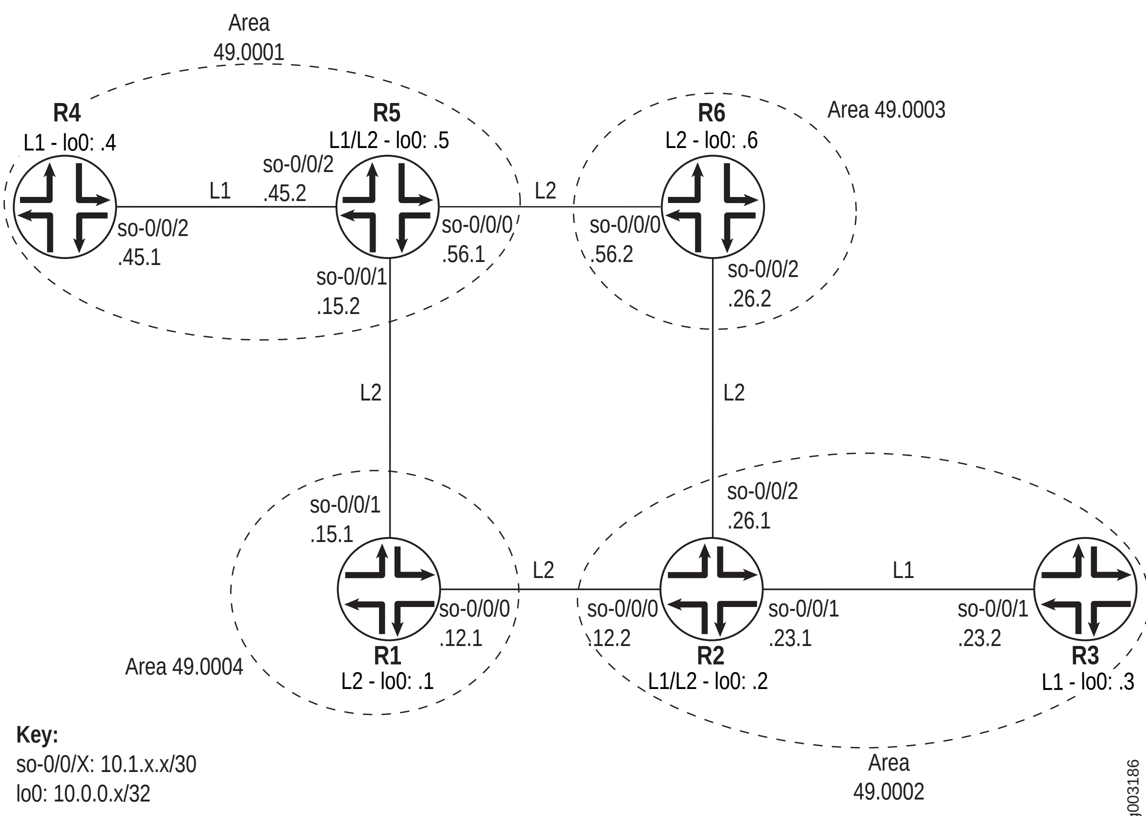
See the *JUNOS Routing Protocols Configuration Guide* for more information on configuring IS-IS on a router.

Display the Status of IS-IS Adjacencies

Purpose Assuming that all the routers are correctly configured for IS-IS, you can verify which neighbors are adjacent and able to exchange IS-IS data. In addition, you can examine the set of routes installed in the forwarding table to verify that the routing protocol process (rpd) has relayed the correct information into the forwarding table.

Figure 9 illustrates the example IS-IS topology used for the procedures in this section.

Figure 9: IS-IS Network Topology



The network consists of Level 1 and Level 2 adjacencies. Level 1 adjacencies are within areas 49.0001 and 49.0002. Level 2 adjacencies occur between all directly connected Level 2 routers regardless of which area they are in. For example, R5 is in area 49.0001, R6 is in area 49.0003, R1 is in area 49.0004, and R2 is in area 49.0002. The network in Figure 9 should have the following adjacencies:

- Level 2 adjacencies between all directly connected Level 2 routers (R1, R2, R5, and R6).
- Level 1 adjacencies between routers in area 49.0001 (R4 and R5) and between routers in area 49.0002 (R2 and R3).

Steps To Take To verify that routers are adjacent and able to exchange IS-IS data, follow these steps:

1. Verify Adjacent Routers on page 120

2. Examine a Route on page 121

3. Examine the Forwarding Table on page 123

4. Examine the Link-State Database on page 124

5. Examine a Link-State Protocol Data Unit Header on page 126

Step 1: Verify Adjacent Routers

Action To verify that routers are adjacent and able to exchange IS-IS data, enter the following CLI operational mode command:

user@host> **show isis adjacency**

Sample Output The following sample output shows the adjacencies that formed for all routers shown in Figure 9:

```
user@R1> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
so-0/0/0.0            R2            2 Up                   19
so-0/0/1.0            R5            2 Up                   18

user@R2> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
so-0/0/0.0            R1            2 Up                   19
so-0/0/1.0            R3            1 Up                   26
so-0/0/2.0            R6            2 Up                   21

user@R3> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
so-0/0/1.0            R2            1 Up                   24

user@R4> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
so-0/0/2.0            R5            1 Up                   23

user@R5> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
so-0/0/0.0            R6            2 Up                   22
so-0/0/1.0            R1            2 Up                   20
so-0/0/2.0            R4            1 Up                   20

user@R6> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
so-0/0/0.0            R5            2 Up                   21
so-0/0/2.0            R2            2 Up                   20
```

What It Means The sample output shows the adjacencies that formed in the network illustrated in Figure 9. The Level 1/Level 2 routers (R2 and R5) formed Level 1 adjacencies with Level 1 routers (R3 and R4), and Level 2 adjacencies with the Level 2 routers (R1 and R6). To view the status of the adjacency, examine the State column. In this example, all adjacencies in the network are up.

If the state is not Up for a particular neighbor, you must first examine the IS-IS configuration for the particular interface. Make sure that the NET address is correct and that the loopback (lo0) interface is configured. Use the **show isis interface** or **show isis interface detail** command to display the IS-IS parameters for all interfaces configured with IS-IS. With these two commands, you can see which interfaces are configured for IS-IS, whether they are configured for Level 1 or Level 2, the IS-IS metric, and other IS-IS information.

Step 2: Examine a Route

Purpose You can determine the cost associated with a route and the selection of a route. In this step, the path from router R5 to R3 is examined in two situations. In the first example, all metrics in the network are set to the default of 10; in the second example, all metrics on a transit router (R6) are set to 5.

Action To examine a route in an IS-IS network, enter one or all of the following CLI commands:

user@host> **show route** *destination-prefix*
user@host> **show route detail** *destination-prefix*
user@host> **show isis route** *destination-prefix*

Sample Output 1 The following sample output shows the route from R5 to R3 when all metrics across interfaces are set to the default of 10:

```
user@R5> show route 10.0.0.3

inet.0: 28 destinations, 28 routes (28 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.3/32        *[IS-IS/18] 00:02:00, metric 30
                      to 10.1.56.2 via so-0/0/0.0
                    > to 10.1.15.1 via so-0/0/1.0

user@R5> show route detail 10.0.0.3

inet.0: 28 destinations, 28 routes (28 active, 0 holddown, 0 hidden)
10.0.0.3/32 (1 entry, 1 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop: 10.1.56.2 via so-0/0/0.0
                Next hop: 10.1.15.1 via so-0/0/1.0, selected
                State: <Active Int>
                Age: 34:29      Metric: 30
                Task: IS-IS
                Announcement bits (1): 0-KRT
                AS path: I

user@R5> show isis route 10.0.0.3
 IS-IS routing table                 Current version: L1: 241 L2: 243
Prefix             L Version Metric Type Interface    Via
10.0.0.3/32        2     243     30 int  so-0/0/0.0   R6
                                         so-0/0/1.0   R1
```

The following sample output shows the IS-IS configuration for transit router R6 with the metric on so-0/0/2.0 changed from the default of 10 to 5:

```
[edit protocols isis]
user@R6# show
level 1 disable;
interface so-0/0/0.0 {
level 2 metric 10;
}
interface so-0/0/2.0 {
    level 2 metric 5;
}
interface fxp0.0 {
    disable;
}
interface lo0.0;
```

Sample Output 2

The following sample output shows the route from R5 to R3 after the metric on R6 is changed from the default of 10 to 5:

```
user@R5> show route 10.0.0.3

inet.0: 28 destinations, 28 routes (28 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.3/32        *[IS-IS/18] 00:00:10, metric 25
                    > to 10.1.56.2 via so-0/0/0.0

user@R5> show route detail 10.0.0.3

inet.0: 28 destinations, 28 routes (28 active, 0 holddown, 0 hidden)
10.0.0.3/32 (1 entry, 1 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop: 10.1.56.2 via so-0/0/0.0, selected
                State: <Active Int>
                Age: 4:57       Metric: 25
                Task: IS-IS
                Announcement bits (1): 0-KRT
                AS path: I

user@R5> show isis route detail 10.0.0.3
 IS-IS routing table                Current version: L1: 250 L2: 257
Prefix             L Version Metric Type Interface    Via
10.0.0.3/32        2     257     25 int  so-0/0/0.0   R6
```

What It Means

Sample output 1 shows the cost for each route and the preferred next hop. In this example, there are two next hops, one through R1 and the other through R6. Both have an equal cost (30) to the destination. The cost is indicated in the Metric field. The preferred next hop is randomly chosen. In this case, the preferred next hop is through R1, interface so-0/0/1.0. In the output for the show route command, the selected next hop is indicated by a forward arrow (>). With the show route detail command, the next hop is indicated by the key word selected. The output for the show isis route command shows the selected interface and indicates that the IS-IS protocol is building the correct routing table from the link-state database.

After the metric on R6 is changed to a lower value, sample output 2 shows a different cost and next hop. With IS-IS, routes with lower total path metrics are preferred over those with higher path metrics. The path through R6 (so-0/0/0.0) is now lower (25) than the path through R1 (so-0/0/1.0) (30). In the output for the show route command, the lower cost (25) is indicated in the Metric field, and the preferred path is indicated by the forward arrow (>) and the keyword selected. The output for the show isis route command shows the selected interface and indicates that the IS-IS protocol is building the correct routing table from the link-state database.

In general, the output for the show route commands shows all active entries in the routing table. The information displayed includes the name of the routing table (inet.0), the number of destinations for which there are routes in the routing table (28), how the route was learned, and the route preference value, such as [IS-IS/18]. In addition, any metric associated with the route (metric 30), and the name of the interface through which the route was learned are displayed.

Step 3: Examine the Forwarding Table

Purpose You can display the set of routes installed in the forwarding table to verify that the routing protocol process (rpd) has relayed the correct information into the forwarding table. This is especially important when there are network problems, such as connectivity. In this procedure, you verify that the routes displayed in Step 2 appear in the forwarding table for router R5.

Action To examine the forwarding table for a router, enter the following CLI command:

user@host> **show route forwarding-table destination** *destination-prefix*

Sample Output

```
user@R5> show route forwarding-table destination 10.0.0.3
Routing table: inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
10.0.0.3/32        user     0 10.1.15.0          ucst   285     7 so-0/0/1.0

user@R5> show route forwarding-table destination 10.0.0.3
Routing table: inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
10.0.0.3/32        user     0 10.1.56.0          ucst   281     9 so-0/0/0.0
```

What It Means The sample output shows the selected next hop between routers R5 and R3 sent from the inet routing table and installed into the forwarding table. The first instance shows the route through R1 and the second instance shows the route through R6. In both instances, the preferred route displayed in Step 2 is installed in the forwarding table.

In general, the sample output includes the destination address and destination type, the next-hop address and next-hop type, the number of references to the next hop, an index number into an internal next-hop database, and the interface used to reach the next hop.

Step 4: Examine the Link-State Database

Purpose You can examine the entire link-state database to obtain important information about the network. In this step, you verify that the key word Attached appears in the output of the Level 1 routers (R3 and R4) and the Level 1/Level 2 routers (R2 and R5).

Action To examine the link-state database for routers at different levels of the network, enter the following CLI command:

user@host> **show isis database**

Sample Output

```
user@R1> show isis database
IS-IS level 1 link-state database:
  0 LSPs

IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R1.00-00                       0x1b   0xd4b5      583 L1 L2
R2.00-00                       0x1d   0x1a4f     1131 L1 L2
R5.00-00                       0x1b   0x6245      883 L1 L2
R6.00-00                       0x20    0xf7c      919 L1 L2
  4 LSPs

user@R2> show isis database
IS-IS level 1 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R2.00-00                       0x56   0xbd8c      862 L1 L2 Attached
R3.00-00                       0x58   0xaca1      463 L1
  2 LSPs

IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R1.00-00                       0x57   0x3e10      871 L1 L2
R2.00-00                       0x5e   0x9790     1150 L1 L2
R5.00-00                       0x5a   0xadba     1162 L1 L2
R6.00-00                       0x56   0xa2b2      484 L1 L2
  4 LSPs

user@R3> show isis database
IS-IS level 1 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R2.00-00                       0x56   0xbd8c      792 L1 L2 Attached
R3.00-00                       0x58   0xaca1      397 L1
  2 LSPs

IS-IS level 2 link-state database:
  0 LSPs

[edit protocols isis]
user@R4> show isis database
IS-IS level 1 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R4.00-00                       0x56   0x34b8     1125 L1
R5.00-00                       0x57   0x22bb      795 L1 L2 Attached
  2 LSPs

IS-IS level 2 link-state database:
  0 LSPs
```

```
user@R5> show isis database
IS-IS level 1 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R4.00-00                       0x56   0x34b8     1071 L1
R5.00-00                       0x57   0x22bb      745 L1 L2 Attached
  2 LSPs

IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R1.00-00                       0x57   0x3e10      707 L1 L2
R2.00-00                       0x5e   0x9790      982 L1 L2
R5.00-00                       0x5a   0xadba     1002 L1 L2
R6.00-00                       0x57   0xa0b3     1064 L1 L2
  4 LSPs

user@R6> show isis database
IS-IS level 1 link-state database:
  0 LSPs

IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
R1.00-00                       0x1b   0xd4b5      728 L1 L2
R2.00-00                       0x1c   0x1c4e      604 L1 L2
R5.00-00                       0x1b   0x6245     1032 L1 L2
R6.00-00                       0x20    0xf7c     1072 L1 L2
  4 LSPs
```

What It Means The sample output shows the details of the Level 1 and Level 2 IS-IS databases for routers R1, R2, R3, R4, R5, and R6. Whether a router is configured for Level 1, Level 2 or Level 1/Level 2 is indicated by the type of IS-IS link-state datebase(s) in the output for the show isis database command for that router. For example, R3 and R4 are Level 1 routers because they do not have LSPs in the Level 2 link-state database, and the R1 and R6 are Level 2 routers because they do not have LSPS in the Level 1 link-state database. R2 and R5 are have LSPs in both Level 1/Level 2 link-state databases, indicating they are Level 1/Level 2 routers.

In addition, the output for R2 shows that it is a Level 1/Level 2 router because it has R3 in its Level 1 database, while R3 does not have the L2 notation in the Attributes field, indicating that it is configured for Level 1.

The details of the Level 2 IS-IS database are the same for all Level 2 routers in the network.

The key word Attached appears in the Level 1 link-state database for R2, R3, R4, and R5, indicating that the Level 2 routers (R2 and R5) can communicate with other Level 2 systems and act as gateways for the Level 1 routers (R3 and R4) in their respective areas. If the links that connect R2 and R5 to the other Level 2 routers (R1 and R6) are broken, the key word Attached will not appear in the output because R2 and R5 will no longer act as gateways for the Level 1 routers.

Step 5: Examine a Link-State Protocol Data Unit Header

Purpose By using the key word extensive, you can examine each header field of a link-state protocol data unit (LSP) and gather important details about the network. In this step, you examine the IS-IS database for router R2.

Action To examine an LSP header, enter the following CLI command:

user@host> **show isis database extensive**

Sample Output

```
user@R2> show isis database extensive
IS-IS level 1 link-state database:
[...Output truncated...]
  Header: LSP ID: R2.00-00, Length: 139 bytes
    Allocated length: 1492 bytes, Router ID: 10.0.0.2
    Remaining lifetime: 1071 secs, Level: 1,Interface: 0
    Estimated free bytes: 1353, Actual free bytes: 1353
    Aging timer expires in: 1071 secs
    Protocols: IP, IPv6

  Packet: LSP ID: R2.00-00, Length: 139 bytes, Lifetime : 1198 secs
    Checksum: 0xbb8d, Sequence: 0x57, Attributes: 0xb <L1 L2 Attached>
    NLPID: 0x83, Fixed length: 27 bytes, Version: 1, Sysid length: 0 bytes
    Packet type: 18, Packet version: 1, Max area: 0
[...Output truncated...]
  Header: LSP ID: R3.00-00, Length: 139 bytes
    Allocated length: 284 bytes, Router ID: 10.0.0.3
    Remaining lifetime: 823 secs, Level: 1,Interface: 68
    Estimated free bytes: 145, Actual free bytes: 145
    Aging timer expires in: 823 secs
    Protocols: IP, IPv6

  Packet: LSP ID: R3.00-00, Length: 139 bytes, Lifetime : 1198 secs
    Checksum: 0xaaa2, Sequence: 0x59, Attributes: 0x1 <L1>
    NLPID: 0x83, Fixed length: 27 bytes, Version: 1, Sysid length: 0 bytes
    Packet type: 18, Packet version: 1, Max area: 0
[...Output truncated...]
IS-IS level 2 link-state database:
[...Output truncated...]
Header: LSP ID: R1.00-00, Length: 194 bytes
    Allocated length: 284 bytes, Router ID: 10.0.0.1
    Remaining lifetime: 398 secs, Level: 2,Interface: 67
    Estimated free bytes: 145, Actual free bytes: 90
    Aging timer expires in: 398 secs
    Protocols: IP, IPv6

  Packet: LSP ID: R1.00-00, Length: 194 bytes, Lifetime : 1196 secs
    Checksum: 0x3e10, Sequence: 0x57, Attributes: 0x3 <L1 L2>
    NLPID: 0x83, Fixed length: 27 bytes, Version: 1, Sysid length: 0 bytes
    Packet type: 20, Packet version: 1, Max area: 0
[...Output truncated...]
Header: LSP ID: R2.00-00, Length: 236 bytes
    Allocated length: 1492 bytes, Router ID: 10.0.0.2
    Remaining lifetime: 677 secs, Level: 2,Interface: 0
    Estimated free bytes: 1256, Actual free bytes: 1256
    Aging timer expires in: 677 secs
    Protocols: IP, IPv6
```

```
  Packet: LSP ID: R2.00-00, Length: 236 bytes, Lifetime : 1198 secs
    Checksum: 0x9790, Sequence: 0x5e, Attributes: 0x3 <L1 L2>
    NLPID: 0x83, Fixed length: 27 bytes, Version: 1, Sysid length: 0 bytes
    Packet type: 20, Packet version: 1, Max area: 0
[...Output truncated...]
```

What It Means The sample output is from router R2 and shows extensive information about the Level 1 and Level 2 link-state databases, which are identical across all Level 2 routers. Level 1 routers only include information for the Level 1 link-state database, which is identical to the Level 1 information in the output for a Level 2 router. The sample output shows the details of four LSPs. Level 1 and Level 2 LSPs include identical types of information except for the packet type. A Level 2 LSP has a packet type of 20 and a Level 1 LSP has a packet type of 18.

The first three examples illustrate different values in the Attributes field:

- <L1 L2> and the key word Attached in the first example, R2.00-00, indicate that router R2 is a Level1/Level 2 router acting as a gateway for Level 1 routers.
- <L1> in the second example, R3.00-00, indicates that R3 is a Level 1 router.
- <L1 L2> in the third example, R1.00-00, indicates that R1 is a Level 2 router (the fourth example is also for a Level 2 router).

The fourth example, R2.00-00, is included to show that a Level 1/Level 2 router appears in both the Level 1 and the Level 2 link-state databases. Note that in the Level 2 link-state database, the key word Attached is not included in the Attributes field.

It is useful to examine one LSP in greater detail. The third LSP, R1.00-00, was originated by R1 as indicated by the LSP ID field. R1 is the hostname of the router. The first 00 indicates that the LSP is for the router itself, and the final 00 denotes that the LSP is not fragmented. Both IPv4 and IPv6 are supported by this router, as indicated in the Protocols field. The Attributes field shows that the router is capable of both Level 1 and Level 2 routing, is not connected to Level 1 routers in other areas, and is not overloaded. The key words Attached and Overloaded would appear in the Attributes field if this were the case. The remaining lifetime of the LSP is 1196 seconds. IS-IS lifetimes start at a configured age (1200 seconds by default) and count down to zero.