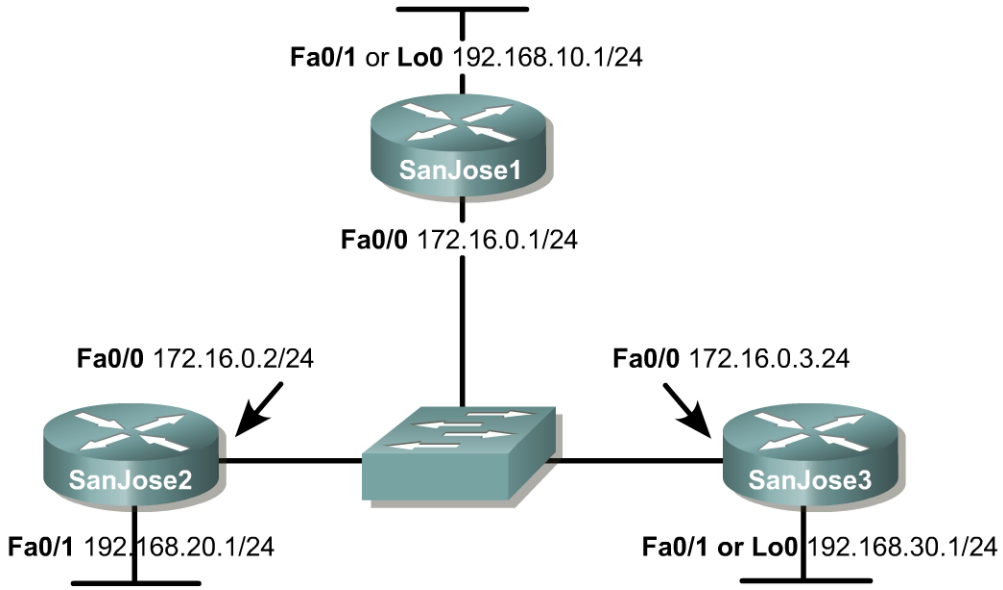
Lab 7.7.1 Configuring Basic Integrated IS-IS



Objective

In this lab, basic Integrated IS-IS will be configured. IS-IS authentication will also be implemented for security purposes.

Scenario

The IS-IS routing protocol has become increasingly popular with widespread usage among Service Providers. The International Travel Agency (ITA) is thinking about implementing IS-IS because it is a link state protocol that enables very fast convergence with large scalability and flexibility. However, before making a final decision, management wants a non-production network set up to test the IS-IS routing protocol.

The backbone of the production ITA WAN consists of three routers connected by way of an Ethernet core. Because the core routers are also connected to the Internet, authentication will be configured to prevent unauthorized routers from participating in the IS-IS process.

Hardware and Software Requirements

Three Cisco 2620, 2621, 2620XM, or 2621XM routers or a combination may be used for this lab. Cisco IOS Release 12.2(12) with the Enterprise Plus or Enterprise Plus IPSec 56 feature set is used. The Enterprise Plus feature set is the minimum requirement for IS-IS support.

Cisco IOS 12.2(12) with the Enterprise Plus feature set requires a minimum of 16 MB of Flash and 48 MB of RAM. The Enterprise Plus IPSec 56 feature set requires a minimum of 16 MB of Flash and 64 MB of RAM.

The image names for the Cisco IOS Release 12.2(12) with the Enterprise Plus and Plus IPSec 56 feature sets are c2600-js-mz.122-12.bin and c2600-jk8s-mz.122-12.bin, respectively. The “j” indicates “Enterprise” and the “s” indicates “Plus”.

Step 1

Build and configure the network according to the diagram, but do not configure IS-IS yet. Loopback addresses can be used to simulate the FastEthernet 0/1 interfaces. When using the FastEthernet 0/1 interfaces, there is the option of configuring **`no keepalive`** on these interfaces to bring them to the “up/up” state without physically cabling the interfaces. This is opposed to actually connecting the FastEthernet 0/1 interfaces to switch ports. It must be ensured that each switch port resides in a different VLAN from the switch ports connecting to the FastEthernet 0/0 interfaces and the other FastEthernet 0/1 interfaces.

> **Note:** IS-IS routing cannot be enabled on an interface until an IP address has been configured on the interface. Configure interface Loopback 0 in place of interface FastEthernet 0/1 on each router for the remainder of the lab. If FastEthernet 0/1 interfaces are used on these routers, the lab will work the same. However, the interface output will vary accordingly.

Use **`ping`** to test connectivity between the directly connected FastEthernet interfaces.

Optional: To allow smooth transition between routers through Telnet, apply the following script on each router in global configuration mode:

```
ip host r1 172.16.0.1
ip host r2 172.16.0.2
ip host r3 172.16.0.3
!
line vty 0 4
 privilege level 15
 no login
```

Once this script is applied to each router, type **r1** on any router. This moves the user immediately to the privileged mode of SanJose1 without being prompted for a password. It is much faster to type r1 than SanJose1, so we use r1 as an abbreviated representation of SanJose1. This process will also be used for SanJose2 and SanJose3 by typing either **r2** or **r3**, respectively. This is useful in a lab setting for moving quickly between routers.

Step 2

IS-IS (ISO/IEC 10589) is implemented with network service access point (NSAP) addresses consisting of three fields: area address, system ID, and N-selector byte: service identifier (NSEL). The area address field may be from one to thirteen octets, the system ID field is normally six octets (must be six for Cisco IOS); and the NSEL identifies a process on the device. It is a loose equivalent to a port or socket in IP, the NSEL is not used in routing decisions.

When the NSEL is set to 00, the NSAP is referred to as the network entity title (NET). NETs and NSAPs are represented in hexadecimal and must start and end on a byte boundary, such as 49.0001.1111.1111.1111.00

Level 1, or L1, IS-IS routing is based upon system ID. Therefore, each router must have a unique system ID within the area. L1 IS-IS routing equates to intra-area routing. It is customary to use either a MAC address from the router or, for Integrated IS-IS, to code the IP address, of a Loopback address, for example, into the system ID. However, numbering 1, 2, 3, 4, and so on is also acceptable.

Area addresses starting with a value of 48, 49, 50, or 51 specify private addresses. This group of addresses should not be advertised to other connectionless network service (CLNS) networks. The area address must be the same for all routers in an area.

On a LAN, one of the routers will be elected the designated intermediate system (DIS) based on interface priority. The default is 64. If all interface priorities are the same, the router with the highest subnetwork point of attachment (SNPA) address is selected. The (Ethernet) MAC addresses serves as the SNPA addresses for Ethernet LANs. The DIS serves the same purpose for IS-IS as the designated router (DR) does for OSPF. The ITA network engineer decides that SanJose1 will be the DIS, so its priority must be set higher than the default setting on the SanJose2 and SanJose3 routers.

Now, configure Integrated IS-IS on each router and set a priority of 100 on the FastEthernet 0/0 interface of SanJose1 as shown in the following:

```
SanJose1(config)#router isis
SanJose1(config-router)#net 49.0001.1111.1111.1111.00
SanJose1(config-router)#interface fa0/0
SanJose1(config-if)#ip router isis
SanJose1(config-if)#isis priority 100
SanJose1(config-if)#interface lo0
SanJose1(config-if)#ip router isis

SanJose2(config)#router isis
SanJose2(config-router)#net 49.0001.2222.2222.2222.00
SanJose2(config-router)#interface fa0/0
SanJose2(config-if)#ip router isis
SanJose2(config-if)#interface lo0
SanJose2(config-if)#ip router isis

SanJose3(config)#router isis
SanJose3(config-router)#net 49.0001.3333.3333.3333.00
SanJose3(config-router)#interface fa0/0
SanJose3(config-if)#ip router isis
SanJose3(config-if)#interface lo0
SanJose3(config-if)#ip router isis
```

1. Identify parts of the NSAP/NET addresses.

   a. Area Address: _____

   b. SanJose1 System ID: _____

   c. SanJose2 System ID: _____

   d. SanJose3 System ID: _____

   e. NSEL: _____

Step 3

Verify IS-IS operation using various **show** commands on any of the three routers. The commands and sample output for SanJose1 is shown as follows:

```
SanJose1#show ip protocols
Routing Protocol is "isis"
  Invalid after 0 seconds, hold down 0, flushed after 0
```



```
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: isis
  Address Summarization:
    None
  Maximum path: 4
  Routing for Networks:
    FastEthernet0/0
    FastEthernet0/1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.30.1         115      00:00:36
    192.168.20.1         115      00:00:36
  Distance: (default is 115)
```

Notice the update timers are set to zero (0). Updates are not sent at regular intervals since they are event-driven. The “Last Update” field indicates how long it has been since the last update as hours:minutes:seconds.

Issue the **show clns neighbors** command to view adjacencies.

```
SanJose1#show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
SanJose2       Fa0/0       0004.9ad2.d0c0  Up     9         L1L2 IS-IS
SanJose3       Fa0/0       0002.16f4.1ba0  Up     29        L1L2 IS-IS
```

Neighbor ISs and neighbor ESs are shown, if applicable. The optional keyword **detail** can be used to display comprehensive neighbor information as follows:

```
SanJose1#show clns neighbors detail

System Id      Interface   SNPA            State  Holdtime  Type Protocol
SanJose2       Fa0/0       0004.9ad2.d0c0  Up     24        L1L2 IS-IS
  Area Address(es): 49.0001
  IP Address(es):  172.16.0.2*
  Uptime: 00:07:30
SanJose3       Fa0/0       0002.16f4.1ba0  Up     27        L1L2 IS-IS
  Area Address(es): 49.0001
  IP Address(es):  172.16.0.3*
  Uptime: 00:07:00
```

Notice that the system ID of the IS neighbors are the hostnames of the respective neighbor routers. Cisco routers support dynamic hostname mapping starting with IOS Release 12.0(5) and the feature is enabled by default. As seen in the sample output, the configured system ID of 2222.2222.2222 has been replaced by the hostname “SanJose2”. Similarly, "SanJose3" replaces 3333.3333.3333.

Also notice that the adjacency Type for both neighbors is “L1L2”. By default, Cisco IOS enables both L1 and L2 adjacency negotiation on IS-IS routers. The router configuration mode command, **is-type**, or the interface configuration command, **isis circuit-type**, can be used to prescribe how the router operates in terms of L1 and L2 routing.

The **show isis database** and the **show clns interface fa0/0** commands can be used to obtain DIS and related information. First, type the **clear isis *** command on all routers to force IS-IS to refresh its link-state databases and recalculate all routes. A minute or two may be needed for all routers to update their respective IS-IS databases.

```
All_Router#clear isis *
```


Issue the **show isis database** command to view the content of the IS-IS database:

```
SanJose1#show isis database

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x00000008   0x088F        1191              0/0/0
SanJose1.01-00      * 0x00000002   0x9B60        1192              0/0/0
SanJose2.00-00        0x00000001   0x8736        1190              0/0/0
SanJose3.00-00        0x00000002   0x39A1        1195              0/0/0
IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x00000017   0x4E1B        1195              0/0/0
SanJose1.01-00      * 0x00000002   0x4D37        1192              0/0/0
SanJose2.00-00        0x00000010   0xF4B9        1191              0/0/0
SanJose3.00-00        0x00000002   0xD703        1195              0/0/0
```

IS-IS retains a separate database for L1 and L2 routing. Because IS-IS is a link-state protocol, the link-state database should be the same for the three San Jose routers.

As discussed earlier, if the **isis priority 100** command had not been placed on the FastEthernet 0/0 interface of SanJose1, the DIS would have been elected on the basis of the highest SNPA. DIS election is preemptive, unlike the behavior with OSPF. The **isis priority 100** command ensures that SanJose1 is elected the DIS, regardless of router boot order. But how can it be determined from the **show isis database** output that SanJose1 is indeed the DIS?

Look at the entries under the link state protocol data unit ID (LSPID) column. The first six octets form the system ID. As addressed earlier, because of the dynamic host mapping feature, the respective router names are listed instead of the numerical system ID. Following the system ID are two octets.

The first octet is the pseudonode ID, representing a LAN. The pseudonode ID is used to distinguish between LAN IDs on the same DIS. When this value is non-zero, the associated LSP is a pseudonode LSP originating from the DIS. The DIS is the only system that originates pseudonode LSPs. The DIS creates one pseudonode LSP for L1 and one for L2, as shown in the previous output.

The pseudonode ID will vary upon reboot of the router as a function of the creation or deletion of virtual interfaces, such as loopback interfaces. The system ID and pseudonode ID together is referred to as the circuit ID. An example is “SanJose1.01”.

A non-pseudonode LSP represents a router and is distinguished by the fact that the two-byte value in the circuit ID is 00.

The last octet forms the LSP fragmentation number. “00” indicates all data fit into a single link state packet (LSP). If there had been more information that did not fit into the first LSP, IS-IS would have created additional LSPs with increasing LSP numbers such as 01, 02, and so on. The asterisk (*) indicates that the LSP was originated by the local system.

Issue the **show clns interface fa0/0** command:

```
SanJose1#show clns interface fa0/0
FastEthernet0/0 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 8 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
```



```
Interface number 0x0, local circuit ID 0x1
Level-1 Metric: 10, Priority: 100, Circuit ID: SanJose1.01
Number of active level-1 adjacencies: 2
Level-2 Metric: 10, Priority: 100, Circuit ID: SanJose1.01
Number of active level-2 adjacencies: 2
Next IS-IS LAN Level-1 Hello in 803 milliseconds
Next IS-IS LAN Level-2 Hello in 2 seconds
```

Notice that the circuit ID, SanJose1.01, which is made up of the system ID and pseudonode ID, identifies the DIS. Circuit Types, Levels, Metric, and Priority information is also displayed.

Additional information about a specific LSP ID may be obtained by appending the LSP ID and **detail** keyword to the **show isis database** command, as shown in the output. The hostname is case sensitive. Also, note that this command can be used to view the IS-IS database of a neighbor router by referencing its hostname in the command.

```
SanJose1#show isis database SanJose1.00-00 detail


IS-IS Level-1 LSP SanJose1.00-00
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x0000000B   0x0292        831               0/0/0
  Area Address: 49.0001
  NLPID:        0xCC
  Hostname: SanJose1
  IP Address:   192.168.10.1
  Metric: 10         IP 172.16.0.0 255.255.255.0
  Metric: 10         IP 192.168.10.0 255.255.255.0
  Metric: 10         IS SanJose1.02
  Metric: 10         IS SanJose1.01

IS-IS Level-2 LSP SanJose1.00-00
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x0000000D   0x4703        709               0/0/0
  Area Address: 49.0001
  NLPID:        0xCC
  Hostname: SanJose1
  IP Address:   192.168.10.1
  Metric: 10         IS SanJose1.02
  Metric: 10         IS SanJose1.01
  Metric: 20         IP 192.168.30.0 255.255.255.0
  Metric: 10         IP 192.168.10.0 255.255.255.0
  Metric: 10         IP 172.16.0.0 255.255.255.0
  Metric: 20         IP 192.168.20.0 255.255.255.0
```

The default IS-IS metric for every link is 10, but notice the metric for the 192.168.20.0 and 192.168.30.0 networks are both 20. This is explained by the fact that the networks are not directly connected but are directly connected to neighbor routers.

Issue the **show isis topology** command as follows to display the paths to the other intermediate systems:


```
SanJose1#show isis topology

IS-IS paths to level-1 routers
System Id            Metric  Next-Hop             Interface   SNPA
SanJose1             --
SanJose2             10      SanJose2             Fa0/0       0004.9ad2.d0c0
SanJose3             10      SanJose3             Fa0/0       0002.16f4.1ba0

IS-IS paths to level-2 routers
System Id            Metric  Next-Hop             Interface   SNPA
SanJose1             --
SanJose2             10      SanJose2             Fa0/0       0004.9ad2.d0c0
SanJose3             10      SanJose3             Fa0/0       0002.16f4.1ba0
```

The highlighted entries in the SNPA column are the MAC addresses of the SanJose2 and SanJose3 FastEthernet 0/0 interfaces.

Issue the **show isis route** as follows to command to view the IS-IS L1 routing table:

```
SanJose1#show isis route

IS-IS not running in OSI mode (*) (only calculating IP routes)

(*) Use "show isis topology" command to display paths to all routers
```

This command has no useful output because the command is specific to OSI routing. Remember, IP IS-IS was enabled on each router. If CLNP were configured in the network, more interesting output would appear.

Issue the **show clns route** command as follows to view the IS-IS L2 routing table:

```
SanJose1#show clns route
Codes: C - connected, S - static, d - DecnetIV
       I - ISO-IGRP,  i - IS-IS,  e - ES-IS

C  49.0001.1111.1111.1111.00 [1/0], Local IS-IS NET
C  49.0001 [2/0], Local IS-IS Area
```

Again, there is no useful output here because this command applies to OSI routing and not IP routing.

Issue the **show ip route** command to view the IP routing table:

```
SanJose1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
        area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

i L1 192.168.30.0/24 [115/20] via 172.16.0.3, FastEthernet0/0
C    192.168.10.0/24 is directly connected, Loopback0
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.0.0 is directly connected, FastEthernet0/0
i L1 192.168.20.0/24 [115/20] via 172.16.0.2, FastEthernet0/0
```


Notice how the routes to the 192.168.30.0 and 192.168.20.0 networks were learned.

The **show clns neighbors, show isis database, show clns interface, show isis topology, show isis route,** and **show clns route** commands illustrate the somewhat confusing nature of IS-IS verification and troubleshooting. There is no clear pattern as to whether incorporation of the keyword **isis** or **clns** in a **show** command applies to IP routing or to OSI routing.

Step 4

L1 routers communicate with other L1 routers in the same area while L2 routers route between L1 areas, forming an interdomain routing backbone. This lab scenario does not illustrate the typical multi-area composition of the set of L2 routers in an IS-IS domain, because the San Jose routers all reside in Area 49.0001. Since the San Jose routers main function is simply to route between areas in the ITA internetwork, they should be configured as L2-only routers. Configure each San Jose router as an L2-only router as follows:

```
SanJose1(config)#router isis
SanJose1(config-router)#is-type level-2-only

SanJose2(config)#router isis
SanJose2(config-router)#is-type level-2-only

SanJose3(config)#router isis
SanJose3(config-router)#is-type level-2-only
```

Note: The **isis circuit-type** interface command can be used to selectively override the router configuration **is-type**, which are now L2-only.

To see the effect of the **is-type** command, reenter the various **show** commands previously issued: **show ip protocols, show clns neighbors, show isis database, show clns interface fa0/0, show isis database SanJose1.00-00 detail, show isis topology,** and **show ip route.** Sample outputs are shown as follows:

```
SanJose1#show ip protocols
Routing Protocol is "isis"
  Invalid after 0 seconds, hold down 0, flushed after 0
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: isis
  Address Summarization:
    None
  Maximum path: 4
  Routing for Networks:
    FastEthernet0/0
    FastEthernet0/1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.30.1         115      00:08:48
    192.168.20.1         115      00:00:09
  Distance: (default is 115)


SanJose1#show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
SanJose2       Fa0/0       0004.9ad2.d0c0  Up     26        L2   IS-IS
SanJose3       Fa0/0       0002.16f4.1ba0  Up     22        L2   IS-IS
```



```
SanJose1#show isis database

IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x00000001   0x623C        1086              0/0/0
SanJose1.01-00      * 0x0000000F   0x3344        1092              0/0/0
SanJose2.00-00        0x00000001   0x13AA        1091              0/0/0
SanJose3.00-00        0x00000002   0xD703        1096              0/0/0
```

If the LSP ID is seen with an LSP Holdtime of 0 followed by a parenthetical value, that rogue entry can be purged by invoking the **clear isis *** command.

```
SanJose1#show clns interface fa0/0
FastEthernet0/0 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 16 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x0, local circuit ID 0x1
    Level-2 Metric: 10, Priority: 100, Circuit ID: SanJose1.01
    Number of active level-2 adjacencies: 2
    Next IS-IS LAN Level-2 Hello in 2 seconds
```

Despite the fact that the Circuit Type is “level-1-2”, the entries following the Circuit Type show that only L2 operations are taking place.

```
SanJose1#show isis database SanJose1.00-00 detail

IS-IS Level-2 LSP SanJose1.00-00
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x00000001   0x623C        892               0/0/0
  Area Address: 49.0001
  NLPID:        0xCC
  Hostname: SanJose1
  IP Address:   192.168.10.1
  Metric: 10         IS SanJose1.02
  Metric: 10         IS SanJose1.01
  Metric: 10         IP 192.168.10.0 255.255.255.0
  Metric: 10         IP 172.16.0.0 255.255.255.0
```

The output shows that the Ids, SanJose1.02 and SanJose.01, on the circuits are used to number the router interfaces participating in IS-IS. This is also seen in the **show clns interface** output.

```
SanJose1#show isis topology

IS-IS paths to level-2 routers
System Id            Metric  Next-Hop             Interface   SNPA
SanJose1             --
SanJose2             10      SanJose2             Fa0/0       0004.9ad2.d0c0
SanJose3             10      SanJose3             Fa0/0       0002.16f4.1ba0
```

```
SanJose1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
```



```
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

i L2 192.168.30.0/24 [115/20] via 172.16.0.3, FastEthernet0/0
C    192.168.10.0/24 is directly connected, Loopback0
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.0.0 is directly connected, FastEthernet0/0
i L2 192.168.20.0/24 [115/20] via 172.16.0.2, FastEthernet0/0
```

2. What types of routes are being placed into the routing table?

_____

Step 5

The default value of the hello interval is ten seconds and the default value of the hello multiplier is three. The hello multiplier specifies the number of IS-IS hello PDUs a neighbor must miss before the router declares the adjacency as down. So, with the default hello interval of ten seconds, it takes 30 seconds for an adjacency to be declared down due to missed hello PDUs. The analogous settings with OSPF are governed by the **ip ospf hello-interval** and **ip ospf dead-interval** interface commands.

A decision is made to adjust the IS-IS timers so that the core routers will detect network failures in less time. This will increase traffic, but this is much less of a concern on the high-speed core Ethernet segment than on a busy WAN link. It is determined that the need for quick convergence on the core outweighs the negative effect of extra control traffic. Change the hello interval to 5 on all Fa0/0 interfaces, as shown below for the SanJose1 router:

```
SanJose1(config)#interface fastethernet 0/0
SanJose1(config-if)#isis hello-interval 5
```

3. How long will it take for an adjacency to be declared down with the new hello interval of five?

_____

Step 6

There should not be any unauthorized routers forming adjacencies within the IS-IS core. Adding authentication to each IS-IS enabled interface can help to ensure this.

Configure interface authentication on SanJose1 as shown below.

```
SanJose1(config)#interface FastEthernet 0/0
SanJose1(config-if)#isis password cisco level-2
```

This command gives the ability to prevent unauthorized routers from forming level-2 adjacencies with this router.

Important: Be sure to add the keyword **level-2**, which refers to the level-2 database, not an encryption level. If no keyword is specified, the default is level-1. Keep in mind the passwords are exchanged in clear text and provide only limited security.

Wait 20 seconds then issue the **show clns neighbors** command on SanJose1.

4. Does SanJose1 still show that it has IS-IS neighbors? Why or why not?

_____

_____

Issue the **debug isis adj-packets** command to verify that SanJose1 does not recognize its neighbors because it requires authentication that has not been configured on SanJose 2 and SanJose3 yet.

```
SanJose1#debug isis adj-packets
IS-IS Adjacency related packets debugging is on
SanJose1#
03:22:28: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/0, length 1497
03:22:29: ISIS-Adj: Sending L2 LAN IIH on Loopback0, length 1514
03:22:30: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/0, length 1497
03:22:31: ISIS-Adj: Rec L2 IIH from 0004.9ad2.d0c0 (FastEthernet0/0), cir type L2,
cir id 1111.1111.1111.01, length 1497
03:22:31: ISIS-Adj: Authentication failed
```

IS-IS routers will not communicate unless the authentication parameters match. However, many other interface-specific IS-IS parameters can vary on a given segment without disrupting communication, such as those set by the commands **isis hello-interval**, **isis hello-multiplier**, **isis retransmit-interval**, **isis retransmit-throttle-interval**, and **isis csnp-interval**. Of course, it makes sense for these parameters to coincide on a given segment.

Correct the authentication mismatch by configuring interface authentication on SanJose2 and SanJose3. After configurations are complete, verify that the routers can communicate by using the **show clns neighbors** command on SanJose1.

```
SanJose2(config)#interface FastEthernet 0/0
SanJose2(config-if)#isis password cisco level-2

SanJose3(config)#interface FastEthernet 0/0
SanJose3(config-if)#isis password cisco level-2

SanJose1#show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
SanJose2       Fa0/0       0004.9ad2.d0c0  Up     23        L2   IS-IS
SanJose3       Fa0/0       0002.16f4.1ba0  Up     26        L2   IS-IS
```

The system IDs will resolve, in time, to the router names. This is done through the dynamic hostname mapping feature automatically enabled on Cisco routers. In the interim, the output may appear with the actual numerical ID for that system.

Step 7

IS-IS provides two additional layers of authentication to prevent unauthorized adjacencies between routers. These are area passwords for L1 and domain passwords for L2. The interface, area, and domain password options for IS-IS all use plain text authentication and therefore are of limited use. However, beginning with IOS Release 12.2(13)T MD5 authentication is available for IS-IS.

The command for L1 password authentication is **area-password** {**password**}. Using the **area-password** command on all routers in an area will prevent unauthorized routers from injecting false routing information into the L1 database.

The command for L2 password authentication is **domain-password** {**password**}. Using the **domain-password** command on all L2 routers in a domain will prevent unauthorized routers from injecting false routing information into the L2 database. Since the core routers are operating at L2, implement domain password authentication as follows:

```
SanJose1(config)#router isis
SanJose1(config-router)#domain-password sanjose
```

Note that the password itself is case sensitive. It is worth configuring mismatched passwords in each case, for instance, interface, area, and domain. This should be done at least once to see what the effect is on IS-IS functionality.

Force IS-IS to refresh its link-state database and recalculate all routes by issuing the **clear isis *** command on all routers. A minute or two may be needed for all routers to update their respective IS-IS databases.

```
All_Router#clear isis *
```

View the SanJose1 link state database to see the following change:

```
SanJose1#show isis database

IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x00000004   0xDCB5        1155              0/0/0
SanJose1.01-00      * 0x00000007   0xB4C1        1156              0/0/0
```

Change the other routers to reflect the new authentication policy.

```
SanJose2(config)#router isis
SanJose2(config-router)#domain-password sanjose

SanJose3(config)#router isis
SanJose3(config-router)#domain-password sanjose
```

View the SanJose1 link state database to verify propagation of LSPs.

```
SanJose1#show isis database

IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
SanJose1.00-00      * 0x00000001   0xE2B2        1189              0/0/0
SanJose1.01-00      * 0x00000002   0xBEBC        1195              0/0/0
SanJose2.00-00        0x00000002   0x5A59        1190              0/0/0
SanJose3.00-00        0x00000002   0xF3DD        1185              0/0/0
```

The configuration of basic Integrated IS-IS routing protocol is now complete. In addition to enabling Integrated IS-IS, L2-specific routing was enabled, and the hello-interval was changed to enable IS-IS to detect network failures faster. Two types of password

authentication, interface and domain, were enabled to prevent unauthorized routers from forming adjacencies with the SanJose core routers.

Save the SanJose1 and SanJose2 configurations for use with the next lab.

