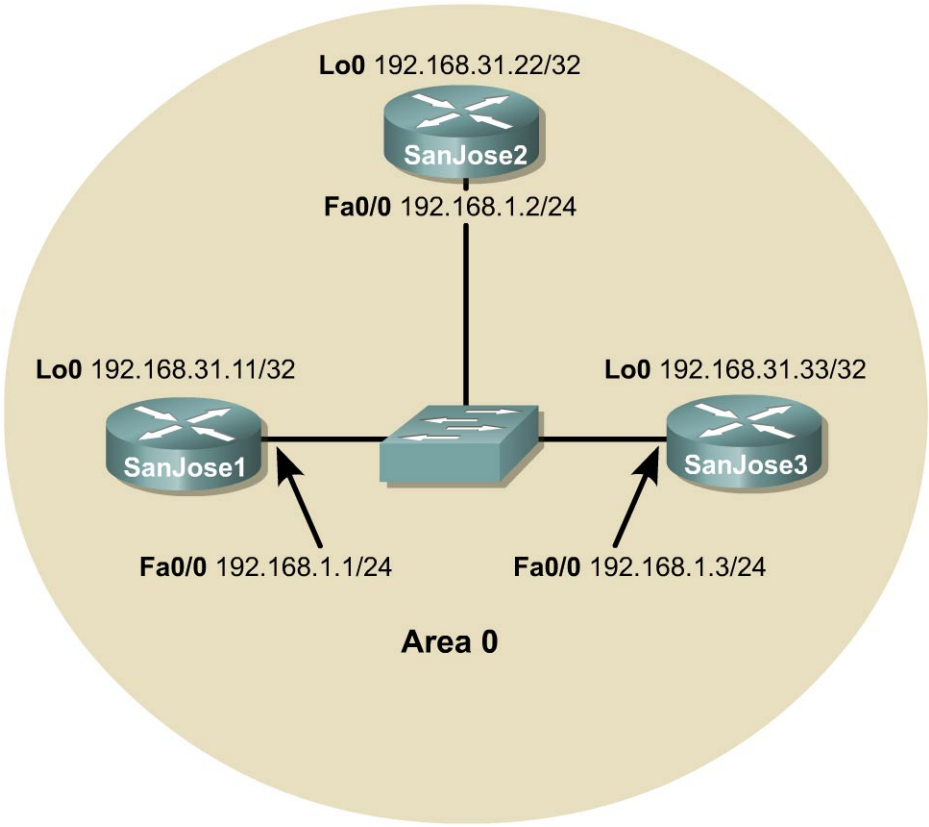
Lab 6.9.1 Configuring OSPF



Objective

In this lab, OSPF will be configured on three Cisco routers. First, configure loopback interfaces to provide stable OSPF Router IDs. Then configure the OSPF process and enable OSPF on the appropriate interfaces. After OSPF is enabled, tune the update timers and configure authentication.

Scenario

The backbone of International Travel Agency's (ITA) WAN, located in San Jose, consists of three routers connected using an Ethernet core. Configure these core routers as members of OSPF Area 0. Because the core routers are connected to the Internet, it is decided to implement security, preventing unauthorized routers from joining Area 0. Also, within the core, the network failures need to be realized quickly.

Step 1

Build and configure the network according to the diagram, but do not configure OSPF yet. A switch or hub is required to connect the three routers through Ethernet.

Use **`ping`** to verify the work and test connectivity between the FastEthernet interfaces.

Step 2

On each router, configure a loopback interface with a unique IP address. Cisco routers use the highest loopback IP address as the OSPF Router ID. In the absence of a loopback interface, the router uses the highest IP address among its active interfaces, which might force a router to change router IDs if an interface goes down. Because loopback interfaces are immune to physical and data link problems, they should be used to derive the router ID. To avoid conflicts with registered network addresses, use private network ranges for the loopback interfaces. Configure the core routers using the following commands:

```
SanJose1(config)#interface loopback 0
SanJose1(config-if)#ip address 192.168.31.11 255.255.255.255

SanJose2(config)#interface loopback 0
SanJose2(config-if)#ip address 192.168.31.22 255.255.255.255

SanJose3(config)#interface loopback 0
SanJose3(config-if)#ip address 192.168.31.33 255.255.255.255
```

Step 3

Now that loopback interfaces are configured, configure OSPF. Use the following commands as an example to configure each router:

```
SanJose1(config)#router ospf 1
SanJose1(config-router)#network 192.168.1.0 0.0.0.255 area 0
```

Note: An OSPF process ID is locally significant. It does not need to match neighboring routers. The ID is needed to identify a unique instance of an OSPF database, because multiple processes can run concurrently on a single router.

Step 4

After enabling OSPF routing on each of the three routers, verify its operation using **show** commands. Several important **show** commands can be used to gather OSPF information. First, issue the **show ip protocols** command on any of the three routers, as follows:

```
SanJose1#show ip protocols
Routing Protocol is "ospf 1"
  Sending updates every 0 seconds
  Invalid after 0 seconds, hold down 0, flushed after 0
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: ospf 1
  Routing for Networks:
    192.168.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 110)
```

Note: The update timers are set to 0. Updates are not sent at regular intervals. Updates are event driven.

Next, use the **show ip ospf** command, as follows, to get more details about the OSPF process, including the router ID:

```
SanJose1#show ip ospf
 Routing Process "ospf 1" with ID 192.168.31.11
 Supports only single TOS(TOS0) routes
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
```



```
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x0
Number of DCbitless external LSA 0
Number of DoNotAge external LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
   Area BACKBONE(0)
      Number of interfaces in this area is 1
      Area has no authentication
      SPF algorithm executed 5 times
      Area ranges are
      Number of LSA 4. Checksum Sum 0x1CAC4
      Number of DCbitless LSA 0
      Number of indication LSA 0
      Number of DoNotAge LSA 0
      Flood list length 0
```

1. What address is the router using as its router ID?

_____

The loopback interface should be seen as the router ID. To see the OSPF neighbors, use the **show ip ospf neighbor** command. The output of this command displays all known OSPF neighbors, including their router IDs, their interface addresses, and their adjacency status. Also issue the **show ip ospf neighbor detail** command, which outputs even more information as follows:

```
SanJose1#show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address
Interface
192.168.31.22     1   FULL/BDR        00:00:36    192.168.1.2
FastEthernet0/0
192.168.31.33     1   FULL/DR         00:00:33    192.168.1.3
FastEthernet0/0

SanJose1#show ip ospf neighbor detail
 Neighbor 192.168.31.22, interface address 192.168.1.2
    In the area 0 via interface FastEthernet0/0
    Neighbor priority is 1, State is FULL, 6 state changes
    DR is 192.168.1.3 BDR is 192.168.1.2
    Options 2
    Dead timer due in 00:00:34
    Index 2/2, retransmission queue length 0, number of
retransmission 2
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 1, maximum is 1
    Last retransmission scan time is 0 msec, maximum is 0 msec
 Neighbor 192.168.31.33, interface address 192.168.1.3
    In the area 0 via interface FastEthernet0/0
    Neighbor priority is 1, State is FULL, 6 state changes
    DR is 192.168.1.3 BDR is 192.168.1.2
    Options 2
  Dead timer due in 00:00:30
    Index 1/1, retransmission queue length 0, number of
retransmission 1
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 1, maximum is 1
    Last retransmission scan time is 0 msec, maximum is 0 msec
```

2. Based on the output of this command, which router is the Designated Router (DR) on this network?

_____

3. Which router is the Backup Designated Router (BDR)?

_____

Most likely, the router with the highest router ID is the DR, the router with the second-highest router ID is the BDR, and the other router is a DROTHER.

Because each interface on a given router is connected to a different network, some of the key OSPF information is interface specific. Issue the **show ip ospf interface** command for the FastEthernet interface on the router as follows:

```
SanJose1#show ip ospf interface fa0/0
FastEthernet0/0 is up, line protocol is up
  Internet Address 192.168.1.1/24, Area 0
  Process ID 1, Router ID 192.168.31.11, Network Type BROADCAST,
Cost: 1
  Transmit Delay is 1 sec, State DROTHER, Priority 1
  Designated Router (ID) 192.168.31.33, Interface address
192.168.1.3
  Backup Designated router (ID) 192.168.31.22, Interface address
192.168.1.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40,
Retransmit 5
    Hello due in 00:00:09
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 2, Adjacent neighbor count is 2
    Adjacent with neighbor 192.168.31.22  (Backup Designated
Router)
    Adjacent with neighbor 192.168.31.33  (Designated Router)
  Suppress hello for 0 neighbor(s)
```

4. Based on the output of this command, what OSPF network type is the Ethernet interface on the router connected to?

_____

5. What is the Hello update timer set to?

_____

6. What is the Dead timer set to?

_____

Ethernet networks are known to OSPF as broadcast networks. The default timer values are ten (10) second hello updates and 40 second dead intervals.

Step 5

It is decided to adjust OSPF timers so that the core routers will detect network failures in less time. This will increase traffic, but this is less of a concern on the high speed core Ethernet segment than on a busy WAN link. It is also decided that the need for quick convergence at the core outweighs the extra traffic. Manually change the Hello and Dead intervals on SanJose1 as follows:


```
SanJose1(config)#interface fastethernet 0/0
SanJose1(config-if)#ip ospf hello-interval 5
SanJose1(config-if)#ip ospf dead-interval 20
```

These commands set the Hello update timer to five (5) seconds and the Dead interval to 20 seconds. Although the Cisco IOS does not require it, configure the Dead interval to four times the Hello interval. This ensures that routers experiencing temporary link problems can recover and are not declared dead unnecessarily, causing a ripple of updates and recalculations throughout the internetwork.

After the timers are changed on SanJose1, issue the **show ip ospf neighbor** command.

7. Does SanJose1 still show that it has OSPF neighbors?

_____

To find out what happened to SanJose1's neighbors, use the IOS **debug** feature by entering the command **debug ip ospf events** as follows:

```
SanJose1#debug ip ospf events
OSPF events debugging is on
SanJose1#
00:08:25: OSPF: Rcv hello from 192.168.31.22 area 0 from
FastEthernet0/0 192.168.1.2
00:08:25: OSPF: Mismatched hello parameters from 192.168.1.2
00:08:25: Dead R 40 C 20, Hello R 10 C 5  Mask R 255.255.255.0
C 255.255.255.0
SanJose1#
00:08:32: OSPF: Rcv hello from 192.168.31.33 area 0 from
FastEthernet0/0 192.168.1.3
00:08:32: OSPF: Mismatched hello parameters from 192.168.1.3
00:08:32: Dead R 40 C 20, Hello R 10 C 5  Mask R 255.255.255.0
C 255.255.255.0
```

8. According to the **debug** output, what is preventing SanJose1 from forming relationships with the other two OSPF routers in Area 0?

_____

The Hello and Dead intervals must be the same before routers within an area can form neighbor adjacencies.

Turn off **debug** using **undebug all**, or just **u all**.

```
SanJose1#undebug all
All possible debugging has been turned off
```

The Hello and Dead intervals are declared in Hello packet headers. In order for OSPF routers to establish a relationship, their Hello and Dead intervals must match.

Configure the SanJose2 and SanJose3 Hello and Dead timers to match the timers on SanJose1. Before continuing, verify that these routers can now communicate by checking the OSPF neighbor table.

Step 6

Whether intentional, or by accident, no unauthorized routers exchanging updates within Area 0 are wanted. This is accomplished by adding encrypted authentication to each OSPF packet header. Select message digest (MD5) authentication. This mode of authentication sends a message digest, or hash, in place of the password. OSPF neighbors must be configured with the same message digest key number, encryption type, and password in order to authenticate using the hash.

To configure a message digest password for SanJose1 to use on its Ethernet interface, use the following commands:

```
SanJose1(config)#interface fastethernet 0/0
SanJose1(config-if)#ip ospf message-digest-key 1 md5 7 itsasecret
SanJose1(config-if)#router ospf 1
SanJose1(config-router)#area 0 authentication message-digest
```

After entering these commands, wait 20 seconds, and then issue the **show ip ospf neighbor** command on SanJose1.

9. Does SanJose1 still show that it has OSPF neighbors?

Use the **debug ip ospf events** command to determine why SanJose1 does not see its neighbors:

```
SanJose1#debug ip ospf events
OSPF events debugging is on
SanJose1#
00:49:32: OSPF: Send with youngest Key 1
SanJose1#
00:49:33: OSPF: Rcv pkt from 192.168.31.33, FastEthernet0/0 :
Mismatch Authentication type. Input packet specified type
0, we use type 2
00:49:33: OSPF: Rcv pkt from 192.168.31.22, FastEthernet0/0 :
Mismatch Authentication type. Input packet specified type , we use type 2
SanJose1#u all
All possible debugging has been turned off
```

Again, it is seen that OSPF routers will not communicate unless certain configurations match. In this case, the routers are not communicating because the authentication fields in the OSPF packet header are different.

Correct this problem by configuring authentication on the other two routers. Remember that the same key number, encryption type, and password must be used on each router.

After the configurations are complete, verify that the routers can communicate by using the **show ip ospf neighbors** command.

```
SanJose1#show ip ospf neighbors
Neighbor ID     Pri   State           Dead Time   Address
Interface
192.168.31.33     1   FULL/DR         00:00:16    192.168.1.3
FastEthernet0/0
192.168.31.22     1   FULL/BDR        00:00:15    192.168.1.2
FastEthernet0/0
```


Step 7

Save the configuration files for each router. These configurations will be used to begin the next lab. At the conclusion of each lab, it is recommended that the configuration file for each router is copied and saved for future reference.

