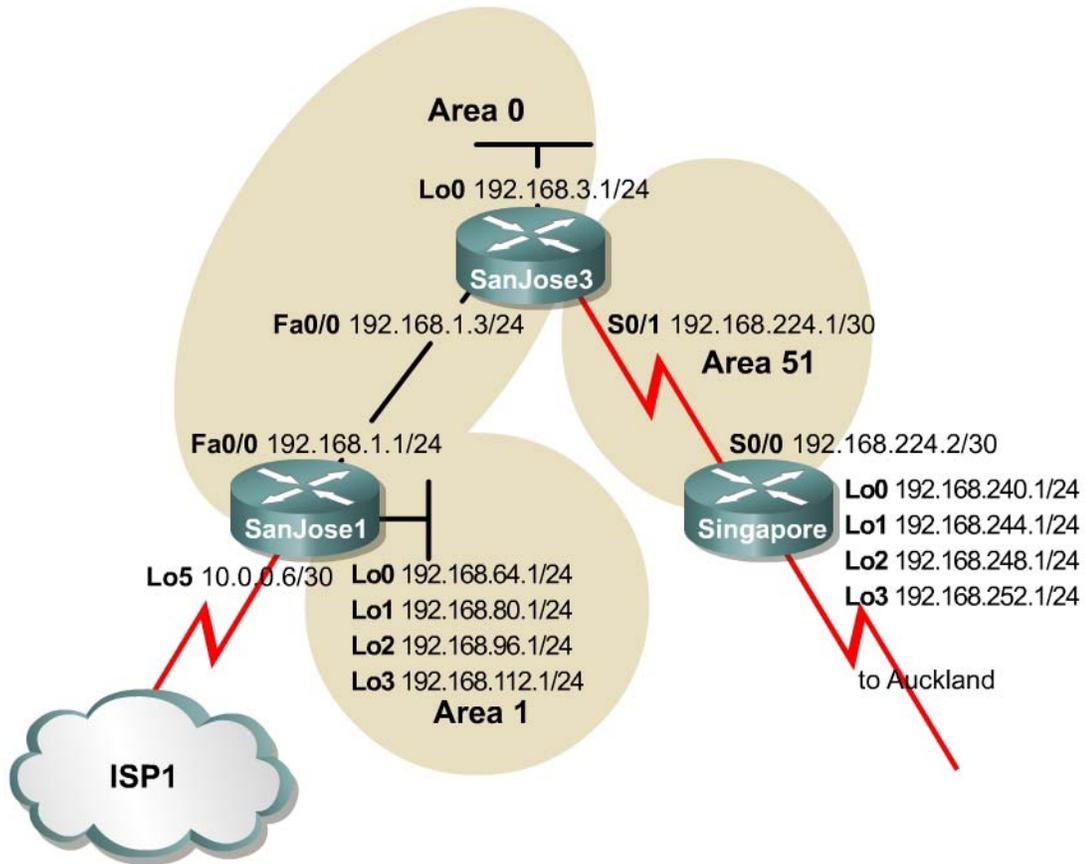


Lab 6.9.5 Configuring an NSSA



Objective

In this lab, the student will configure an OSPF NSSA in order to import external routing information while retaining the benefits of a stub area.

Scenario

The implementation of a totally stubby area in Area 2 was very successful. Now implement it in Area 51 for more efficient routing and greater route stability. A stub or totally stubby area will not work, because the Singapore router in Area 51 has the added responsibility of redistributing external routes from Auckland using Type 5 LSAs. To meet every need, it is decided to configure Area 51 as an a Not So Stubby Area (NSSA).

Step 1

Build and configure the network according to the diagram. Also configure multiarea OSPF according to the diagram. However, do not configure NSSA yet. Use the configuration files from the previous lab if available and make adjustments as necessary. In this case it is easiest to just remove and reapply the OSPF process. Reboot after reconfiguring OSPF if there are any problems.

Note: This lab requires the use of subnet 0.

Configure each router with the loopback address indicated in the diagram. Be sure to configure SanJose1 and Singapore with additional loopbacks (Lo0, Lo1, Lo2, Lo3). On SanJose1, these loopback interfaces simulate the serial links to local San Jose sites: Westasman, Baypointe, Vista, and Eastasman. On Singapore, the loopbacks simulate Auckland networks.

Use **ping** and **show ip route** to test connectivity between all interfaces. Each router should be able to ping all network interfaces as the following shows:

```
SanJose3#show ip route
<output omitted>
 192.168.224.0/30 is subnetted, 1 subnets
C    192.168.224.0 is directly connected, Serial0/0
 192.168.64.0/32 is subnetted, 1 subnets
O IA  192.168.64.1 [110/2] via 192.168.1.1, 00:03:49, FastEthernet0/0
 192.168.80.0/32 is subnetted, 1 subnets
O IA  192.168.80.1 [110/2] via 192.168.1.1, 00:03:49, FastEthernet0/0
 192.168.96.0/32 is subnetted, 1 subnets
O IA  192.168.96.1 [110/2] via 192.168.1.1, 00:03:49, FastEthernet0/0
 192.168.112.0/32 is subnetted, 1 subnets
O IA  192.168.112.1 [110/2] via 192.168.1.1, 00:03:49, FastEthernet0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.3.0/24 is directly connected, Loopback0
```

Step 2

Configure Singapore as follows to redistribute connected routes into the OSPF domain:

```
Singapore(config)#router ospf 1
Singapore(config-router)#redistribute connected subnets
```

This command advertises Singapore's loopbacks as external networks. Check the routing tables of all three routers. They should be complete. SanJose1 and SanJose3 should also have Type 2 external routes to the Auckland networks as the following shows:

```
SanJose1#show ip route
<output omitted>
 192.168.224.0/30 is subnetted, 1 subnets
O IA  192.168.224.0 [110/782] via 192.168.1.3, 00:11:16, FastEthernet0/0
 192.168.240.0/30 is subnetted, 1 subnets
O E2  192.168.240.0 [110/20] via 192.168.1.3, 00:04:54, FastEthernet0/0
O E2  192.168.244.0/24 [110/20] via 192.168.1.3, 00:09:34, FastEthernet0/0
 192.168.64.0/30 is subnetted, 1 subnets
C    192.168.64.0 is directly connected, Loopback0
 192.168.80.0/30 is subnetted, 1 subnets
C    192.168.80.0 is directly connected, Loopback1
 192.168.96.0/30 is subnetted, 1 subnets
C    192.168.96.0 is directly connected, Loopback2
O E2  192.168.248.0/24 [110/20] via 192.168.1.3, 00:09:35, FastEthernet0/0
 192.168.112.0/30 is subnetted, 1 subnets
C    192.168.112.0 is directly connected, Loopback3
C    192.168.1.0/24 is directly connected, FastEthernet0/0
O E2  192.168.252.0/24 [110/20] via 192.168.1.3, 00:09:38, FastEthernet0/0
 192.168.3.0/32 is subnetted, 1 subnets
•    192.168.3.1 [110/2] via 192.168.1.3, 00:11:19, FastEthernet0/0
•
```

Step 3

The following shows that Singapore has several interarea (IA) routes.

```
Singapore#show ip route
<output omitted>
Gateway of last resort is not set
  192.168.224.0/30 is subnetted, 1 subnets
C       192.168.224.0 is directly connected, Serial0/0
  192.168.240.0/30 is subnetted, 1 subnets
C       192.168.240.0 is directly connected, Loopback0
C       192.168.244.0/24 is directly connected, Loopback1
  192.168.64.0/32 is subnetted, 1 subnets
O IA    192.168.64.1 [110/66] via 192.168.224.1, 00:00:48, Serial0/0
  192.168.80.0/32 is subnetted, 1 subnets
O IA    192.168.80.1 [110/66] via 192.168.224.1, 00:00:48, Serial0/0
  192.168.96.0/32 is subnetted, 1 subnets
O IA    192.168.96.1 [110/66] via 192.168.224.1, 00:00:49, Serial0/0
C       192.168.248.0/24 is directly connected, Loopback2
  192.168.112.0/32 is subnetted, 1 subnets
O IA    192.168.112.1 [110/66] via 192.168.224.1, 00:00:49, Serial0/0
O IA    192.168.1.0/24 [110/65] via 192.168.224.1, 00:00:49, Serial0/0
C       192.168.252.0/24 is directly connected, Loopback3
  192.168.3.0/32 is subnetted, 1 subnets
O IA    192.168.3.1 [110/65] via 192.168.224.1, 00:00:49, Serial0/0
```

In Lab 6.9.4, Capetown's table was minimized by configuring Area 2 as a stub. Attempt to repeat this configuration with the following commands on Singapore:

```
Singapore(config)#router ospf 1
Singapore(config-router)#area 51 stub
```

1. What does the router output when this command is entered?

Because Singapore imports routes that are external to OSPF, it is considered an ASBR. ASBRs cannot be members of a stub area. Stub areas do not permit Type 5 LSAs. Issue the `show ip ospf database` command on Singapore. Note that OSPF Router IDs are used as references in managing the link-state database. The OSPF process may have to be removed and reinstalled or possibly the routers will need to be rebooted to get the desired result:

```
Singapore#show ip ospf database

      OSPF Router with ID (192.168.252.1) (Process ID 1)

      Router Link States (Area 51)
Link ID        ADV Router    Age         Seq#         Checksum Link count
192.168.3.1    192.168.3.1   817        0x80000004  0xF239   2
192.168.252.1  192.168.252.1 1307       0x80000002  0xB918   2

      Summary Net Link States (Area 51)
Link ID        ADV Router    Age         Seq#         Checksum
192.168.1.0    192.168.3.1   1262       0x80000003  0xABB6
192.168.3.1    192.168.3.1   1308       0x80000001  0x8FD1
192.168.64.1   192.168.3.1   1258       0x80000001  0xF72B
192.168.80.1   192.168.3.1   1258       0x80000001  0x47CB
192.168.96.1   192.168.3.1   1258       0x80000001  0x966C
192.168.112.1  192.168.3.1   1258       0x80000001  0xE50D

      Type-5 AS External Link States
Link ID        ADV Router    Age         Seq#         Checksum Tag
```

192.168.224.0	192.168.252.1	429	0x80000001	0x7D74	0
192.168.240.0	192.168.252.1	432	0x80000001	0xCC15	0
192.168.244.0	192.168.252.1	713	0x80000001	0xB228	0
192.168.248.0	192.168.252.1	713	0x80000001	0x8650	0
192.168.252.0	192.168.252.1	713	0x80000001	0x5A78	0

2. According to the output of this command, what link IDs are included under Type 5 AS External Link States?

All Auckland network routes, loopbacks, are Type5 external links.

The workaround for this situation is to configure Area 51 as an NSSA. Enter the following commands:

```
Singapore(config)#router ospf 1
Singapore(config-router)#area 51 nssa

SanJose3(config)#router ospf 1
SanJose3(config-router)#area 51 nssa
```

Now use the `show ip ospf database` command on Singapore. Because stub areas do not support Type 5 LSAs, external routes are redistributed and are advertised as Type 7 LSAs. The output of this command should verify that Type 5 LSAs have been replaced by Type 7 LSAs.

```
Singapore#show ip ospf database
```

```
OSPF Router with ID (192.168.252.1) (Process ID 1)

Router Link States (Area 51)
Link ID          ADV Router      Age      Seq#           Checksum Link count
192.168.3.1     192.168.3.1    10      0x80000006    0x9A87   2
192.168.252.1  192.168.252.1  10      0x80000004    0x5B6E   2

Summary Net Link States (Area 51)
Link ID          ADV Router      Age      Seq#           Checksum
192.168.1.0     192.168.3.1    137     0x80000004    0x4F0C
192.168.3.1     192.168.3.1    137     0x80000002    0x3327
192.168.64.1    192.168.3.1    138     0x80000002    0x9B80
192.168.80.1    192.168.3.1    138     0x80000002    0xEA21
192.168.96.1    192.168.3.1    138     0x80000002    0x3AC1
192.168.112.1   192.168.3.1    138     0x80000002    0x8962

Type-7 AS External Link States (Area 51)
Link ID          ADV Router      Age      Seq#           Checksum Tag
192.168.224.0   192.168.252.1  19      0x80000001    0xA0FA   0
192.168.240.0   192.168.252.1  20      0x80000001    0xEF9B   0
192.168.244.0   192.168.252.1  21      0x80000001    0xD5AE   0
192.168.248.0   192.168.252.1  21      0x80000001    0xA9D6   0
192.168.252.0   192.168.252.1  21      0x80000001    0x7DFE   0
```

Enter the `show ip route` command on Singapore. Below you will see how the routing table changes with the `no-summary` option in OSPF.

NSSA routers receive updates from the ABR the same way stub area routers do. Singapore's routing table should look similar to how Capetown's table did when it was in a stub area. See Lab 6.8.2. SanJose3 continues to flood Area 51 with summary link, Type 3 and Type 4, LSAs. Because the goal is to reduce the burden on Area 51 routers, reconfigure SanJose3 as follows to filter interarea summary LSAs:

```
SanJose3(config)#router ospf 1
SanJose3(config-router)#area 51 nssa no-summary
```

Again, check Singapore's routing table:

```
Singapore#show ip route
<output omitted>
Gateway of last resort is 192.168.224.1 to network 0.0.0.0

 192.168.224.0/30 is subnetted, 1 subnets
C    192.168.224.0 is directly connected, Serial0/0
 192.168.240.0/30 is subnetted, 1 subnets
C    192.168.240.0 is directly connected, Loopback0
C    192.168.244.0/24 is directly connected, Loopback1
C    192.168.248.0/24 is directly connected, Loopback2
C    192.168.252.0/24 is directly connected, Loopback3
O*IA 0.0.0.0/0 [110/65] via 192.168.224.1, 00:00:04, Serial0/0
```

3. What has changed?

All interarea (IA) routes are replaced with the 0.0.0.0/0 default route. Area 51 is now acting like Area 2 when it was configured as totally stubby. See Lab 6.8.2. The primary difference is that an NSSA can redistribute external routes.

NSSAs allow the OSPF link state databases to be minimized within an area, yet still import external routes as Type 7 LSAs. The NSSA ABR, in this case SanJose3, must convert these Type 7s into Type 5s, which will overflow into Area 0. On SanJose3, issue the `show ip ospf database` command as follows:

```
SanJose3#show ip ospf database

      OSPF Router with ID (192.168.3.1) (Process ID 1)

      Router Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum Link count
192.168.3.1    192.168.3.1   170        0x80000007   0x45B2   2
192.168.112.1  192.168.112.1 1711       0x80000008   0x148A   1

      Net Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
192.168.1.1    192.168.112.1 1712       0x80000001   0xA10A

      Summary Net Link States (Area 0)

Link ID        ADV Router    Age         Seq#          Checksum
192.168.64.1   192.168.112.1 1238       0x80000005   0xE7CA
192.168.80.1   192.168.112.1 1238       0x80000005   0x376B
192.168.96.1   192.168.112.1 1238       0x80000005   0x860C
192.168.112.1  192.168.112.1 1238       0x80000005   0xD5AC
192.168.224.0  192.168.3.1   1748       0x80000001   0x92E5

      Router Link States (Area 51)

Link ID        ADV Router    Age         Seq#          Checksum
Link count
192.168.3.1    192.168.3.1   165        0x8000000B   0x908C   2
192.168.252.1  192.168.252.1 278        0x80000004   0x5B6E   2

      Summary Net Link States (Area 51)

Link ID        ADV Router    Age         Seq#          Checksum
0.0.0.0        192.168.3.1   172        0x80000001   0x12B6

      Type-7 AS External Link States (Area 51)

Link ID        ADV Router    Age         Seq#          Checksum Tag
192.168.224.0  192.168.252.1 287        0x80000001   0xA0FA   0
192.168.240.0  192.168.252.1 287        0x80000001   0xEF9B   0
192.168.244.0  192.168.252.1 287        0x80000001   0xD5AE   0
192.168.248.0  192.168.252.1 287        0x80000001   0xA9D6   0
192.168.252.0  192.168.252.1 287        0x80000001   0x7DFE   0

      Type-5 AS External Link States
```

Link ID	ADV Router	Age	Seq#	Checksum	Tag
192.168.240.0	192.168.3.1	161	0x80000001	0x5A35	0
192.168.244.0	192.168.3.1	163	0x80000001	0x4048	0
192.168.248.0	192.168.3.1	163	0x80000001	0x1470	0
192.168.252.0	192.168.3.1	163	0x80000001	0xE798	0

4. Does SanJose3's database include link IDs that use Type 7 LSAs?

5. Does SanJose3's database include link IDs that use Type 5 LSAs?

SanJose3 converts the Type7 LSAs from Singapore and reproduces them as Type 5 LSAs to SanJose1.

Issue the **show ip route** command on SanJose3:

```
SanJose3#show ip route
<output omitted>
Gateway of last resort is not set
  192.168.224.0/30 is subnetted, 1 subnets
C       192.168.224.0 is directly connected, Serial0/0
  192.168.240.0/30 is subnetted, 1 subnets
O N2    192.168.240.0 [110/20] via 192.168.224.2, 00:03:23, Serial0/0
O N2    192.168.244.0/24 [110/20] via 192.168.224.2, 00:03:23, Serial0/0
  192.168.64.0/32 is subnetted, 1 subnets
O IA    192.168.64.1 [110/2] via 192.168.1.1, 00:03:23, FastEthernet0/0
  192.168.80.0/32 is subnetted, 1 subnets
O IA    192.168.80.1 [110/2] via 192.168.1.1, 00:03:23, FastEthernet0/0
  192.168.96.0/32 is subnetted, 1 subnets
O IA    192.168.96.1 [110/2] via 192.168.1.1, 00:03:24, FastEthernet0/0
O N2    192.168.248.0/24 [110/20] via 192.168.224.2, 00:03:24, Serial0/0
  192.168.112.0/32 is subnetted, 1 subnets
IA     192.168.112.1 [110/2] via 192.168.1.1, 00:03:30, FastEthernet0/0
C       192.168.1.0/24 is directly connected, FastEthernet0/0
O N2    192.168.252.0/24 [110/20] via 192.168.224.2, 00:03:30, Serial0/0
C       192.168.3.0/24 is directly connected, Loopback0
```

6. According to the output of this command, what kind of OSPF route is the external route to 192.168.248.0/24?

NSSA Type 2 (N2) routes are learned through Type 7 LSAs.

Finally, check SanJose1's routing table. The external route to 192.168.248.0/24 should still be installed. Issue the **show ip ospf database** command on SanJose1:

```
SanJose1#show ip ospf database

          OSPF Router with ID (192.168.112.1) (Process ID 1)
          Router Link States (Area 0)
Link ID      ADV Router    Age         Seq#         Checksum
Link count
192.168.3.1  192.168.3.1   390        0x80000007  0x45B2    2
192.168.112.1 192.168.112.1 1931       0x80000008  0x148A    1

          Net Link States (Area 0)
Link ID      ADV Router    Age         Seq#         Checksum
192.168.1.1  192.168.112.1 1931       0x80000001  0xA10A
```

```

Summary Net Link States (Area 0)
Link ID      ADV Router    Age      Seq#      Checksum
192.168.64.1 192.168.112.1 1456    0x80000005 0xE7CA
192.168.80.1 192.168.112.1 1457    0x80000005 0x376B
192.168.96.1 192.168.112.1 1457    0x80000005 0x860C
192.168.112.1 192.168.112.1 1457    0x80000005 0xD5AC
192.168.224.0 192.168.3.1 1967    0x80000001 0x92E5

Router Link States (Area 1)
Link ID      ADV Router    Age      Seq#      Checksum
Link count
192.168.112.1 192.168.112.1 1457    0x80000006 0x39FE  4

Summary Net Link States (Area 1)
Link ID      ADV Router    Age      Seq#      Checksum
192.168.1.0 192.168.112.1 1924    0x80000009 0xA14D
192.168.3.1 192.168.112.1 1919    0x80000001 0x9B57
192.168.224.0 192.168.112.1 1919    0x80000001 0x9E6B

Summary ASB Link States (Area 1)
Link ID      ADV Router    Age      Seq#      Checksum
192.168.3.1 192.168.112.1 387     0x80000003 0x7F71

Type-5 AS External Link States
Link ID      ADV Router    Age      Seq#      Checksum Tag
192.168.240.0 192.168.3.1 383     0x80000001 0x5A35  0
192.168.244.0 192.168.3.1 383     0x80000001 0x4048  0
192.168.248.0 192.168.3.1 383     0x80000001 0x1470  0
192.168.252.0 192.168.3.1 384     0x80000001 0xE798  0

```

7. Does SanJose1's database include link IDs that use Type 7 LSAs?

8. Does SanJose1's database include link IDs that use Type 5 LSAs?

Because SanJose3 converts Type 7 LSAs to Type 5, SanJose1 is unaware of the NSSA configuration of Area 51.

```

SanJose1#show ip route
<output omitted>
Gateway of last resort is not set
  192.168.224.0/30 is subnetted, 1 subnets
O IA   192.168.224.0 [110/782] via 192.168.1.3, 00:06:38, FastEthernet0/0
  192.168.240.0/30 is subnetted, 1 subnets
O E2   192.168.240.0 [110/20] via 192.168.1.3, 00:06:32, FastEthernet0/0
O E2   192.168.244.0/24 [110/20] via 192.168.1.3, 00:06:32, FastEthernet0/0
  192.168.64.0/30 is subnetted, 1 subnets
C      192.168.64.0 is directly connected, Loopback0
  192.168.80.0/30 is subnetted, 1 subnets
C      192.168.80.0 is directly connected, Loopback1
  192.168.96.0/30 is subnetted, 1 subnets
C      192.168.96.0 is directly connected, Loopback2
O E2   192.168.248.0/24 [110/20] via 192.168.1.3, 00:06:33, FastEthernet0/0
  192.168.112.0/30 is subnetted, 1 subnets
C      192.168.112.0 is directly connected, Loopback3
C      192.168.1.0/24 is directly connected, FastEthernet0/0
O E2   192.168.252.0/24 [110/20] via 192.168.1.3, 00:06:35, FastEthernet0/0
  192.168.3.0/32 is subnetted, 1 subnets
O      192.168.3.1 [110/2] via 192.168.1.3, 00:06:41, FastEthernet0/0

```

Save the configuration files on each router.