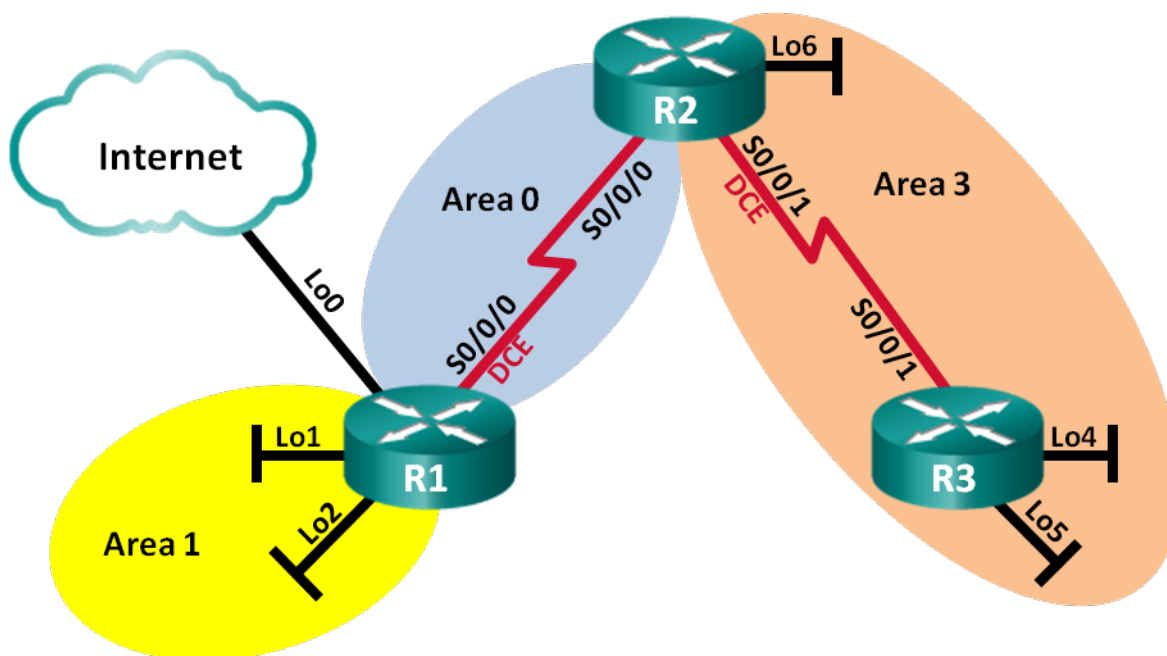


Lab - Configuring Multi-area OSPFv2

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask
R1	Lo0	209.165.200.225	255.255.255.252
	Lo1	192.168.1.1	255.255.255.0
	Lo2	192.168.2.1	255.255.255.0
	S0/0/0 (DCE)	192.168.12.1	255.255.255.252
R2	Lo6	192.168.6.1	255.255.255.0
	S0/0/0	192.168.12.2	255.255.255.252
	S0/0/1 (DCE)	192.168.23.1	255.255.255.252
R3	Lo4	192.168.4.1	255.255.255.0
	Lo5	192.168.5.1	255.255.255.0
	S0/0/1	192.168.23.2	255.255.255.252

Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Configure a Multi-area OSPFv2 Network

Background / Scenario

To make OSPF more efficient and scalable, OSPF supports hierarchical routing using the concept of areas. An OSPF area is a group of routers that share the same link-state information in their link-state databases (LSDBs). When a large OSPF area is divided into smaller areas, it is called multi-area OSPF. Multi-area OSPF is useful in larger network deployments to reduce processing and memory overhead.

In the lab, you will configure a multi-area OSPFv2 network.

Note: The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). Other routers and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

Note: Make sure that the routers have been erased and have no startup configurations. If you are unsure, contact your instructor.

Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- Console cables to configure the Cisco IOS devices via the console ports
- Serial cables as shown in the topology

Part 1: Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on the routers.

Step 1: Cable the network as shown in the topology.

Step 2: Initialize and reload the routers as necessary.

Step 3: Configure basic settings for each router.

- Disable DNS lookup.
- Configure device name, as shown in the topology.
- Assign **class** as the privileged EXEC password.
- Assign **cisco** as the console and vty passwords.
- Configure **logging synchronous** for the console line.
- Configure an MOTD banner to warn users that unauthorized access is prohibited.
- Configure the IP addresses listed in the Addressing Table for all interfaces. DCE interfaces should be configured with a clock rate of 128000. Bandwidth should be set to 128 Kb/s on all serial interfaces.
- Copy the running configuration to the startup configuration.

Step 4: Verify Layer 3 connectivity.

Use the **show ip interface brief** command to verify that the IP addressing is correct and that the interfaces are active. Verify that each router can ping their neighbor's serial interface.

Part 2: Configure a Multi-area OSPFv2 Network

In Part 2, you will configure a multi-area OSPFv2 network with a process ID of 1. All LAN loopback interfaces should be passive.

Step 1: Identify the OSPF router types in the topology.

Identify the Backbone router(s):

Identify the Autonomous System Boundary Router(s) (ASBR):

Identify the Area Border Router(s) (ABR):

Identify the Internal router(s):

Step 2: Configure OSPF on R1.

a. Configure a router ID of 1.1.1.1 with OSPF process ID of 1.

b. Add the networks for R1 to OSPF.

```
R1(config-router)# network 192.168.1.0 0.0.0.255 area 1
```

```
R1(config-router)# network 192.168.2.0 0.0.0.255 area 1
```

```
R1(config-router)# network 192.168.12.0 0.0.0.3 area 0
```

c. Set LAN loopback interfaces, Lo1 and Lo2, as passive.

d. Create a default route to the Internet using exit interface Lo0.

Note: You may see the “%Default route without gateway, if not a point-to-point interface, may impact performance” message. This is normal behavior if using a Loopback interface to simulate a default route.

e. Configure OSPF to propagate the routes throughout the OSPF areas.

Step 3: Configure OSPF on R2.

a. Configure a router ID of 2.2.2.2 with OSPF process ID of 1.

b. Add the networks for R2 to OSPF. Add the networks to the correct area. Write the commands used in the space below.

c. Set all LAN loopback interfaces as passive.

Step 4: Configure OSPF on R3.

a. Configure a router ID of 3.3.3.3 with OSPF process ID of 1.

b. Add the networks for R3 to OSPF. Write the commands used in the space below.

c. Set all LAN loopback interfaces as passive.

Step 5: Verify that OSPF settings are correct and adjacencies have been established between routers.

- Issue the **show ip protocols** command to verify OSPF settings on each router. Use this command to identify the OSPF router types and to determine the networks assigned to each area.

R1# **show ip protocols**

*** IP Routing is NSF aware ***

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 1.1.1.1

It is an area border and autonomous system boundary router

Redistributing External Routes from,

Number of areas in this router is 2. 2 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.1.0 0.0.0.255 area 1

192.168.2.0 0.0.0.255 area 1

192.168.12.0 0.0.0.3 area 0

Passive Interface(s):

Loopback1

Loopback2

Routing Information Sources:

Gateway	Distance	Last Update
2.2.2.2	110	00:01:45

Distance: (default is 110)

R2# **show ip protocols**

*** IP Routing is NSF aware ***

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 2.2.2.2

It is an area border router

Number of areas in this router is 2. 2 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.6.0 0.0.0.255 area 3

192.168.12.0 0.0.0.3 area 0

192.168.23.0 0.0.0.3 area 3

Passive Interface(s):

Loopback6

Routing Information Sources:

Gateway	Distance	Last Update
3.3.3.3	110	00:01:20
1.1.1.1	110	00:10:12

Distance: (default is 110)

R3# **show ip protocols**

*** IP Routing is NSF aware ***

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 3.3.3.3

Number of areas in this router is 1. 1 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.4.0 0.0.0.255 area 3

192.168.5.0 0.0.0.255 area 3

192.168.23.0 0.0.0.3 area 3

Passive Interface(s):

Loopback4

Loopback5

Routing Information Sources:

Gateway	Distance	Last Update
1.1.1.1	110	00:07:46
2.2.2.2	110	00:07:46

Distance: (default is 110)

What is the OSPF router type for each router?

R1:

R2:

R3:

Issue the **show ip ospf neighbor** command to verify that OSPF adjacencies have been established between routers.

R1# **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
2.2.2.2	0	FULL/ -	00:00:34	192.168.12.2	Serial0/0/0

R2# **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
1.1.1.1	0	FULL/ -	00:00:36	192.168.12.1	Serial0/0/0
3.3.3.3	0	FULL/ -	00:00:36	192.168.23.2	Serial0/0/1

R3# **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
2.2.2.2	0	FULL/ -	00:00:38	192.168.23.1	Serial0/0/1

b. Issue the **show ip ospf interface brief** command to display a summary of interface route costs.

R1# **show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Se0/0/0	1	0	192.168.12.1/30	781	P2P	1/1	
Lo1	1	1	192.168.1.1/24	1	LOOP	0/0	

```
Lo2          1      1          192.168.2.1/24      1      LOOP  0/0
```

```
R2# show ip ospf interface brief
```

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Se0/0/0	1	0	192.168.12.2/30	781	P2P	1/1	
Lo6	1	3	192.168.6.1/24	1	LOOP	0/0	
Se0/0/1	1	3	192.168.23.1/30	781	P2P	1/1	

```
R3# show ip ospf interface brief
```

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Lo4	1	3	192.168.4.1/24	1	LOOP	0/0	
Lo5	1	3	192.168.5.1/24	1	LOOP	0/0	
Se0/0/1	1	3	192.168.23.2/30	781	P2P	1/1	

Reflection

What are three advantages for designing a network with multi-area OSPF?

Router Interface Summary Table

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.