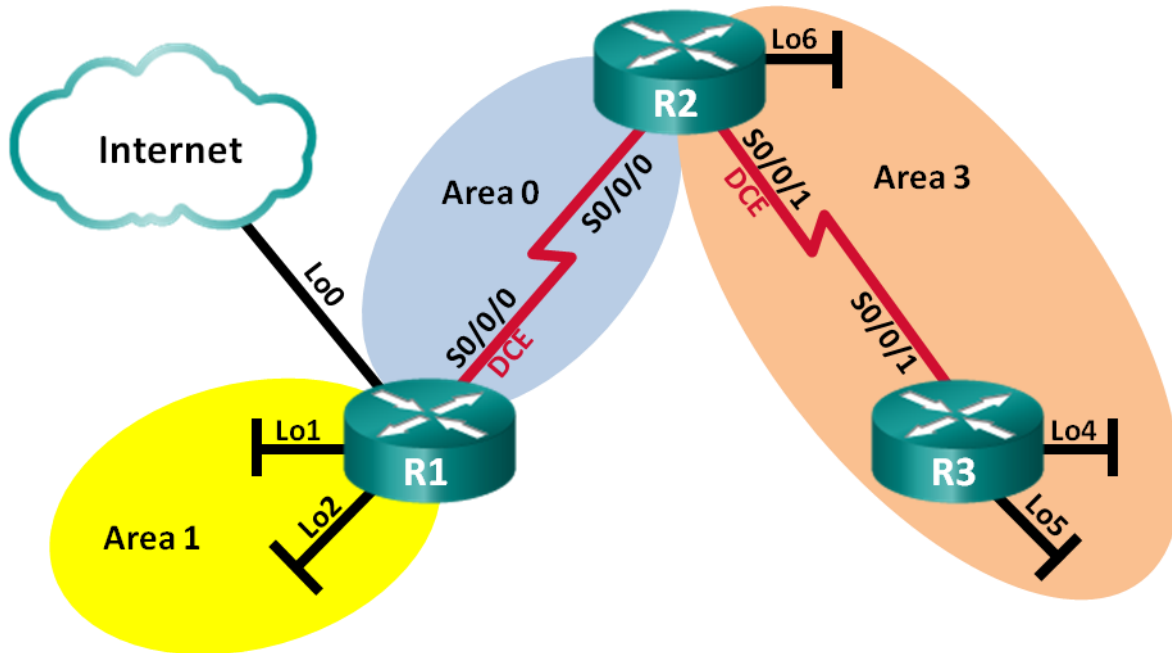


Lab - Configuring Multi-area OSPFv2

Not submitting the packet tracer file will grant you a zero in the post-lab grade.

Topology



Addressing Table (Lo -> loopback interface)

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 from scratch.

Required Resources

- Three routers (Cisco 1941)
- Serial DCE 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.

First, install the serial interface on all routers - use this video to help you upto minute 0:32, nevermind the video using different type of routers; the procedure is still the same

https://www.youtube.com/watch?v=K5Rm5_ravSs

Step 2: Configure basic settings for each router.

- a. Configure the IP addresses listed in the Addressing Table for all interfaces. DCE interfaces should be configured with a clock rate of 128000. Tx Ring Limit should be set to 128 Kb/s on all serial interfaces

To configure Lo0 on R1 for example use these commands:

```
R1(config)# int loopback 0
R1(config-if)# ip add 209.165.200.225 255.255.255.252
R1(config-if)# no shutdown
```

and so on...

- b. Copy the running configuration to the startup configuration.

Step 3: 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: Configure OSPF on R1.

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

```
R1(config)# router ospf 1
R1(config-router)# router-id 1.1.1.1
```

- 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.

```
R1(config-router)# passive-interface lo1
R1(config-router)# passive-interface lo2
R1(config-router)# exit
```

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

```
R1(config)# ip route 0.0.0.0 0.0.0.0 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.

```
R1(config)# router ospf 1
R1(config-router)# default-information originate
```

Step 2: Configure OSPF on R2.

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

```
R2(config)# router ospf 1
R2(config-router)# router-id 2.2.2.2
```

- 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.

```
R2(config-router)# passive-interface lo6
```

Step 3: Configure OSPF on R3.

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

```
R3(config)# router ospf 1
```

```
R3(config-router)# router-id 3.3.3.3
```

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

- c. Set all LAN loopback interfaces as passive.

```
R3(config-router)# passive-interface lo4
```

```
R3(config-router)# passive-interface lo5
```

Step 4: Verify that OSPF settings are correct and adjacencies have been established between routers.

- a. 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 - ABR and ASBR

R2 - ABR

R3 - No special OSPF router type

- b. 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

- c. 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	

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.

Device Configs - Final

Router R1

```
R1# show run
```

```
Building configuration...
```

```
Current configuration : 2062 bytes
```

```
!  
version 15.2  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname R1  
!  
boot-start-marker  
boot-end-marker  
!  
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2  
!  
no aaa new-model  
memory-size iomem 15  
!  
ip cef  
!
```

```
no ip domain lookup
no ipv6 cef
multilink bundle-name authenticated
!
interface Loopback0
 ip address 209.165.200.225 255.255.255.252
!
interface Loopback1
 ip address 192.168.1.1 255.255.255.0
!
interface Loopback2
 ip address 192.168.2.1 255.255.255.0
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 bandwidth 128
 ip address 192.168.12.1 255.255.255.252
 clock rate 128000
!
interface Serial0/0/1
 no ip address
 shutdown
!
router ospf 1
 router-id 1.1.1.1
 passive-interface Loopback1
 passive-interface Loopback2
 network 192.168.1.0 0.0.0.255 area 1
 network 192.168.2.0 0.0.0.255 area 1
 network 192.168.12.0 0.0.0.3 area 0
 default-information originate
!
ip forward-protocol nd
!
```



```
no ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Loopback0
!
control-plane
!
!
banner motd @
  Unauthorized Access is Prohibited! @
!
line con 0
  password cisco
  logging synchronous
  login
line aux 0
line 2
  no activation-character
  no exec
  transport preferred none
  transport input all
  transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
  stopbits 1
line vty 0 4
  password cisco
  login
  transport input none
!
scheduler allocate 20000 1000
!
end
```

Router R2

```
R2# show run
Building configuration...

Current configuration : 1905 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
```

```
!  
no aaa new-model  
memory-size iomem 15  
!  
ip cef  
!  
no ip domain lookup  
no ipv6 cef  
multilink bundle-name authenticated  
!  
interface Loopback6  
ip address 192.168.6.1 255.255.255.0  
!  
interface Embedded-Service-Engine0/0  
no ip address  
shutdown  
!  
interface GigabitEthernet0/0  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface GigabitEthernet0/1  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
bandwidth 128  
ip address 192.168.12.2 255.255.255.252  
!  
interface Serial0/0/1  
bandwidth 128  
ip address 192.168.23.1 255.255.255.252  
clock rate 128000  
!  
router ospf 1  
router-id 2.2.2.2  
passive-interface Loopback6  
network 192.168.6.0 0.0.0.255 area 3  
network 192.168.12.0 0.0.0.3 area 0  
network 192.168.23.0 0.0.0.3 area 3  
!  
ip forward-protocol nd  
!  
no ip http server  
no ip http secure-server
```

```
!  
control-plane  
!  
banner motd @  
  Unauthorized Access is Prohibited! @  
!  
line con 0  
  password cisco  
  logging synchronous  
  login  
line aux 0  
line 2  
  no activation-character  
  no exec  
  transport preferred none  
  transport input all  
  transport output pad telnet rlogin lapb-ta mop udptn v120 ssh  
  stopbits 1  
line vty 0 4  
  password cisco  
  login  
  transport input all  
!  
scheduler allocate 20000 1000  
!  
end
```

Router R3

```
R3# show run  
Building configuration...  
  
Current configuration : 1958 bytes  
!  
version 15.2  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname R3  
!  
boot-start-marker  
boot-end-marker  
!  
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2  
!  
no aaa new-model  
memory-size iomem 15  
!  
ip cef
```

```
!  
no ip domain lookup  
no ipv6 cef  
!  
multilink bundle-name authenticated  
!  
interface Loopback4  
ip address 192.168.4.1 255.255.255.0  
!  
interface Loopback5  
ip address 192.168.5.1 255.255.255.0  
!  
interface Embedded-Service-Engine0/0  
no ip address  
shutdown  
!  
interface GigabitEthernet0/0  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface GigabitEthernet0/1  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
no ip address  
shutdown  
clock rate 2000000  
!  
interface Serial0/0/1  
bandwidth 128  
ip address 192.168.23.2 255.255.255.252  
!  
router ospf 1  
router-id 3.3.3.3  
passive-interface Loopback4  
passive-interface Loopback5  
network 192.168.4.0 0.0.0.255 area 3  
network 192.168.5.0 0.0.0.255 area 3  
network 192.168.23.0 0.0.0.3 area 3  
!  
ip forward-protocol nd  
!  
no ip http server  
no ip http secure-server
```

```
!  
control-plane  
!  
banner motd @  
  Unauthorized Access is Prohibited! @  
!  
line con 0  
  password cisco  
  logging synchronous  
  login  
line aux 0  
line 2  
  no activation-character  
  no exec  
  transport preferred none  
  transport input all  
  transport output pad telnet rlogin lapb-ta mop udptn v120 ssh  
  stopbits 1  
line vty 0 4  
  password cisco  
  login  
  transport input none  
!  
scheduler allocate 20000 1000  
!  
end
```