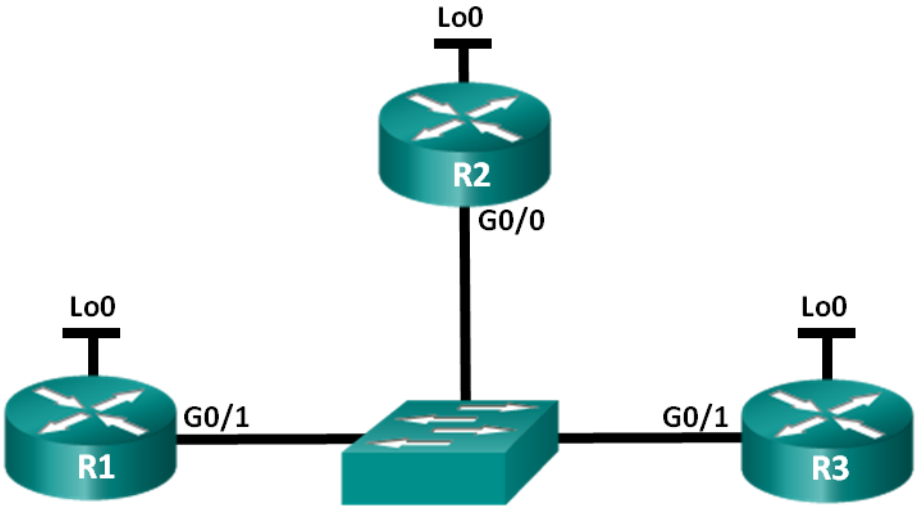
Lab - Configuring OSPFv2 on a Multiaccess Network (Instructor Version)

Instructor Note: Red font color or Gray highlights indicate text that appears in the instructor copy only.

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask
R1	G0/1	192.168.1.1	255.255.255.0
	Lo0	192.168.31.11	255.255.255.255
R2	G0/0	192.168.1.2	255.255.255.0
	Lo0	192.168.31.22	255.255.255.255
R3	G0/1	192.168.1.3	255.255.255.0
	Lo0	192.168.31.33	255.255.255.255

Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Configure and Verify OSPFv2 on the DR, BDR, and DROther

Part 3: Configure OSPFv2 Interface Priority to Determine the DR and BDR

Background / Scenario

A multiaccess network is a network with more than two devices on the same shared media. Examples include Ethernet and Frame Relay. On multiaccess networks, OSPFv2 elects a Designated Router (DR) to be the collection and distribution point for link-state advertisements (LSAs) that are sent and received. A Backup Designated Router (BDR) is also elected in case the DR fails. All other routers become DROthers as this indicates a router that is neither the DR nor the BDR.

Because the DR acts as a focal point for OSPF routing protocol communication, the router chosen should be capable of supporting a heavier traffic load than other routers in the network. A router with a powerful CPU and adequate DRAM is typically the best choice for the DR.

In this lab, you will configure OSPFv2 on the DR, BDR, and DROther. You will then modify the priority of routers to control the outcome of the DR/BDR election process and ensure that the desired router becomes the DR.

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). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches, 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 and switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

Instructor Note: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 1 Switch (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet 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.

Attach the devices as shown in the topology diagram, and cable as necessary.

Step 2: Initialize and reload the routers.

Step 3: Configure basic settings for each router.

a. Disable DNS lookup.

b. Configure device names as shown in the topology.

c. Assign **class** as the privileged EXEC password.

d. Assign **cisco** as the console and vty passwords.

e. Encrypt the plain text passwords.

f. Configure a MOTD banner to warn users that unauthorized access is prohibited.

g. Configure **logging synchronous** for the console line.

h. Configure the IP addresses listed in the Addressing Table for all interfaces.

i. Use the **show ip interface brief** command to verify that the IP addressing is correct and that the interfaces are active.

j. Copy the running configuration to the startup configuration.

Part 2: Configure and Verify OSPFv2 on the DR, BDR, and DROther

In Part 2, you will configure OSPFv2 on the DR, BDR, and DROther. The DR and BDR election process takes place as soon as the first router has its interface enabled on the multiaccess network. This can happen as the routers are powered-on or when the OSPF **network** command for that interface is configured. If a new router enters the network after the DR and BDR have already been elected, it does not become the DR or BDR, even if it has a higher OSPF interface priority or router ID than the current DR or BDR. Configure the OSPF process on the router with the highest router ID first to ensure that this router becomes the DR.

Step 1: Configure OSPF on R3.

Configure the OSPF process on R3 (the router with the highest router ID) to ensure that this router becomes the DR.

a. Assign 1 as the process ID for the OSPF process. Configure the router to advertise the 192.168.1.0/24 network. Use an area ID of 0 for the OSPF *area-id* parameter in the **network** statement.

What factor determined that R3 has the highest router ID?

_____

Highest loopback address

b. Verify that OSPF has been configured and R3 is the DR.

What command would you use to verify that OSPF has been configured correctly and R3 is the DR?

_____

show ip ospf interface or **show ip ospf interface brief**

```
R3# show ip ospf interface
GigabitEthernet0/1 is up, line protocol is up
  Internet Address 192.168.1.3/24, Area 0, Attached via Network Statement
  Process ID 1, Router ID 192.168.31.33, Network Type BROADCAST, Cost: 1
  Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0           1         no           no            Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.31.33, Interface address 192.168.1.3
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:06
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
```

Step 2: Configure OSPF on R2.

Configure the OSPF process on R2 (the router with the second highest router ID) to ensure that this router becomes the BDR.

a. Assign 1 as the process ID for the OSPF process. Configure the router to advertise the 192.168.1.0/24 network. Use an area ID of 0 for the OSPF *area-id* parameter in the **network** statement.

b. Verify that the OSPF has been configured and that R2 is the BDR. Record the command used for verification.

_____

show ip ospf interface

```
R2# show ip ospf interface
GigabitEthernet0/0 is up, line protocol is up
  Internet Address 192.168.1.2/24, Area 0, Attached via Network Statement
  Process ID 1, Router ID 192.168.31.22, Network Type BROADCAST, Cost: 1
  Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0           1         no          no            Base
  Transmit Delay is 1 sec, State BDR, 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
    oob-resync timeout 40
    Hello due in 00:00:03
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.31.33  (Designated Router)
  Suppress hello for 0 neighbor(s)
```

c. Issue the **show ip ospf neighbor** command to view information about the other routers in the OSPF area.

```
R2# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.31.33     1   FULL/DR         00:00:33    192.168.1.3     GigabitEthernet0/0
```

Notice that R3 is the DR.

Step 3: Configure OSPF on R1.

Configure the OSPF process on R1 (the router with the lowest router ID). This router will be designated as DROther instead of DR or BDR.

a. Assign 1 as the process ID for the OSPF process. Configure the router to advertise the 192.168.1.0/24 network. Use an area ID of 0 for the OSPF *area-id* parameter in the **network** statement.

b. Issue **show ip ospf interface brief** command to verify that OSPF has been configured and R1 is the DROther.

```
R1# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Gi0/1        1     0               192.168.1.1/24     1     DROTH 2/2
```

c. Issue the **show ip ospf neighbor** command to view information about the other routers in the OSPF area.

```
R1# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.31.22     1   FULL/BDR        00:00:35    192.168.1.2     GigabitEthernet0/1
192.168.31.33     1   FULL/DR         00:00:30    192.168.1.3     GigabitEthernet0/1
```

What priority are both the DR and BDR routers? _____ One

Part 3: Configure OSPFv2 Interface Priority to Determine the DR and BDR

In Part 3, you will configure router interface priority to determine the DR/BDR election, reset the OSPFv2 process, and then verify that the DR and BDR routers have changed. OSPF interface priority overrides all other settings in determining which routers become the DR and BDR.

Step 1: Configure R1 G0/1 with OSPF priority 255.

A value of 255 is the highest possible interface priority.

```
R1(config)# interface g0/1
R1(config-if)# ip ospf priority 255
R1(config-if)# end
```

Step 2: Configure R3 G0/1 with OSPF priority 100.

```
R3(config)# interface g0/1
R3(config-if)# ip ospf priority 100
R3(config-if)# end
```

Step 3: Configure R2 G0/0 with OSPF priority 0.

A priority of 0 causes the router to be ineligible to participate in an OSPF election and does not become a DR or BDR.

```
R2(config)# interface g0/0
R2(config-if)# ip ospf priority 0
R2(config-if)# end
```

Step 4: Reset the OSPF process.

a. Issue the **show ip ospf neighbor** command to determine the DR and BDR.

b. Has the DR designation changed? _____ No Which router is the DR? _____ R3

Has the BDR designation changed? _____ Yes Which router is the BDR? _____ R1

What is the role of R2 now? _____ DROther

Explain the immediate effects caused by the **ip ospf priority** command.

_____

_____

_____

The effect for changing the ospf priority on an interface usually only takes effect when the existing DR goes down. The DR does not relinquish its status just because a new interface reports a higher priority in

its hello packet. The DR does not change its status until a new election occurs. Issuing the **clear ip ospf process** command on all of the routers resets the OSPF process.

If a router interface is assigned an OSPF priority of 0, the interface will not be elected for either the DR or BDR role and the router changes its state immediately to DROther.

Note: If the DR and BDR designations did not change, issue the **clear ip ospf 1 process** command on all of the routers to reset the OSPF processes and force a new election.

If the **clear ip ospf process** command does not reset the DR and BDR, issue the **reload** command on all routers after saving the running configuration to the startup configuration.

c. Issue the **show ip ospf interface** command on R1 and R3 to confirm the priority settings and DR/BDR status on the routers.

```
R1# show ip ospf interface
GigabitEthernet0/1 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 DR, Priority 255
  Designated Router (ID) 192.168.31.11, Interface address 192.168.1.1
  Backup Designated router (ID) 192.168.31.33, Interface address 192.168.1.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  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
    Adjacent with neighbor 192.168.31.33  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)

R3# show ip ospf interface
GigabitEthernet0/1 is up, line protocol is up
  Internet Address 192.168.1.3/24, Area 0
  Process ID 1, Router ID 192.168.31.33, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 100
  Designated Router (ID) 192.168.31.11, Interface address 192.168.1.1
  Backup Designated router (ID) 192.168.31.33, Interface address 192.168.1.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 2
  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
    Adjacent with neighbor 192.168.31.11  (Designated Router)
```

```
  Suppress hello for 0 neighbor(s)
```

Which router is now the DR? _____ R1

Which router is now the BDR? _____ R3

Did the interface priority override the router ID in determining the DR/BDR? _____ yes

Reflection

1. List the criteria used from highest to lowest for determining the DR on an OSPF network.

   _____

   _____

   _____

   Highest is interface priority. Next is highest router ID. The highest router ID can be explicitly set using the **router-id** command. If no router ID is explicitly set, the router ID is based on the highest loopback address, as it was at the start of this lab. In the event no loopbacks are configured, the router ID is the highest active interface address.

2. What is the significance of a 255 interface priority?

   _____

   Highest possible priority

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

Router R1

```
R1#show run
```

```
Building configuration...

Current configuration : 1623 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
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
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
!
interface Loopback0
 ip address 192.168.31.11 255.255.255.255
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 192.168.1.1 255.255.255.0
 ip ospf priority 255
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
!
interface Serial0/0/1
```

```
 no ip address
 shutdown
!
router ospf 1
 network 192.168.1.0 0.0.0.255 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
control-plane
!
banner motd ^C
Unauthorized access is strictly prohibited.
^C
!
line con 0
 password 7 045802150C2E
 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 7 060506324F41
 login
 transport input all
line vty 5 15
 password 7 060506324F41
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Router R2

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

Current configuration : 1708 bytes
!
version 15.2
```

```
service timestamps debug datetime msec
service timestamps log datetime msec
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
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
!
interface Loopback0
 ip address 192.168.31.22 255.255.255.255
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 ip address 192.168.1.2 255.255.255.0
 ip ospf priority 0
duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
!
interface Serial0/0/1
 no ip address
 shutdown
!
router ospf 1
 network 192.168.1.0 0.0.0.255 area 0
```

```
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!!
control-plane
!
banner motd ^C
Unauthorized access is strictly prohibited.
^C
!
line con 0
 password 7 0822455D0A16
 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 7 110A1016141D
 login
 transport input all
line vty 5 15
 password 7 110A1016141D
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Router R3

```
R3#show run
Building configuration...

Current configuration : 1662 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname R3
```

```
!
boot-start-marker
boot-end-marker
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
memory-size iomem 10
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
!
interface Loopback0
 ip address 192.168.31.33 255.255.255.255
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 192.168.1.3 255.255.255.0
 ip ospf priority 100
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
!
interface Serial0/0/1
 no ip address
 shutdown
!
router ospf 1
 network 192.168.1.0 0.0.0.255 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
```

```
!
control-plane
!
banner motd ^C
Unauthorized access is strictly prohibited. ^C
!
line con 0
 password 7 02050D480809
 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 7 14141B180F0B
 login
 transport input all
line vty 5 15
 password 7 14141B180F0B
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```