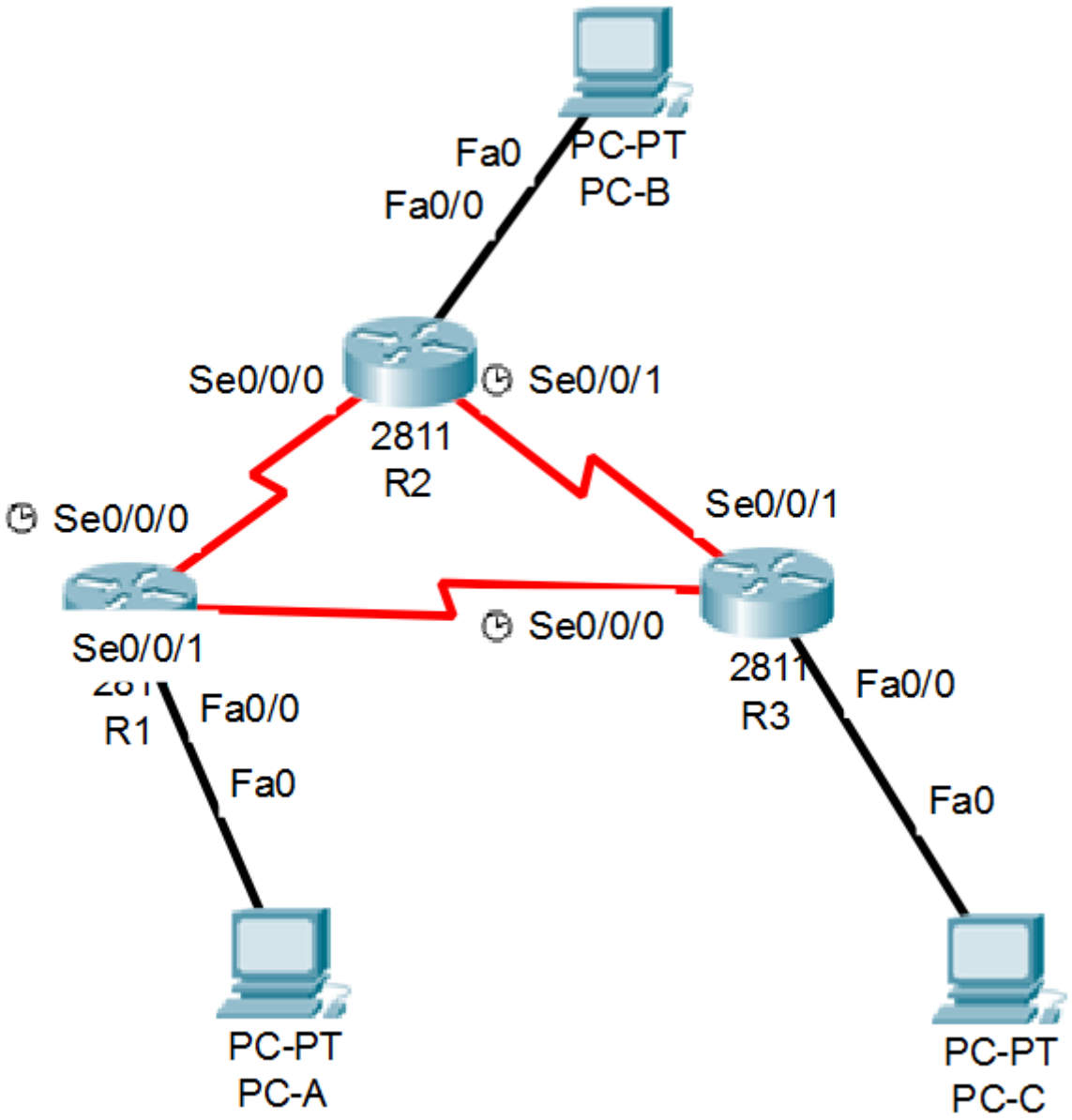
Single-Area OSPFv2

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	F0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0 (DCE)	192.168.12.1	255.255.255.252	N/A
	S0/0/1	192.168.13.1	255.255.255.252	N/A
R2	F0/0	192.168.2.1	255.255.255.0	N/A
	S0/0/0	192.168.12.2	255.255.255.252	N/A
	S0/0/1 (DCE)	192.168.23.1	255.255.255.252	N/A
R3	F0/0	192.168.3.1	255.255.255.0	N/A
	S0/0/0 (DCE)	192.168.13.2	255.255.255.252	N/A
	S0/0/1	192.168.23.2	255.255.255.252	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1
PC-B	NIC	192.168.2.3	255.255.255.0	192.168.2.1
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1

Note: Make sure that the routers have been erased and have no startup configurations.

Required Resources

- 3 Routers (Cisco 2811 with Cisco IOS)
- 3 PCs (Windows with terminal emulation program)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology

Part 1: Build the Network and Configure Basic Device Settings

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

a. Disable DNS lookup.
b. Configure device name as shown in the topology.
c. Assign **pass** as the privileged EXEC password.
d. Assign **pass** as the console and vty passwords.
e. Configure a message of the day (MOTD) banner to warn users that unauthorized access is prohibited.
f. Configure **logging synchronous** for the console line.
g. Configure the IP address listed in the Addressing Table for all interfaces.
h. Set the clock rate for all DCE serial interfaces at **128000**.
i. Copy the running configuration to the startup configuration.

Step 4: Configure PC hosts.

Step 5: Test connectivity.

The routers should be able to ping one another, and each PC should be able to ping its default gateway. The PCs are unable to ping other PCs until OSPF routing is configured. Verify and troubleshoot if necessary.

Part 2: Configure and Verify OSPF Routing

In Part 2, you will configure OSPFv2 routing on all routers in the network and then verify that routing tables are updated correctly. After OSPF has been verified, you will configure OSPF authentication on the links for added security.

Step 1: Configure OSPF on R1.

a. Use the **router ospf** command in global configuration mode to enable OSPF on R1.

```
R1(config)# router ospf 1
```

Note: The OSPF process id is kept locally and has no meaning to other routers on the network.

b. Configure the **network** statements for the networks on R1. Use an area ID of 0.

```
R1(config-router)# network 192.168.1.0 0.0.0.255 area 0
R1(config-router)# network 192.168.12.0 0.0.0.3 area 0
R1(config-router)# network 192.168.13.0 0.0.0.3 area 0
```

Step 2: Configure OSPF on R2 and R3.

Use the **router ospf** command and add the **network** statements for the networks on R2 and R3. Neighbor adjacency messages display on R1 when OSPF routing is configured on R2 and R3.

```
R1#
00:22:29: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.23.1 on Serial0/0/0 from LOADING
to FULL, Loading Done
R1#
00:23:14: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.23.2 on Serial0/0/1 from LOADING
to FULL, Loading Done
R1#
```

Step 3: Verify OSPF neighbors and routing information.

a. Issue the **show ip ospf neighbor** command to verify that each router lists the other routers in the network as neighbors.

```
R1# show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------
```

b. Issue the **show ip route** command to verify that all networks display in the routing table on all routers.

```
R1# show ip route
[output omitted]

O    192.168.2.0/24 [110/65] via 192.168.12.2, 00:32:33, Serial0/0/0
O    192.168.3.0/24 [110/65] via 192.168.13.2, 00:31:48, Serial0/0/1
     192.168.23.0/30 is subnetted, 1 subnets
O       192.168.23.0/30 [110/128] via 192.168.12.2, 00:31:38, Serial0/0/0
                        [110/128] via 192.168.13.2, 00:31:38, Serial0/0/1
```

What command would you use to only see the OSPF routes in the routing table?

_____
___

Step 4: Verify OSPF protocol settings.

The **show ip protocols** command is a quick way to verify vital OSPF configuration information. This information includes the OSPF process ID, the router ID, networks the router is advertising, the neighbors the router is receiving updates from, and the default administrative distance, which is 110 for OSPF.

```
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 192.168.13.1
```

```
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Maximum path: 4
Routing for Networks:
  192.168.1.0 0.0.0.255 area 0
  192.168.12.0 0.0.0.3 area 0
  192.168.13.0 0.0.0.3 area 0
Routing Information Sources:
  Gateway         Distance      Last Update
  192.168.23.2         110      00:19:16
  192.168.23.1         110      00:20:03
Distance: (default is 110)
```

Step 5: Verify OSPF process information.

Use the **show ip ospf** command to examine the OSPF process ID and router ID. This command displays the OSPF area information, as well as the last time the SPF algorithm was calculated.

```
R1# show ip ospf
 Routing Process "ospf 1" with ID 192.168.13.1
[output omitted]
    Area BACKBONE(0)
        Number of interfaces in this area is 3
        Area has no authentication
        SPF algorithm last executed 00:22:53.756 ago
        [output omitted]
```

Step 6: Verify OSPF interface settings.

a. Issue the **show ip ospf interface brief** command to display a summary of OSPF-enabled interfaces.

```
R1# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Se0/0/1      1     0               192.168.13.1/30    64    P2P   1/1
Se0/0/0      1     0               192.168.12.1/30    64    P2P   1/1
Fa0/0        1     0               192.168.1.1/24     1     DR    0/0
```

b. For a more detailed list of every OSPF-enabled interface, issue the **show ip ospf interface** command.

```
R1# show ip ospf interface
```

c. What is the OSPF cost of Serial 0/0/0? _____

Step 7: Verify end-to-end connectivity.

Each PC should be able to ping the other PCs in the topology. Verify and troubleshoot if necessary.

Note: It may be necessary to disable the PC firewall to ping between PCs.

Part 3: Change Router ID Assignments

The OSPF router ID is used to uniquely identify the router in the OSPF routing domain. Cisco routers derive the router ID in one of three ways and with the following precedence:

1) IP address configured with the OSPF **router-id** command, if present
2) Highest IP address of any of the router's loopback addresses, if present
3) Highest active IP address on any of the router's physical interfaces

Because no router IDs or loopback interfaces have been configured on the three routers, the router ID for each router is determined by the highest IP address of any active interface.

In Part 3, you will change the OSPF router ID assignment using loopback addresses. You will also use the **router-id** command to change the router ID.

Step 1: Change router IDs using loopback addresses.

a. Assign an IP address to loopback 0 on R1.

```
R1(config)# interface lo0
R1(config-if)# ip address 1.1.1.1 255.255.255.255
R1(config-if)# end
```

b. Assign IP addresses to Loopback 0 on R2 and R3. Use IP address 2.2.2.2/32 for R2 and 3.3.3.3/32 for R3.

c. Save the running configuration to the startup configuration on all three routers.

d. You must reload the routers in order to reset the router ID to the loopback address. Issue the **reload** command on all three routers. Press Enter to confirm the reload.

e. After the router completes the reload process, issue the **show ip protocols** command to view the new router ID on R1.

R1 ID: _____

f. Issue the **show ip ospf neighbor** command to display the router ID changes for the neighboring routers.
R2 ID: _____
R3 ID: _____

Step 2: Change the router ID on R1 using the router-id command.

The preferred method for setting the router ID is with the **router-id** command.

a. Issue the **router-id 11.11.11.11** command on R1 to reassign the router ID. Notice the informational message that appears when issuing the **router-id** command.

```
R1(config)# router ospf 1
R1(config-router)# router-id 11.11.11.11
Reload or use "clear ip ospf process" command, for this to take effect
R1(config)# end
```

b. You will receive an informational message telling you that you must either reload the router or use the **clear ip ospf process** command for the change to take effect. Issue the **clear ip ospf process** command on all three routers. Type **yes** to reply to the reset verification message, and press ENTER.

c. Set the router ID for R2 to **22.22.22.22** and the router ID for R3 to **33.33.33.33**. Then use **clear ip ospf process** command to reset ospf routing process.

d. Issue the **show ip protocols** command to verify that the router ID changed on R1.

e. Issue the **show ip ospf neighbor** command on R1 to verify that new router ID for R2 and R3 is listed.

```
R1# show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
_____________     0   FULL/  -        00:00:36    192.168.13.2    Serial0/0/1
_____________     0   FULL/  -        00:00:32    192.168.12.2    Serial0/0/0
```

Part 4: Configure OSPF Passive Interfaces

Step 1: Configure a passive interface.

a. Issue the **show ip ospf interface F0/0** command on R1. Notice the timer indicating when the next Hello packet is expected. Hello packets are sent every 10 seconds and are used between OSPF routers to verify that their neighbors are up.

```
R1# show ip ospf interface F0/0
FastEthernet0/0 is up, line protocol is up
  Internet Address 192.168.1.1/24, Area 0, Attached via Network Statement
  Process ID 1, Router ID 11.11.11.11, 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) 11.11.11.11, Interface address 192.168.1.1
  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 00:00:02
```

b. Issue the **passive-interface** command to change the F0/0 interface on R1 to passive.

```
R1(config)# router ospf 1
R1(config-router)# passive-interface F0/0
```

c. Re-issue the **show ip ospf interface F0/0** command to verify that F0/0 is now passive.

```
R1# show ip ospf interface F0/0
FastEthernet0/0 is up, line protocol is up
  Internet Address 192.168.1.1/24, Area 0, Attached via Network Statement
  Process ID 1, Router ID 11.11.11.11, Network Type BROADCAST, Cost: 1
[output omitted]
    No Hellos (Passive interface)
  …
```

d. Issue the **show ip route** command on R2 and R3 to verify that a route to the 192.168.1.0/24 network is still available.

```
R2# show ip route
O     192.168.1.0/24 [110/65] via 192.168.12.1, 00:58:32, Serial0/0/0
```

Step 2: Set passive interface as the default on a router.

a. Issue the **show ip ospf neighbor** command on R1 to verify that R2 is listed as an OSPF neighbor.

```
R1# show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
33.33.33.33       0   FULL/  -        00:00:31    192.168.13.2    Serial0/0/1
22.22.22.22       0   FULL/  -        00:00:32    192.168.12.2    Serial0/0/0
```

b. Issue the **passive-interface default** command on R2 to set the default for all OSPF interfaces as passive.

```
R2(config)# router ospf 1
R2(config-router)# passive-interface default
```

```
*Apr  3 00:03:00.979: %OSPF-5-ADJCHG: Process 1, Nbr 11.11.11.11 on Serial0/0/0
from FULL to DOWN, Neighbor Down: Interface down or detached
*Apr  3 00:03:00.979: %OSPF-5-ADJCHG: Process 1, Nbr 33.33.33.33 on Serial0/0/1
from FULL to DOWN, Neighbor Down: Interface down or detached
```

c. Re-issue the **show ip ospf neighbor** command on R1. After the dead timer expires, R2 will no longer be listed as an OSPF neighbor.

d. Issue the **show ip ospf interface S0/0/0** command on R2 to view the OSPF status of interface S0/0/0.

```
R2# show ip ospf interface s0/0/0
Serial0/0/0 is up, line protocol is up
…
    No Hellos (Passive interface)
…
```

e. R1 and R3 should no longer have a route to the 192.168.2.0/24 network. You can verify this by using the **show ip route** command. Why is that?

f. On R2, issue the **no passive-interface** command so the router will send and receive OSPF routing updates. After entering this command, you will see an informational message that a neighbor adjacency has been established with R1.

```
R2(config)# router ospf 1
R2(config-router)# no passive-interface s0/0/0
R2(config-router)#
*Apr  3 00:18:03.463: %OSPF-5-ADJCHG: Process 1, Nbr 11.11.11.11 on Serial0/0/0
from LOADING to FULL, Loading Done
```

g. Re-issue the **show ip route** and **show ip ospf neighbor** commands on R1 and R3, and look for a route to the 192.168.2.0/24 network.

What interface is R3 using to route to the 192.168.2.0/24 network? _____

What is the accumulated cost metric for the 192.168.2.0/24 network on R3? _____

Does R2 show up as an OSPF neighbor on R1? _____

Does R2 show up as an OSPF neighbor on R3? _____

What does this information tell you?

_____
___
_____
___
_____
___
_____
___

h. Change interface S0/0/1 on R2 to allow it to advertise OSPF routes. Record the commands used below.

_____
___
_____
___

i. Re-issue the **show ip route** command on R3.

What interface is R3 using to route to the 192.168.2.0/24 network? _____

What is the accumulated cost metric for the 192.168.2.0/24 network on R3 now and how is this calculated?

_____
___

Is R2 listed as an OSPF neighbor to R3? _____

Done