Basic Single Area OSPFv2

Introduction

Open Shortest Path First (OSPF) is a link-state routing protocol for IP networks. OSPFv2 is defined for IPv4 networks, and OSPFv3 is defined for IPv6 networks. OSPF detects changes in the topology, such as link failures, and converges on a new loop-free routing structure very quickly. It computes each route using Dijkstra's algorithm, a shortest path first algorithm.

Objective(s)

In this lab the student will:

- Basic Router configs for R1,R2 and R3
- Configure and Verify OSPF routing
- Configure OSPF Passive Interfaces
- Propagating a Default Route in OSPF

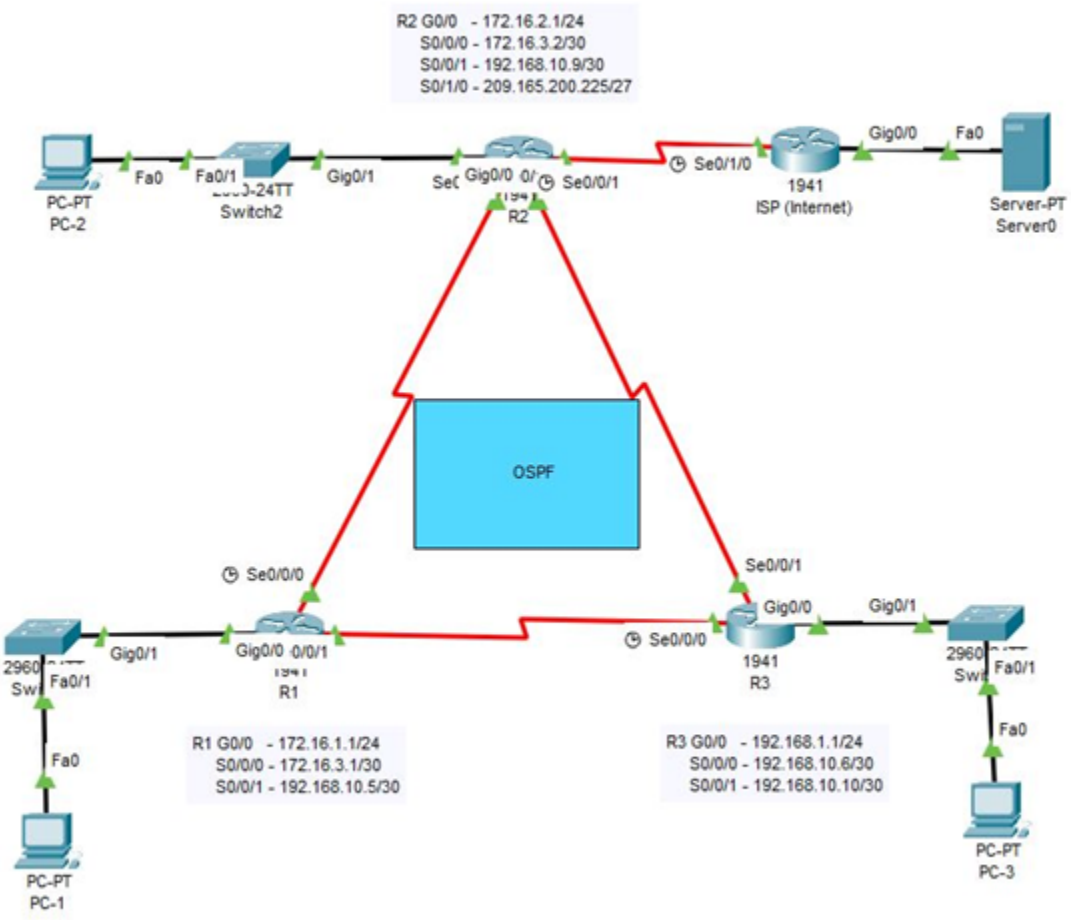
Equipment/Supplies Needed

- Your computer workstation
- Cisco Packet Tracer
- Basic Single Area OSPFv2.pkt file

Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0	172.16.1.1	255.255.255.0	N/A
	S0/0/0	172.16.3.1	255.255.255.252	N/A
	S0/0/1	192.168.10.5	255.255.255.252	N/A
R2	G0/0	172.16.2.1	255.255.255.0	N/A
	S0/0/0	172.16.3.2	255.255.255.252	N/A
	S0/0/1	192.168.10.9	255.255.255.252	N/A
	S0/1/0	209.165.200.225	255.255.255.224	N/A
R3	G0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0	192.168.10.6	255.255.255.252	N/A
	S0/0/1	192.168.10.10	255.255.255.252	N/A
SW1	VLAN1	172.16.1.254	255.255.255.0	172.16.1.1
SW2	VLAN1	172.16.2.254	255.255.255.0	172.16.2.1
SW3	VLAN1	192.168.1.254	255.255.255.0	192.168.1.1
PC-1	NIC	172.16.1.2	255.255.255.0	172.16.1.1
PC-2	NIC	172.16.2.2	255.255.255.0	172.16.2.1
PC-3	NIC	192.168.1.2	255.255.255.0	192.168.1.1

Topology



Procedure

Perform the steps in this lab in the order they are presented to you. Answer all questions and record the requested information in a file.

In this activity, the IP addressing is already configured on the PC's , Switches and ISP router and Server.. You are responsible for configuring the three router topology with basic single area OSPFv2 and then verifying connectivity between end devices. Configure all LAN interfaces as passive interfaces. You will also configure a default static route on R2 pointing to the internet and will share the default static with R1 and R3 using OSPF.

Part 1: Build the Network and Verify Connectivity

In Part 1, you will set up the network topology and configure basic settings, such as the interface IP addresses, device access, and passwords, ect.

Step 1: Configure PC hosts.

Step 2: Initialize and reload the routers as necessary.

Step 3: Configure basic settings for each router.

- Disable DNS lookup.
- Configure IP addresses for the routers, as listed in the Addressing Table.
- Configure device name as shown in the topology.
- Assign **cyber** as the console and vty passwords.
- Assign **security** as the privileged EXEC password.
- Configure logging synchronous to prevent console and vty messages from interrupting command entry.
- Configure a message of the day. "**Unauthorized Access is Prohibited**"
- Copy the running configuration to the startup configuration.

Step 4: The routers should be able to ping one another, and each PC should be able to ping its default gateway. The PCs will not be able 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.

Step 1: Configure OSPF on R1

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.

Configure the **network** statements for the networks on R1. Use the area ID of 0. And use wildcard masks in the network statement.

Note: Wildcard masks are used to specify a range of network addresses. They are commonly used with routing protocols (like OSPF) and access lists. Just like a subnet mask, a wildcard mask is 32 bits long. It acts as an inverted subnet mask, but with a wildcard mask, the zero bits indicate that the corresponding bit position must match the same bit position in the IP address. The one bits indicate that the corresponding bit position doesn't have to match the bit position in the IP address.

R1(config-router)# **network 172.16.1.0 0.0.0.255 area 0**

R1(config-router)# **network 172.16.3.0 0.0.0.0.3 area 0**

R1(config-router)# **network 192.168.10.4 0.0.0.3 area 0**

Step 2: Configure OSPF on all LAN interfaces on R2 and R3. Exclude connection to the ISP.

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#

00:57:42: %OSPF-5-ADJCHG: Process 1, Nbr **192.168.10.10** on Serial0/0/1 from LOADING to FULL, Loading Done

R1(config-router)#

00:57:44: %OSPF-5-ADJCHG: Process 1, Nbr **209.165.200.225** on Serial0/0/0 from LOADING to FULL, Loading Done

Step 3: Verify OSPF neighbors and routing information.

1. 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
209.165.200.225	0	FULL/ -	00:00:35	172.16.3.2	Serial0/0/0
192.168.10.10	0	FULL/ -	00:00:33	192.168.10.6	Serial0/0/1

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

R1#**show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 5 subnets, 3 masks

C 172.16.1.0/24 is directly connected, GigabitEthernet0/0

L 172.16.1.1/32 is directly connected, GigabitEthernet0/0

O 172.16.2.0/24 [110/65] via 172.16.3.2, 00:05:55, Serial0/0/0

C 172.16.3.0/30 is directly connected, Serial0/0/0

L 172.16.3.1/32 is directly connected, Serial0/0/0

O 192.168.1.0/24 [110/65] via 192.168.10.6, 00:05:55, Serial0/0/1

192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks

C 192.168.10.4/30 is directly connected, Serial0/0/1

L 192.168.10.5/32 is directly connected, Serial0/0/1

O 192.168.10.8/30 [110/128] via 172.16.3.2, 00:05:55, Serial0/0/0

[110/128] via 192.168.10.6, 00:05:55, Serial0/0/1

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

Step 4: Verify OSPF protocol settings.

Note: 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**

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 192.168.10.5

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

Maximum path: 4

Routing for Networks:

172.16.1.0 0.0.0.255 area 0

172.16.3.0 0.0.0.3 area 0

192.168.10.4 0.0.0.3 area 0

Routing Information Sources:

Gateway Distance Last Update

192.168.10.5 110 00:10:36

192.168.10.10 110 00:10:38

209.165.200.225 110 00:10:36

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 192.168.10.5

Supports only single TOS(TOS0) routes

Supports opaque LSA

SPF schedule delay 5 secs, Hold time between two SPFs 10 secs

Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

External flood list length 0

Area BACKBONE(0)

Number of interfaces in this area is 3

Area has no authentication

SPF algorithm executed 1 times

Area ranges are

Number of LSA 3. Checksum Sum 0x026bc2

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length

Part 3: - Configure OSPF Passive Interfaces

Note: The **passive-interface** command prevents routing updates from being sent through the specified router interface. This is commonly done to reduce traffic on the LANs as they do not need to receive dynamic routing protocol communication. In Part 4, you will use the **passive-interface** command to configure a single interface as passive. You will also configure OSPF so that all interfaces on the router are passive by default, and then enable OSPF routing advertisements on selected interfaces.

Step 1: Configure a passive interface

Issue the **show ip ospf interface g0/0** 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.

GigabitEthernet0/0 is up, line protocol is up

Internet address is 172.16.1.1/24, Area 0

Process ID 1, Router ID 192.168.10.5, Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 192.168.10.5, Interface address 172.16.1.1

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Hello due in 00:00:05

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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Issue the **passive-interface** command to change the G0/0 interface on R1 to passive.

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

R1(config-router)# **passive-interface g0/0**

Re-issue the **show ip ospf interface g0/0** command to verify that G0/0 is now passive.

GigabitEthernet0/0 is up, line protocol is up

Internet address is 172.16.1.1/24, Area 0

Process ID 1, Router ID 192.168.10.5, Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State WAITING, Priority 1

No designated router on this network

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

No Hellos (Passive interface)

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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Configure all gigabit interfaces on the routers R2 and R3 to be passive-interfaces.

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.

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 5 subnets, 3 masks

C 172.16.1.0/24 is directly connected, GigabitEthernet0/0

L 172.16.1.1/32 is directly connected, GigabitEthernet0/0

O 172.16.2.0/24 [110/65] via 172.16.3.2, 00:28:08, Serial0/0/0

C 172.16.3.0/30 is directly connected, Serial0/0/0

L 172.16.3.1/32 is directly connected, Serial0/0/0

O 192.168.1.0/24 [110/65] via 192.168.10.6, 00:28:08, Serial0/0/1

192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks

C 192.168.10.4/30 is directly connected, Serial0/0/1

L 192.168.10.5/32 is directly connected, Serial0/0/1

O 192.168.10.8/30 [110/128] via 172.16.3.2, 00:28:08, Serial0/0/0

[110/128] via 192.168.10.6, 00:28:08, Serial0/0/1

Part 4: Propagating a Default Route in OSPF

On R2 configure an IPv4 default route to the Internet and propagate that default route to other OSPF routers. You will then verify the default route is in downstream routing tables and that hosts can now access a web server on the Internet.

Step 1: Configure a default route on R2 using the exit interface to the Internet.

Step 2: Propagate the route in OSPF

Configure OSPF to propagate the default route in OSPF routing updates.

R2(config-router)# **default-information originate**

Step 3: Examine the routing tables on R1 and R3.

Examine the routing tables of R1 and R3 to verify that the route has been propagated.

R1# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

*** - candidate default**, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

172.16.0.0/16 is variably subnetted, 5 subnets, 3 masks

O 172.16.1.0/24 [110/65] via 172.16.3.1, 00:45:03, Serial0/0/0

C 172.16.2.0/24 is directly connected, GigabitEthernet0/0

L 172.16.2.1/32 is directly connected, GigabitEthernet0/0

C 172.16.3.0/30 is directly connected, Serial0/0/0

L 172.16.3.2/32 is directly connected, Serial0/0/0

O 192.168.1.0/24 [110/65] via 192.168.10.10, 00:45:32, Serial0/0/1

192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks

O 192.168.10.4/30 [110/128] via 172.16.3.1, 00:45:03, Serial0/0/0

[110/128] via 192.168.10.10, 00:45:03, Serial0/0/1

C 192.168.10.8/30 is directly connected, Serial0/0/1

L 192.168.10.9/32 is directly connected, Serial0/0/1

209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks

C 209.165.200.224/27 is directly connected, Serial0/1/0

L 209.165.200.225/32 is directly connected, Serial0/1/0

S* 0.0.0.0/0 is directly connected, Serial0/1/0

FINAL STEP: Verify Connectivity

Verify that **PC1**, **PC2**, and **PC3** can ping the web server.

Submit Your Work:

Submit all text files, screenshots, or answers to questions to your instructor Using the most appropriate method below.

Packet Tracer:

Submit Packet Tracer file as well as your text file with your findings and notes.

Rubric

Checklist/Single Point Mastery

Concerns Working Towards Proficiency	Criteria Standards for This Competency	Accomplished Evidence of Mastering Competency
	Criteria #1: Configure OSPF protocol needed on all 3 routers for connectivity between networks (45 pts)	Configure OSPF protocol needed on all 3 routers for connectivity between networks. (45 pts) 3 router OSPF adjacencies - (7.5 pts) 3 LANs advertised. (7.5 pts)
	Criteria #2: Configure default static route, and propagate to other OSPF routers (20 pts)	Configure default static route on R2, and propagate the static route to other OSPF routers (30 pts) Default static route (15 pts) Propagated through OSPF (15 pts)
	Criteria #3: Configure Passive interfaces. (10 pts)	Configure Passive interfaces on all LAN interfaces on each router. (10 pts) 3 Passive interfaces (3.3 pts)
	Criteria #4: Test connectivity between all remote networks using ping. (10 pts)	Test connectivity between all remote networks using ping. (10 pts) 4 remote networks total (2.5 pts)
	Criteria #5: Submit instructions document with lab questions completed. (5 pts)	Criteria #5: Submit instructions document with lab questions completed. (5 pts)