Samantha Neri, Khushveen Kaur Umra
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# Lab 8 Report

**Contribution:** Samantha Neri (50%), Khushveen Kaur Umra (50%)

## 1) Summarize what you learned in a few paragraphs. (20 points)

In Lab 8 we've gained experience and learned how to configure OSPF routing using Cisco IOS XE and the Cisco Catalyst 9300 switch. We noticed that we refresh our knowledge from Lab 6 and used that to start configuring OSPF routing, then compared it to static routing. Starting off with the basic setup of the switch, we first configured the loopback interface and then configured the rest of the interfaces of our switch. Unfortunately, we had some trouble at the beginning due to an error in our configuration from the start but eventually found that we incorrectly named the switches (GE 1/0/1 and GE 1/0/2). After that, we were able to test our configuration by successfully pinging three interfaces and the TA's switch from our switch.

Next, we set our static routing table entries and then continued to learn more about static routing. We gained this experience by creating two static routes on our switch; one to network 10.0.2.0/24 and the other to the loopback interface of the TA's switch. We observed that our ping results were all successful from the odd # PC, but noticed that the even # PC was only able to successfully ping address 192.168.1.22. Also, we learned about the difference between routing protocols and static routing. Static routes are used in small networks with predictable traffic with less bandwidth available for routing updates. On the other hand, a routing protocol would consume a certain amount of bandwidth to update all routers of all able routes.

We then configured the OSPF and learned more about the Open Shortest Path First protocol by performing exercises such as setting it up, pinging certain IPs, and then observing any trends and behavior of the results. In the end, we ended the lab by ensuring our switch was properly reset.

**EXERCISES:**

**Question 1:** Provide the following:
(a) Use the show run command and take a screenshot of the static routes created.

```
ip default-gateway 192.168.254.254
ip forward-protocol nd
ip http server
ip http authentication local
ip http secure-server
ip route 10.0.2.0 255.255.255.0 192.168.1.2 5
ip route 10.2.2.2 255.255.255.255 192.168.1.2 5
ip ssh authentication-retries 2
ip ssh version 2
```

(b)Capture screenshots of each ping result.

**From Odd Numbered PC:**

```
co2061-9300-11#ping 192.168.1.22
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.22, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
co2061-9300-11#ping 192.168.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
co2061-9300-11#ping 10.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
co2061-9300-11#ping 10.0.2.254
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.2.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
co2061-9300-11#
```

**From Even Numbered PC:**

```
[489labuser@co2061-22 ~]$ ping 192.168.1.22
PING 192.168.1.22 (192.168.1.22) 56(84) bytes of data.
64 bytes from 192.168.1.22: icmp_seq=1 ttl=254 time=0.914 ms
64 bytes from 192.168.1.22: icmp_seq=2 ttl=254 time=0.870 ms
64 bytes from 192.168.1.22: icmp_seq=3 ttl=254 time=1.10 ms
64 bytes from 192.168.1.22: icmp_seq=4 ttl=254 time=0.983 ms
64 bytes from 192.168.1.22: icmp_seq=5 ttl=254 time=0.917 ms
64 bytes from 192.168.1.22: icmp_seq=6 ttl=254 time=0.712 ms
64 bytes from 192.168.1.22: icmp_seq=7 ttl=254 time=0.876 ms
64 bytes from 192.168.1.22: icmp_seq=8 ttl=254 time=1.08 ms
64 bytes from 192.168.1.22: icmp_seq=9 ttl=254 time=1.09 ms
64 bytes from 192.168.1.22: icmp_seq=10 ttl=254 time=0.779 ms
64 bytes from 192.168.1.22: icmp_seq=11 ttl=254 time=0.997 ms
^C
--- 192.168.1.22 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10012ms
rtt min/avg/max/mdev = 0.712/0.938/1.100/0.125 ms
[489labuser@co2061-22 ~]$ ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
^C
--- 192.168.1.2 ping statistics ---
40 packets transmitted, 0 received, 100% packet loss, time 39000ms

[489labuser@co2061-22 ~]$ ping 10.2.2.2
PING 10.2.2.2 (10.2.2.2) 56(84) bytes of data.
^C
--- 10.2.2.2 ping statistics ---
4 packets transmitted, 0 received, 100% packet loss, time 3000ms

[489labuser@co2061-22 ~]$ ping 10.0.2.254
PING 10.0.2.254 (10.0.2.254) 56(84) bytes of data.
^C
--- 10.0.2.254 ping statistics ---
4 packets transmitted, 0 received, 100% packet loss, time 2999ms
```

(c) Prepare a table that shows which ping attempts were successful and which ones failed.

| Ping Attempts | Odd Numbered PC | Even Numbered PC |
|---|---|---|
| **192.168.1.22** | Successful | |
| **192.168.1.2** | Successful | |
| **10.2.2.2** | Successful | |
| **10.0.2.254** | Successful | |
| **192.168.1.22** | | Successful |
| **192.168.1.2** | | Failed |
| **10.2.2.2** | | Failed |
| **10.0.2.254** | | Failed |

(d) Provide comments on why you think certain ping attempts failed, even after setting static routes on your switch. (10 points)

→ We think that certain attempts from the even # PC failed since the odd # PC was configured to know how to reach the even #'s address, but the even # PC didn't know how to reach the address or how to ping back. The static routes on the switch were not configured, which resulted in ping failures, as they were not properly configured to respond to ping requests. Therefore the local IPs need to be configured in order to send a response back.

**Question 2:** Considering our network in the CprE 489 lab which has 12 switches, and assuming that each router has two local networks (including the simulated network by the loopback interface), how many static routes should be configured on all the switches to make sure that all networks are reachable? (10 points)

→ We know that there are 12 switches in the network and each router has two local networks. That means there would be a total of 24 local networks in the network.

In order to ensure that all networks are reachable, each switch would need to have a static route configured for each of the 24 local networks. This means that there would be 24 static routes per switch, resulting in a total of 288 static routes that would need to be configured on all the 12 switches in the network in the CprE 489 lab.

**Question 3:** Include the output of the show run command that is related to the OSPF setups. (10 points)

```
router ospf 111
 network 10.0.22.0 0.0.0.255 area 0
 network 10.22.22.22 0.0.0.0 area 0
 network 192.168.1.0 0.0.0.255 area 0
!
```

**Question 4:** Ping these three IPs from the even-numbered computer again:
• 192.168.1.X • 192.168.1.2 • 10.2.2.2 • 10.0.2.254

Include screenshots and explain the results. (10 points)

```
[489labuser@co2061-22 ~]$ ping 192.168.1.22
PING 192.168.1.22 (192.168.1.22) 56(84) bytes of data.
64 bytes from 192.168.1.22: icmp_seq=1 ttl=254 time=0.764 ms
64 bytes from 192.168.1.22: icmp_seq=2 ttl=254 time=0.962 ms
64 bytes from 192.168.1.22: icmp_seq=3 ttl=254 time=1.16 ms
64 bytes from 192.168.1.22: icmp_seq=4 ttl=254 time=0.964 ms
64 bytes from 192.168.1.22: icmp_seq=5 ttl=254 time=0.965 ms
^Z
[5]+  Stopped                 ping 192.168.1.22
[489labuser@co2061-22 ~]$ ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
64 bytes from 192.168.1.2: icmp_seq=1 ttl=253 time=0.884 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=253 time=0.862 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=253 time=0.895 ms
64 bytes from 192.168.1.2: icmp_seq=4 ttl=253 time=0.980 ms
64 bytes from 192.168.1.2: icmp_seq=5 ttl=253 time=0.963 ms
^Z
[6]+  Stopped                 ping 192.168.1.2
[489labuser@co2061-22 ~]$ ping 10.2.2.2
PING 10.2.2.2 (10.2.2.2) 56(84) bytes of data.
64 bytes from 10.2.2.2: icmp_seq=1 ttl=253 time=0.913 ms
64 bytes from 10.2.2.2: icmp_seq=2 ttl=253 time=1.00 ms
64 bytes from 10.2.2.2: icmp_seq=3 ttl=253 time=0.734 ms
64 bytes from 10.2.2.2: icmp_seq=4 ttl=253 time=0.965 ms
64 bytes from 10.2.2.2: icmp_seq=5 ttl=253 time=0.793 ms
64 bytes from 10.2.2.2: icmp_seq=6 ttl=253 time=0.887 ms
^Z
[7]+  Stopped                 ping 10.2.2.2
[489labuser@co2061-22 ~]$ ping 10.0.2.254
PING 10.0.2.254 (10.0.2.254) 56(84) bytes of data.
64 bytes from 10.0.2.254: icmp_seq=1 ttl=253 time=0.887 ms
64 bytes from 10.0.2.254: icmp_seq=2 ttl=253 time=0.774 ms
64 bytes from 10.0.2.254: icmp_seq=3 ttl=253 time=1.25 ms
64 bytes from 10.0.2.254: icmp_seq=4 ttl=253 time=0.872 ms
64 bytes from 10.0.2.254: icmp_seq=5 ttl=253 time=0.968 ms
^Z
[8]+  Stopped                 ping 10.0.2.254
[489labuser@co2061-22 ~]$
```

**Q4 Results** → OSPF is a routing protocol that allows routers in a network to dynamically share information about network topology and automatically adjust their routing tables accordingly. Here, by setting up OSPF, it helped us to ensure that the traffic was being routed efficiently and reliably throughout the network. Adding an OSPF setup resolved any routing issues that were causing the ping failures in the previous configuration. By dynamically updating the routing tables and selecting the best available routes, OSPF helped us to resolve that issue. Also, now that we pinged the IP addresses using the even # PC again, we observed that they were successfully pinged. This is due to us now utilizing OSPF on our switch. OSPF sends or receives link-state advertisements, converges more quickly than RIP, and switches have an identical link-state database.

**Questions 5-9:** Include the output of the following commands (executed on your switch), and answer the questions:

• show ip route

```
co2061-9300-11#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, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
S        10.0.2.0/24 [5/0] via 192.168.1.2
O        10.0.10.0/24 [110/2] via 192.168.1.10, 00:01:57, GigabitEthernet1/0/2
C        10.0.22.0/24 is directly connected, GigabitEthernet1/0/1
L        10.0.22.254/32 is directly connected, GigabitEthernet1/0/1
S        10.2.2.2/32 [5/0] via 192.168.1.2
O        10.10.10.10/32
           [110/2] via 192.168.1.10, 00:01:34, GigabitEthernet1/0/2
C        10.22.22.22/32 is directly connected, Loopback0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, GigabitEthernet1/0/2
L        192.168.1.22/32 is directly connected, GigabitEthernet1/0/2
co2061-9300-11#
```

**o Question 5:** Which routes are directly connected? Which routes are via OSPF, if any? Of the OSPF routes, is there a route from an area other than area 0? (5 points)

→ Directly connected routes: 10.0.22.0/24, 10.0.22.254/32, 10.22.22.22/32, 192.168.1.0/24, 192.168.1.22/32
→ We have 2 routes that are via OSPF: 10.0.10.0/24 and 10.10.10.10/32
→ Of the 2 OSPF routes, both have a route from an area other than 0.

• show ip protocols

```
co2061-9300-11#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospf 111"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 10.22.22.22
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.0.22.0 0.0.0.255 area 0
    10.22.22.22 0.0.0.0 area 0
    192.168.1.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.10.10.10           110      00:02:35
    10.2.2.2              110      00:02:35
  Distance: (default is 110)

co2061-9300-11#
```

o **Question 6:** What is the Router ID? If you look at your interfaces' IP addresses, which one of them is similar to the router ID? (5 points)

→ Router ID is 10.22.22.22
→ IP address similar to router ID: 10.2.2.2

o **Question 7:** Look for the line "Distance: (default is ...)." What is the number? (5 points)

→ default number is 110

• Show ip ospf neighbor

```
co2061-9300-11#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
10.2.2.2          1   FULL/DR         00:00:34    192.168.1.2     GigabitEthernet1/0/2
10.10.10.10       1   FULL/DROTHER    00:00:35    192.168.1.10    GigabitEthernet1/0/2
co2061-9300-11#
```

o **Question 8:** Find the neighbor with the ID: 10.2.2.2. What is the Address field in this record? (5 points)
→ Address field: 192.168.1.2

• show ip ospf interface

```
co2061-9300-11#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
10.2.2.2          1   FULL/DR         00:00:34    192.168.1.2     GigabitEthernet1/0/2
10.10.10.10       1   FULL/DROTHER    00:00:35    192.168.1.10    GigabitEthernet1/0/2
co2061-9300-11# show ip ospf interface
Loopback0 is up, line protocol is up
  Internet Address 10.22.22.22/32, Interface ID 52, Area 0
  Attached via Network Statement
  Process ID 111, Router ID 10.22.22.22, Network Type LOOPBACK, Cost: 1
  Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0           1         no          no            Base
  Loopback interface is treated as a stub Host
GigabitEthernet1/0/2 is up, line protocol is up (connected)
  Internet Address 192.168.1.22/24, Interface ID 53, Area 0
  Attached via Network Statement
  Process ID 111, Router ID 10.22.22.22, 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) 10.2.2.2, Interface address 192.168.1.2
  Backup Designated router (ID) 10.22.22.22, Interface address 192.168.1.22
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:04
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Can be protected by per-prefix Loop-Free FastReroute
  Can be used for per-prefix Loop-Free FastReroute repair paths
  Index 1/3/3, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 2, Adjacent neighbor count is 2
    Adjacent with neighbor 10.2.2.2  (Designated Router)
    Adjacent with neighbor 10.10.10.10
  Suppress hello for 0 neighbor(s)
GigabitEthernet1/0/1 is up, line protocol is up (connected)
  Internet Address 10.0.22.254/24, Interface ID 55, Area 0
  Attached via Network Statement
  Process ID 111, Router ID 10.22.22.22, 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) 10.22.22.22, Interface address 10.0.22.254
  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 00:00:07
  Supports Link-local Signaling (LLS)
```

```
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Can be protected by per-prefix Loop-Free FastReroute
  Can be used for per-prefix Loop-Free FastReroute repair paths
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  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)
co2061-9300-11#
```

o **Question 9:** Look for the Cost set on each interface. List these numbers for all your interfaces. (5 points)

→ Internet Address 10.22.22.22/32, interface ID 52 : cost = 1
→ Address 192.168.1.22/24, interface ID 53 : cost = 1
→ Address 10.0.22.254/24, interface ID 55 : cost = 1

**Reset the Student Switch**
You are required to reset the student switch to the initial configuration before the end of the lab section regardless of whether you have completed Exercises 1 and 2. This is to ensure that all switches are reset to the initial configuration so that future lab sections are not impacted in any way. Demonstrate you have successfully reset the switch to the TA before the end of the lab section (10 points) and include your answers to Tasks 1 and 2 in the lab report (10 points).

```
!
policy-map system-cpp-policy
!
!
!
!
!
interface GigabitEthernet0/0
 vrf forwarding Mgmt-vrf
 ip address 192.168.77.111 255.255.255.0
 negotiation auto
!
interface GigabitEthernet1/0/1
 no switchport
 no ip address
!
interface GigabitEthernet1/0/2
 no switchport
 no ip address
!
interface GigabitEthernet1/0/3
!
```

```
interface AppGigabitEthernet1/0/1
!
interface Vlan1
 no ip address
!
ip default-gateway 192.168.254.254
ip forward-protocol nd
ip http server
ip http authentication local
ip http secure-server
ip ssh authentication-retries 2
ip ssh version 2
!
!
!
!
!
!
!
!
control-plane
 service-policy input system-cpp-policy
!
!
line con 0
 stopbits 1
line vty 5 15
!
!
!
!
!
!
!
end
```