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*Advanced Cisco CCNP
Networking*

Basic OSPF Configuration

Lab 1

OSPF Setup Lab 1

Purpose

The first purpose of this lab was to review the implementation and concept of OSPF. The second function of this lab was to gain experience using the equipment in the CCNP lab.

Background Information on Lab Concepts

OSPF (Open Shortest Path First) is a routing protocol (for IPV4 and IPV6) used to distribute traffic in a network. Notably, OSPF is a link-state protocol. This means OSPF has full awareness of the topology of its network by sending position requests (or LSA's) to each router on the network. It essentially has a picture of all the devices in the area, allowing it to find the shortest path to route traffic. The method OSPF uses to find the shortest path between links is called Dijkstra's Algorithm. Dijkstra's Algorithm is generally used to find the shortest path between two points, and it is frequently utilized in GPS apps such as Google Maps. To understand how OSPF uses Dijkstra's Algorithm, imagine you are in a large maze and must deliver envelopes to mailboxes scattered throughout the maze. While walking through the maze, you discover a mailbox, and deliver your first envelope. Eventually, after an extended period of time, you find all of the mailboxes and deliver all of your envelopes. When you are given a new set of envelopes to deliver, you enter the maze again, but this time you remember the position of the mailboxes from your last time entering the maze. Since you remember the mailbox positions, you can deliver the envelopes faster. Eventually, after multiple series of delivering the envelopes, you have learned the layout of the mailboxes and maze. Therefore, you can efficiently deliver the envelopes. OSPF works the same way. Instead of delivering envelopes to mailboxes, OSPF delivers packets to routers. Overtime, it learns the topology (or maze) of the network and finds the shortest path between routers using Dijkstra's Algorithm. By having a full picture of the network and knowing the shortest path between routers, OSPF can quickly route traffic. However, where OSPF can come short is the processing power it requires. Running Dijkstra's Algorithm as well as storing the topology of the network (especially in large networks) can require increased CPU usage.

Lab Summary

Before setting up the lab, my team familiarized ourselves on the configuration of OSPF. We noted new commands that would be required to setup OSPF. Afterwards, we started by setting up our topology in packet tracer (a networking simulation application). Our next step was to subnet the required networks and assign IPV4 addresses to each interface. We then created a document including all the commands and IP addresses needed for setting up OSPF. We tested and debugged this configuration in packet tracer. Once the simulated configuration functioned correctly, we applied it to the equipment in the CCNP lab. We encountered some issues, which are covered later in the problem section of this document. After these problems were resolved, we tested the network by pinging each interface and reviewing the IP routes, and we found everything was configured properly.

Lab Commands

Router> **enable**

Turns on privileged exec mode which allows changes to be made to the router.

Router# **config t**

Enters the router config file and allows you to make changes to the router configuration file.

Router# **copy run start**

Saves the running-configuration (current config on the router, includes the edits you have made during the session, clears when the router powers off) to the startup-configuration (file that router pulls running-config from on bootup, default config).

Router# **show ip route**

Displays information about the various routes that are available to the router, including the protocol by which the route was acquired (OSPF, RIP, EGRIP, static, etc.)

Router# **show ip ospf**

Displays general information about all OSPF instances and roles on the router.

```
Router# show ip ospf interface
```

Displays the OSPF status of all OSPF-enabled interfaces on the router.

```
Router# show ip route
```

Displays information about the various routes that are available to the router, including the protocol by which the route was acquired (OSPF, RIP, EGRIP, static, etc.)

```
Router# show ip ospf neighbor
```

Displays the OSPF status of routers that are directly connected and OSPF-enabled.

```
Router(config)# interface [interface] [id]
```

Enables configuration on a specific interface.

```
Router(config)# router ospf [process id]
```

Enables the OSPF routing protocol and enters router configuration mode.

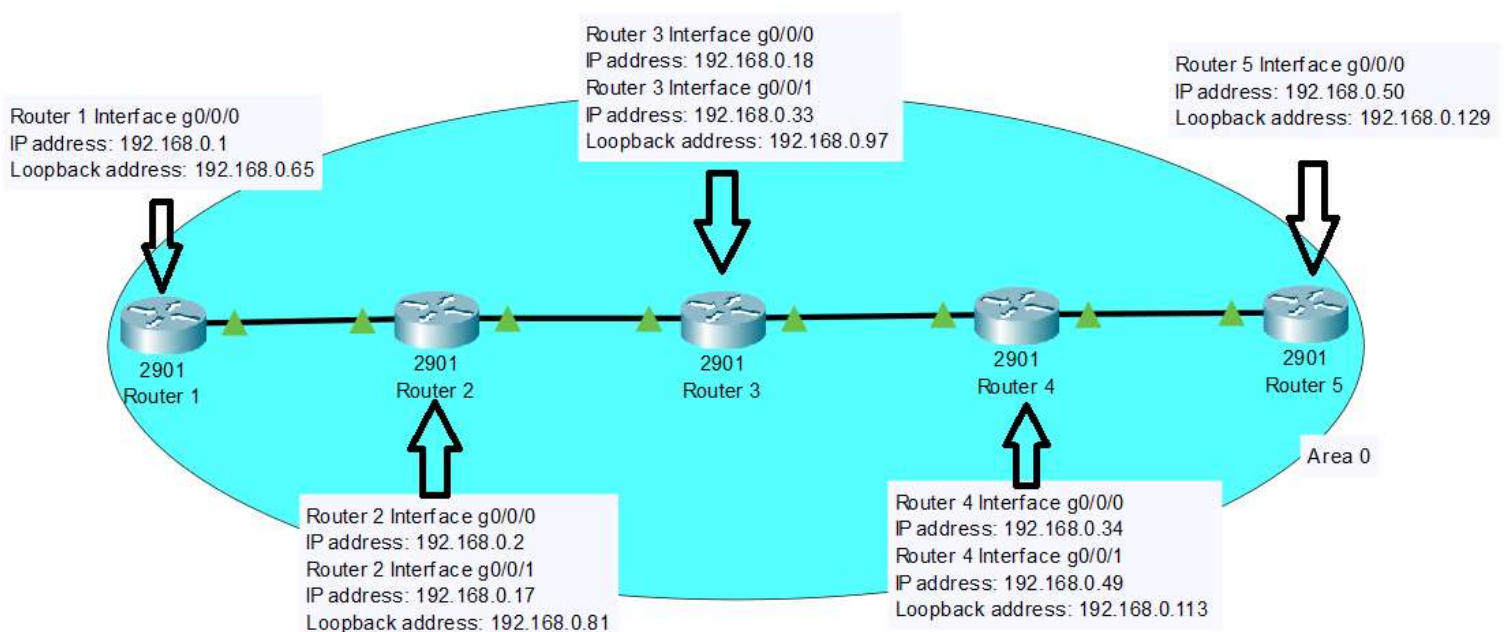
It is good practice for the process ID to be the same, however isn't necessary for OSPF to form adjacencies; process ID is only locally significant. Each OSPF process retains a different routing table, so depending on the configuration, process ID could determine what routes are redistributed. A router can have multiple OSPF processes but will contain a separate OSPF database per process.

```
Router(config-router)# network [network address] [wildcard mask] area [area number]
```

Activates OSPFv2 for a specific subnet.

This command is typed after you enter router OSPF configuration mode. Routers in a particular area share a complete topological database and have route summaries of external areas.

Network Diagram with IP's



Configurations

Router 1:

```
R1#show run:
Building configuration...
Current configuration : 1850 bytes
Last configuration change at 17:51:00 UTC
Thu Sep 9 2021
version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no platform punt-keepalive disable-kernel-core
hostname R1
boot-start-marker
boot-end-marker
vrf definition Mgmt-intf
address-family ipv4
exit-address-family
address-family ipv6
exit-address-family
no aaa new-model
subscriber templating
multilink bundle-name authenticated
license udi pid ISR4321/K9 sn FDO21482DXE
spanning-tree extend system-id
redundancy
mode none
vlan internal allocation policy ascending
interface Loopback0
ip address 192.168.0.65 255.255.255.240
interface GigabitEthernet0/0/0
ip address 192.168.0.1 255.255.255.240
negotiation auto
interface GigabitEthernet0/0/1
no ip address
shutdown
negotiation auto
interface Serial0/1/0
no ip address
shutdown
interface Serial0/1/1
no ip address
```

```
shutdown
interface GigabitEthernet0/2/0
no ip address
shutdown
negotiation auto
interface GigabitEthernet0/2/1
no ip address
shutdown
negotiation auto
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
interface Vlan1
no ip address
shutdown
router ospf 1
network 192.168.0.0 0.0.0.15 area 0
network 192.168.0.16 0.0.0.15 area 0
network 192.168.0.32 0.0.0.15 area 0
network 192.168.0.48 0.0.0.15 area 0
network 192.168.0.64 0.0.0.15 area 0
network 192.168.0.80 0.0.0.15 area 0
network 192.168.0.96 0.0.0.15 area 0
network 192.168.0.112 0.0.0.15 area 0
network 192.168.0.128 0.0.0.15 area 0
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
control-plane
line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login
end
```

R1#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.0.81	1	FULL/DR	00:00:35	192.168.0.2	GigabitEthernet0/0/0

R1#show ip ospf

```
Routing Process "ospf 1" with ID 192.168.0.65
Start time: 00:10:16.387, Time elapsed: 00:26:13.307
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msec
Minimum hold time between two consecutive SPF's 10000 msec
Maximum wait time between two consecutive SPF's 10000 msec
```

Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
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
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled
Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 2 (1 loopback)
Area has no authentication
SPF algorithm last executed 00:05:36.244 ago
SPF algorithm executed 1 times
Area ranges are
Number of LSA 9. Checksum Sum 0x03B402
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 0

R1#show ip ospf interface

Loopback0 is up, line protocol is up

Internet Address 192.168.0.65/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.65, 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

GigabitEthernet0/0/0 is up, line protocol is up

Internet Address 192.168.0.1/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.65, 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) 192.168.0.81, Interface address 192.168.0.2

Backup Designated router (ID) 192.168.0.65, Interface address 192.168.0.1

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

oob-resync timeout 40

Hello due in 00:00:02

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/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 192.168.0.81 (Designated Router)

Suppress hello for 0 neighbor(s)

R1#show ip ospf border-routers

OSPF Router with ID (192.168.0.65) (Process ID 1)
Base Topology (MTID 0)
Internal Router Routing Table
Codes: i - Intra-area route, I - Inter-area route

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
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
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

```
192.168.0.0/24 is variably subnetted, 11 subnets, 2 masks
C    192.168.0.0/28 is directly connected, GigabitEthernet0/0/0
L    192.168.0.1/32 is directly connected, GigabitEthernet0/0/0
O    192.168.0.16/28
     [110/2] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
O    192.168.0.32/28
     [110/3] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
O    192.168.0.48/28
     [110/4] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
C    192.168.0.64/28 is directly connected, Loopback0
L    192.168.0.65/32 is directly connected, Loopback0
O    192.168.0.81/32
     [110/2] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
O    192.168.0.97/32
     [110/3] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
O    192.168.0.113/32
     [110/4] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
O    192.168.0.129/32
     [110/5] via 192.168.0.2, 00:09:14, GigabitEthernet0/0/0
```

Router 2:

R2#show run

Building configuration...	subscriber templating
Current configuration : 1866 bytes	multilink bundle-name authenticated
Last configuration change at 17:38:14 UTC	license udi pid ISR4321/K9 sn FDO21500G1N
Thu Sep 9 2021	spanning-tree extend system-id
version 15.5	redundancy
service timestamps debug datetime msec	mode none
service timestamps log datetime msec	vlan internal allocation policy ascending
no platform punt-keepalive disable-kernel-	interface Loopback0
core	ip address 192.168.0.81 255.255.255.240
hostname R2	interface GigabitEthernet0/0/0
boot-start-marker	ip address 192.168.0.2 255.255.255.240
boot-end-marker	negotiation auto
vrf definition Mgmt-intf	interface GigabitEthernet0/0/1
address-family ipv4	ip address 192.168.0.17 255.255.255.240
exit-address-family	negotiation auto
address-family ipv6	interface Serial0/1/0
exit-address-family	no ip address
no aaa new-model	shutdown
	interface Serial0/1/1

```

no ip address
shutdown
interface GigabitEthernet0/2/0
no ip address
shutdown
negotiation auto
interface GigabitEthernet0/2/1
no ip address
shutdown
negotiation auto
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
interface Vlan1
no ip address
shutdown
router ospf 1
network 192.168.0.0 0.0.0.15 area 0
network 192.168.0.16 0.0.0.15 area 0

network 192.168.0.32 0.0.0.15 area 0
network 192.168.0.48 0.0.0.15 area 0
network 192.168.0.64 0.0.0.15 area 0
network 192.168.0.80 0.0.0.15 area 0
network 192.168.0.96 0.0.0.15 area 0
network 192.168.0.112 0.0.0.15 area 0
network 192.168.0.128 0.0.0.15 area 0
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
control-plane
line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login
end

```

R2#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.0.97	1	FULL/DR	00:00:37	192.168.0.18	GigabitEthernet0/0/1
192.168.0.65	1	FULL/BDR	00:00:38	192.168.0.1	GigabitEthernet0/0/0

R2#show ip ospf

```

Routing Process "ospf 1" with ID 192.168.0.81
Start time: 00:18:55.769, Time elapsed: 00:31:43.284
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msec
Minimum hold time between two consecutive SPF's 10000 msec
Maximum wait time between two consecutive SPF's 10000 msec
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
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
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled
Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps
Area BACKBONE(0)

```

Number of interfaces in this area is 3 (1 loopback)
Area has no authentication
SPF algorithm last executed 00:21:15.328 ago
SPF algorithm executed 16 times
Area ranges are
Number of LSA 9. Checksum Sum 0x03B402
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 0

R2#show ip ospf interface

Loopback0 is up, line protocol is up

Internet Address 192.168.0.81/28, Area 0, Attached via Network Statement

Process ID 1, Router ID 192.168.0.81, 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

GigabitEthernet0/0/1 is up, line protocol is up

Internet Address 192.168.0.17/28, Area 0, Attached via Network Statement

Process ID 1, Router ID 192.168.0.81, 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) 192.168.0.97, Interface address 192.168.0.18

Backup Designated router (ID) 192.168.0.81, Interface address 192.168.0.17

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 1/2/2, flood queue length 0

Next 0x0(0)/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 192.168.0.97 (Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0 is up, line protocol is up

Internet Address 192.168.0.2/28, Area 0, Attached via Network Statement

Process ID 1, Router ID 192.168.0.81, 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) 192.168.0.81, Interface address 192.168.0.2

Backup Designated router (ID) 192.168.0.65, Interface address 192.168.0.1

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)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/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 1, Adjacent neighbor count is 1

Adjacent with neighbor 192.168.0.65 (Backup Designated Router)
Suppress hello for 0 neighbor(s)

R2#show ip ospf border-routers

OSPF Router with ID (192.168.0.81) (Process ID 1)

Base Topology (MTID 0)

Internal Router Routing Table

Codes: i - Intra-area route, I - Inter-area route

R2#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
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
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

```
192.168.0.0/24 is variably subnetted, 12 subnets, 2 masks
C    192.168.0.0/28 is directly connected, GigabitEthernet0/0/0
L    192.168.0.2/32 is directly connected, GigabitEthernet0/0/0
C    192.168.0.16/28 is directly connected, GigabitEthernet0/0/1
L    192.168.0.17/32 is directly connected, GigabitEthernet0/0/1
O    192.168.0.32/28
      [110/2] via 192.168.0.18, 00:30:07, GigabitEthernet0/0/1
O    192.168.0.48/28
      [110/3] via 192.168.0.18, 00:29:25, GigabitEthernet0/0/1
O    192.168.0.65/32
      [110/2] via 192.168.0.1, 00:23:30, GigabitEthernet0/0/0
C    192.168.0.80/28 is directly connected, Loopback0
L    192.168.0.81/32 is directly connected, Loopback0
O    192.168.0.97/32
      [110/2] via 192.168.0.18, 00:24:24, GigabitEthernet0/0/1
O    192.168.0.113/32
      [110/3] via 192.168.0.18, 00:24:11, GigabitEthernet0/0/1
O    192.168.0.129/32
      [110/4] via 192.168.0.18, 00:23:58, GigabitEthernet0/0/1
```

Router 3:

R3#show run

Building configuration...

Current configuration : 1715 bytes

Last configuration change at 17:46:53 UTC

Thu Sep 9 2021

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname R3

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21441WDF

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

```

interface Loopback0
ip address 192.168.0.97 255.255.255.240
interface GigabitEthernet0/0/0
ip address 192.168.0.18 255.255.255.240
negotiation auto
interface GigabitEthernet0/0/1
ip address 192.168.0.33 255.255.255.240
negotiation auto
interface Serial0/1/0
no ip address
shutdown
interface Serial0/1/1
no ip address
shutdown
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
interface Vlan1
no ip address
shutdown
router ospf 1

network 192.168.0.0 0.0.0.15 area 0
network 192.168.0.16 0.0.0.15 area 0
network 192.168.0.32 0.0.0.15 area 0
network 192.168.0.48 0.0.0.15 area 0
network 192.168.0.64 0.0.0.15 area 0
network 192.168.0.80 0.0.0.15 area 0
network 192.168.0.96 0.0.0.15 area 0
network 192.168.0.112 0.0.0.15 area 0
network 192.168.0.128 0.0.0.15 area 0
!
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
control-plane
line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login
end

```

R3#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.0.113	1	FULL/DR	00:00:30	192.168.0.34	GigabitEthernet0/0/1
192.168.0.81	1	FULL/BDR	00:00:39	192.168.0.17	GigabitEthernet0/0/0

R3#show ip ospf

```

Routing Process "ospf 1" with ID 192.168.0.97
Start time: 00:18:58.990, Time elapsed: 00:37:38.181
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msecs
Minimum hold time between two consecutive SPFs 10000 msecs
Maximum wait time between two consecutive SPFs 10000 msecs
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msecs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
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
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled

```

Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps

Area BACKBONE(0)
Number of interfaces in this area is 3 (1 loopback)
Area has no authentication
SPF algorithm last executed 00:28:40.980 ago
SPF algorithm executed 14 times
Area ranges are
Number of LSA 9. Checksum Sum 0x03AC06
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 0

R3#show ip ospf interface

Loopback0 is up, line protocol is up

Internet Address 192.168.0.97/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.97, 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

GigabitEthernet0/0/1 is up, line protocol is up

Internet Address 192.168.0.33/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.97, 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) 192.168.0.113, Interface address 192.168.0.34

Backup Designated router (ID) 192.168.0.97, Interface address 192.168.0.33

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 1/2/2, flood queue length 0

Next 0x0(0)/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 192.168.0.113 (Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0 is up, line protocol is up

Internet Address 192.168.0.18/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.97, 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) 192.168.0.97, Interface address 192.168.0.18

Backup Designated router (ID) 192.168.0.81, Interface address 192.168.0.17

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

oob-resync timeout 40

Hello due in 00:00:01

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

```
Next 0x0(0)/0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 3
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
  Adjacent with neighbor 192.168.0.81  (Backup Designated Router)
Suppress hello for 0 neighbor(s)
```

R3#show ip ospf border-routers

```
OSPF Router with ID (192.168.0.97) (Process ID 1)
  Base Topology (MTID 0)
Internal Router Routing Table
Codes: i - Intra-area route, I - Inter-area route
```

R3#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
       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
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR
```

Gateway of last resort is not set

```
192.168.0.0/24 is variably subnetted, 12 subnets, 2 masks
O       192.168.0.0/28
        [110/2] via 192.168.0.17, 00:38:31, GigabitEthernet0/0/0
C       192.168.0.16/28 is directly connected, GigabitEthernet0/0/0
L       192.168.0.18/32 is directly connected, GigabitEthernet0/0/0
C       192.168.0.32/28 is directly connected, GigabitEthernet0/0/1
L       192.168.0.33/32 is directly connected, GigabitEthernet0/0/1
O       192.168.0.48/28
        [110/2] via 192.168.0.34, 00:36:50, GigabitEthernet0/0/1
O       192.168.0.65/32
        [110/3] via 192.168.0.17, 00:30:55, GigabitEthernet0/0/0
O       192.168.0.81/32
        [110/2] via 192.168.0.17, 00:31:08, GigabitEthernet0/0/0
C       192.168.0.96/28 is directly connected, Loopback0
L       192.168.0.97/32 is directly connected, Loopback0
O       192.168.0.113/32
        [110/2] via 192.168.0.34, 00:31:36, GigabitEthernet0/0/1
O       192.168.0.129/32
        [110/3] via 192.168.0.34, 00:31:23, GigabitEthernet0/0/1
```

Router 4:

R4#show run

Building configuration...	address-family ipv4
Current configuration : 1716 bytes	exit-address-family
Last configuration change at 17:40:03 UTC	address-family ipv6
Thu Sep 9 2021	exit-address-family
version 15.5	no aaa new-model
service timestamps debug datetime msec	subscriber templating
service timestamps log datetime msec	multilink bundle-name authenticated
no platform punt-keepalive disable-kernel-	license udi pid ISR4321/K9 sn FDO215009QY
core	spanning-tree extend system-id
hostname R4	redundancy
boot-start-marker	mode none
boot-end-marker	vlan internal allocation policy ascending
vrf definition Mgmt-intf	interface Loopback0
	ip address 192.168.0.113 255.255.255.240

```

interface GigabitEthernet0/0/0
ip address 192.168.0.34 255.255.255.240
negotiation auto
interface GigabitEthernet0/0/1
ip address 192.168.0.49 255.255.255.240
negotiation auto
interface Serial0/1/0
no ip address
shutdown
interface Serial0/1/1
no ip address
shutdown
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
interface Vlan1
no ip address
shutdown
router ospf 1

network 192.168.0.0 0.0.0.15 area 0
network 192.168.0.16 0.0.0.15 area 0
network 192.168.0.32 0.0.0.15 area 0
network 192.168.0.48 0.0.0.15 area 0
network 192.168.0.64 0.0.0.15 area 0
network 192.168.0.80 0.0.0.15 area 0
network 192.168.0.96 0.0.0.15 area 0
network 192.168.0.112 0.0.0.15 area 0
network 192.168.0.128 0.0.0.15 area 0
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
control-plane
line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login
end

```

R4#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.0.129	1	FULL/DR	00:00:32	192.168.0.50	GigabitEthernet0/0/1
192.168.0.97	1	FULL/BDR	00:00:34	192.168.0.33	GigabitEthernet0/0/0

R4#show ip ospf

```

Routing Process "ospf 1" with ID 192.168.0.113
Start time: 00:18:55.086, Time elapsed: 00:43:19.564
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msecs
Minimum hold time between two consecutive SPFs 10000 msecs
Maximum wait time between two consecutive SPFs 10000 msecs
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msecs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
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
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled
Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps
Area BACKBONE(0)

```

Number of interfaces in this area is 3 (1 loopback)
Area has no authentication
SPF algorithm last executed 00:35:21.707 ago
SPF algorithm executed 11 times
Area ranges are
Number of LSA 9. Checksum Sum 0x03A20B
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 0

R4#show ip ospf interface

Loopback0 is up, line protocol is up

Internet Address 192.168.0.113/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.113, 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

GigabitEthernet0/0/1 is up, line protocol is up

Internet Address 192.168.0.49/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.113, 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) 192.168.0.129, Interface address 192.168.0.50

Backup Designated router (ID) 192.168.0.113, Interface address 192.168.0.49

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 1/2/2, flood queue length 0

Next 0x0(0)/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 192.168.0.129 (Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0 is up, line protocol is up

Internet Address 192.168.0.34/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.113, 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) 192.168.0.113, Interface address 192.168.0.34

Backup Designated router (ID) 192.168.0.97, Interface address 192.168.0.33

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 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 0, maximum is 2

Last flood scan time is 0 msec, maximum is 1 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 192.168.0.97 (Backup Designated Router)
Suppress hello for 0 neighbor(s)

R4#show ip ospf border-routers

OSPF Router with ID (192.168.0.113) (Process ID 1)
Base Topology (MTID 0)
Internal Router Routing Table
Codes: i - Intra-area route, I - Inter-area route

R4#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
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
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR
Gateway of last resort is not set
192.168.0.0/24 is variably subnetted, 12 subnets, 2 masks
O 192.168.0.0/28
[110/3] via 192.168.0.33, 00:44:10, GigabitEthernet0/0/0
O 192.168.0.16/28
[110/2] via 192.168.0.33, 00:44:10, GigabitEthernet0/0/0
C 192.168.0.32/28 is directly connected, GigabitEthernet0/0/0
L 192.168.0.34/32 is directly connected, GigabitEthernet0/0/0
C 192.168.0.48/28 is directly connected, GigabitEthernet0/0/1
L 192.168.0.49/32 is directly connected, GigabitEthernet0/0/1
O 192.168.0.65/32
[110/4] via 192.168.0.33, 00:37:31, GigabitEthernet0/0/0
O 192.168.0.81/32
[110/3] via 192.168.0.33, 00:37:44, GigabitEthernet0/0/0
O 192.168.0.97/32
[110/2] via 192.168.0.33, 00:38:25, GigabitEthernet0/0/0
C 192.168.0.112/28 is directly connected, Loopback0
L 192.168.0.113/32 is directly connected, Loopback0
O 192.168.0.129/32
[110/2] via 192.168.0.50, 00:37:59, GigabitEthernet0/0/1

Router 5:

R5#show run

Building configuration...	no aaa new-model
Current configuration : 1700 bytes	subscriber templating
Last configuration change at 17:46:56 UTC	multilink bundle-name authenticated
Thu Sep 9 2021	license udi pid ISR4321/K9 sn FDO214420HM
version 15.5	spanning-tree extend system-id
service timestamps debug datetime msec	redundancy
service timestamps log datetime msec	mode none
no platform punt-keepalive disable-kernel-	vlan internal allocation policy ascending
core	interface Loopback0
hostname R5	ip address 192.168.0.129 255.255.255.240
boot-start-marker	interface GigabitEthernet0/0/0
boot-end-marker	ip address 192.168.0.50 255.255.255.240
vrf definition Mgmt-intf	negotiation auto
address-family ipv4	interface GigabitEthernet0/0/1
exit-address-family	no ip address
address-family ipv6	shutdown
exit-address-family	negotiation auto
	interface Serial0/1/0

```

no ip address
shutdown
interface Serial0/1/1
no ip address
shutdown
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
interface Vlan1
no ip address
shutdown
router ospf 1
network 192.168.0.0 0.0.0.15 area 0
network 192.168.0.16 0.0.0.15 area 0
network 192.168.0.32 0.0.0.15 area 0
network 192.168.0.48 0.0.0.15 area 0

network 192.168.0.64 0.0.0.15 area 0
network 192.168.0.80 0.0.0.15 area 0
network 192.168.0.96 0.0.0.15 area 0
network 192.168.0.112 0.0.0.15 area 0
network 192.168.0.128 0.0.0.15 area 0
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
control-plane
line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login
end

```

R5#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.0.113	1	FULL/BDR	00:00:36	192.168.0.49	GigabitEthernet0/0/0

R5#show ip ospf

```

Routing Process "ospf 1" with ID 192.168.0.129
Start time: 00:18:39.892, Time elapsed: 00:48:23.760
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msecs
Minimum hold time between two consecutive SPF's 10000 msecs
Maximum wait time between two consecutive SPF's 10000 msecs
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msecs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
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
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled
Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps
Area BACKBONE(0)
  Number of interfaces in this area is 2 (1 loopback)
  Area has no authentication
  SPF algorithm last executed 00:41:07.593 ago
  SPF algorithm executed 9 times
  Area ranges are

```


Number of LSA 9. Checksum Sum 0x03A20B
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 0

R5#show ip ospf interface

Loopback0 is up, line protocol is up
Internet Address 192.168.0.129/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.129, 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
GigabitEthernet0/0/0 is up, line protocol is up
Internet Address 192.168.0.50/28, Area 0, Attached via Network Statement
Process ID 1, Router ID 192.168.0.129, 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) 192.168.0.129, Interface address 192.168.0.50
Backup Designated router (ID) 192.168.0.113, Interface address 192.168.0.49
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 1/1/1, flood queue length 0
Next 0x0(0)/0x0(0)/0x0(0)
Last flood scan length is 0, maximum is 3
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 192.168.0.113 (Backup Designated Router)
Suppress hello for 0 neighbor(s)

R5#show ip ospf border-routers

OSPF Router with ID (192.168.0.129) (Process ID 1)
Base Topology (MTID 0)
Internal Router Routing Table
Codes: i - Intra-area route, I - Inter-area route

R5#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
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
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR
Gateway of last resort is not set
192.168.0.0/24 is variably subnetted, 11 subnets, 2 masks
O 192.168.0.0/28
[110/4] via 192.168.0.49, 00:48:56, GigabitEthernet0/0/0
O 192.168.0.16/28
[110/3] via 192.168.0.49, 00:48:56, GigabitEthernet0/0/0
O 192.168.0.32/28

```

    [110/2] via 192.168.0.49, 00:48:56, GigabitEthernet0/0/0
C    192.168.0.48/28 is directly connected, GigabitEthernet0/0/0
L    192.168.0.50/32 is directly connected, GigabitEthernet0/0/0
O    192.168.0.65/32
    [110/5] via 192.168.0.49, 00:43:01, GigabitEthernet0/0/0
O    192.168.0.81/32
    [110/4] via 192.168.0.49, 00:43:14, GigabitEthernet0/0/0
O    192.168.0.97/32
    [110/3] via 192.168.0.49, 00:43:55, GigabitEthernet0/0/0
O    192.168.0.113/32
    [110/2] via 192.168.0.49, 00:43:42, GigabitEthernet0/0/0
C    192.168.0.128/28 is directly connected, Loopback0
L    192.168.0.129/32 is directly connected, Loopback0

```

Pings:

Router 1:

R1#ping 192.168.0.65

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.65, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R1#ping 192.168.0.81

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.81, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R1#ping 192.168.0.97

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.97, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms

R1#ping 192.168.0.113

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.113, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R1#ping 192.168.0.129

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.129, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Router 2:

R2#ping 192.168.0.65

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.65, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R2#ping 192.168.0.81

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.81, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R2#ping 192.168.0.97

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.97, timeout is 2 seconds:
!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R2#ping 192.168.0.113

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.113, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R2#ping 192.168.0.129

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.129, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Router 3:

R3#ping 192.168.0.65

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.65, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R3#ping 192.168.0.81

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.81, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R3#ping 192.168.0.97

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.97, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R3#ping 192.168.0.113

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.113, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R3#ping 192.168.0.129

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.129, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Router 4:

R4#ping 192.168.0.65

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.65, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R4#ping 192.168.0.81

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.81, timeout is 2 seconds:
!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R4#ping 192.168.0.97

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.97, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R4#ping 192.168.0.113

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.113, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R4#ping 192.168.0.129

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.129, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Router 5:

R5#ping 192.168.0.65

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.65, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R5#ping 192.168.0.81

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.81, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R5#ping 192.168.0.97

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.97, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R5#ping 192.168.0.113

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.113, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms

R5#ping 192.168.0.129

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.129, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Problems

Problems we encountered in this lab were mostly a result of unfamiliarity with the equipment. For example, we were unable to connect our console cables to the correct router. Another member of the lab, Colby, explained to us that the console cables were color coded. With this information, and with Colby's help, we were able to correctly connect our PC to the router's console. A second issue we experienced was incorrectly configuring the wildcard mask, which we discovered when testing the connection between different interfaces, and when our configuration file was proofread by another student, Gabriel Rosas. To fix this issue, we correctly configured our wildcard masks. An overall issue we experienced was the increased freedom we were given. We were expected to solve most of our

problems without instructor help. We were able to manage by working together and learning each of our individual strengths.

Conclusions

The purpose of this lab was for us to familiarize ourselves with the CCNP equipment and how to setup OSPF. To setup OSPF, we first researched how it worked and what new commands we should know. We then created a simulated network in packet tracer and applied that configuration to the equipment in the CCNP lab. Most of our configuration was setup correctly, but, as explained above, we did have to remedy a few issues. Through this lab, I learned how to use the equipment in the CCNP lab, as well as how to work with other members in my team to setup the necessary configurations.

Instructor Signoff