A circuit board

Description automatically generated

OSPF Lab

connections with ospf

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***Purpose***

In this last lab, we were asked to configure 4 routers with OSPF such that 4 computers connected to those routers would be able to ping each other. To do this, I used OSPF, Serial DCE connections, configured clock rates, and planned out IPs for each interface.

***Background***

OSPF, or Open Shortest Route First, is a routing protocol used to sort packets to their destination’s devices. To begin, this works by learning about every router and subnet in the entire network. This will result in every router having identical information about the network. The way routers learn this is by sending Link State Advertisements, or LSA. These LSAs contain basic information about the subnet, router, and other networking information. Once all LSAs have been sent out and received, the routers will store them in a Link State Database, or LSDB. The end goal of OSPF is for every router to have identical LSDBs. There are three main steps to achieving this uniformity, becoming OSPF neighbors, exchanging database information, and choosing the best routes. The best routes are finally chosen by running a calculation called SPF, and those routes are added to the routing table, and then all the computers can communicate freely. In addition, this lab uses IPv4 connections, meaning we must use OSPFv2, as OSPF v3 works only with IPv6 connections.

***Lab Summary***

To begin, I connected 4 computers to a unique router with copper straight-through connections. Then, I connected the routers using Serial DCE Connections, making sure that each connection had one clock rate interface. I then configured the 4 LAN networks (11, 12, 13, and 14) between the computers and their respective routers. Lastly, I configured the serial interfaces, OSPF, and WAN networks (15, 16, and 17) on each of the routers according to their interfaces.

***Lab Commands***

In order to complete this lab, it was required to apply two new commands in order to configure OSPF properly. The two commands learned are **router ospf [*process-id*]** and **network [*ip address*][*wildcard mask*] area [*area-id*].** The router command enables OSPF on a router, facilitating further configuration. The process-id in this command is used as an identifier for the proceeding OSPF processes. The network command identifies which interface to include in the OSPF process, and to what area the interface will be assigned to.

A close up of a map

Description automatically generated***Network Topology***

***Configurations***

R1#show run

Building configuration...

Current configuration : 827 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname R1

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 11.0.0.1 255.255.255.0

duplex auto

speed auto

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 15.0.0.1 255.255.255.0

clock rate 56000

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router ospf 1

log-adjacency-changes

network 15.0.0.0 0.0.0.255 area 0

network 11.0.0.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

R1#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

16.0.0.1 0 FULL/ - 00:00:34 15.0.0.2 Serial0/1/0

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

11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 11.0.0.0/24 is directly connected, GigabitEthernet0/0/0

L 11.0.0.1/32 is directly connected, GigabitEthernet0/0/0

12.0.0.0/24 is subnetted, 1 subnets

O 12.0.0.0/24 [110/65] via 15.0.0.2, 00:05:15, Serial0/1/0

13.0.0.0/24 is subnetted, 1 subnets

O 13.0.0.0/24 [110/129] via 15.0.0.2, 00:05:05, Serial0/1/0

14.0.0.0/24 is subnetted, 1 subnets

O 14.0.0.0/24 [110/193] via 15.0.0.2, 00:05:05, Serial0/1/0

15.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 15.0.0.0/24 is directly connected, Serial0/1/0

L 15.0.0.1/32 is directly connected, Serial0/1/0

16.0.0.0/24 is subnetted, 1 subnets

O 16.0.0.0/24 [110/128] via 15.0.0.2, 00:05:15, Serial0/1/0

17.0.0.0/24 is subnetted, 1 subnets

O 17.0.0.0/24 [110/192] via 15.0.0.2, 00:05:05, Serial0/1/0

R1#show ip ospf interface

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

Internet address is 11.0.0.1/24, Area 0

Process ID 1, Router ID 15.0.0.1, Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 15.0.0.1, Interface address 11.0.0.1

No backup designated router on this network

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

Hello due in 00:00:03

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)

Serial0/1/0 is up, line protocol is up

Internet address is 15.0.0.1/24, Area 0

Process ID 1, Router ID 15.0.0.1, Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:01

Index 2/2, flood queue length 0

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

Last flood scan length is 1, maximum is 1

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

Neighbor Count is 1 , Adjacent neighbor count is 1

Adjacent with neighbor 16.0.0.1

Suppress hello for 0 neighbor(s)

R2#show run

Building configuration...

Current configuration : 852 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname R2

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 12.0.0.1 255.255.255.0

duplex auto

speed auto

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 16.0.0.1 255.255.255.0

clock rate 56000

interface Serial0/1/1

ip address 15.0.0.2 255.255.255.0

interface Vlan1

no ip address

shutdown

router ospf 1

log-adjacency-changes

network 15.0.0.0 0.0.0.255 area 0

network 16.0.0.0 0.0.0.255 area 0

network 12.0.0.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

R2#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

17.0.0.1 0 FULL/ - 00:00:33 16.0.0.2 Serial0/1/0

15.0.0.1 0 FULL/ - 00:00:30 15.0.0.1 Serial0/1/1

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, 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

11.0.0.0/24 is subnetted, 1 subnets

O 11.0.0.0/24 [110/65] via 15.0.0.1, 00:23:22, Serial0/1/1

12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 12.0.0.0/24 is directly connected, GigabitEthernet0/0/0

L 12.0.0.1/32 is directly connected, GigabitEthernet0/0/0

13.0.0.0/24 is subnetted, 1 subnets

O 13.0.0.0/24 [110/65] via 16.0.0.2, 00:23:22, Serial0/1/0

14.0.0.0/24 is subnetted, 1 subnets

O 14.0.0.0/24 [110/129] via 16.0.0.2, 00:23:22, Serial0/1/0

15.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 15.0.0.0/24 is directly connected, Serial0/1/1

L 15.0.0.2/32 is directly connected, Serial0/1/1

16.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 16.0.0.0/24 is directly connected, Serial0/1/0

L 16.0.0.1/32 is directly connected, Serial0/1/0

17.0.0.0/24 is subnetted, 1 subnets

O 17.0.0.0/24 [110/128] via 16.0.0.2, 00:23:22, Serial0/1/0

R2#show ip ospf interface

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

Internet address is 12.0.0.1/24, Area 0

Process ID 1, Router ID 16.0.0.1, Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 16.0.0.1, Interface address 12.0.0.1

No backup designated router on this network

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

Hello due in 00:00:04

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)

Serial0/1/1 is up, line protocol is up

Internet address is 15.0.0.2/24, Area 0

Process ID 1, Router ID 16.0.0.1, Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:04

Index 2/2, flood queue length 0

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

Last flood scan length is 1, maximum is 1

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

Neighbor Count is 1 , Adjacent neighbor count is 1

Adjacent with neighbor 15.0.0.1

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Internet address is 16.0.0.1/24, Area 0

Process ID 1, Router ID 16.0.0.1, Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:03

Index 3/3, flood queue length 0

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

Last flood scan length is 1, maximum is 1

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

Neighbor Count is 1 , Adjacent neighbor count is 1

Adjacent with neighbor 17.0.0.1

Suppress hello for 0 neighbor(s)

R3#show run

Building configuration...

Current configuration : 852 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname R3

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 13.0.0.1 255.255.255.0

duplex auto

speed auto

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 17.0.0.1 255.255.255.0

clock rate 56000

interface Serial0/1/1

ip address 16.0.0.2 255.255.255.0

interface Vlan1

no ip address

shutdown

router ospf 1

log-adjacency-changes

network 13.0.0.0 0.0.0.255 area 0

network 17.0.0.0 0.0.0.255 area 0

network 16.0.0.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

R3#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

17.0.0.2 0 FULL/ - 00:00:36 17.0.0.2 Serial0/1/0

16.0.0.1 0 FULL/ - 00:00:35 16.0.0.1 Serial0/1/1

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, 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

11.0.0.0/24 is subnetted, 1 subnets

O 11.0.0.0/24 [110/129] via 16.0.0.1, 00:37:20, Serial0/1/1

12.0.0.0/24 is subnetted, 1 subnets

O 12.0.0.0/24 [110/65] via 16.0.0.1, 00:37:20, Serial0/1/1

13.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 13.0.0.0/24 is directly connected, GigabitEthernet0/0/0

L 13.0.0.1/32 is directly connected, GigabitEthernet0/0/0

14.0.0.0/24 is subnetted, 1 subnets

O 14.0.0.0/24 [110/65] via 17.0.0.2, 00:37:20, Serial0/1/0

15.0.0.0/24 is subnetted, 1 subnets

O 15.0.0.0/24 [110/128] via 16.0.0.1, 00:37:20, Serial0/1/1

16.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 16.0.0.0/24 is directly connected, Serial0/1/1

L 16.0.0.2/32 is directly connected, Serial0/1/1

17.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 17.0.0.0/24 is directly connected, Serial0/1/0

L 17.0.0.1/32 is directly connected, Serial0/1/0

R3#show ip ospf interface

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

Internet address is 13.0.0.1/24, Area 0

Process ID 1, Router ID 17.0.0.1, Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 17.0.0.1, Interface address 13.0.0.1

No backup designated router on this network

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

Hello due in 00:00:06

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)

Serial0/1/1 is up, line protocol is up

Internet address is 16.0.0.2/24, Area 0

Process ID 1, Router ID 17.0.0.1, Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:08

Index 2/2, flood queue length 0

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

Last flood scan length is 1, maximum is 1

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

Neighbor Count is 1 , Adjacent neighbor count is 1

Adjacent with neighbor 16.0.0.1

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Internet address is 17.0.0.1/24, Area 0

Process ID 1, Router ID 17.0.0.1, Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:03

Index 3/3, flood queue length 0

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

Last flood scan length is 1, maximum is 1

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

Neighbor Count is 1 , Adjacent neighbor count is 1

Adjacent with neighbor 17.0.0.2

Suppress hello for 0 neighbor(s)

R4#show run

Building configuration...

Current configuration : 809 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname R4

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 14.0.0.1 255.255.255.0

duplex auto

speed auto

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

no ip address

clock rate 2000000

shutdown

interface Serial0/1/1

ip address 17.0.0.2 255.255.255.0

interface Vlan1

no ip address

shutdown

router ospf 1

log-adjacency-changes

network 14.0.0.0 0.0.0.255 area 0

network 17.0.0.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

R4#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

17.0.0.1 0 FULL/ - 00:00:33 17.0.0.1 Serial0/1/1

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, 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

11.0.0.0/24 is subnetted, 1 subnets

O 11.0.0.0/24 [110/193] via 17.0.0.1, 00:43:56, Serial0/1/1

12.0.0.0/24 is subnetted, 1 subnets

O 12.0.0.0/24 [110/129] via 17.0.0.1, 00:43:56, Serial0/1/1

13.0.0.0/24 is subnetted, 1 subnets

O 13.0.0.0/24 [110/65] via 17.0.0.1, 00:43:56, Serial0/1/1

14.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 14.0.0.0/24 is directly connected, GigabitEthernet0/0/0

L 14.0.0.1/32 is directly connected, GigabitEthernet0/0/0

15.0.0.0/24 is subnetted, 1 subnets

O 15.0.0.0/24 [110/192] via 17.0.0.1, 00:43:56, Serial0/1/1

16.0.0.0/24 is subnetted, 1 subnets

O 16.0.0.0/24 [110/128] via 17.0.0.1, 00:43:56, Serial0/1/1

17.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 17.0.0.0/24 is directly connected, Serial0/1/1

L 17.0.0.2/32 is directly connected, Serial0/1/1

R4#show ip ospf interface

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

Internet address is 14.0.0.1/24, Area 0

Process ID 1, Router ID 17.0.0.2, Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 17.0.0.2, Interface address 14.0.0.1

No backup designated router on this network

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

Hello due in 00:00:00

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)

Serial0/1/1 is up, line protocol is up

Internet address is 17.0.0.2/24, Area 0

Process ID 1, Router ID 17.0.0.2, Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:01

Index 2/2, flood queue length 0

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

Last flood scan length is 1, maximum is 1

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

Neighbor Count is 1 , Adjacent neighbor count is 1

Adjacent with neighbor 17.0.0.1

Suppress hello for 0 neighbor(s)

***Problems***

The only two major problems I encountered while configuring this lab topology were using the wrong type of serial connection, and incorrectly planning my IP scheme. For the first problem, all I did was set up the routers with DTE connections instead of DCE, which was easily fixed. However, the second issue was more confusing to fix. I had assigned the connections between the computers and routers to be in the 11.0.0.0/24 subnet, and the router connections to be in the 12.0.0.0/24 subnet. A similar way to think of this would be for half of a class of students to have the same name. Because of this, the router does not know which 11.0.0.0 subnet to route to, just like a teacher might get confused at which John forgot to do his homework. This was fixed by assigning each connection a unique subnet, like in the diagram included earlier.

***Conclusion***

In conclusion, I set up OSPF on each router and had to re-assign their IPs because of the routing issue. In the process, I learned a lot about OSPF through researching how it functions and by setting it up, and how to repair an IP scheme.