

LAB PROGRAM -7

Q) Configure OSPF Routing Protocol

Procedure :

COMPASS
Date: 27/7/23

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Experiment - 7

Aim: Configure OSPF Routing Protocol

Topology:

Area 3: R1 (S1/0: 20.0.0.1, F2/0: 10.0.0.1) connected to PC-1 (10.0.0.10). Def GW: 10.0.0.1.

Area 0: R1 (S2/0: 20.0.0.2) connected to R2 (S1/1: 30.0.0.1, S2/1: 30.0.0.2).

Area 2: R2 (S1/1: 30.0.0.1, S2/1: 30.0.0.2) connected to R3 (F2/0: 40.0.0.1). R3 connected to PC-2 (40.0.0.10). Def GW: 40.0.0.1.

Procedure:

Step 1: Configure the IP Address and gateway According to the topology seen Above

Step 2: Configure each of the routers According to the IP Address given in topology.

Step 3: Encapsulation ppp and cbrk state need to be set as done in RIP protocol experiment

Router 1:

```
R1 (config) # router ospf 1
R1 (config) # router-id 1.1.1.1
R1 (config-router) # network 10.0.0.0 0.255.255.255 area 3
R1 (config-router) # network 20.0.0.0 0.255.255.255 area 1
R1 (config-router) # exit
```

Router 2:

```
R2 (Config)# router ospf 1
R2 (Config-router)# router-id 2.2.2.2
R2 (Config-router)# network 20.0.0.0 0.255.255.255 area 1
R2 (Config-router)# network 30.0.0.0 0.255.255.255 area 0
R2 (Config-router)# exit
```

Router 3:

```
R3 (Config)# router ospf 1
R3 (Config-router)# router-id 3.3.3.3
R3 (Config-router)# network 30.0.0.0 0.255.255.255 area 0
R3 (Config-router)# network 40.0.0.0 0.255.255.255 area 2
R3 (Config-router)# exit
```

step 1: To keep the routers Active we have to configure interface loopback

Router 1:

```
R1 (Config-if)# interface loopback 0
R1 (Config-if)# ip address 172.16.1.252 255.255.0.0
R1 (Config-if)# no shutdown
```

Router 2:

```
R2 (Config-if)# interface loopback 0
R2 (Config-if)# ip address 172.16.1.253 255.255.0.0
R2 (Config-if)# no shutdown
```

Router 3:

```
R3 (Config-if)# interface loopback 0
R3 (Config-if)# ip address 172.16.1.254 255.255.0.0
R3 (Config-if)# no shutdown
```


Step 5: Create virtual link b/w R1, R2 by this we can create a virtual link to connect to Area 0

Router 1:

R1(Config)# router ospf 1

R1(Config-router)# area 1 virtual-link 2.2.2.2

Router 2:

R2(Config)# router ospf 1

R2(Config-router)# area 1 virtual-link 1.1.1.1

R2(Config-router)# exit

Finally, After creating virtual link, show ip route for all routers.

Result:

PC > ping 40.0.0.10

pinging 40.0.0.10 with 32 bytes of data:

Request timed out

Reply from 40.0.0.10: bytes=32 time=10ms TTL=125

Reply from 40.0.0.10: bytes=32 time=2ms TTL=125

Reply from 40.0.0.10: bytes=32 time=9ms TTL=125

ping statistics for 40.0.0.10:

Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),

Approximate round trip times in milli-seconds:

Minimum = 2ms, Maximum = 10ms, Average = 7ms

Router 1:

show ip route

- 0 IA 10.0.0.0/8 [110/65] via 20.0.0.1 00:00:21, Serial2/6
- 20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
- c 20.0.0.0/8 is directly connected, Serial12/0
- c 20.0.0.0/32 is directly connected, Serial12/0
- 30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
- c 30.0.0.0/8 is directly connected, Serial3/0
- c 30.0.0.0/32 is directly connected, Serial3/0
- 0 IA 40.0.0.0/8 [110/65] via 30.0.0.2 00:04:44, Serial3/0
- c 172.16.0.0/16 is directly connected, Loopback0

observation:

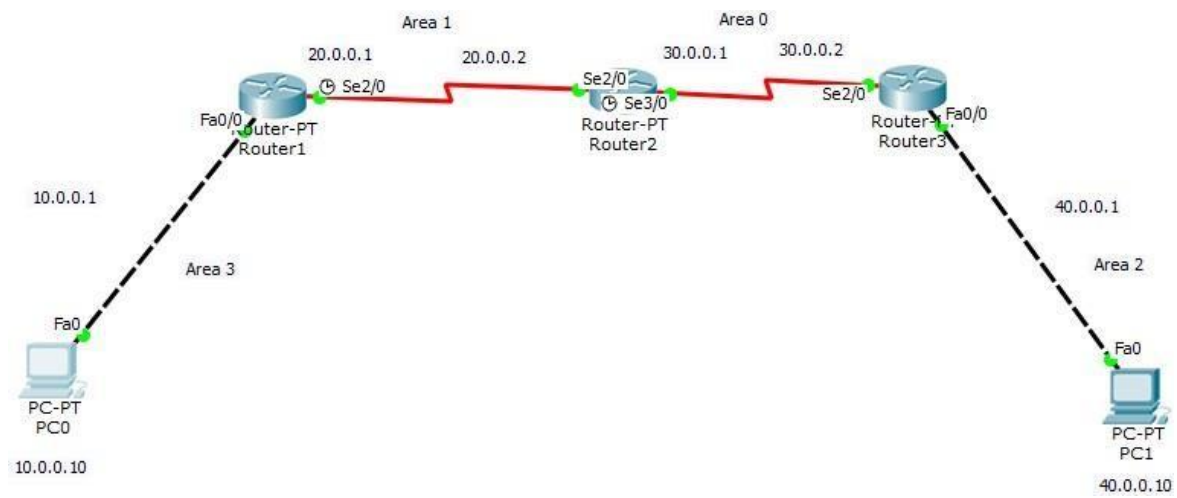
The OSPF protocol is a link-state routing protocol, which means that the routers exchange topology information with their nearest neighbors.

It is an interdomain protocol, which means that it is used within an area. Each router contains the information of every domain, and based on this information, it determines shortest path. The goal of routing is to learn routes. The OSPF achieves by learning about every router and subnet within the entire network. The way the router learns this information by sending LSA. These LSAs contain information about every router, subnet, and other networking information. [To keep routers Active we use interface loop back.].

We use virtual link to connect to the backbone through a non-backbone area.


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Topology :



Router Configuration :

Router 1 :

 Router1

Physical Config CLI

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface fa0/0
Router(config-if)#ip add 10.0.0.1 255.0.0.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
exit
Router(config)#interface se2/0
Router(config-if)#ip add 20.0.0.1 255.0.0.0
Router(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface se2/0
Router(config-if)#encapsulation ppp
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to down
clock rate 64000
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

%LINK-5-CHANGED: Interface Serial2/0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to down

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router(config)#router ospf 1
Router(config-router)#router-id 1.1.1.1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 3
Router(config-router)#network 20.0.0.0 0.255.255.255 area 1
Router(config-router)#exit
Router(config)#
00:18:07: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial2/0 from LOADING to FULL, Loading I

Router(config)#interface se2/0
Router(config-if)#interface loopback 0

Router(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

Router(config-if)#ip address 172.16.1.252 255.255.0.0
Router(config-if)#no shut
```

```
Router(config)#interface se2/0
Router(config-if)#interface loopback 0

Router(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

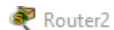
%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

Router(config-if)#ip address 172.16.1.252 255.255.0.0
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#router ospf 1
Router(config-router)#area 1 virtual-link 2.2.2.2
Router(config-router)#exit
Router(config)#
00:24:20: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on OSPF_VL0 from LOADING to FULL, Loading Done
exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip route
Codes: C - connected, S - static, I - IGRP, 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

C    10.0.0.0/8 is directly connected, FastEthernet0/0
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    20.0.0.0/8 is directly connected, Serial2/0
C    20.0.0.2/32 is directly connected, Serial2/0
O    30.0.0.0/8 [110/128] via 20.0.0.2, 00:00:54, Serial2/0
O IA 40.0.0.0/8 [110/129] via 20.0.0.2, 00:00:54, Serial2/0
C    172.16.0.0/16 is directly connected, Loopback0
Router#
```

Router 2 :



Physical Config CLI

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface se2/0
Router(config-if)#ip add 20.0.0.2
% Incomplete command.
Router(config-if)#ip add 20.0.0.2 255.0.0.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
exit
Router(config)#ip add 20.0.0.2
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, chang
Router(config)#interface se3/0
Router(config-if)#ip add 30.0.0.1 255.0.0.0
Router(config-if)#no shut

%LINK-5-CHANGED: Interface Serial3/0, changed state to down
Router(config-if)#no shut
Router(config-if)#
%LINK-5-CHANGED: Interface Serial3/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to down
interface se2/0
Router(config-if)#encapsulation ppp
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up
no shut
Router(config-if)#exit
Router(config)#interface se3/0
Router(config-if)#encapsulation ppp
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to down
clock rate 640000
Unknown clock rate
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up

%LINK-5-CHANGED: Interface Serial2/0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to down

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router(config)#router ospf
% Incomplete command.
Router(config)#router ospf 1
Router(config-router)#router-id 2.2.2.2
Router(config-router)#network 20.0.0.0 0.255.255.255 area 1
Router(config-router)#network 20.0.0.0 0.255.255.255 area 1
00:18:05: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Serial2/
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
00:19:20: %OSPF-5-ADJCHG: Process 1, Nbr 40.0.0.1 on Serial3/0 from LOADING to FULL, Loading Done
```



```

Router(config)#interface se3/0
Router(config-if)#interface loopback 0

Router(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
ip add 172.16.1.253 255.255.0.0
Router(config-if)#no shut
Router(config-if)#
%LINK-5-CHANGED: Interface Serial3/0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to down

00:23:22: %OSPF-5-ADJCHG: Process 1, Nbr 40.0.0.1 on Serial3/0 from FULL to DOWN, Neighbor Down: Interface down or detached

%LINK-5-CHANGED: Interface Serial3/0, changed state to up

Router(config-if)#exit
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up
t
00:23:33: %OSPF-4-ERRRCV: Received invalid packet: mismatch area ID, from backbone area must be virtual-link but not found from 20.0.0.2, Serial2/0

Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

00:23:41: %OSPF-5-ADJCHG: Process 1, Nbr 40.0.0.1 on Serial3/0 from LOADING to FULL, Loading Done

Router#
00:23:43: %OSPF-4-ERRRCV: Received invalid packet: mismatch area ID, from backbone area must be virtual-link but not found from 20.0.0.2, Serial2/0
config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#
00:23:53: %OSPF-4-ERRRCV: Received invalid packet: mismatch area ID, from backbone area must be virtual-link but not found from 20.0.0.2, Serial2/0

Router(config-router)#area 1 virtual-link
00:24:03: %OSPF-4-ERRRCV: Received invalid packet: mismatch area ID, from backbone area must be virtual-link but not found from 20.0.0.2, Serial2/0
1.1.1.1
Router(config-router)#
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
00:24:18: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on OSPF_VL0 from LOADING to FULL, Loading Done

% Ambiguous command: "c"
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, Serial2/0
C       20.0.0.1/32 is directly connected, Serial2/0
    30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

```

```
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#area 1 virtual-link 1.1.1.1
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip route
Codes: C - connected, S - static, I - IGRP, 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

O IA 10.0.0.0/8 [110/65] via 20.0.0.1, 00:00:34, Serial2/0
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      20.0.0.0/8 is directly connected, Serial2/0
C      20.0.0.1/32 is directly connected, Serial2/0
    30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      30.0.0.0/8 is directly connected, Serial3/0
C      30.0.0.2/32 is directly connected, Serial3/0
O IA 40.0.0.0/8 [110/65] via 30.0.0.2, 00:01:24, Serial3/0
C      172.16.0.0/16 is directly connected, Loopback0
Router#
```

Router 3 :

```
Router3
Physical Config CLI
IOS Commar

Router>en
Router#config t
Enter configuration commands, one per line. End with CNIL/Z.
Router(config)#interface fa0/0
Router(config-if)#ip add 40.0.0.1 255.0.0.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
exit
Router(config)#interface se2/0
Router(config-if)#ip add 30.0.0.2 255.0.0.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to down

Router(config)#interface se2/0
Router(config-if)#encapsulation ppp
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up
no shut
Router(config-if)#exit
Router(config)#router ospf 1
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#
00:18:56: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial2/0 from LOADING to FULL, Loading Done

Router(config-router)#network 40.0.0.0 0.255.255.255 area 2
Router(config-router)#exit
Router(config)#interface se2/0
Router(config-if)#interface loopback 0

Router(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
ip add 172.16.1.254 255.255.0.0
Router(config-if)#no shut
Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to down

00:22:58: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial2/0 from FULL to DOWN, Neighbor Down: Interface down or detached

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

00:23:18: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial2/0 from LOADING to FULL, Loading Done

Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```



```

Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip route
Codes: C - connected, S - static, I - IGRP, 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

O IA 10.0.0.0/8 [110/129] via 30.0.0.1, 00:05:53, Serial2/0
O IA 20.0.0.0/8 [110/128] via 30.0.0.1, 00:06:30, Serial2/0
    30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     30.0.0.0/8 is directly connected, Serial2/0
C     30.0.0.1/32 is directly connected, Serial2/0
C     40.0.0.0/8 is directly connected, FastEthernet0/0
C     172.16.0.0/16 is directly connected, Loopback0
Router#

```

Ping Result :

P0

