Independent University, Bangladesh (IUB)
Department of Computer Science &
Engineering
Data Communication & Networking (CSE 316)

EXPERIMENT#9: Dynamic Routing (OSPF)

OPEN SHORTEST PATH FIRST (OSPF)

OSPF was developed by the internet community to answer the need to a highly functional and non-proprietary Internal Gateway Protocol (IGP) for TCP/IP. OSPF is a link-state routing protocol, which is different from the Bellman-Ford vector based algorithm used in RIP.

OSPF is a link-state protocol. A link can be thought like an interface on the router. The link state is a description of the interface and its relation with its neighbor routers. An interface description can include the IP address of interface, subnet mask, peer IP address, bandwidth, etc. All these link state information are kept in link state database. OSPF uses the Dijkstra algorithm to calculate the shortest path to all known destinations. This is a link state algorithm. The algorithm places each router as the root of a tree and calculates the shortest path to each destination based on the cumulative cost required to reach that destination through the tree.

In an OSPF network, each router has its own view of the network topology. Link or interface cost is a general indication of the overhead required to reach the peer router through a certain interface. In OSPF, the interface cost is inversely proportional to the bandwidth of that interface. A higher bandwidth indicates a lower cost, therefore, less overhead to reach the destination.

OSPF uses multicast flooding to exchange link-state updates among all routers. Any change in network topology is flooded to all routers in the network. Areas are introduced to put a boundary on link-state updates. Link-state flooding and calculation of Dijkstra algorithm is limited to changes within an area. All routers within an area have the same link-state database. A router with all of its interfaces within the same area is called an Internal Router (IR). A router with interfaces in multiple areas is called, Area Border Router (ABR).

- Configuring OSPF on Routers
- Configuring OSPF includes the following two steps in global configuration mode:
- Enabling an OSPF process using the router ospf <process-id> command.
- Assigning areas to the interfaces using the network <network or IP address> < Wildcard-mask> <area-id> command.

The OSPF process-id is a numeric value local to the router. It does not have to match process-ids on other routers.

Objective:

Your task is to configure (RIP) Routing Information Protocol between PC0, PC1, PC2 and PC4

1. Built network according to Figure 1
2. Configure OSPF between the routers
3. Ping from each PC to all other PCs
4. Check Routing Table for all the routers
5. Check Routing Simulation for each PC to all other PCs
6. Connect serial interfaces between Router0 - Router1 and Router 2 – Router 3 (Figure 2)
7. Check Routing Table for all the routers
8. Check Routing Simulation for each PC to all other PCs
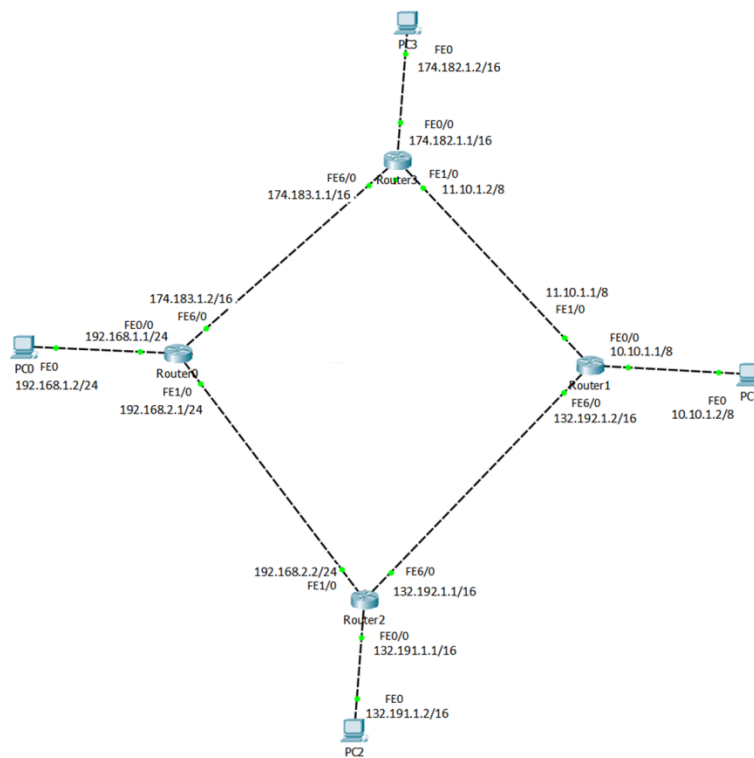
Figure 1

Tools and Materials:

In a real life Scenario:
Four Workstations with terminal Program (such as putty), four Cisco routers, four PCs, eight RJ45 cross-over cables, two serial cable (DCE)

For Lab Purpose:
Cisco Packet Tracer Software

Instructions:

Router0

Router>en
Router#conf t
Router(config)#hostname Router0
Router0(config)#interface FastEthernet0/0
Router0(config-if)#no shut
Router0(config-if)#ip address 192.168.1.1 255.255.255.0
Router0(config-if)#interface FastEthernet1/0
Router0(config-if)#no shut
Router0(config-if)#ip address 192.168.2.1 255.255.255.0
Router0(config-if)#interface FastEthernet6/0
Router0(config-if)#no shut
Router0(config-if)#ip address 174.183.1.2 255.255.0.0
Router0(config-if)#exit

Router0(config)#router ospf 1
Router0(config-router)#network 192.168.1.0 0.0.0.255 area 1
Router0(config-router)#network 192.168.2.0 0.0.0.255 area 1
Router0(config-router)#network 174.183.0.0 0.0.255.255 area 1

Router2

Router>en
Router#conf t
Router(config)#hostname Router2
Router2(config)#interface FastEthernet0/0
Router2(config-if)#no shut
Router2(config-if)#ip address 132.191.1.1 255.255.0.0
Router2(config-if)#interface FastEthernet1/0
Router2(config-if)#no shut
Router2(config-if)#ip address 192.168.2.2 255.255.255.0
Router2(config-if)#interface FastEthernet6/0
Router2(config-if)#no shut
Router2(config-if)#ip address 132.192.1.1 255.255.0.0
Router2(config-if)#exit

Router2(config)#router ospf 1
Router2(config-router)#network 132.191.0.0 0.0.255.255 area 1
Router2(config-router)#network 192.168.2.0 0.255.255.255 area 1
Router2(config-router)#network 132.192.0.0 0.0.255.255 area 1

Router1

```
Router>en
Router#conf t
Router(config)#hostname Router1
Router1(config)#interface FastEthernet0/0
Router1(config-if)#no shut
Router1(config-if)#ip address 10.10.1.1 255.0.0.0
Router1(config-if)#interface FastEthernet1/0
Router1(config-if)#no shut
Router1(config-if)#ip address 11.10.1.1 255.0.0.0
Router1(config-if)#interface FastEthernet6/0
Router1(config-if)#no shut
Router1(config-if)#ip address 132.192.1.2 255.255.0.0
Router1(config-if)#exit

Router1(config)#router ospf 1
Router1(config-router)#network 10.0.0.0 0.255.255.255 area 1
Router1(config-router)#network 11.0.0.0 0.255.255.255 area 1
Router1(config-router)#network 132.192.0.0 0.0.255.255 area 1
```

Router3

```
Router>en
Router#conf t
Router(config)#hostname Router3
Router3(config)#interface FastEthernet0/0
Router3(config-if)#no shut
Router3(config-if)#ip address 174.182.1.1 255.255.0.0
Router3(config-if)#interface FastEthernet1/0
Router3(config-if)#no shut
Router3(config-if)#ip address 11.10.1.2 255.0.0.0
Router3(config-if)#interface FastEthernet6/0
Router3(config-if)#no shut
Router3(config-if)#ip address 174.183.1.1 255.255.0.0
Router3(config-if)#exit

Router3(config)#router ospf 1
Router3(config-router)#network 174.182.0.0 0.0.255.255 area 1
Router3(config-router)#network 11.0.0.0 0.255.255.255 area 1
Router3(config-router)#network 174.183.0.0 0.0.255.255 area 1
```

Result

Router0

Router0#show ip route ospf

O 10.0.0.0 [110/3] via 192.168.2.2, 00:21:03, FastEthernet1/0
[110/3] via 174.183.1.1, 00:21:03, FastEthernet6/0
O 11.0.0.0 [110/2] via 174.183.1.1, 00:21:03, FastEthernet6/0
O 132.191.0.0 [110/2] via 192.168.2.2, 00:23:06, FastEthernet1/0
O 132.192.0.0 [110/2] via 192.168.2.2, 00:21:56, FastEthernet1/0
O 174.182.0.0 [110/2] via 174.183.1.1, 00:21:33, FastEthernet6/0

Router2

Router2#show ip route ospf

O 10.0.0.0 [110/2] via 132.192.1.2, 00:22:00, FastEthernet6/0
O 11.0.0.0 [110/2] via 132.192.1.2, 00:21:02, FastEthernet6/0
O 174.182.0.0 [110/3] via 192.168.2.1, 00:21:02, FastEthernet1/0
[110/3] via 132.192.1.2, 00:21:02, FastEthernet6/0
O 174.183.0.0 [110/2] via 192.168.2.1, 00:21:32, FastEthernet1/0
O 192.168.1.0 [110/2] via 192.168.2.1, 00:23:05, FastEthernet1/0
Router1

Router1#show ip route ospf

O 132.191.0.0 [110/2] via 132.192.1.1, 00:21:58, FastEthernet6/0
O 174.182.0.0 [110/2] via 11.10.1.2, 00:21:03, FastEthernet1/0
O 174.183.0.0 [110/2] via 11.10.1.2, 00:21:03, FastEthernet1/0
O 192.168.1.0 [110/3] via 11.10.1.2, 00:21:03, FastEthernet1/0
[110/3] via 132.192.1.1, 00:21:03, FastEthernet6/0
O 192.168.2.0 [110/2] via 132.192.1.1, 00:21:58, FastEthernet6/0

Router3

Router3#show ip route ospf

O 10.0.0.0 [110/2] via 11.10.1.1, 00:21:03, FastEthernet1/0
O 132.191.0.0 [110/3] via 11.10.1.1, 00:21:03, FastEthernet1/0
[110/3] via 174.183.1.2, 00:21:03, FastEthernet6/0
O 132.192.0.0 [110/2] via 11.10.1.1, 00:21:03, FastEthernet1/0
O 192.168.1.0 [110/2] via 174.183.1.2, 00:21:33, FastEthernet6/0
O 192.168.2.0 [110/2] via 174.183.1.2, 00:21:33, FastEthernet6/0

Configure All the PCs with appropriate static IP and gateway and Ping from each PC to all other PCs

C:\>ping 10.10.1.2

Pinging 10.10.1.2 with 32 bytes of data:

Request timed out.
Reply from 10.10.1.2: bytes=32 time=16ms TTL=125
Reply from 10.10.1.2: bytes=32 time=12ms TTL=125
Reply from 10.10.1.2: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.1.2:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 16ms, Average = 9ms

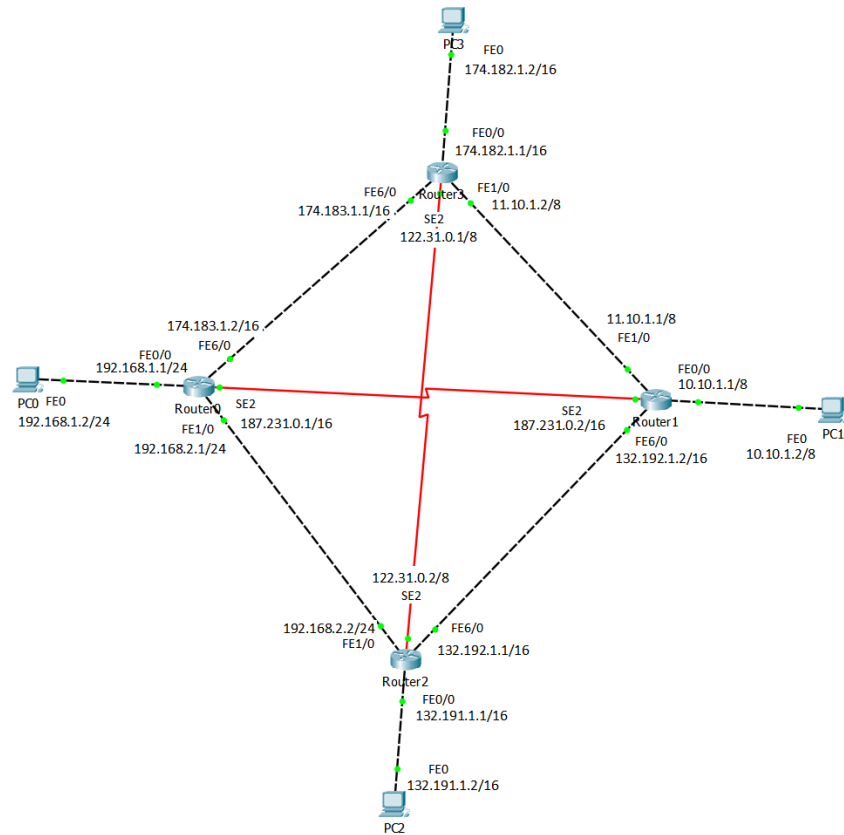**Connect serial interfaces between Router0 - Router1 and Router 2 – Router 3**

Figure 2

Instructions:

Router0

Router0#conf t
Router0(config)#interface Serial2/0
Router0(config-if)#no shut
Router0(config-if)# clock rate 64000
Router0(config-if)#ip address 187.231.0.1 255.255.0.0
Router0(config-if)#exit

Router0(config)#router ospf
Router0(config-router)#network 187.231.0.0 0.0.255.255 area 1

Router2

Router2#conf t
Router2(config)#interface Serial2/0
Router2(config-if)#no shut
Router2(config-if)# clock rate 64000
Router2(config-if)#ip address 122.31.0.2 255.0.0.0
Router2(config-if)#exit

Router2(config)#router ospf 1
Router2(config-router)#network 122.0.0.0 0.255.255.255 area 1

Router1

Router1#conf t
Router1(config)#interface Serial2/0
Router1(config-if)#no shut
Router1(config-if)#ip address 187.231.0.2 255.255.0.0
Router1(config-if)#exit

Router1(config)#router ospf 1
Router1(config-router)#network 187.231.0.0 0.0.255.255 area 1

Router3

Router3#conf t
Router3(config)#interface Serial2/0
Router3(config-if)#no shut
Router3(config-if)#ip address 122.31.0.1 255.0.0.0
Router3(config-if)#exit

Router3(config)#router ospf 1
Router3(config-router)#network 122.0.0.0 0.255.255.255