ASSIGNMENT

COURSE	Networking Fundamentals	ASSIGNMENT NO	8
MODULE	Routing	ASSIGNMENT DATE	30/08/2024
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Q1. Explain Routing and various types of routing with their advantages?

Ans:

"Answer in points along with the advantages"

1. Routing :

- Definition: Routing is the process of selecting the best path for data packets to travel across a network from the source to the destination.
- Function: Routers use routing tables to determine the optimal path based on various factors like distance, cost, and congestion.

2. Types of Routing:

a. Static Routing:

- Description: Routes are manually configured by the network administrator.
- Advantages:
    - Control: Offers full control over routing decisions.
    - Predictability: Network paths are predictable since they don't change unless manually updated.
    - Lower Overhead: Consumes less bandwidth and resources as no routing updates are exchanged.

b. Dynamic Routing:

- Description: Routes are automatically determined by routing protocols based on current network conditions.
- Advantages:
  - Adaptability: Automatically adjusts to changes in the network, such as link failures or congestion.
  - Scalability: Suitable for larger networks where manual configuration would be cumbersome.
  - Load Balancing: Can distribute traffic across multiple paths to optimize network performance.

c. Default Routing:

- Description: A default route is used when no other specific route is available for a destination.
- Advantages:
  - Simplicity: Simplifies the routing table by reducing the number of entries required.
  - Efficiency: Useful in smaller or stub networks where most traffic is routed through a single gateway.

d. Dynamic Routing Protocols:

i. RIP (Routing Information Protocol):

- Description: A distance-vector protocol that uses hop count as a metric.
- Advantages:
  - Simplicity: Easy to configure and understand.
  - Compatibility: Widely supported on various devices.

ii. OSPF (Open Shortest Path First):

- Description: A link-state protocol that uses the shortest path first (SPF) algorithm.
- Advantages:

- o Speed: Quickly converges after a change in the network topology.

- o Efficiency: Reduces unnecessary routing updates using areas and summarization.

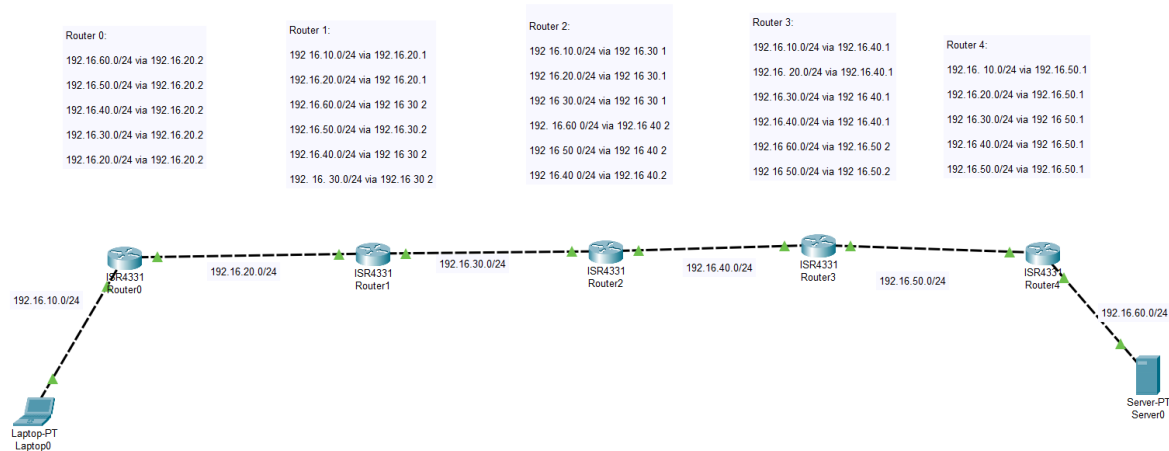iii. EIGRP (Enhanced Interior Gateway Routing Protocol):

- Description: An advanced distance-vector protocol developed by Cisco.

- Advantages:

    - o Hybrid: Combines the best features of distance-vector and link-state protocols.

    - o Fast Convergence: Quickly adapts to network changes with minimal downtime.

iv. BGP (Border Gateway Protocol):

- Description: An exterior gateway protocol used to route between different autonomous systems on the internet.

- Advantages:

    - o Scalability: Can handle very large networks, like those of ISPs.

    - o Policy Control: Provides extensive control over routing policies and path selection.

**Q2.** Configure a network with 4-6 routers and do static-routing.

"Write down your observation"
"Attach the screenshot of your findings"

Router 0:

192.16.60.0/24 via 192.16.20.2

192.16.50.0/24 via 192.16.20.2

192.16.40.0/24 via 192.16.20.2

192.16.30.0/24 via 192.16.20.2

192.16.20.0/24 via 192.16.20.2

Router 1:

192.16.10.0/24 via 192.16.20.1

192.16.20.0/24 via 192.16.20.1

192.16.60.0/24 via 192.16.30.2

192.16.50.0/24 via 192.16.30.2

192.16.40.0/24 via 192.16.30.2

192.16.30.0/24 via 192.16.30.2

Router 2:

192.16.10.0/24 via 192.16.30.1

192.16.20.0/24 via 192.16.30.1

192.16.30.0/24 via 192.16.30.1

192.16.60.0/24 via 192.16.40.2

192.16.50.0/24 via 192.16.40.2

192.16.40.0/24 via 192.16.40.2

Router 3:

192.16.10.0/24 via 192.16.40.1

192.16.20.0/24 via 192.16.40.1

192.16.30.0/24 via 192.16.40.1

192.16.40.0/24 via 192.16.40.1

192.16.60.0/24 via 192.16.50.2

192.16.50.0/24 via 192.16.50.2

Router 4:

192.16.10.0/24 via 192.16.50.1

192.16.20.0/24 via 192.16.50.1

192.16.30.0/24 via 192.16.50.1

192.16.40.0/24 via 192.16.50.1

192.16.50.0/24 via 192.16.50.1

Observations:

1. **Manual Configuration:**
   o Each route must be manually entered, which can be time-consuming and prone to errors, especially in larger networks.

2. **Predictability and Control:**
   o Static routing provides full control over the routing paths. The paths remain consistent unless manually changed, which ensures predictability in how packets will travel across the network.

3. **No Routing Overhead:**
   o Since static routes do not involve routing protocol exchanges, there is no additional bandwidth consumption for routing updates. This results in lower network overhead.

4. **Limited Scalability:**
   o As the network grows, the number of static routes increases, making the network more difficult to manage. This makes static routing less suitable for larger networks.

5. **Network Changes:**
   o Static routes do not automatically adjust to changes in the network, such as link failures. If a link goes down, the network administrator must manually reconfigure the routing tables to restore connectivity.

6. **Efficiency in Small Networks:**
   o For small networks, static routing can be efficient as the number of routes is manageable, and it avoids the complexity of dynamic routing protocols.

7. **Troubleshooting:**
   o Static routes can simplify troubleshooting since the paths are predefined, allowing easier identification of routing issues.

Q3. Connect the network as given in the below diagram
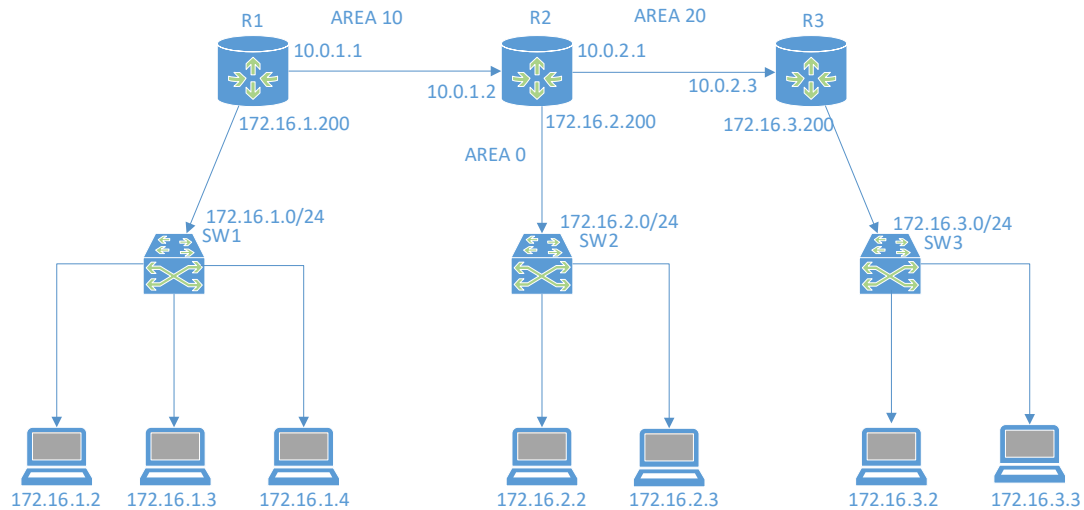
Configure the Network using static first and then OSPF

!!IMPORTANT!!

For R2

1. **Select only 2811 Router**
2. **Go to>>Physical>>switch-off Router Power**
3. **Select under modules>> NM-2FEW Module**
4. **Drag and drop additional interface in empty space.**
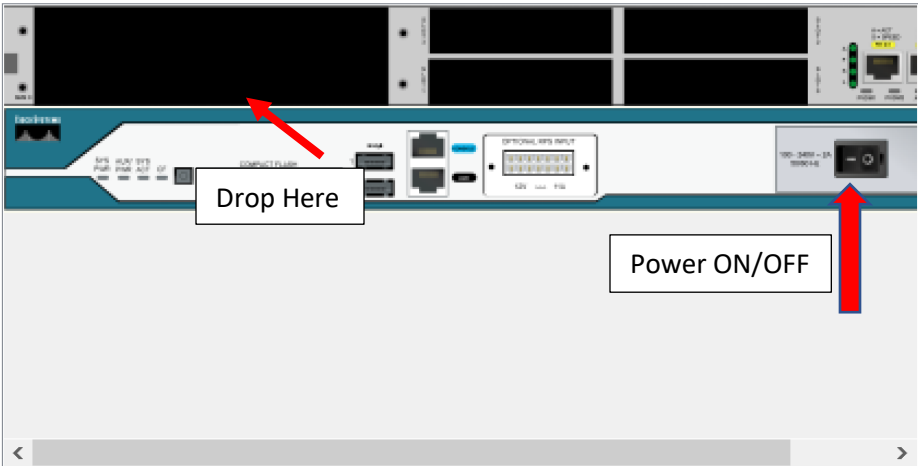5. **Power ON the Router, now you can configure 3 interfaces in Router**

Physical | Config | CLI | Attributes

Physical Device View

MODULES
NM-1E
NM-1E2W
NM-1FE-FX
NM-1FE-TX
NM-1FE2W
NM-2E2W
NM-2FE2W
NM-2W
NM-4A/S
NM-4E
NM-8A/S
NM-8AM
NM-Cover
NM-ESW-161
HWIC-1GE-SFP
HWIC-2T
HWIC-4ESW
HWIC-8A
HWIC-AP-AG-B
WIC-1AM

Zoom In | Original Size | Zoom Out

Drop Here

Power ON/OFF

Customize Icon in Physical View

Customize Icon in Logical View

The NM-2FE2W Module provides two Fast-Ethernet interfaces for use with copper media, in addition to two Wan Interface Card expansion slots. Ideal for a wide range of LAN applications, the Fast Ethernet network modules support many internetworking features and standards.

Additional Interfaces

Solution:

1. **Draw the Network and show the topology in Packet Tracer**
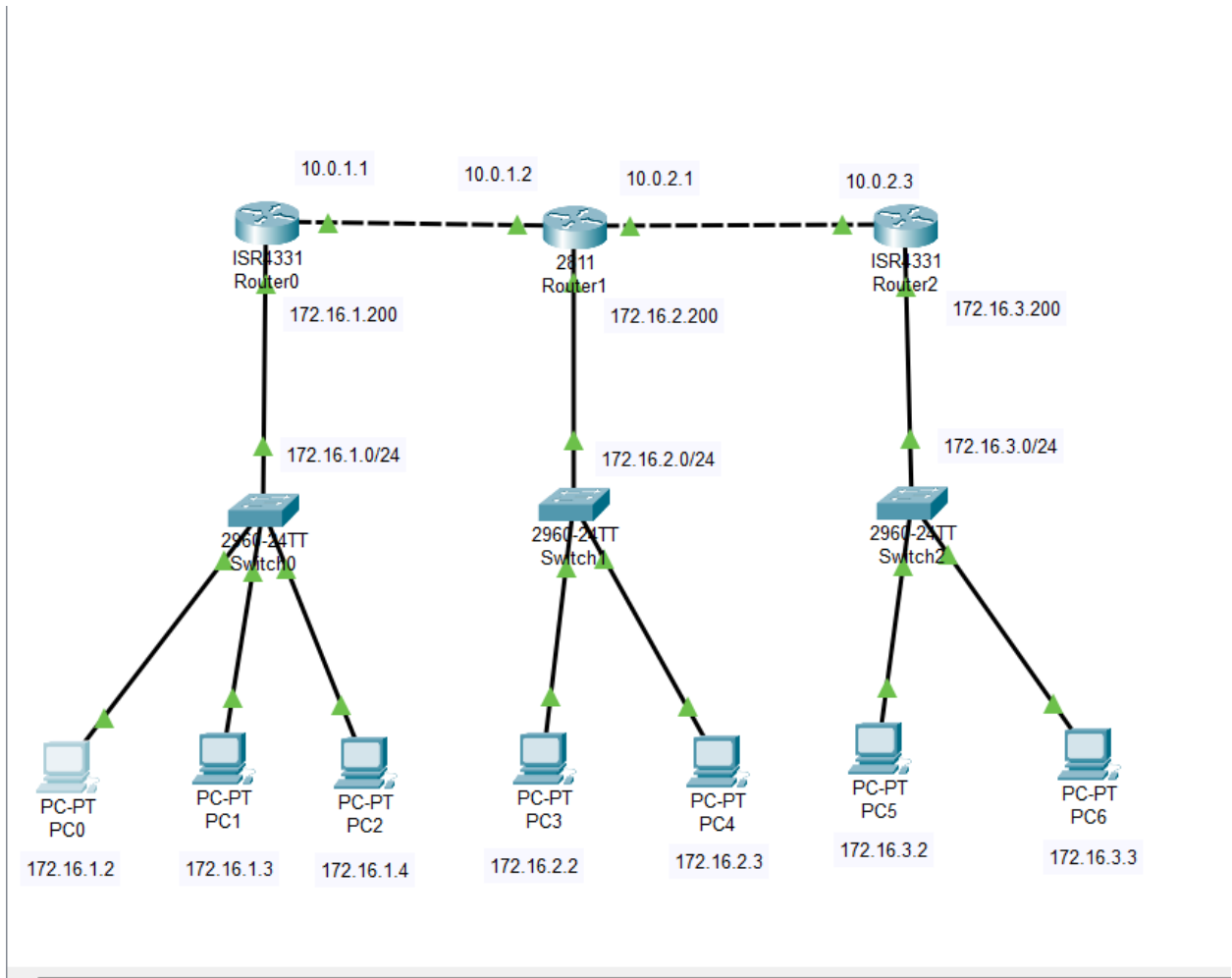
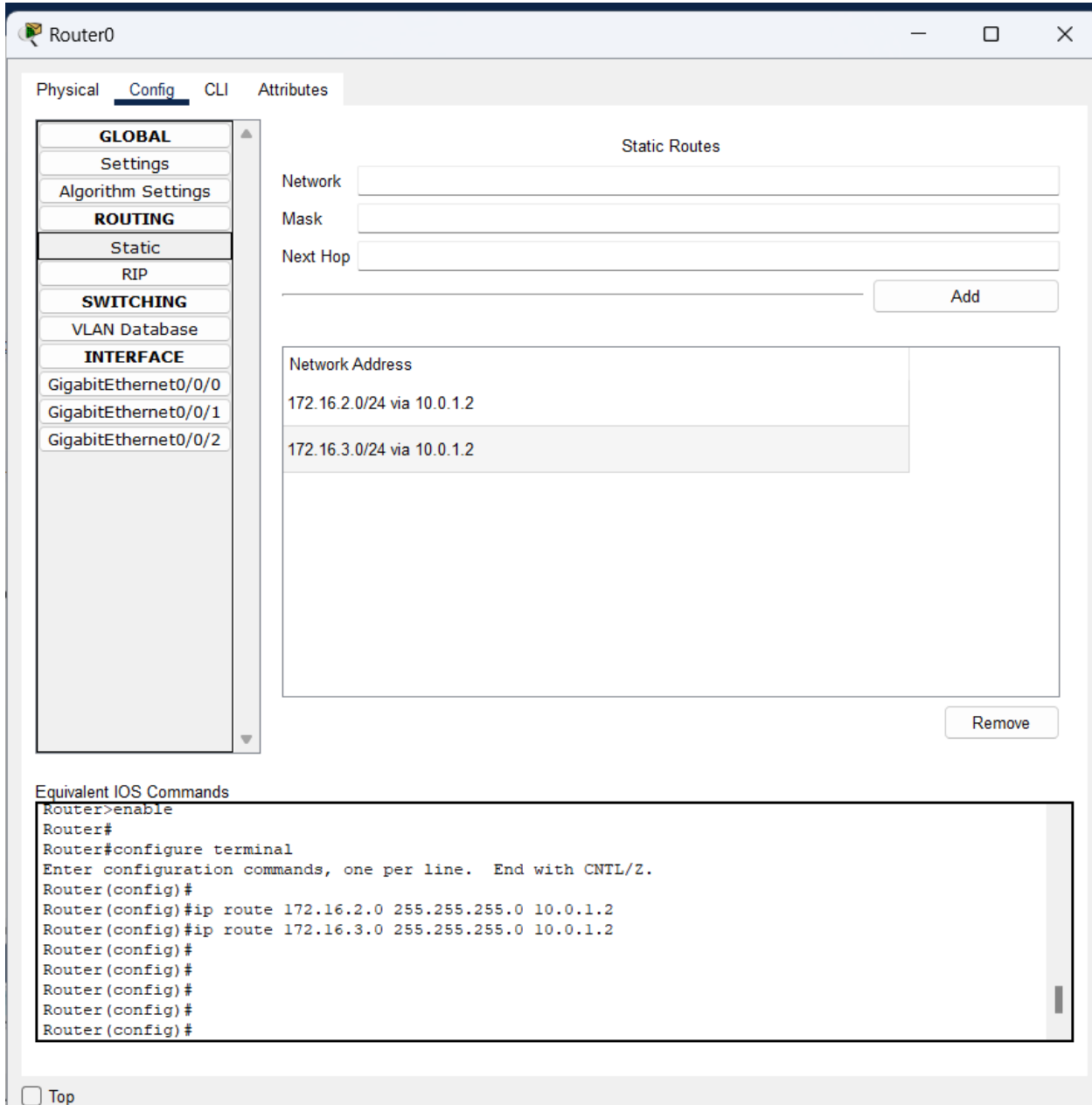## 2. Assign the IP's to all devices as per the network topology

"Attach the screenshot of one PC and all Router Interface Configuration"
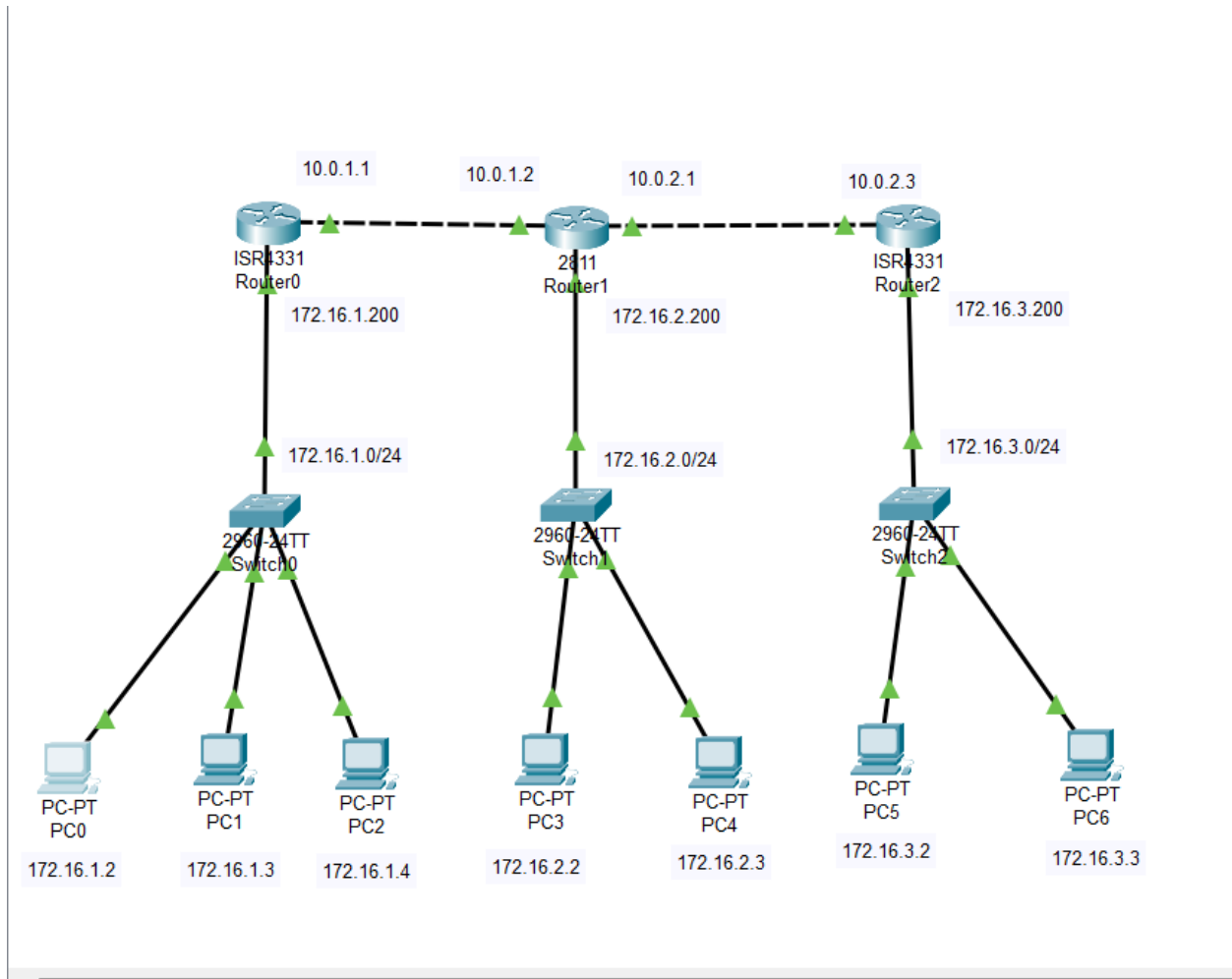
3. **Configure the Static route in each router**

"Attach the screenshot of all Router Interface Configuration"

4. **Ping 172.16.1.2 to 172.16.2.3 and 172.16.1.3 to 172.16.3.2**

   "Attach the screenshot of both successful ping results"

172.16.1.2 to 172.16.2.3:

```
C:\>ping 172.16.2.3

Pinging 172.16.2.3 with 32 bytes of data:

Reply from 172.16.2.3: bytes=32 time<1ms TTL=126
Reply from 172.16.2.3: bytes=32 time<1ms TTL=126
Reply from 172.16.2.3: bytes=32 time<1ms TTL=126
Reply from 172.16.2.3: bytes=32 time<1ms TTL=126

Ping statistics for 172.16.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

172.16.1.3 to 172.16.3.2 :

```
C:\>ping 172.16.3.2

Pinging 172.16.3.2 with 32 bytes of data:

Reply from 172.16.3.2: bytes=32 time<1ms TTL=125
Reply from 172.16.3.2: bytes=32 time<1ms TTL=125
Reply from 172.16.3.2: bytes=32 time<1ms TTL=125
Reply from 172.16.3.2: bytes=32 time<1ms TTL=125

Ping statistics for 172.16.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```
☐ Top

5. **Enter the following commands to configure the dynamic routing using OSPF routing commands**

Go to Router >>CLI Press ENTER
On R1,
R1(config)# router ospf 1
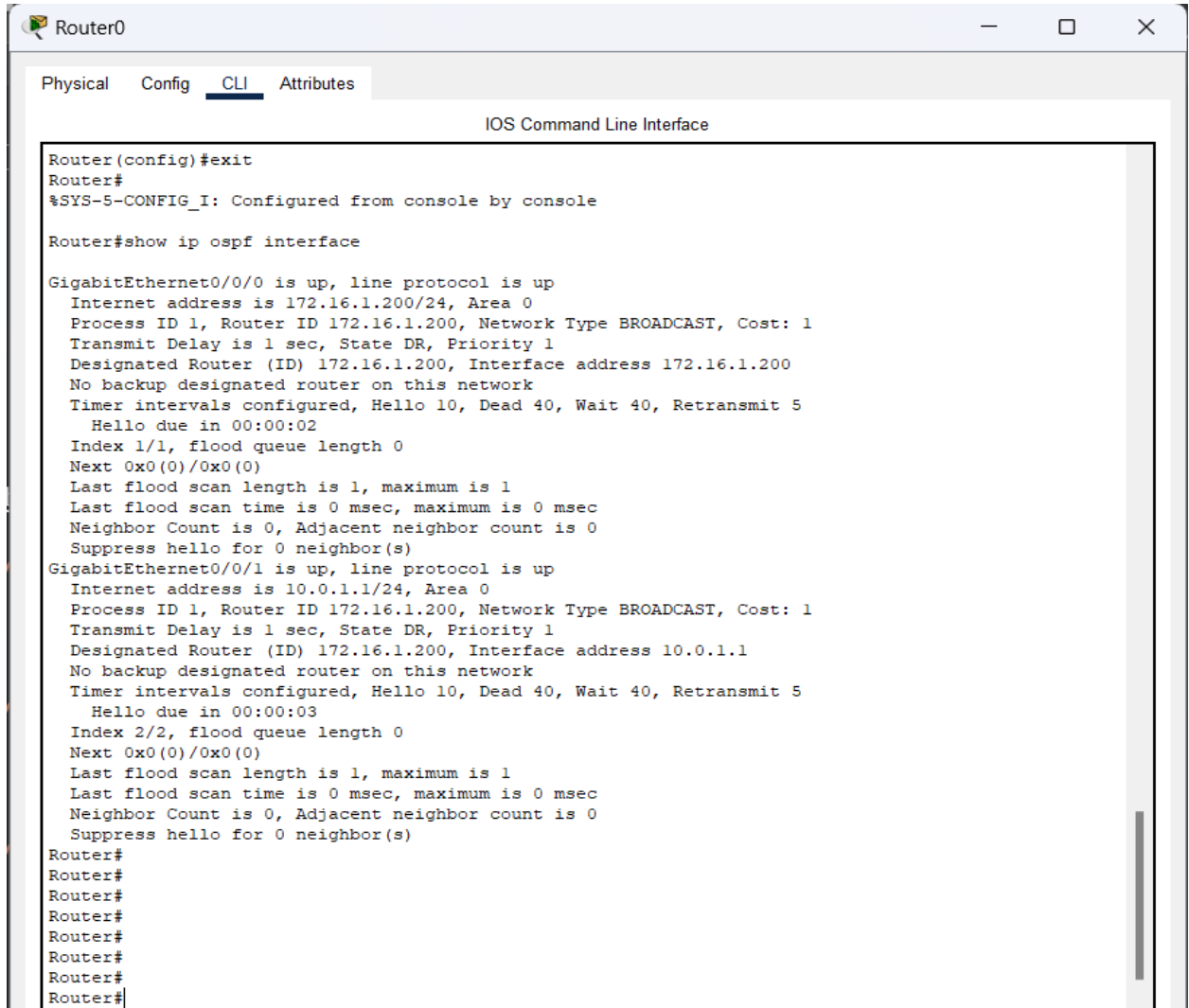R1(config-router)# network 172.16.1.0 0.0.0.255 area 0
R1(config-router)# network 10.0.1.0 0.255.255.255 area 0

"Attach the screenshot of Router Configuration"

Check the router configuration using following

R1# show ip ospf interface

"Attach the screenshot of Result"

Router0 — □ ✕

Physical   Config   CLI   Attributes

IOS Command Line Interface

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

Router#show ip ospf interface

GigabitEthernet0/0/0 is up, line protocol is up
  Internet address is 172.16.1.200/24, Area 0
  Process ID 1, Router ID 172.16.1.200, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 172.16.1.200, Interface address 172.16.1.200
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:02
  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)
GigabitEthernet0/0/1 is up, line protocol is up
  Internet address is 10.0.1.1/24, Area 0
  Process ID 1, Router ID 172.16.1.200, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 172.16.1.200, Interface address 10.0.1.1
  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 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 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
```

R1# show ip protocols

```
Router#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 172.16.1.200
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.1.0 0.0.0.255 area 0
    10.0.0.0 0.255.255.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    172.16.1.200         110      00:04:55
  Distance: (default is 110)

Router#
```

"Attach the screenshot of Result"

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R1# show ip route

"Attach the screenshot of Result"

```
Router#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

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.0.1.0/24 is directly connected, GigabitEthernet0/0/1
L       10.0.1.1/32 is directly connected, GigabitEthernet0/0/1
     172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
C       172.16.1.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.1.200/32 is directly connected, GigabitEthernet0/0/0
S       172.16.2.0/24 [1/0] via 10.0.1.2
S       172.16.3.0/24 [1/0] via 10.0.1.2

Router#
```

On R2,

R2(config)# router ospf 1
R2(config-router)# network 172.16.2.0 0.0.0.255 area 0
R2(config-router)# network 10.0.1.0 0.255.255.255 area 0
R2(config-router)# network 10.0.2.0 0.255.255.255 area 0

"Attach the screenshot of Router Configuration"

```
Router#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 172.16.2.200
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.2.0 0.0.0.255 area 0
    10.0.0.0 0.255.255.255 area 0
  Routing Information Sources:
    Gateway          Distance      Last Update
    172.16.1.200          110       00:05:20
    172.16.2.200          110       00:05:20
  Distance: (default is 110)

Router#
```

```
Router#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

     10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C       10.0.1.0/24 is directly connected, FastEthernet0/1
L       10.0.1.2/32 is directly connected, FastEthernet0/1
C       10.0.2.0/24 is directly connected, FastEthernet1/0
L       10.0.2.1/32 is directly connected, FastEthernet1/0
     172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
S       172.16.1.0/24 [1/0] via 10.0.1.1
C       172.16.2.0/24 is directly connected, FastEthernet0/0
L       172.16.2.200/32 is directly connected, FastEthernet0/0
S       172.16.3.0/24 [1/0] via 10.0.2.3

Router#
Router#show ip ospf interface

FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.2.200/24, Area 0
  Process ID 1, Router ID 172.16.2.200, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 172.16.2.200, Interface address 172.16.2.200
  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)
FastEthernet0/1 is up, line protocol is up
  Internet address is 10.0.1.2/24, Area 0
  Process ID 1, Router ID 172.16.2.200, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 172.16.1.200, Interface address 10.0.1.1
  Backup Designated Router (ID) 172.16.2.200, Interface address 10.0.1.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
 --More--
```

On R3,

R3(config)# router ospf 1
R3(config-router)# network 172.16.3.0 0.0.0.255 area 0
R3(config-router)# network 10.0.2.0 0.255.255.255 area 0

"Attach the screenshot of Router Configuration"

```
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#router ospf 1
Router(config-router)#network 172.16.3.0 0.0.0.255 area 0
Router(config-router)#network 10.0.2.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
01:03:18: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.2.200 on GigabitEthernet0/0/1 from LOADING to FULL,
Loading Done

Router#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

      10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O        10.0.1.0/24 [110/2] via 10.0.2.1, 00:00:06, GigabitEthernet0/0/1
C        10.0.2.0/24 is directly connected, GigabitEthernet0/0/1
L        10.0.2.3/32 is directly connected, GigabitEthernet0/0/1
      172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
S        172.16.1.0/24 [1/0] via 10.0.2.1
S        172.16.2.0/24 [1/0] via 10.0.2.1
C        172.16.3.0/24 is directly connected, GigabitEthernet0/0/0
L        172.16.3.200/32 is directly connected, GigabitEthernet0/0/0

Router#
```

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```
Router#show ip ospf interface

GigabitEthernet0/0/0 is up, line protocol is up
  Internet address is 172.16.3.200/24, Area 0
  Process ID 1, Router ID 172.16.3.200, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 172.16.3.200, Interface address 172.16.3.200
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:02
  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)
GigabitEthernet0/0/1 is up, line protocol is up
  Internet address is 10.0.2.3/24, Area 0
  Process ID 1, Router ID 172.16.3.200, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 172.16.2.200, Interface address 10.0.2.1
  Backup Designated Router (ID) 172.16.3.200, Interface address 10.0.2.3
  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 172.16.2.200  (Designated Router)
  Suppress hello for 0 neighbor(s)
Router#
Router#
```

```
Router#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 172.16.3.200
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.3.0 0.0.0.255 area 0
    10.0.0.0 0.255.255.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    172.16.1.200        110        00:14:27
    172.16.2.200        110        00:03:06
    172.16.3.200        110        00:03:06
  Distance: (default is 110)

Router#
```

6. **Establish the connectivity by sending ping packets from one Network to another**

"Attach the screenshot of your findings"

```
C:\>ping 172.16.3.2

Pinging 172.16.3.2 with 32 bytes of data:

Reply from 172.16.3.2: bytes=32 time<1ms TTL=125
Reply from 172.16.3.2: bytes=32 time<1ms TTL=125
Reply from 172.16.3.2: bytes=32 time<1ms TTL=125
Reply from 172.16.3.2: bytes=32 time<1ms TTL=125

Ping statistics for 172.16.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.2.2

Pinging 172.16.2.2 with 32 bytes of data:

Reply from 172.16.2.2: bytes=32 time<1ms TTL=126
Reply from 172.16.2.2: bytes=32 time<1ms TTL=126
Reply from 172.16.2.2: bytes=32 time<1ms TTL=126
Reply from 172.16.2.2: bytes=32 time<1ms TTL=126

Ping statistics for 172.16.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.1.4

Pinging 172.16.1.4 with 32 bytes of data:

Reply from 172.16.1.4: bytes=32 time=1ms TTL=128
Reply from 172.16.1.4: bytes=32 time<1ms TTL=128
Reply from 172.16.1.4: bytes=32 time<1ms TTL=128
Reply from 172.16.1.4: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.1.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```