

DATE : 27-NOVEMBER-2024

LAB- 7

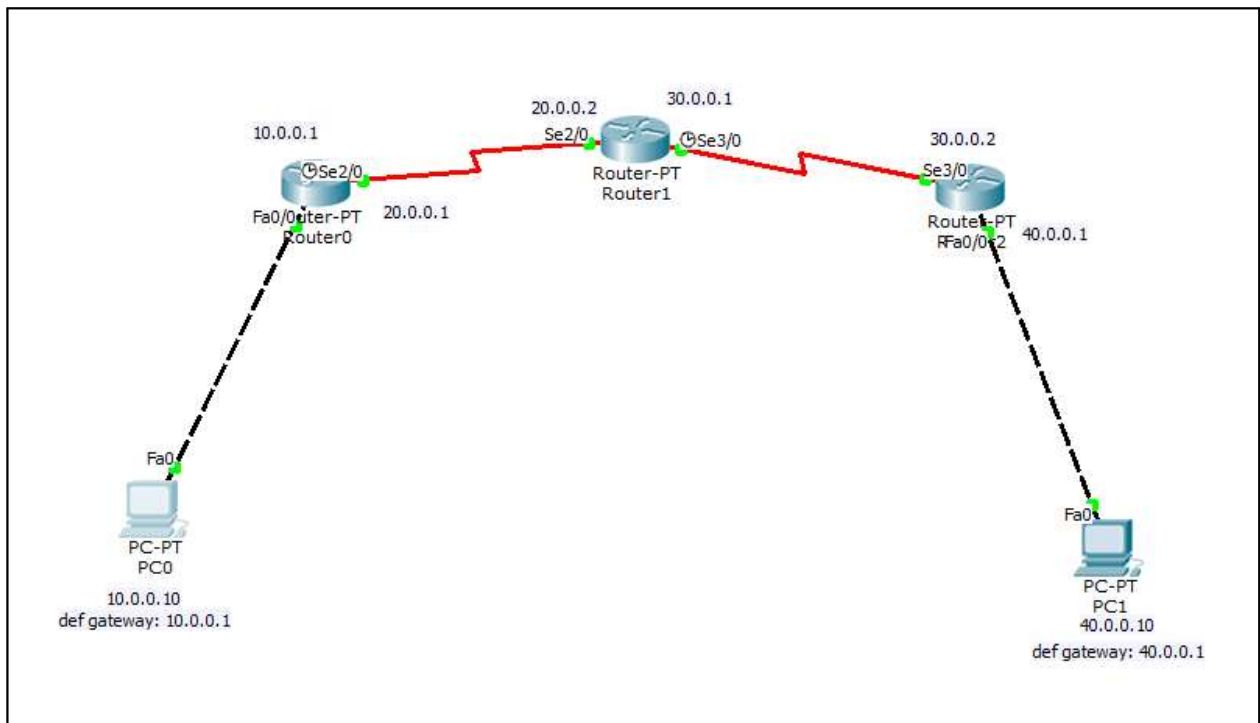
Question:

Configure OSPF routing protocol

Aim:

To Configure OSPF routing protocol

Topology:



Topology Description:

The topology consists of three routers (R1, R2, R3), two PCs (PC0 and PC1), and connections established as follows:

Devices and Configuration

1. R1 (Router 1):
 - Connected to PC0 via FastEthernet 0/0.
 - Connected to R2 via Serial 1/0.
 - Belongs to Area 3 for its connection with PC0 and Area 1 for its connection with R2.
 2. R2 (Router 2):
 - Connected to R1 via Serial 1/0.
 - Connected to R3 via Serial 1/1.
 - Acts as a bridge between Area 1 and Area 0.
 - Plays a crucial role in forming the OSPF backbone (Area 0).
 3. R3 (Router 3):
 - Connected to PC1 via FastEthernet 0/0.
 - Connected to R2 via Serial 1/0.
 - Belongs to Area 0 for its connection with R2 and Area 2 for its connection with PC1.
 4. PC0 (Host 1):
 - IP Address: 10.0.0.10/24
 - Default Gateway: 10.0.0.1
 - Connected to R1 via FastEthernet.
 5. PC1 (Host 2):
 - IP Address: 40.0.0.10/24
 - Default Gateway: 40.0.0.1
 - Connected to R3 via FastEthernet.
-

Area Assignments

- Area 0 (Backbone Area):
 - Connects R2 and R3.
 - All OSPF areas must connect to Area 0 for full connectivity.
- Area 1:
 - Connects R1 and R2.
- Area 3:
 - Connects R1 and PC0.
- Area 2:
 - Connects R3 and PC1

Router 0 (R1) Configuration:

IOS Command Line Interface

```

Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface fastethernet 0/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown

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

Router(config-if)#exit
Router(config)#interface serial 2/0
Router(config-if)#ip address 20.0.0.1 255.0.0.0
Router(config-if)#encapsulation ppp
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown

%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

```

Router 1 (R2) Configuration:

```

Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface serial 2/0
Router(config-if)#ip address 20.0.0.2 255.0.0.0
Router(config-if)#encasulation ppp
      ^
% Invalid input detected at '^' marker.

Router(config-if)#encapsulation ppp
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state
to up
exit
Router(config)#interface serial 3/0
Router(config-if)#ip address 30.0.0.1 255.0.0.0
Router(config-if)#encapsulation ppp
Router(config-if)#no shutdown

```

Router 2 (R3) Configuration:

IOS Command Line Interface

```

Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface fastethernet 0/0
Router(config-if)#ip address 40.0.0.1 255.0.0.0
Router(config-if)#no shutdown

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

Router(config-if)#exit
Router(config)#interface serial 3/0
Router(config-if)#ip address 30.0.0.2 255.0.0.0
Router(config-if)#encapsulation ppp
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface Serial3/0, changed state to up

```

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Step 2: Configure Loopback interfaces:

Router 0 (R1):

```

Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#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 add 172.16.1.252 255.255.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#

```

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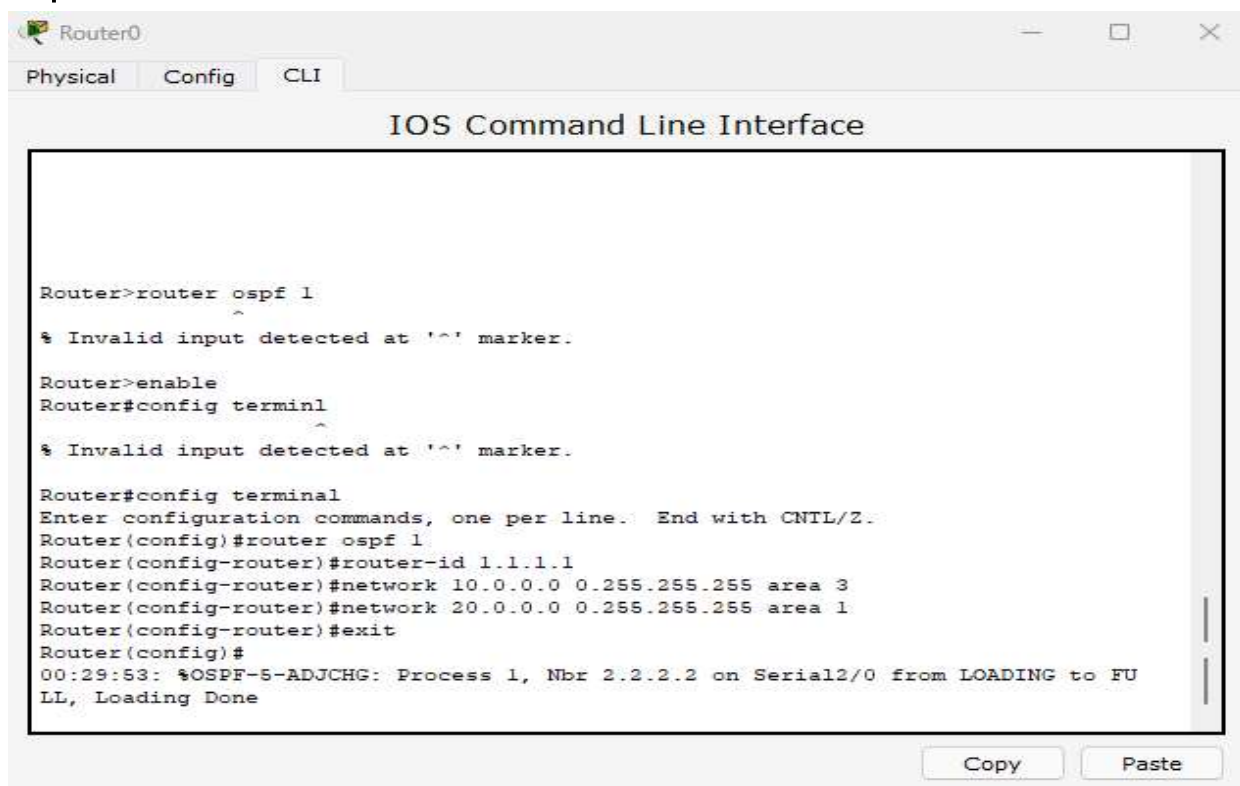
Router 1 (R2):

```
Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface loopback 0
Router(config-if)#ip add 172.16.1.253 255.255.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#
```

[Copy](#)[Paste](#)**Router 2 (R3):**

```
Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface loopback 0
Router(config-if)#ip add 172.16.1.254 255.255.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#
```

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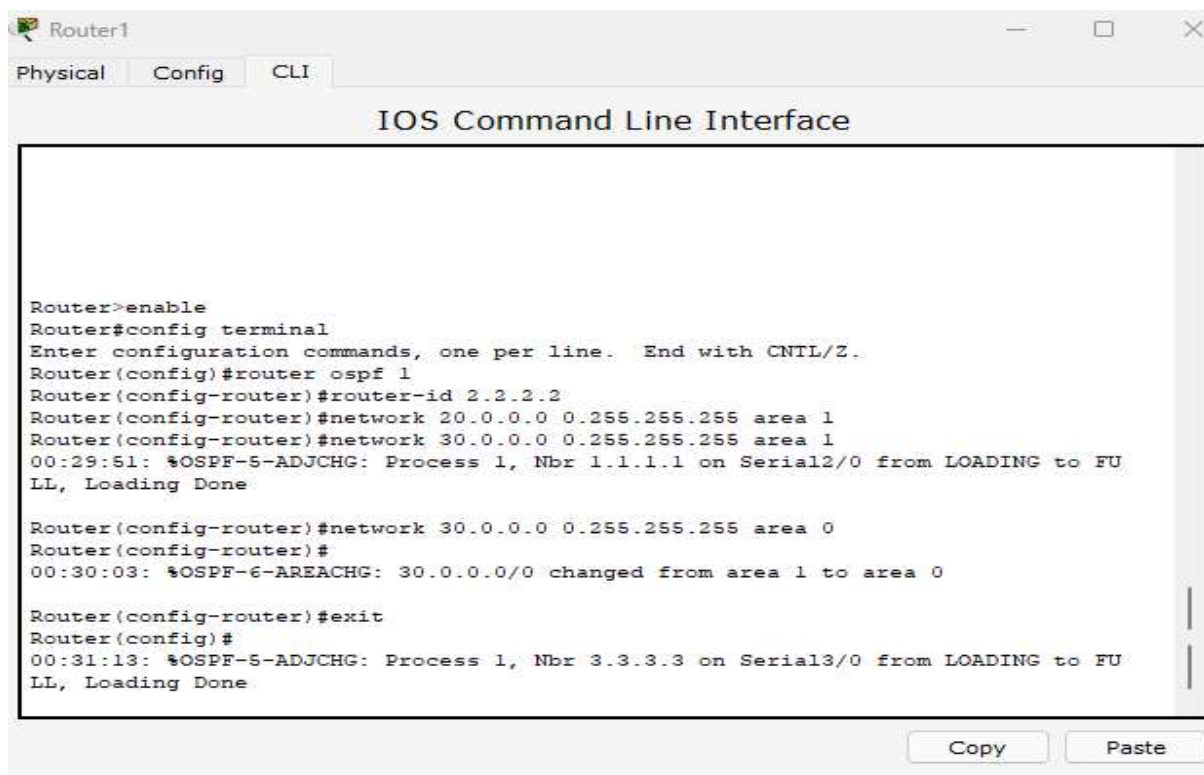
Step 2: Enable OSPF on the routers:

The screenshot shows the CLI of Router0. The user enters 'router ospf 1' but receives an error. They then enter 'enable' and 'config terminal', also receiving errors. Finally, they enter 'config terminal' correctly and proceed with the OSPF configuration: 'router ospf 1', 'router-id 1.1.1.1', 'network 10.0.0.0 0.255.255.255 area 3', and 'network 20.0.0.0 0.255.255.255 area 1'. The process ends with 'exit' and a confirmation message for the OSPF process on Serial2/0.

```
Router>router ospf 1
% Invalid input detected at '^' marker.

Router>enable
Router#config terminal
% Invalid input detected at '^' marker.

Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
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)#
00:29:53: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial2/0 from LOADING to FULL, Loading Done
```

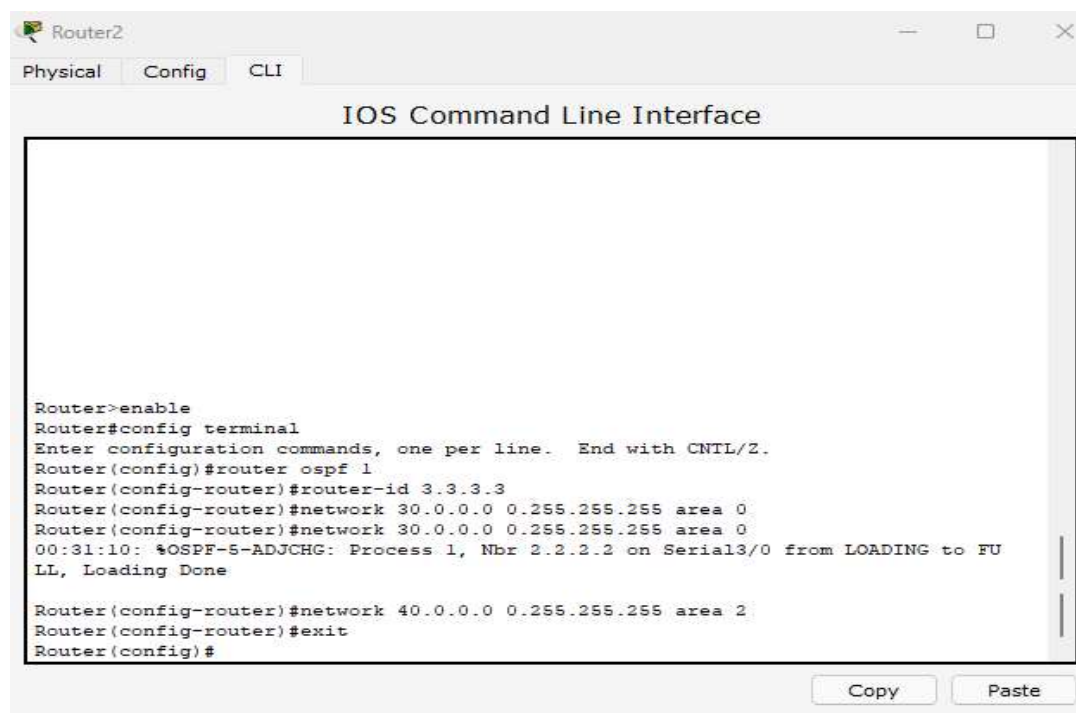


The screenshot shows the CLI of Router1. The user enters 'enable' and 'config terminal'. They then enter 'router ospf 1' and 'router-id 2.2.2.2'. They add 'network 20.0.0.0 0.255.255.255 area 1' and 'network 30.0.0.0 0.255.255.255 area 1'. A confirmation message shows the OSPF process for 1.1.1.1 on Serial2/0. They then add 'network 30.0.0.0 0.255.255.255 area 0'. A confirmation message shows the area change for 30.0.0.0/0 from area 1 to area 0. They exit the configuration with 'exit' and a confirmation message for the OSPF process on Serial3/0.

```
Router>enable
Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
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 30.0.0.0 0.255.255.255 area 1
00:29:51: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Serial2/0 from LOADING to FULL, Loading Done

Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#
00:30:03: %OSPF-6-AREACHG: 30.0.0.0/0 changed from area 1 to area 0

Router(config-router)#exit
Router(config)#
00:31:13: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3 on Serial3/0 from LOADING to FULL, Loading Done
```

Router2

Physical Config CLI

IOS Command Line Interface

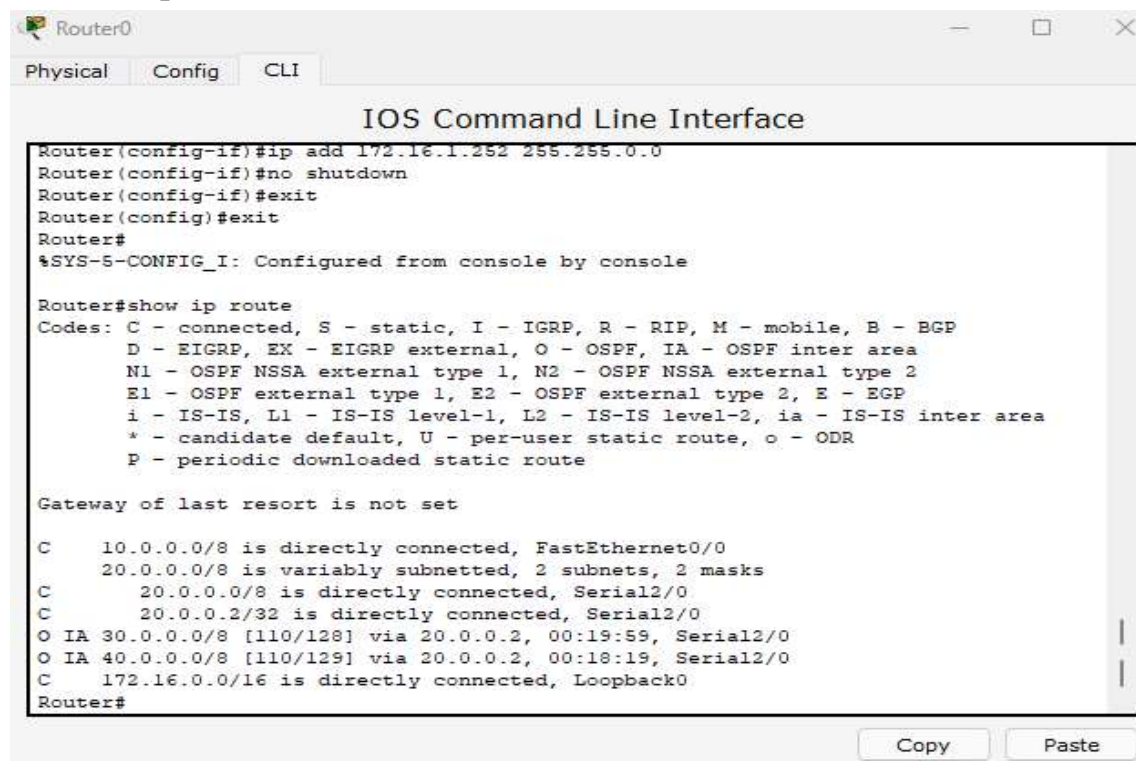
```

Router>enable
Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#router-id 3.3.3.3
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
00:31:10: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial3/0 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)#

```

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R1#show ip route:



Router0

Physical Config CLI

IOS Command Line Interface

```

Router(config-if)#ip add 172.16.1.252 255.255.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

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

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    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 IA 30.0.0.0/8 [110/128] via 20.0.0.2, 00:19:59, Serial2/0
O IA 40.0.0.0/8 [110/129] via 20.0.0.2, 00:18:19, Serial2/0
C    172.16.0.0/16 is directly connected, Loopback0
Router#

```

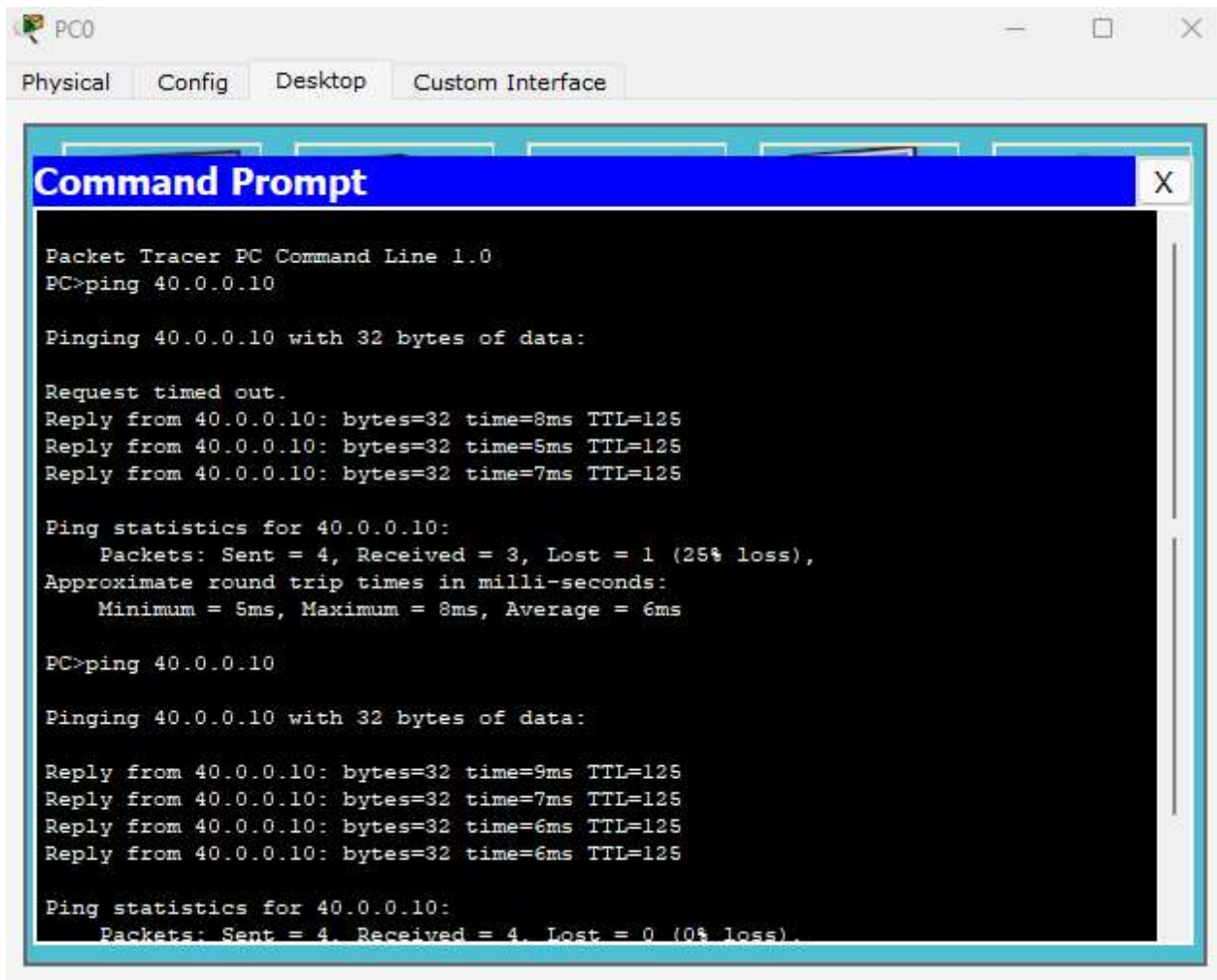
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Step 6: Test connectivity

1. Ping from PC0 to PC1:

Copy code

```
ping 40.0.0.10
```




```

PC0
Physical Config Desktop Custom Interface

Command Prompt
Pinging 40.0.0.10 with 32 bytes of data:

Request timed out.
Reply from 40.0.0.10: bytes=32 time=8ms TTL=125
Reply from 40.0.0.10: bytes=32 time=5ms TTL=125
Reply from 40.0.0.10: bytes=32 time=7ms 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 = 5ms, Maximum = 8ms, Average = 6ms

PC>ping 40.0.0.10

Pinging 40.0.0.10 with 32 bytes of data:

Reply from 40.0.0.10: bytes=32 time=9ms TTL=125
Reply from 40.0.0.10: bytes=32 time=7ms TTL=125
Reply from 40.0.0.10: bytes=32 time=6ms TTL=125
Reply from 40.0.0.10: bytes=32 time=6ms TTL=125

Ping statistics for 40.0.0.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 6ms, Maximum = 9ms, Average = 7ms

PC>

```

Observation:

The experiment demonstrates how OSPF dynamically learns and advertises routes, enabling efficient and scalable routing across multiple areas.

OSPF neighbors should establish adjacency.

Routing tables on all routers must display networks from all areas with **OIA** indicating inter-area routes.

Connectivity between PC0 (10.0.0.10) and PC1 (40.0.0.10) should be successful.