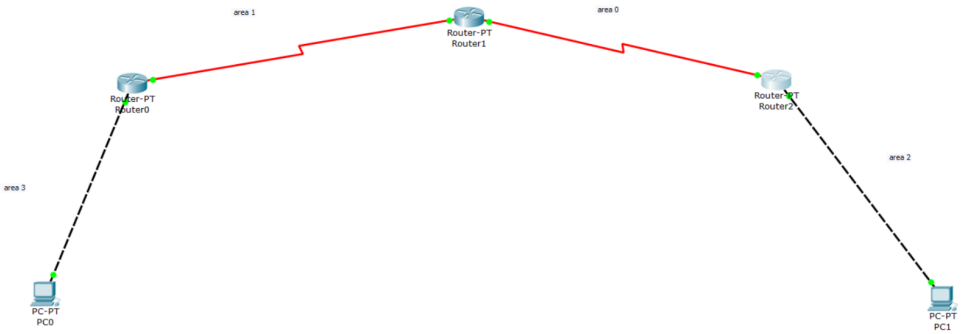
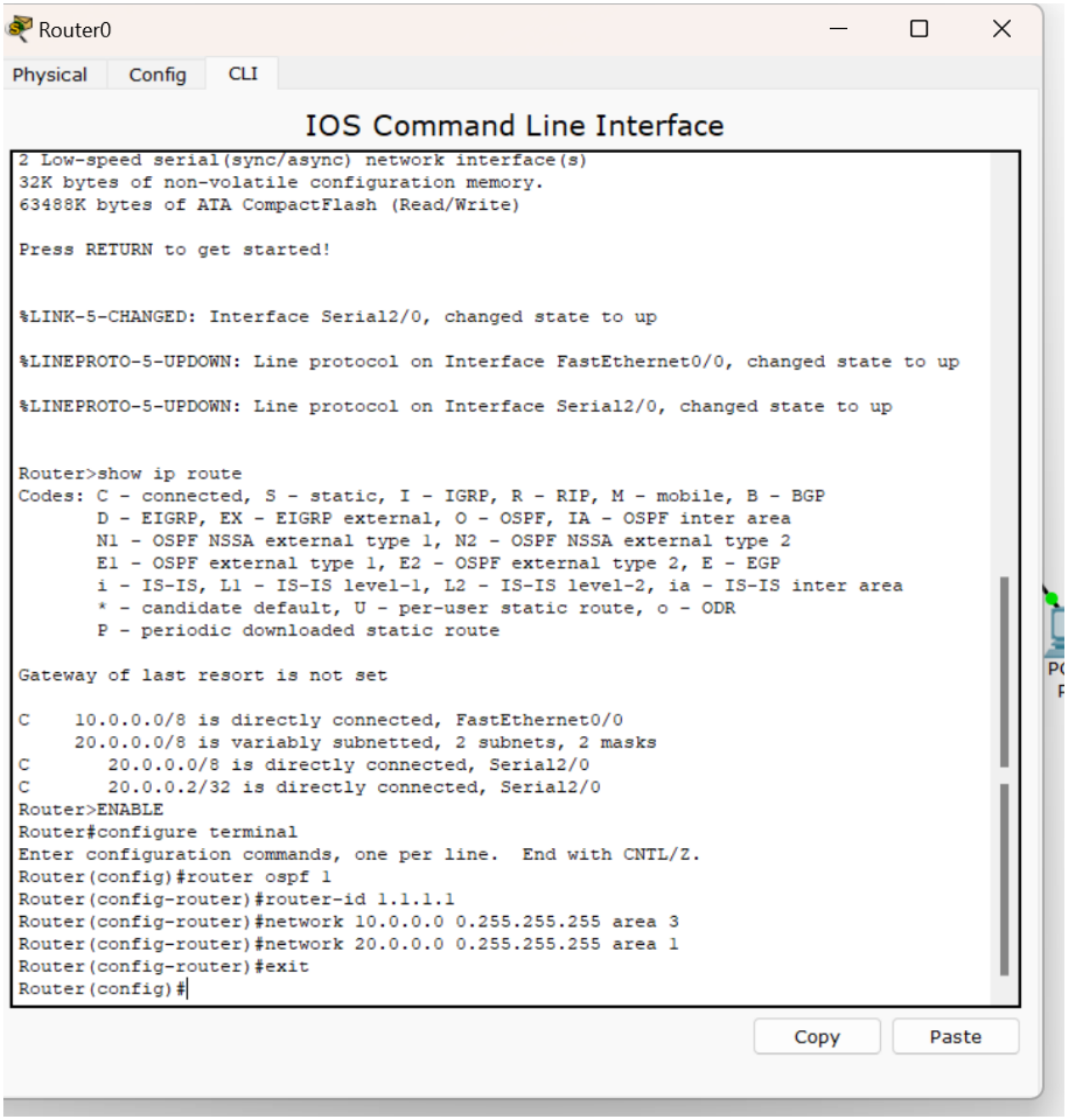
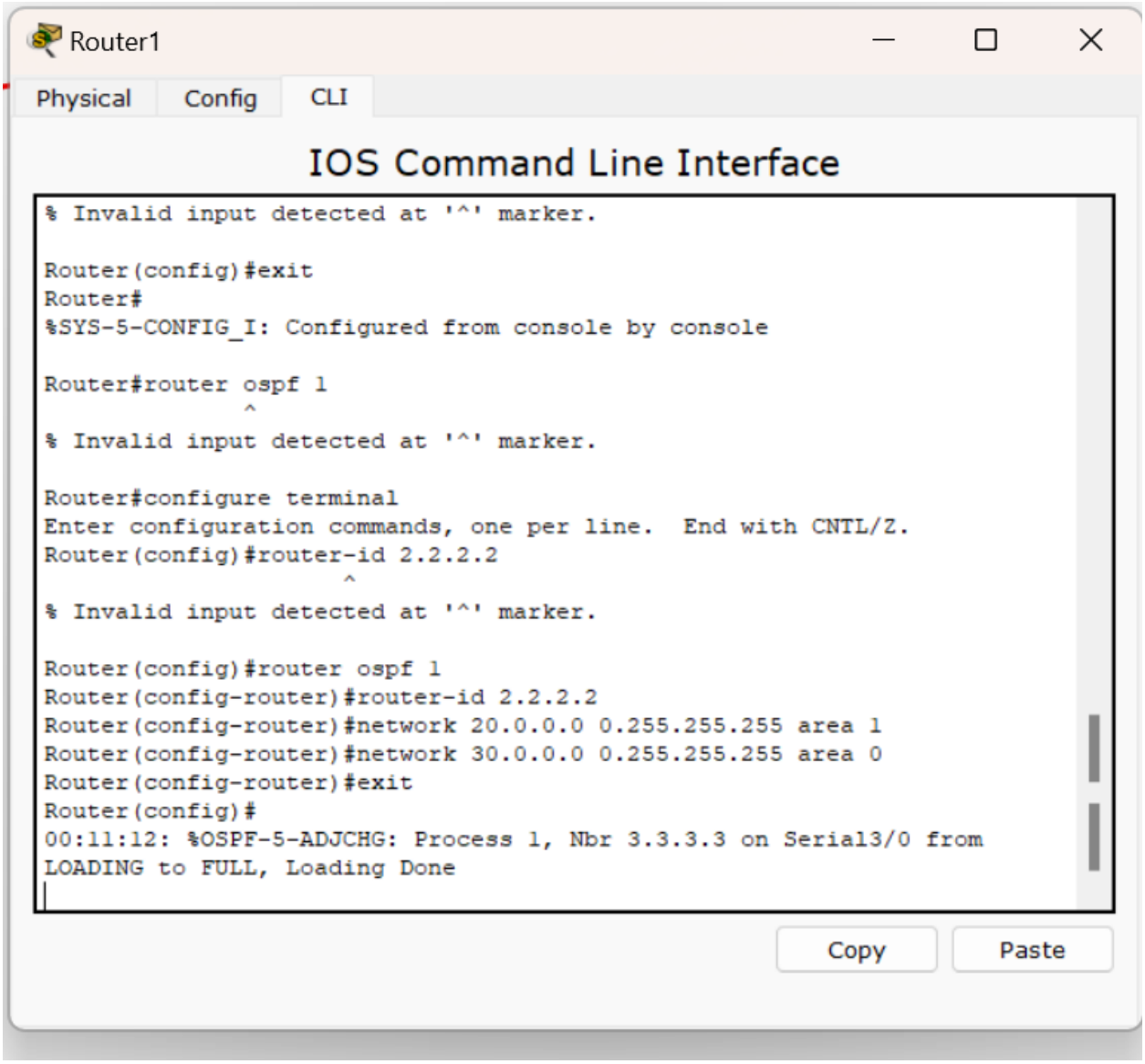
Topology:

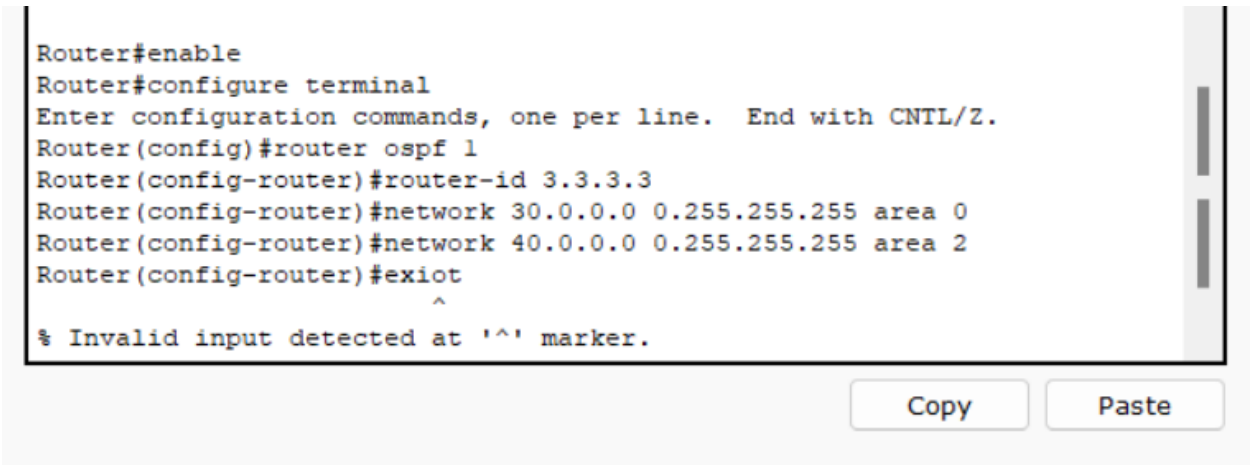

area 1
area 0
Router-PT
Router1
Router-PT
Router0
Router-PT
Router2
area 2
area 3
PC-PT
PC0
PC-PT
PC1

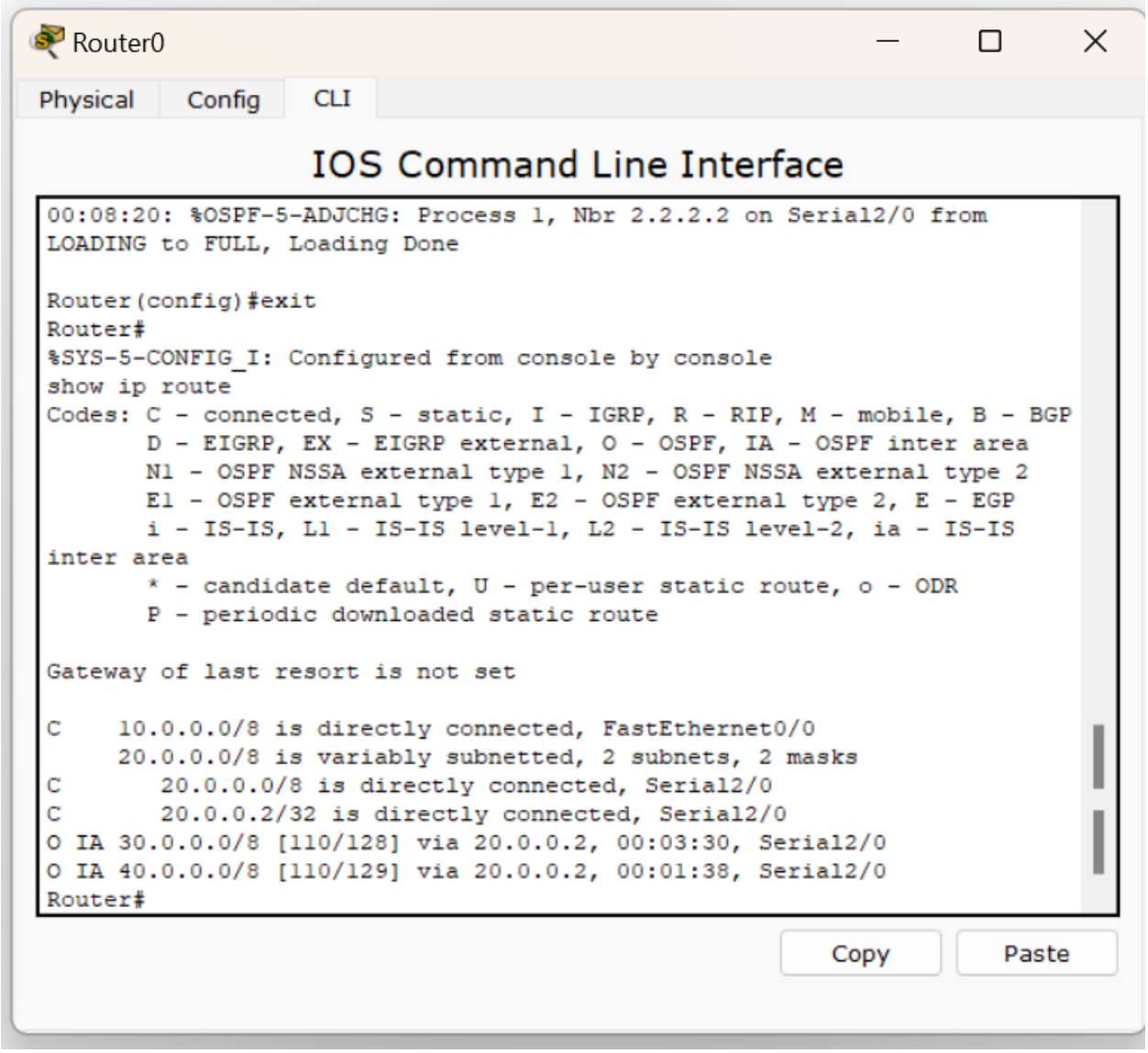

Router0
Physical
Config
CLI
IOS Command Line Interface
2 Low-speed serial(sync/async) network interface(s)
32K bytes of non-volatile configuration memory.
63488K bytes of ATA CompactFlash (Read/Write)
Press RETURN to get started!
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up
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
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
Router>ENABLE
Router#configure 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)#
Copy
Paste

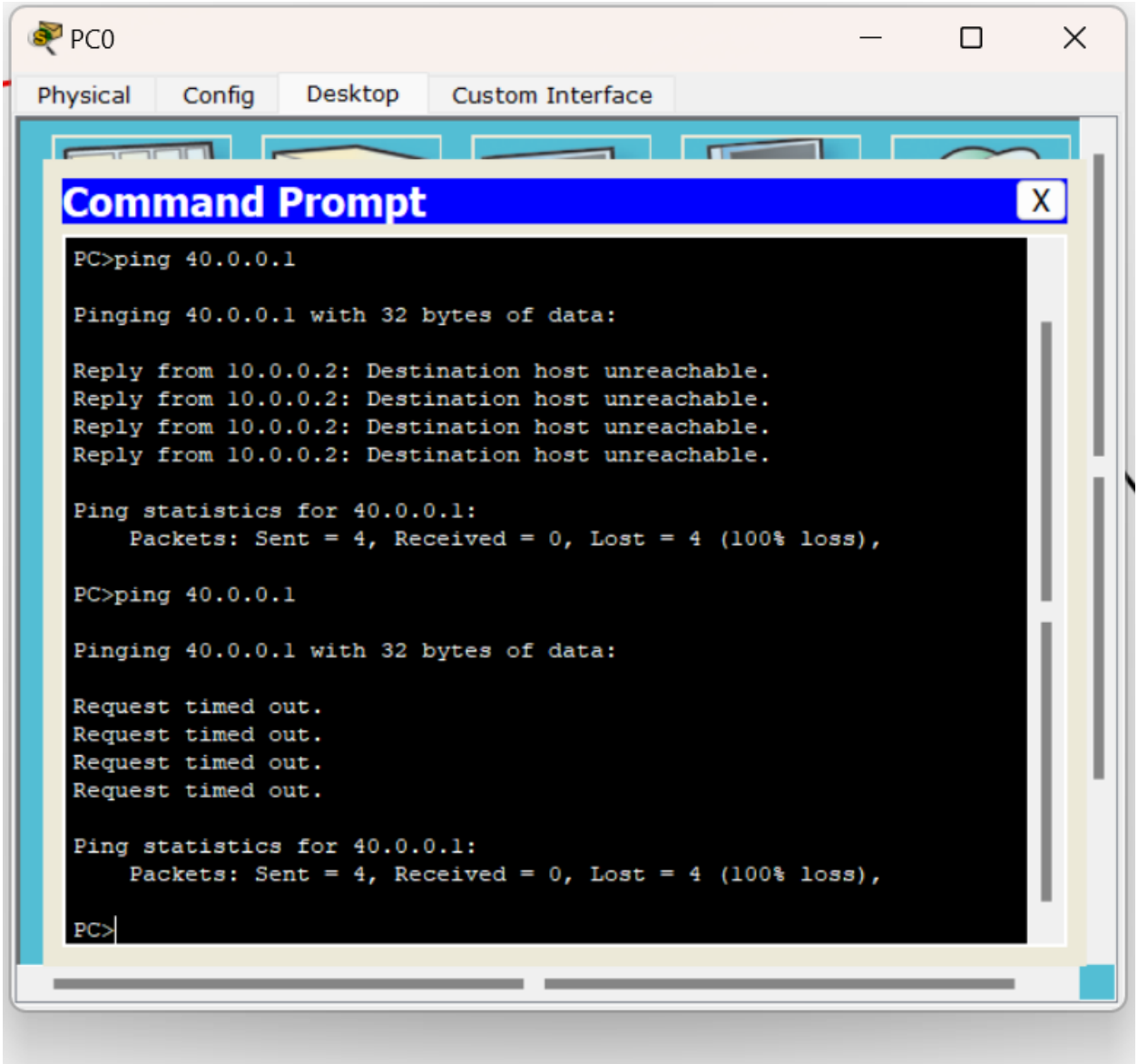
Router 1:


Router1
Physical
Config
CLI
IOS Command Line Interface
% Invalid input detected at '^' marker.
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
Router#router ospf 1
^
% Invalid input detected at '^' marker.
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router-id 2.2.2.2
^
% Invalid input detected at '^' marker.
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 0
Router(config-router)#exit
Router(config)#
00:11:12: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3 on Serial3/0 from
LOADING to FULL, Loading Done
Copy
Paste

Router 2:


Router#enable
Router#configure 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 40.0.0.0 0.255.255.255 area 2
Router(config-router)#exiot
^
% Invalid input detected at '^' marker.
Copy
Paste


Router0
Physical
Config
CLI
IOS Command Line Interface
00:08:20: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial2/0 from
LOADING to FULL, Loading Done
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
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 IA 30.0.0.0/8 [110/128] via 20.0.0.2, 00:03:30, Serial2/0
O IA 40.0.0.0/8 [110/129] via 20.0.0.2, 00:01:38, Serial2/0
Router#
Copy
Paste



Loopback

Router 0:

```
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 IA 30.0.0.0/8 [110/128] via 20.0.0.2, 00:03:30, Serial2/0
O IA 40.0.0.0/8 [110/129] via 20.0.0.2, 00:01:38, Serial2/0
Router#enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface loopback 0\
                                  ^
% Invalid input detected at '^' marker.

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)#
```

Router 1:

```
Router#enable
Router#configure 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 172.16.1.253 255.255.0.0
Router(config-if)#no shutdown
Router(config-if)#
```

Router 2:

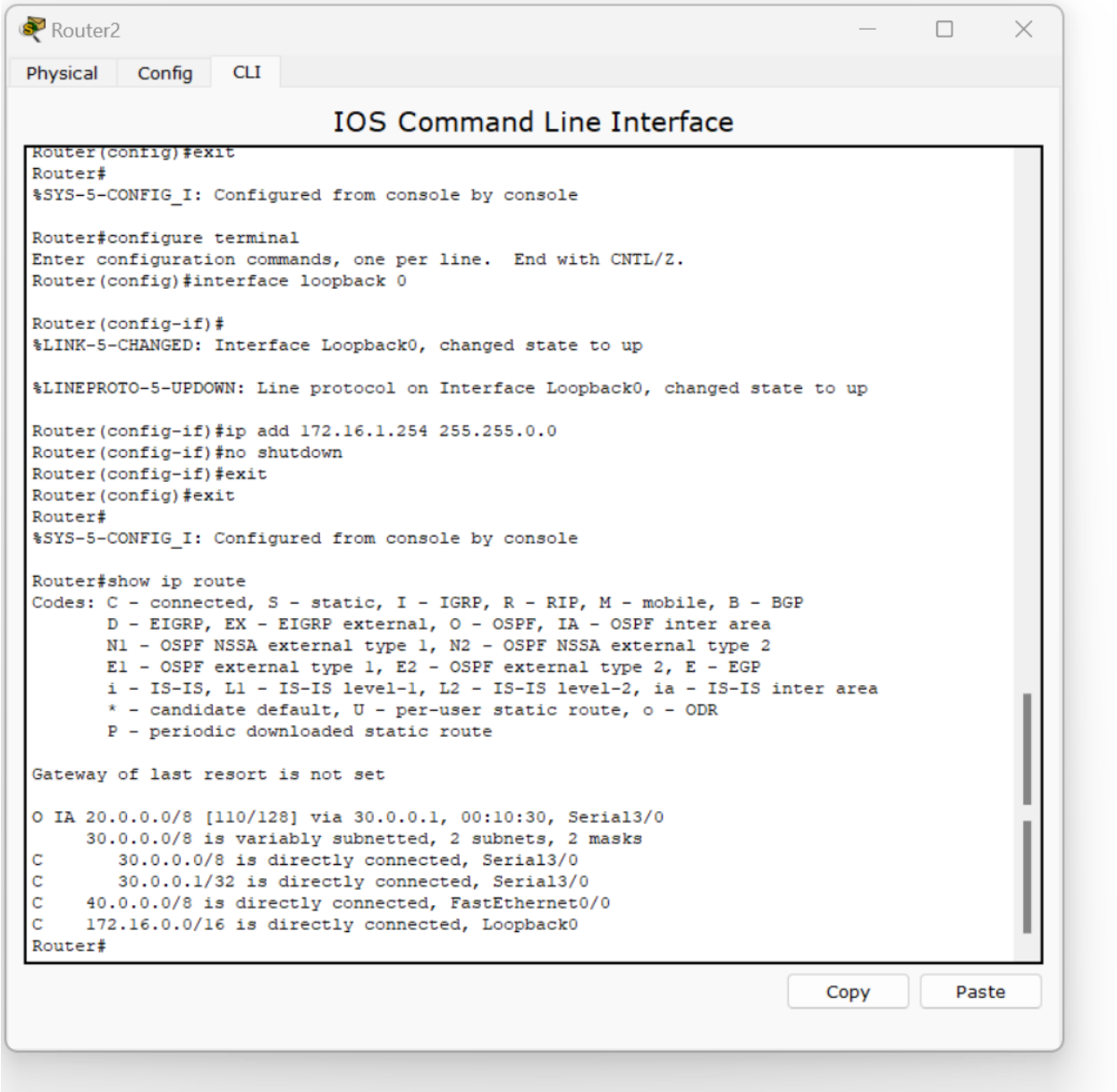
```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface loopback 0

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 172.16.1.254 255.255.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#exit
Router#
```

Show ip route after interface loopback for router 2



We notice that router 3 does not know about area 3(there is on 10.0.0.0 shown in the above fig)

Virtual link
Router 0:

```
%SYS-5-CONFIG_I: Configured from console by console

Router#enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#area 1 virtual-link 2.2.2.2
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

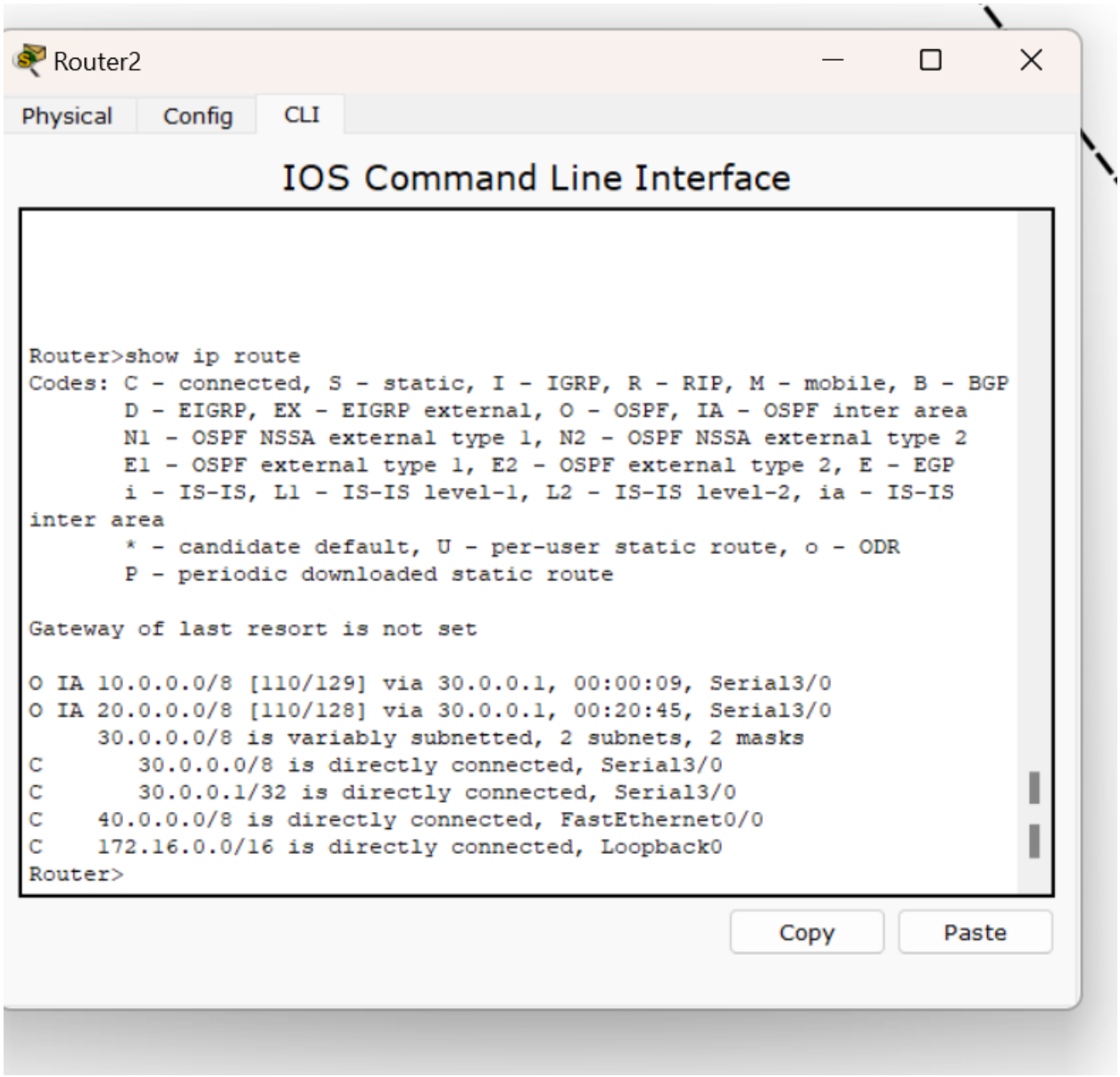
Router 1

```
from backbone area must be virtual-link but not found from 20.0.0.2,
Serial2/0

Router(config-router)#router ospf 1
Router(config-router)#area 1 virtual
00:31:23: %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

% Incomplete command.
Router(config-router)#area 1 virtual-link 1.1.1
00:31:33: %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
.1
Router(config-router)#area 1 virtual-link 1.1.1.1
Router(config-router)#exit
Router(config)#exi
00:31:48: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on OSPF_VL0 from
```

Show ip route command after configuring the virtual link so that router 2 knows that area 3



Now we see that the ping command works

```
PC>ping 40.0.0.1/
Ping request could not find host 40.0.0.1/. Please check the name and try again.
PC>ping 40.0.0.1

Pinging 40.0.0.1 with 32 bytes of data:

Reply from 40.0.0.1: bytes=32 time=2ms TTL=125
Reply from 40.0.0.1: bytes=32 time=2ms TTL=125
Reply from 40.0.0.1: bytes=32 time=4ms TTL=125
Reply from 40.0.0.1: bytes=32 time=4ms TTL=125

Ping statistics for 40.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 3ms

PC>
```