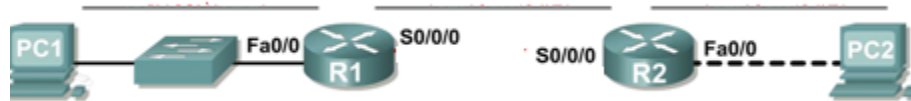


## Topology Diagram



## Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	192.168.1.65	255.255.255.192	N/A
	S0/0/0	192.168.1.129	255.255.255.192	N/A
R2	Fa0/0	192.168.1.193	255.255.255.192	N/A
	S0/0/0	192.168.1.190	255.255.255.192	N/A
PC1	NIC	192.168.1.126	255.255.255.192	192.168.1.65
PC2	NIC	192.168.1.254	255.255.255.192	192.168.1.193

## Learning Objectives

Upon completion of this lab, you will be able to:

- Subnet an address space given requirements.
- Assign appropriate addresses to interfaces and document.
- Configure and activate Serial and FastEthernet interfaces.
- Test and verify configurations.
- Reflect upon and document the network implementation.

## Scenario

In this lab activity, you will design and apply an IP addressing scheme for the topology shown in the Topology Diagram. You will be given one address block that you must subnet to provide a logical addressing scheme for the network. The routers will then be ready for interface address configuration according to your IP addressing scheme. When the configuration is complete, verify that the network is working properly.

## Task 1: Subnet the Address Space.

### Step 1: Examine the network requirements.

You have been given the 192.168.1.0/24 address space to use in your network design. The network consists of the following segments:

- The network connected to router R1 will require enough IP addresses to support 15 hosts.
- The network connected to router R2 will require enough IP addresses to support 30 hosts.

- The link between router R1 and router R2 will require IP addresses at each end of the link.

**Step 2: Consider the following questions when creating your network design.**

1. How many subnets are needed for this network?

We will have **3 subnets** in this network –

- The network connected to router R1.
- The network connected to router R2.
- The link between router R1 and router R2.

2. What is the subnet mask for this network in dotted decimal format?

Since our requirement is of 3 subnets, the subnet mask bits will be calculated as,

$$2^n \geq 3$$

$$\Rightarrow n = 2$$

Thus, we use 2 bits from the last 8 bits of the IP address as the subnet mask.

In binary format, it is represented as -

11111111. 11111111. 11111111.11000000

Converting this to dotted decimal format – **255.255.255.192**

3. What is the subnet mask for the network in slash format?

**/26**

4. How many usable hosts are there per subnet?

Number of usable hosts =  $2^{32-n} - 2$  where n = subnet mask

$$\Rightarrow \text{Number of usable hosts in each subnet} = 2^6 - 2 = \mathbf{62 \text{ hosts.}}$$

**Step 3: Assign sub-network addresses to the Topology Diagram.**

1. Assign subnet 1 to the network attached to R1.
2. Assign subnet 2 to the link between R1 and R2.
3. Assign subnet 3 to the network attached to R2.

Subnet 0 – 192.168.1.0 – 192.168.1.63

Subnet 1 – 192.168.1.64 – 192.168.1.127

Subnet 2 – 192.168.1.128 – 192.168.1.191

Subnet 3 – 192.168.1.192 – 192.168.1.255

**Task 2: Determine Interface Addresses.**

**Step 1: Assign appropriate addresses to the device interfaces.**

1. Assign the first valid host address in subnet 1 to the LAN interface on R1.

**192.168.1.65**

2. Assign the last valid host address in subnet 1 to PC1.

**192.168.1.126**

3. Assign the first valid host address in subnet 2 to the WAN interface on R1.

**192.168.1.129**

4. Assign the last valid host address in subnet 2 to the WAN interface on R2.

**192.168.1.190**

5. Assign the first valid host address in subnet 3 to the LAN interface of R2.

**192.168.1.193**

6. Assign the last valid host address in subnet 3 to PC2.

**192.168.1.254**

**Step 2: Document the addresses to be used in the table provide under the Topology Diagram.**

**Task 3: Configure the Serial and FastEthernet Addresses.**

**Step 1: Configure the router interfaces.**

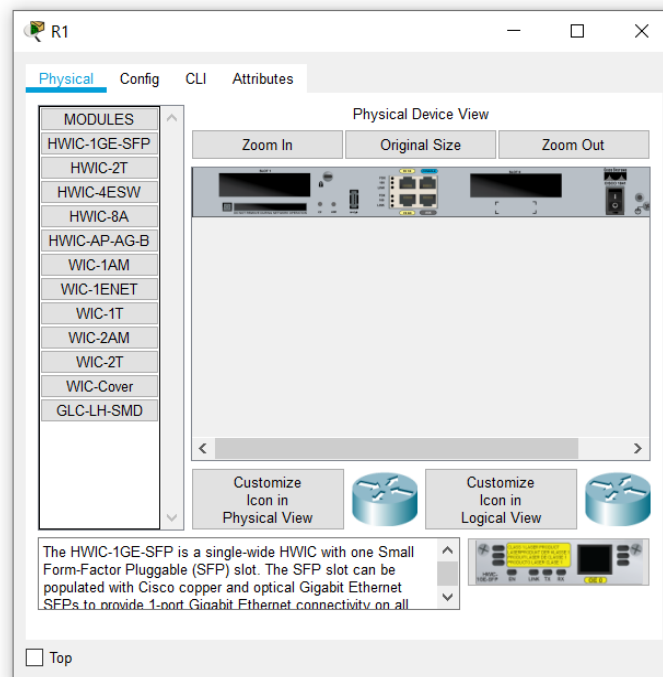
Configure the interfaces on the R1 and R2 routers with the IP addresses from your network design. Please note, to complete the activity in Packet Tracer you will be using the Config Tab. When you have finished, be sure to save the running configuration to the NVRAM of the router.



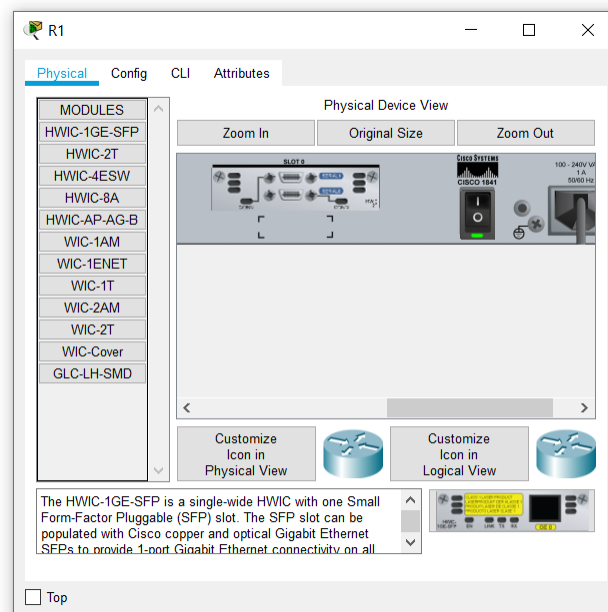
Fig 1. Network devices

## Adding Serial Ports to Routers

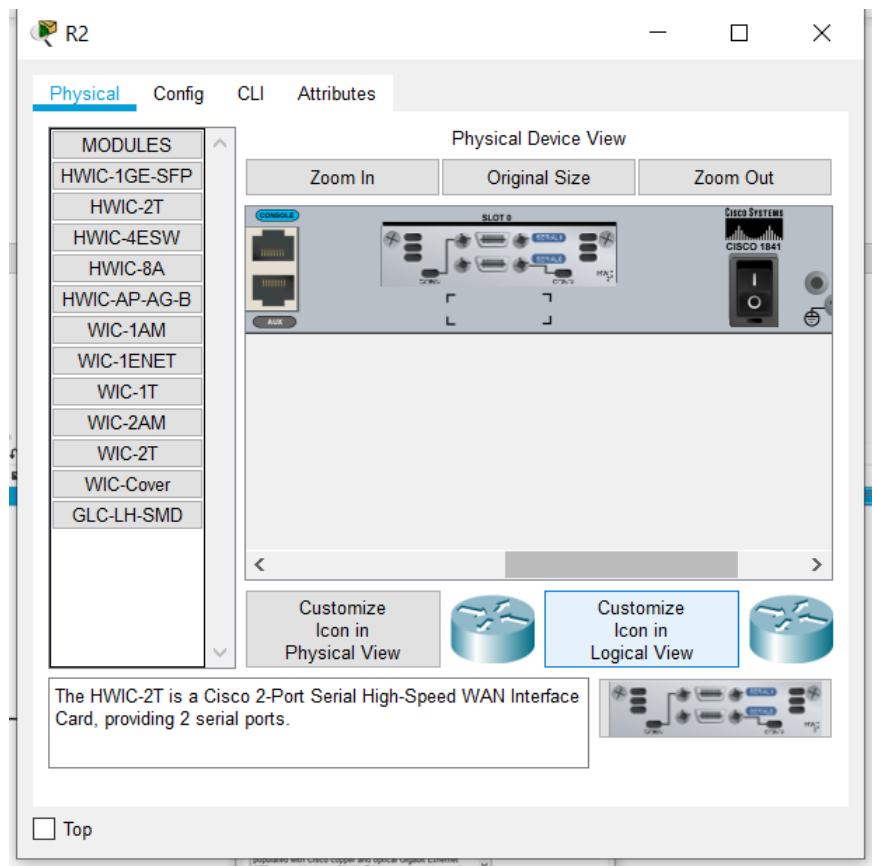
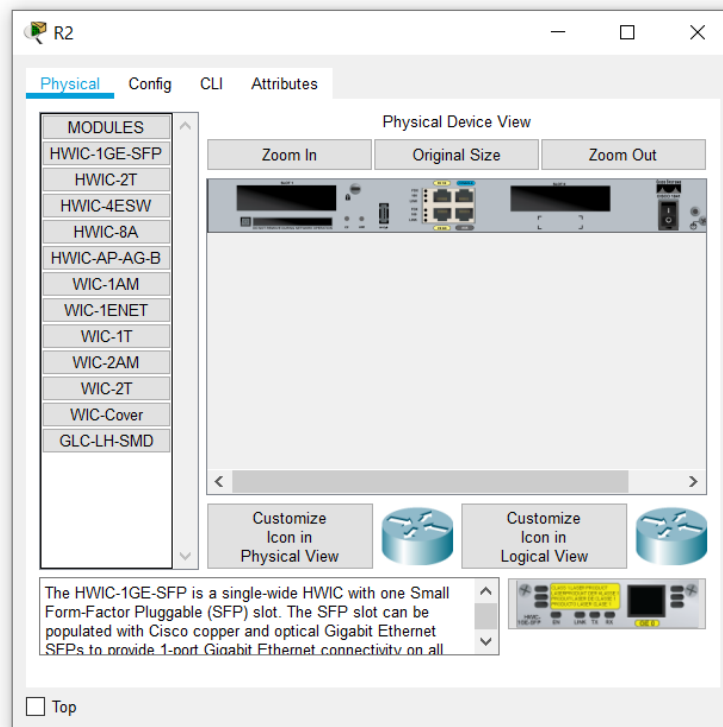
- a. Turn Router off in Physical Tab



- b. Click on HWIC-2T tab and drag Cisco HWIC-2T 2-Port Serial WAN Interface Card to router then turn router on



Similarly, 2 serial ports are added to R2



Now, we can connect R1 and R2 using DTE



## Router Configuration

Interface Fa0/0 of R1

The screenshot shows the configuration window for R1, specifically the 'Config' tab. The left sidebar lists various configuration categories: GLOBAL, Settings, Algorithm Settings, ROUTING, Static, RIP, SWITCHING, VLAN Database, and INTERFACE. Under the INTERFACE category, 'FastEthernet0/0' is selected. The main configuration area for 'FastEthernet0/0' includes the following settings:

- Port Status: ☒ On
- Bandwidth: ☒ 100 Mbps ☐ 10 Mbps ☒ Auto
- Duplex: ☒ Half Duplex ☐ Full Duplex ☒ Auto
- MAC Address: 00E0.A368.7E01
- IP Configuration:
  - IP Address: 192.168.1.65
  - Subnet Mask: 255.255.255.192
- Tx Ring Limit: 10

Below the configuration area, there is a section for 'Equivalent IOS Commands' which displays the following commands and status messages:

```
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
```

At the bottom left of the window, there is a 'Top' button.

## Interface S0/0/0 of R1

The screenshot shows the configuration window for R1, specifically for the Serial0/1/0 interface. The left sidebar has a tree view with categories: GLOBAL, ROUTING, SWITCHING, and INTERFACE. Under INTERFACE, Serial0/1/0 is selected. The main area shows the configuration for Serial0/1/0 with the following settings:

- Port Status: ☒ On
- Duplex: ☐ Full Duplex
- Clock Rate: 2000000
- IP Configuration:
  - IP Address: 192.168.1.129
  - Subnet Mask: 255.255.255.192
- Tx Ring Limit: 10

Equivalent IOS Commands:

```
Router(config-if)#exit
Router(config)#interface Serial0/1/0
Router(config-if)#ip address 192.168.1.129 255.255.255.192
Router(config-if)#ip address 192.168.1.129 255.255.255.192
Router(config-if)#no shutdown
Router(config-if)#
```

☐ Top

## Interface Fa0/0 of R2

The screenshot shows the configuration window for R2, specifically for the FastEthernet0/0 interface. The left sidebar has a tree view with categories: GLOBAL, ROUTING, SWITCHING, and INTERFACE. Under INTERFACE, FastEthernet0/0 is selected. The main area shows the configuration for FastEthernet0/0 with the following settings:

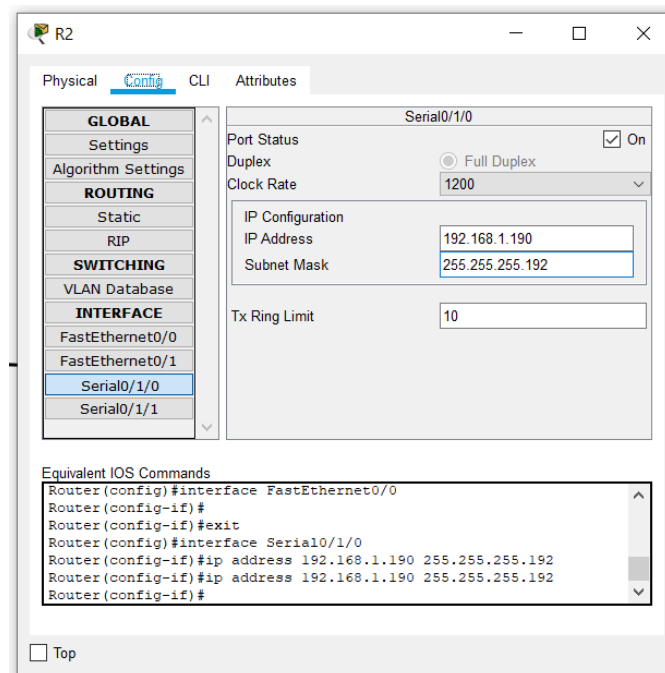
- Port Status: ☒ On
- Bandwidth: ☐ 100 Mbps ☐ 10 Mbps
- Duplex: ☐ Half Duplex ☒ Full Duplex
- MAC Address: 0007.ECAD.3001
- IP Configuration:
  - IP Address: 192.168.1.193
  - Subnet Mask: 255.255.255.192
- Tx Ring Limit: 10

Equivalent IOS Commands:

```
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/1/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#
```

☐ Top

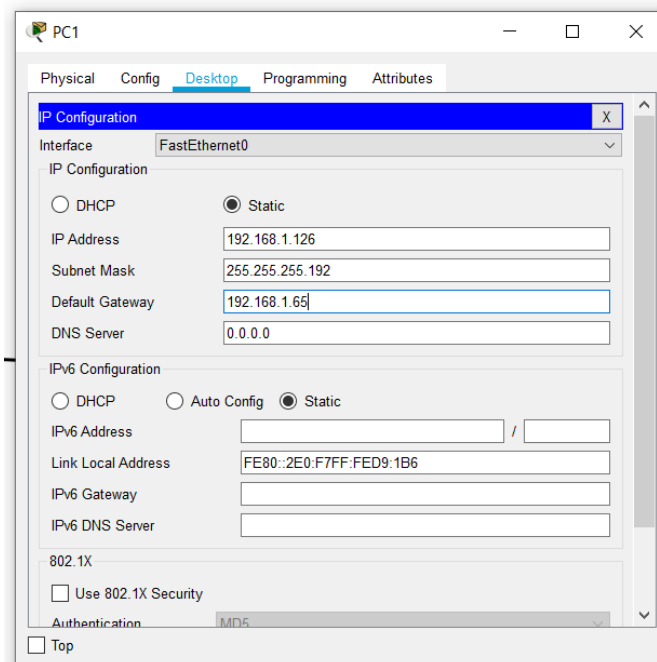
## Interface S0/0/0 of R2



## Step 2: Configure the PC interfaces.

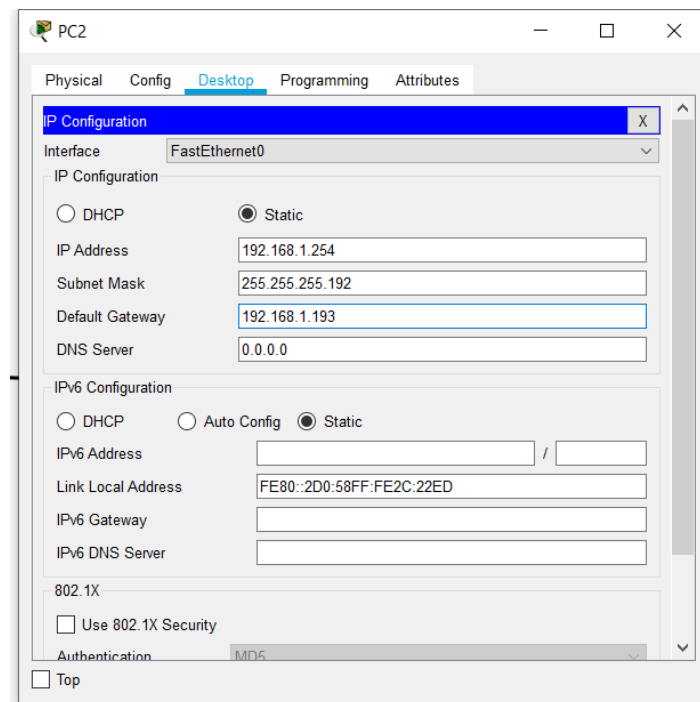
Configure the Ethernet interfaces of PC1 and PC2 with the IP addresses and default gateways from your network design.

PC1 -

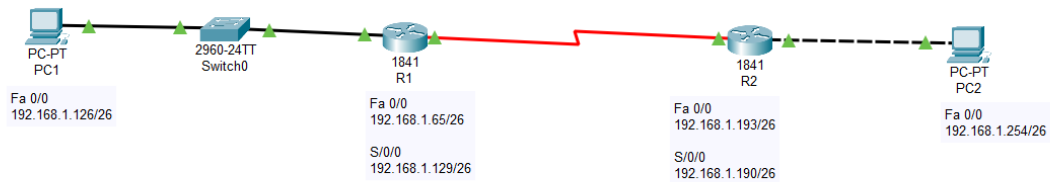




## PC2 -

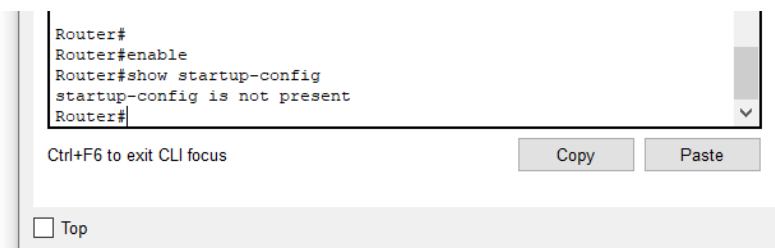


## Final Network-

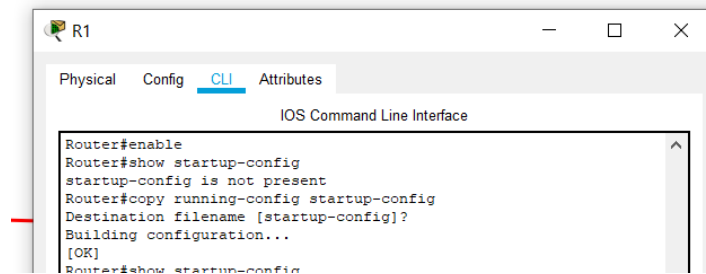


Save the running configuration to the NVRAM of the router

Initially, the both routers have no startup-config



Saving running-config as startup- config for both routers–



The startup-config shows the running-config details as expected

R1 -

```
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.1.65 255.255.255.192
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/1/0
 ip address 192.168.1.129 255.255.255.192
 clock rate 2000000
!
interface Serial0/1/1
 no ip address
 clock rate 2000000
 shutdown
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
--More-- |
```

R2 –

```
!  
!  
!  
!  
spanning-tree mode pvst  
!  
!  
!  
!  
!  
interface FastEthernet0/0  
ip address 192.168.1.193 255.255.255.192  
duplex auto  
speed auto  
!  
interface FastEthernet0/1  
no ip address  
duplex auto  
speed auto  
shutdown  
!  
interface Serial0/1/0  
ip address 192.168.1.190 255.255.255.192  
!  
interface Serial0/1/1  
no ip address  
clock rate 2000000  
shutdown  
!  
interface Vlan1  
no ip address  
shutdown  
!  
ip classless  
!  
ip flow-export version 9  
!  
!  
!  
!  
!  
!  
--More--
```

#### Task 4: Verify the Configurations.

Answer the following questions to verify that the network is operating as expected.

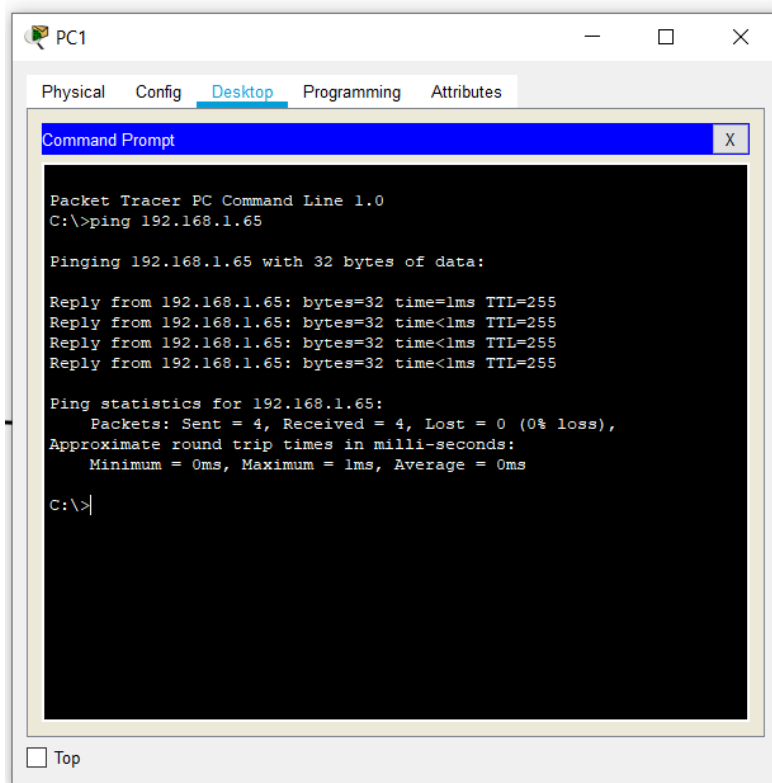
From the host attached to R1, is it possible to ping the default gateway? \_\_\_yes\_\_\_

From the host attached to R2, is it possible to ping the default gateway? \_\_\_yes\_\_\_

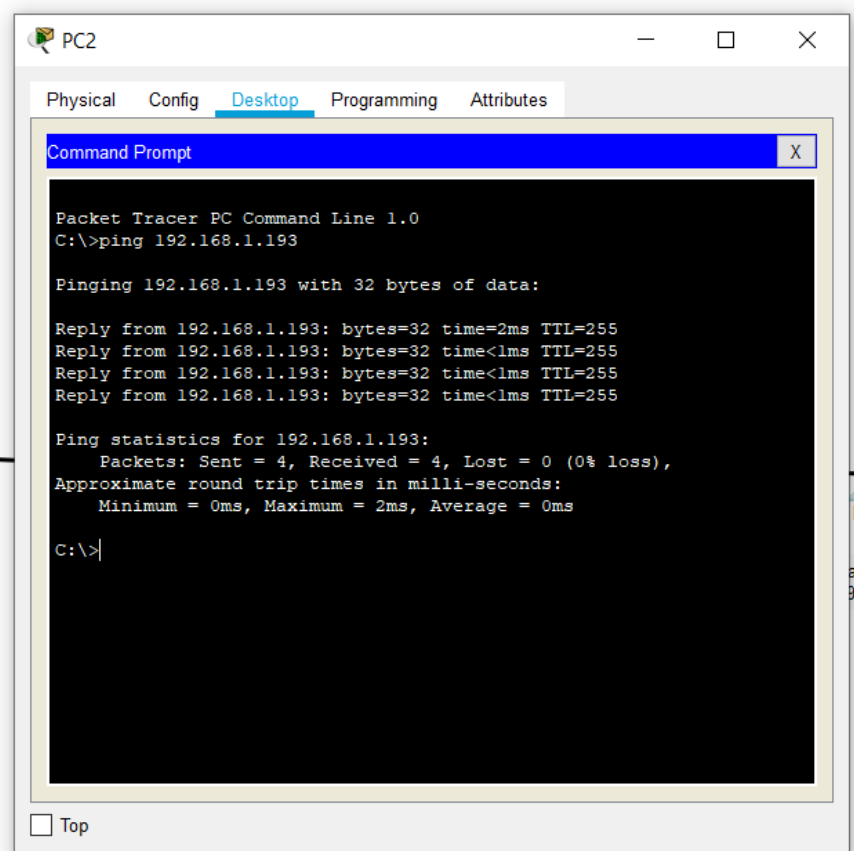
From the router R1, is it possible to ping the Serial 0/0/0 interface of R2? \_\_\_yes\_\_\_

From the router R2, is it possible to ping the Serial 0/0/0 interface of R1? \_\_\_yes\_\_\_

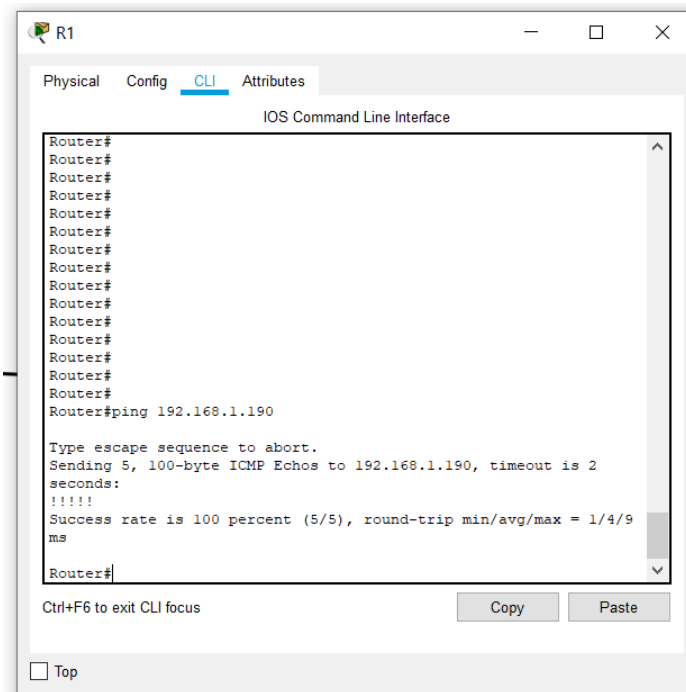
The answer to the above questions should be **yes**. If any of the above pings failed, check your physical connections and configurations.



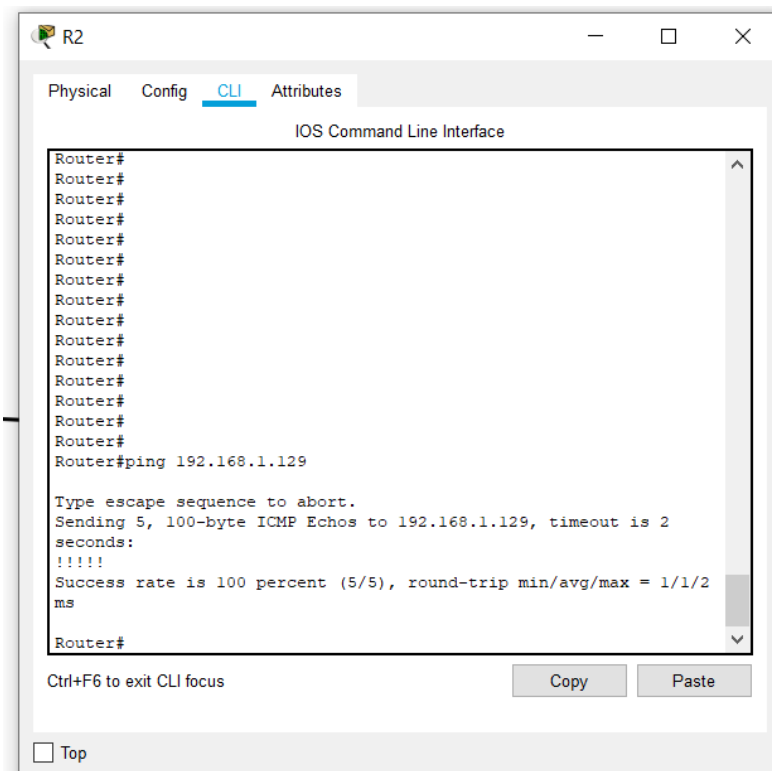
Pinging default gateway of PC1



Pinging default gateway of PC2



Pinging S0/0/0 of R2 from R1

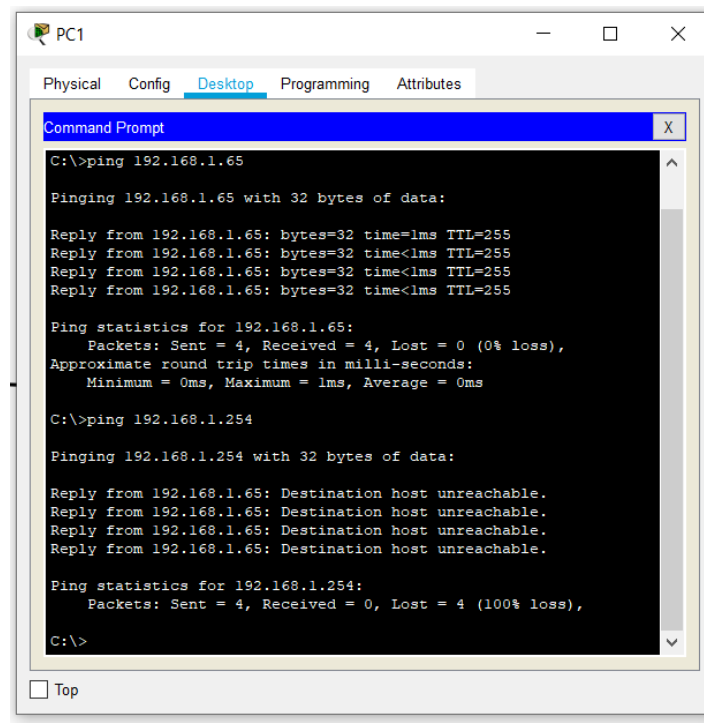


Pinging S0/0/0 of R1 from R2

## Task 5: Reflection

Are there any devices on the network that cannot ping each other?

Yes, devices that are not a part of the same network cannot ping each other. For example, PC1 and PC2 cannot ping each other



```
C:\>ping 192.168.1.65

Pinging 192.168.1.65 with 32 bytes of data:

Reply from 192.168.1.65: bytes=32 time=1ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.1.254

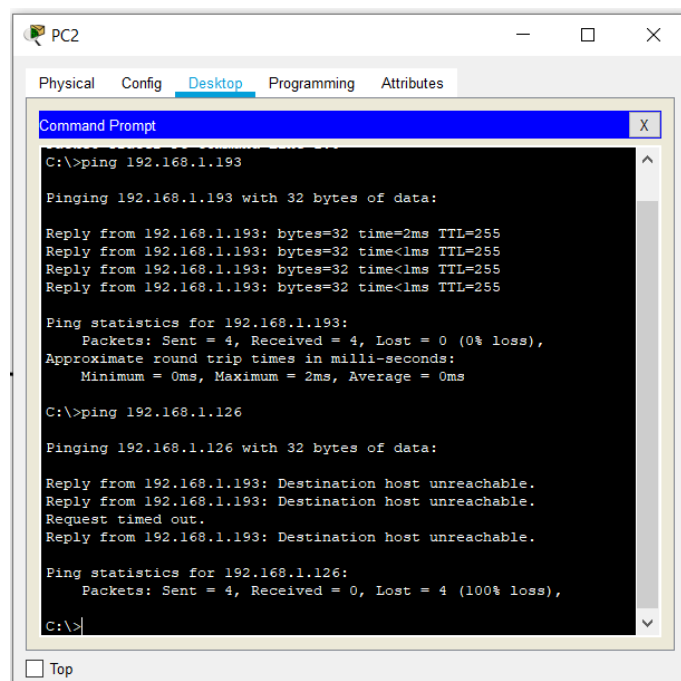
Pinging 192.168.1.254 with 32 bytes of data:

Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.

Ping statistics for 192.168.1.254:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Pinging PC2 from PC1 - failed



```
C:\>ping 192.168.1.193

Pinging 192.168.1.193 with 32 bytes of data:

Reply from 192.168.1.193: bytes=32 time=2ms TTL=255
Reply from 192.168.1.193: bytes=32 time<1ms TTL=255
Reply from 192.168.1.193: bytes=32 time<1ms TTL=255
Reply from 192.168.1.193: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>ping 192.168.1.126

Pinging 192.168.1.126 with 32 bytes of data:

Reply from 192.168.1.193: Destination host unreachable.
Reply from 192.168.1.193: Destination host unreachable.
Request timed out.
Reply from 192.168.1.193: Destination host unreachable.

Ping statistics for 192.168.1.126:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Pinging PC1 from PC2 – failed

```
PC2
Physical Config Desktop Programming Attributes
Command Prompt
Minimum = 0ms, Maximum = 2ms, Average = 0ms
C:\>ping 192.168.1.126
Pinging 192.168.1.126 with 32 bytes of data:
Reply from 192.168.1.193: Destination host unreachable.
Reply from 192.168.1.193: Destination host unreachable.
Request timed out.
Reply from 192.168.1.193: Destination host unreachable.
Ping statistics for 192.168.1.126:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ping 192.168.1.65
Pinging 192.168.1.65 with 32 bytes of data:
Reply from 192.168.1.193: Destination host unreachable.
Reply from 192.168.1.193: Destination host unreachable.
Request timed out.
Reply from 192.168.1.193: Destination host unreachable.
Ping statistics for 192.168.1.65:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>
```

Failed to ping R1 from PC2

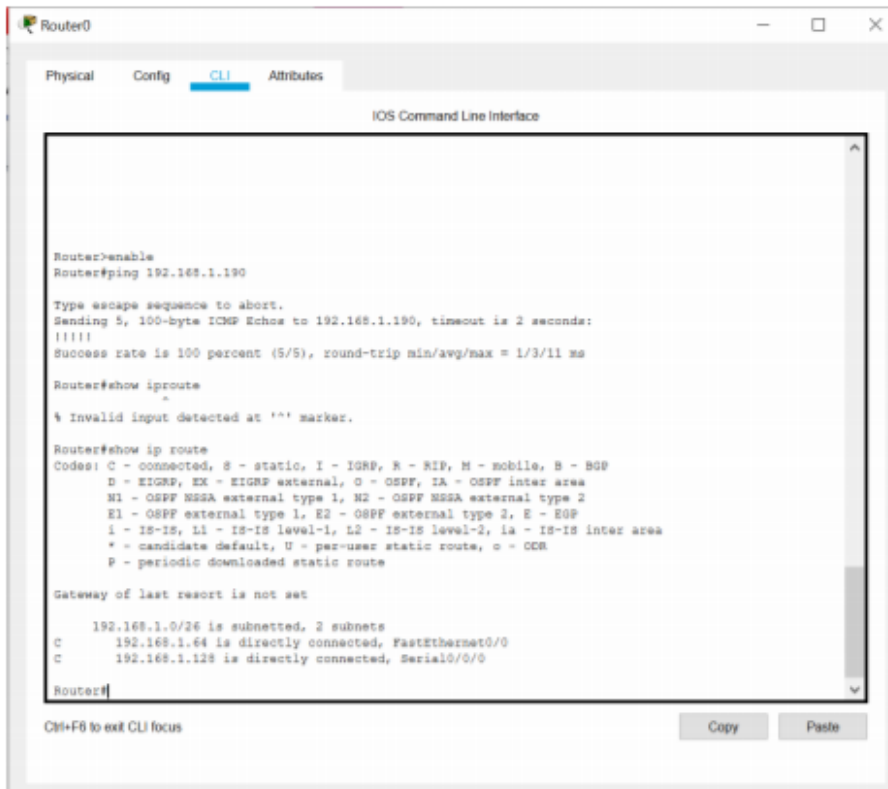
```
PC1
Physical Config Desktop Programming Attributes
Command Prompt
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.1.254
Pinging 192.168.1.254 with 32 bytes of data:
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Ping statistics for 192.168.1.254:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ping 192.168.1.193
Pinging 192.168.1.193 with 32 bytes of data:
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Reply from 192.168.1.65: Destination host unreachable.
Ping statistics for 192.168.1.193:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>
```

Failed to ping R2 from PC1

What is missing from the network that is preventing communication between these devices?

1. Switch is missing

2. Routers in our network only have address of devices which are directly connected to its interfaces in routing table. Hence static or dynamic routing is absent



The screenshot shows the CLI of Router0. The user has entered 'enable' to enter privileged mode. Then, they executed 'ping 192.168.1.190', which was successful. Next, they entered 'show iproute', which resulted in an 'Invalid input detected' error. Finally, they entered 'show ip route', which displayed the routing table. The table shows two directly connected routes: 192.168.1.64 on FastEthernet0/0 and 192.168.1.128 on Serial0/0/0. The routing table also includes a legend for route codes (C, S, I, E, N1, N2, E1, E2, I1, I2, \*, U, P) and a note that the gateway of last resort is not set.

```
Router0>enable
Router0#ping 192.168.1.190

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 192.168.1.190, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/11 ms

Router0#show iproute
% Invalid input detected at '^' marker.

Router0#show ip route
Codes: C - connected, S - static, I - IGMP, 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

    192.168.1.0/26 is subnetted, 2 subnets
C       192.168.1.64 is directly connected, FastEthernet0/0
C       192.168.1.128 is directly connected, Serial0/0/0
Router0#
```



The screenshot shows the CLI of Router1. The user has entered 'enable' to enter privileged mode. Then, they executed 'ping 192.168.1.129', which was successful. Next, they entered 'show ip route', which displayed the routing table. The table shows two directly connected routes: 192.168.1.128 on Serial0/0/0 and 192.168.1.192 on FastEthernet0/0. The routing table also includes a legend for route codes (C, S, I, E, N1, N2, E1, E2, I1, I2, \*, U, P) and a note that the gateway of last resort is not set.

```
Router1>enable
Router1#ping 192.168.1.129

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 192.168.1.129, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/7/13 ms

Router1#show ip route
Codes: C - connected, S - static, I - IGMP, 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

    192.168.1.0/26 is subnetted, 2 subnets
C       192.168.1.128 is directly connected, Serial0/0/0
C       192.168.1.192 is directly connected, FastEthernet0/0
Router1#
```