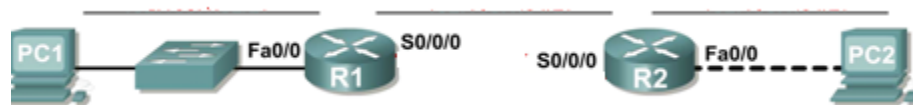


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Batch : B
Roll No : 29

CEL 51, DCCN, Monsoon 2020

Lab 6: Subnet and Router Configuration

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 Fast Ethernet 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?

Ans. First we see which network needs the highest number of hosts. The R2 network has 30 hosts so we will need $5(2^5 = 32)$ host bits and thus **3 subnet**.

- The network connected to router R1
- The network connected to router R2
- Link between router R1 and R2

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

Ans. Class C network as the IP address is 192.168.1.0. The default subnet mask for class C is 255.255.255.0. The first three octets are dedicated to network and don't change. Since our requirement is of 3 subnets, the subnet mask will be calculated as

$$2^n \geq 3$$

Thus, **n=2**

We use 2 bits for subnet in the last 8 bits of IP Address and 6 bits as host bits. The binary format 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?

Ans. It is the total number of 1's in the binary form of the subnet mask. So, the subnet mask for the network in slash format is **/26**.

4. How many usable hosts are there per subnet?

Ans. Usable hosts = $2^h - 2 = 2^6 - 2 = 62$

h = number of zero in the binary form of subnet mask = 6

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

1. Assign subnet 1 to the network attached to R1.

Subnet 1: **192.168.1.64-198.162.1.127**

2. Assign subnet 2 to the link between R1 and R2.

Subnet 2: **192.168.1.128-198.162.1.191**

3. Assign subnet 3 to the network attached to R2.

Subnet 3: **192.168.1.192-198.162.1.255**

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.

Ans. 192.168.1.65

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

Ans. 192.168.1.126

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

Ans. 192.168.1.129

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

Ans. 192.168.1.190

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

Ans. 192.168.1.193

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

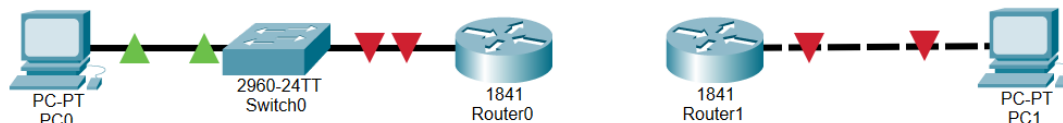
Ans. 192.168.1.254

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

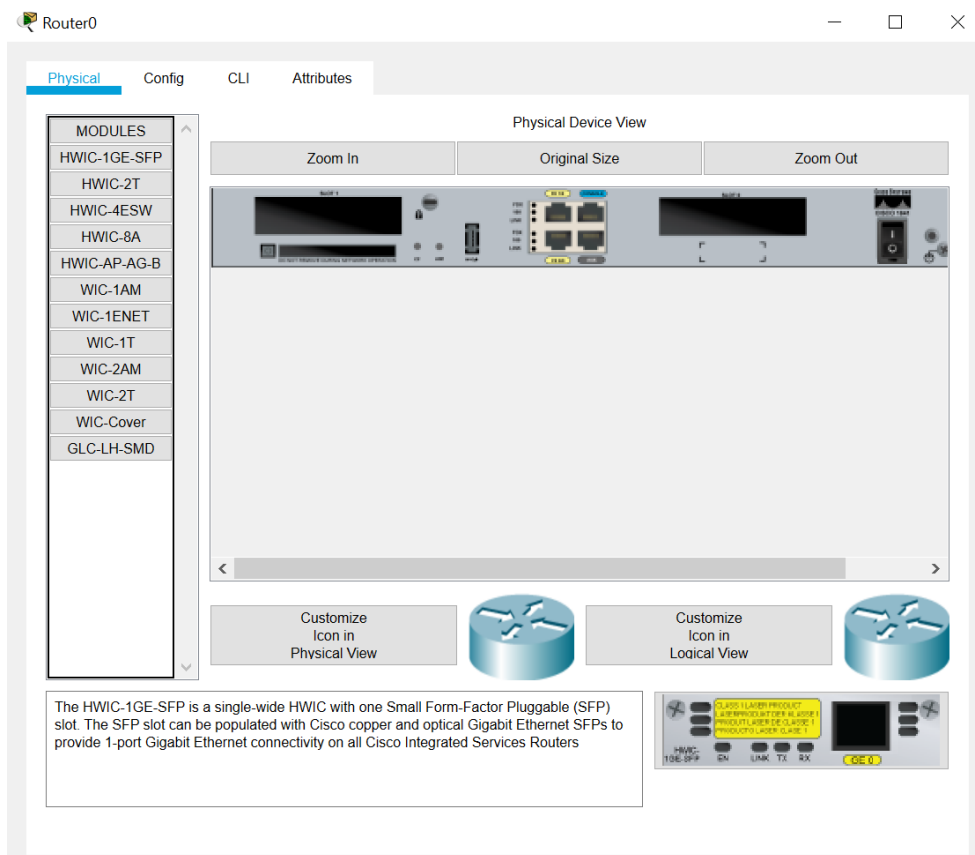
Task 3: Configure the Serial and FastEthernet Addresses.

Step 1: Configure the router interfaces.

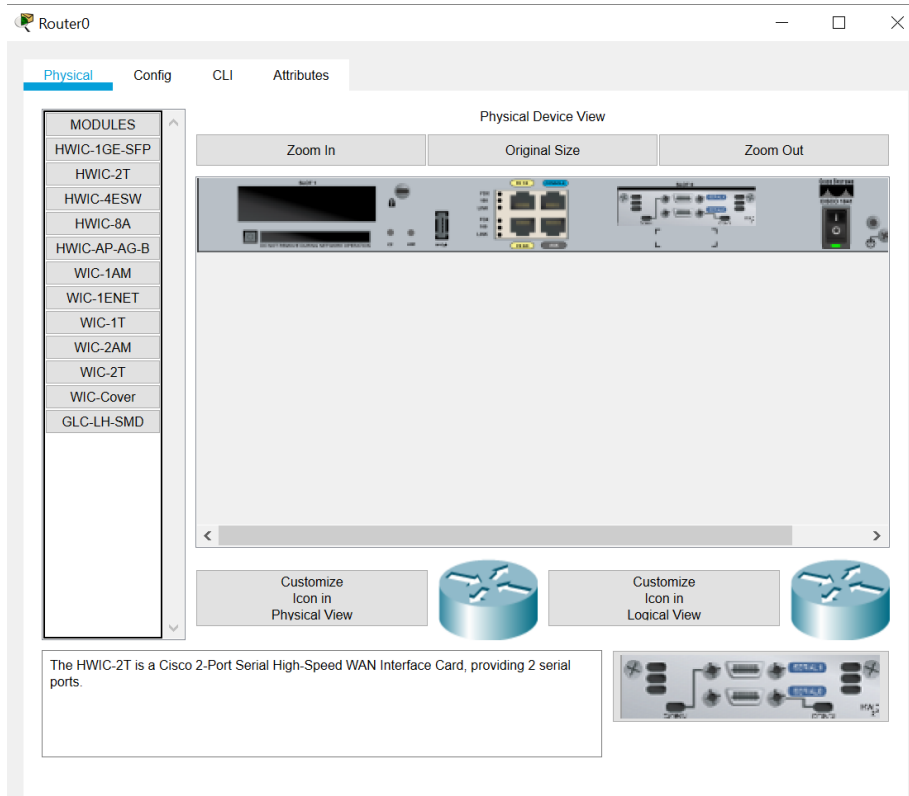
Configure the interfaces on the R1 and R2 routers with the IP addresses from your network design. Please note, to complete the activity in Packet Tracer you will be using the Config Tab. When you have finished, be sure to save the running configuration to the NVRAM of the router.



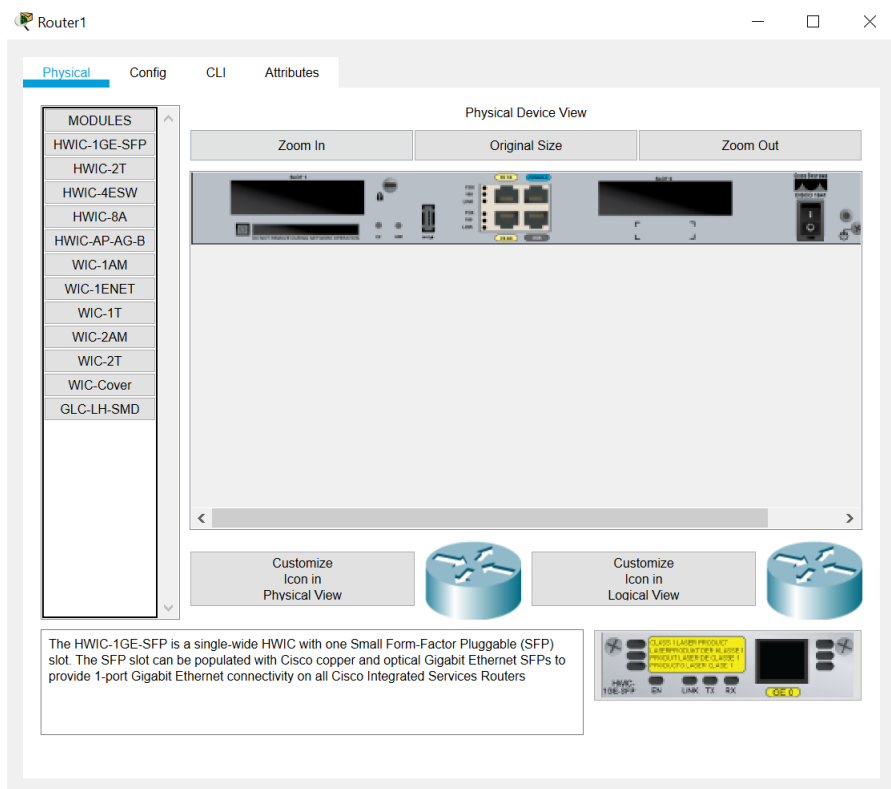
Adding Serial Ports to Router



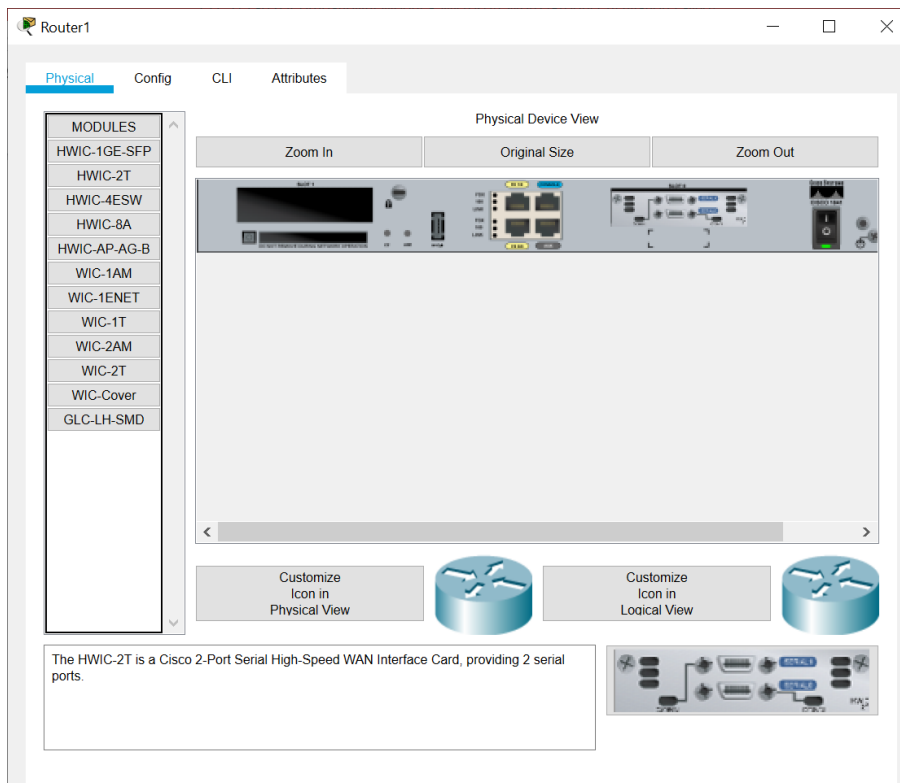
Turn the Router 0 off



Click on HWIC-2T tab and drag HWIC-2T 2-Port Serial WAN Interface Card to router and turn the router on

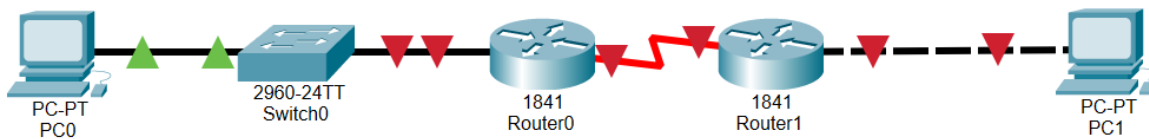


Turn the Router 1 off



Click on HWIC-2T tab and drag HWIC-2T 2-Port Serial WAN Interface Card to router and turn the router on

Now we can connect R1 and R2 using serial DTE



Router Configuration

Router0

Physical

Config

CLI

Attributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

FastEthernet0/0

FastEthernet0/1

Serial0/0/0

Serial0/0/1

FastEthernet0/0

Port Status ☒ On

Bandwidth ☒ 100 Mbps ☐ 10 Mbps ☒ Auto

Duplex ☐ Half Duplex ☒ Full Duplex ☒ Auto

MAC Address 0002.4A4E.EC01

IP Configuration

IPv4 Address 192.168.1.65

Subnet Mask 255.255.255.192

Tx Ring Limit 10

Equivalent IOS Commands

```
Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 192.168.1.129 255.255.255.224
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)#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)#ip address 192.168.1.129 255.255.255.192
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.1.65 255.255.255.192
Router(config-if)#ip address 192.168.1.65 255.255.255.192
Router(config-if)#ip address 192.168.1.65 255.255.255.192
Router(config-if)#
```

Configuration of Fa0/0 of R0

Router0

Physical **Config** CLI Attributes

GLOBAL

- Settings
- Algorithm Settings

ROUTING

- Static
- RIP

SWITCHING

- VLAN Database

INTERFACE

- FastEthernet0/0
- FastEthernet0/1
- Serial0/0/0**
- Serial0/0/1

Serial0/0/0

Port Status ☒ On

Duplex ☐ Full Duplex

Clock Rate 2000000

IP Configuration

IPv4 Address 192.168.1.129

Subnet Mask 255.255.255.192

Tx Ring Limit 10

Equivalent IOS Commands

```
Router(config-if)#no ip address
Router(config-if)#ip address
% Incomplete command.
Router(config-if)#no ip address
Router(config-if)#ip address
% Incomplete command.
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 192.168.1.129 255.255.255.224
Router(config-if)#ip address 192.168.1.129 255.255.255.192
Router(config-if)#
```

Configuration of S0/0/0 of R0

FastEthernet0/0	
Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input type="radio"/> 100 Mbps <input type="radio"/> 10 Mbps <input checked="" type="checkbox"/> Auto
Duplex	<input type="radio"/> Half Duplex <input checked="" type="radio"/> Full Duplex <input checked="" type="checkbox"/> Auto
MAC Address	00E0.8FBC.7701
IP Configuration	
IPv4 Address	192.168.1.193
Subnet Mask	255.255.255.192
Tx Ring Limit	10

Equivalent IOS Commands

```
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 192.168.1.190 255.255.255.224
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.1.193 255.255.255.224
Router(config-if)#ip address 192.168.1.193 255.255.255.192
Router(config-if)#
```

Configuration of Fa0/0 of R1

Router1

Physical **Config** CLI Attributes

GLOBAL

- Settings
- Algorithm Settings

ROUTING

- Static
- RIP

SWITCHING

- VLAN Database

INTERFACE

- FastEthernet0/0
- FastEthernet0/1
- Serial0/0/0**
- Serial0/0/1

Serial0/0/0

Port Status ☒ On

Duplex ☐ Full Duplex

Clock Rate 2000000

IP Configuration

IPv4 Address 192.168.1.190

Subnet Mask 255.255.255.192

Tx Ring Limit 10

Equivalent IOS Commands

```
%LINK-3-CHANGED: Interface Serial0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 192.168.1.190 255.255.255.224
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#ip address 192.168.1.190 255.255.255.192
Router(config-if)#
```

Configuration of S0/0/0 of R1

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.

PC0

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.168.1.126

Subnet Mask 255.255.255.192

Default Gateway 192.168.1.65

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::260:2FFF:FE80:52D8

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

Password

Configuration of Fa0/0 of PC0

PC1

Physical
Config
Desktop
Programming
Attributes

IP Configuration
X

Interface
FastEthernet0

IP Configuration

☐ DHCP
☒ Static

IPv4 Address
192.168.1.254

Subnet Mask
255.255.255.192

Default Gateway
192.168.1.193

DNS Server
0.0.0.0

IPv6 Configuration

☐ Automatic
☒ Static

IPv6 Address
/

Link Local Address
FE80::201:96FF:FE7B:3888

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

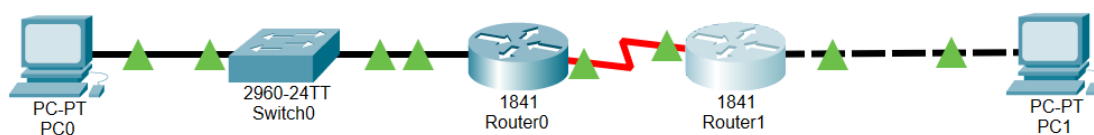
Authentication
MD5

Username

Password

Configuration of Fa0/0 of PC1

The Network is now connected





```
Router#enable
Router#show startup-config
startup-config is not present
Router#
```

Physical Config CLI Attributes

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

Router#enable
Router#show startup-config
startup-config is not present
Router#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#show startup-config
Using 706 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
```

For R0

```
!  
!  
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-- |
```

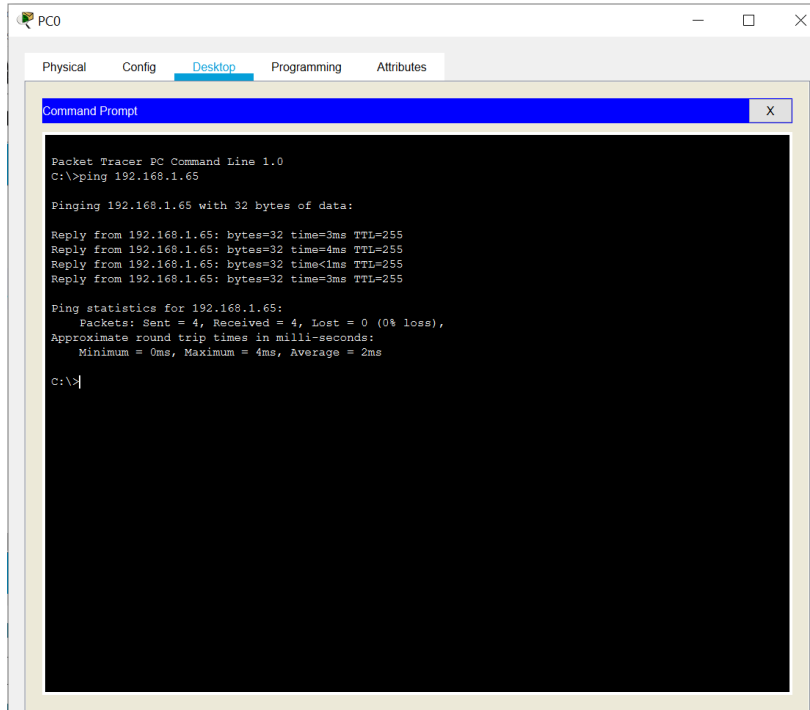
For R1

```
!  
!  
!  
!  
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



The screenshot shows a Packet Tracer PC window for PC0. The 'Desktop' tab is active, displaying a 'Command Prompt' window. The command prompt shows the execution of the command 'ping 192.168.1.65'. The output indicates that the ping was successful, with four replies received from 192.168.1.65. The statistics show 4 packets sent, 4 received, and 0% loss, with an average round trip time of 2ms.

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.65

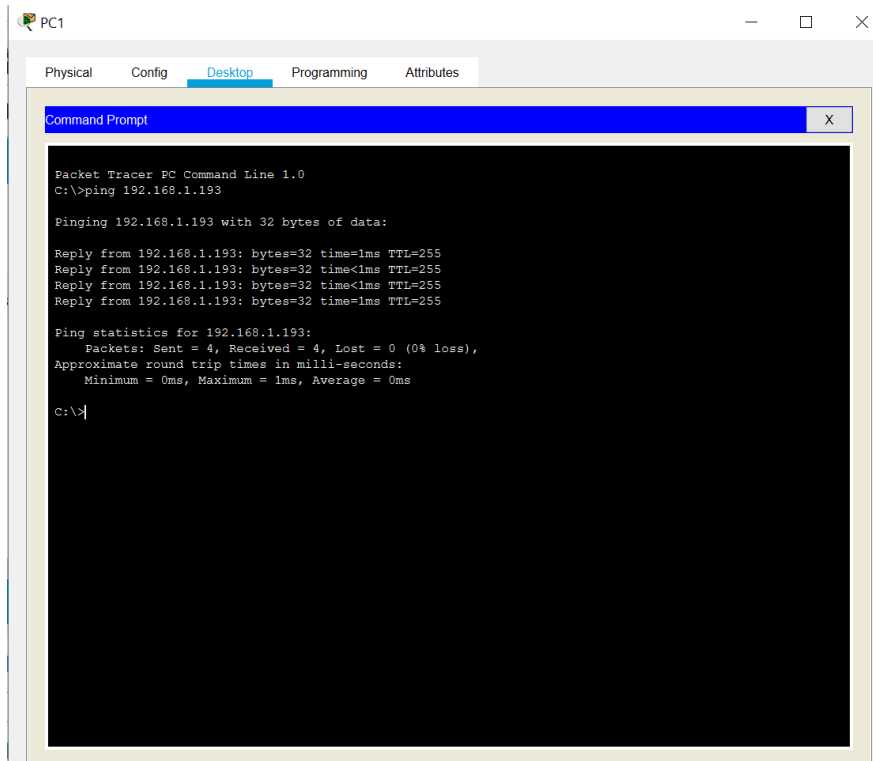
Pinging 192.168.1.65 with 32 bytes of data:

Reply from 192.168.1.65: bytes=32 time=3ms TTL=255
Reply from 192.168.1.65: bytes=32 time=4ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time=3ms 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 = 4ms, Average = 2ms

C:\>
```

From the host attached to R2, is it possible to ping the default gateway? Yes



The screenshot shows a Packet Tracer PC window for PC1. The 'Desktop' tab is active, displaying a 'Command Prompt' window. The command prompt shows the execution of the command 'ping 192.168.1.193'. The output indicates that the ping was successful, with four replies received from 192.168.1.193. The statistics show 4 packets sent, 4 received, and 0% loss, with an average round trip time of 0ms.

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.193

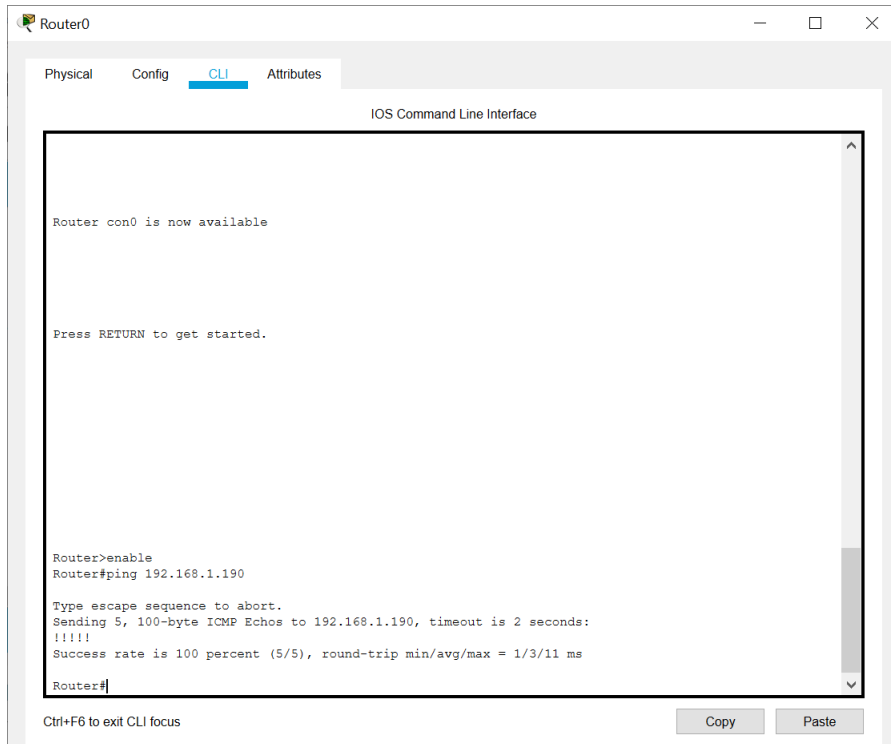
Pinging 192.168.1.193 with 32 bytes of data:

Reply from 192.168.1.193: bytes=32 time=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
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 = 1ms, Average = 0ms

C:\>
```

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**

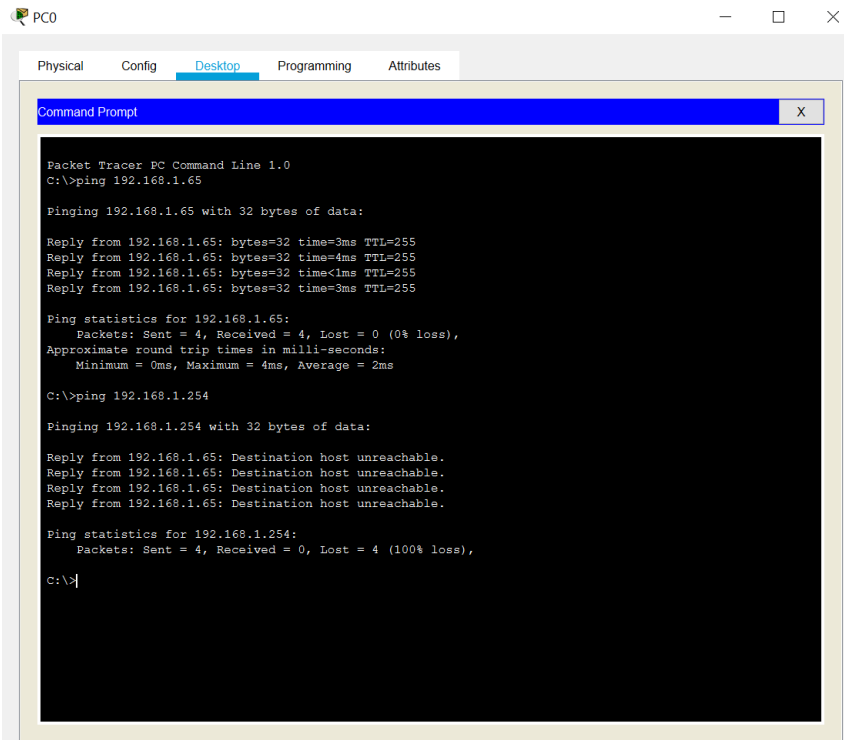


The answer to the above questions should be **yes**. If any of the above pings failed, check your physical connections and configurations.

Task 5: Reflection

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

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



```
PC0
Physical Config Desktop Programming Attributes
Command Prompt
Packet Tracer PC Command Line 1.0
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=3ms TTL=255
Reply from 192.168.1.65: bytes=32 time=4ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time=3ms 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 = 4ms, Average = 2ms

C:\>ping 192.168.1.254

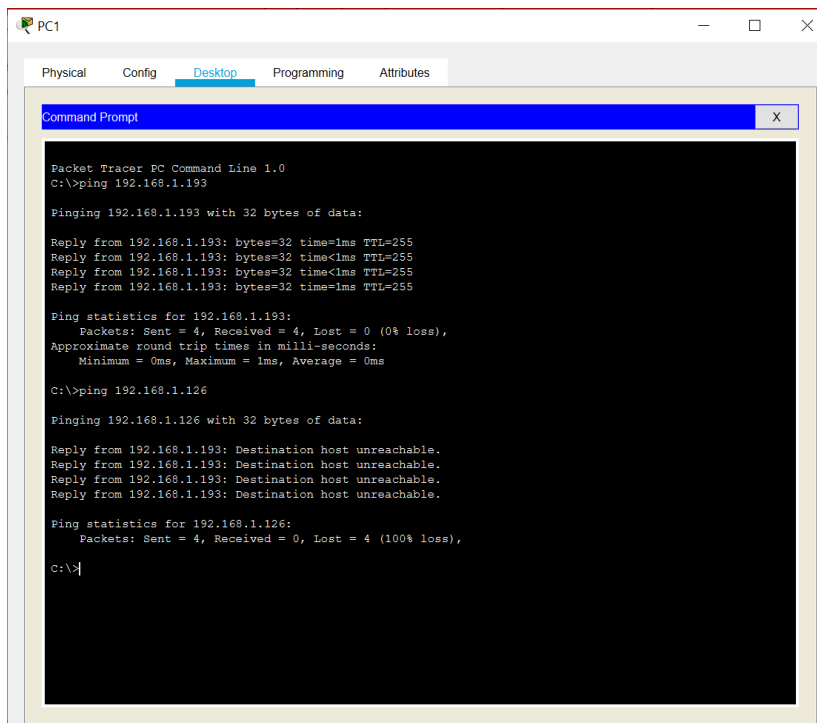
Pinging 192.168.1.254 with 32 bytes of data:

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 PC1 from PC0-Failure but R0-success



```
PC1
Physical Config Desktop Programming Attributes
Command Prompt
Packet Tracer PC Command Line 1.0
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=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
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 = 1ms, 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.
Reply from 192.168.1.193: Destination host unreachable.
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 PC0 from PC1- Failure but R1-success


```
PC1
Physical Config Desktop Programming Attributes
Command Prompt X

Pinging 192.168.1.193 with 32 bytes of data:
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
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 = 1ms, 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.
Reply from 192.168.1.193: Destination host unreachable.
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.
Reply from 192.168.1.193: Destination host unreachable.
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:\>
```

Pinging R0 from PC1- Failure

```
PC0
Physical Config Desktop Programming Attributes
Command Prompt X

Pinging 192.168.1.65 with 32 bytes of data:
Reply from 192.168.1.65: bytes=32 time=3ms TTL=255
Reply from 192.168.1.65: bytes=32 time=4ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time=3ms 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 = 4ms, Average = 2ms

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.
Request timed out.
Reply from 192.168.1.65: Destination host unreachable.

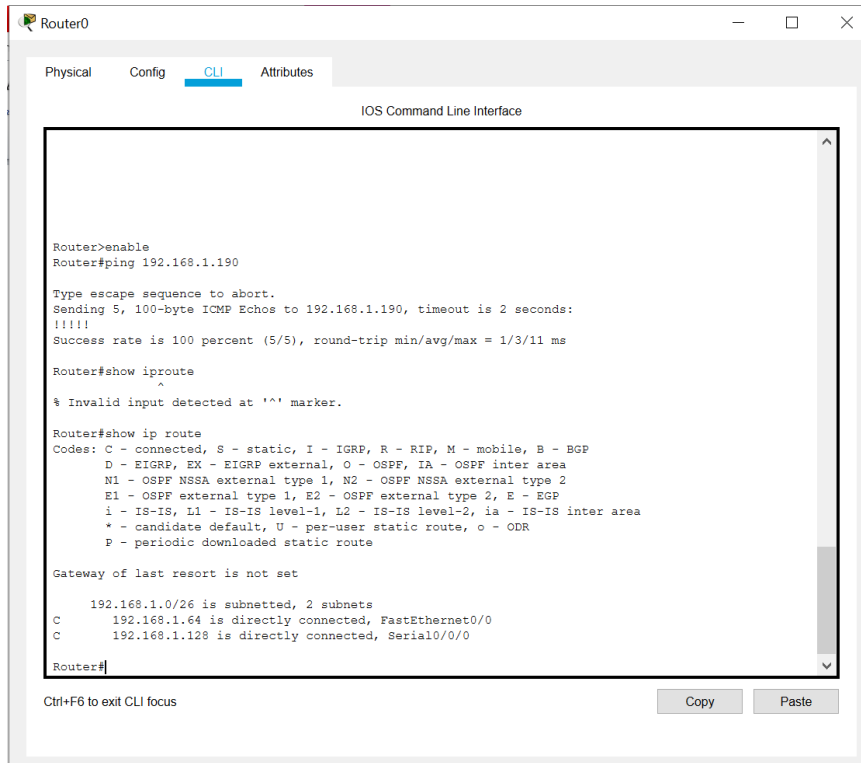
Ping statistics for 192.168.1.193:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Pinging R1 from PC0- Failure

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

Switch is missing in communication between the two PC. 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.



```
Router0
Physical Config CLI Attributes
IOS Command Line Interface

Router>enable
Router#ping 192.168.1.190

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos 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

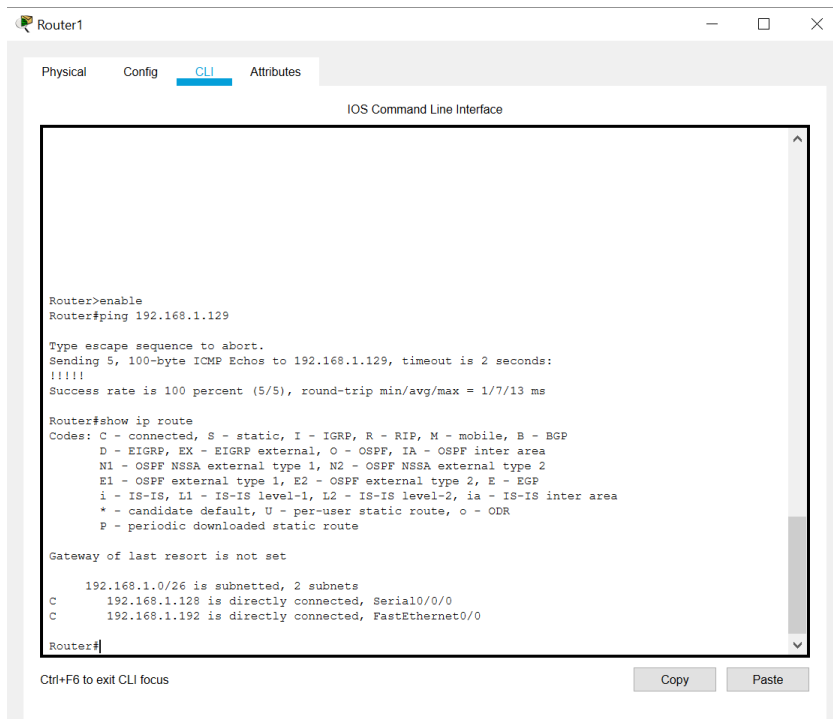
Router#show iproute
^
% Invalid input detected at '^' marker.

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

      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

Router#
```



```
Router1
Physical Config CLI Attributes
IOS Command Line Interface

Router>enable
Router#ping 192.168.1.129

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos 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

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

      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

Router#
```

CONCLUSION:

In this experiment I learnt about subnetting a given address space and assigning subnets to various networks accordingly.

I also learnt about configuring serial port on router and established a connection between two routers using serial DTE.

