Practical File Of

Introduction to Computer Networks

CS156

Submitted By

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G14 - A

Submitted To

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Experiment No. 1

Aim: -

Introduction of Cables, Network devices: Hub, Switches, Router etc.

Material Required-

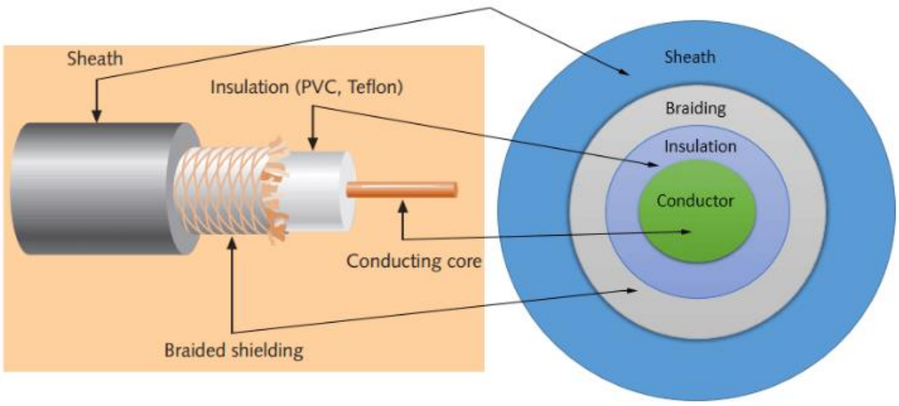
Coaxial Cables, Twisted Pair Cables, Fibre Optics Cable, Switch, Hub, Router.

Theory:-

Cables -

1) Coaxial Cables:

A coaxial cable is an electrical cable with a copper conductor and an insulator shielding around it and a braided metal mesh that prevents signal interference and cross talk. Coaxial cable is also known as **coax.**



The core copper conductor is used for the transmission of signals and the insulator is used to provide insulation to the copper conductor and the insulator is surrounded by a braided metal conductor which helps to prevent the interference of electrical signals and prevent cross talk. This entire setup is again covered with a protective plastic layer to provide extra safety to the cable.

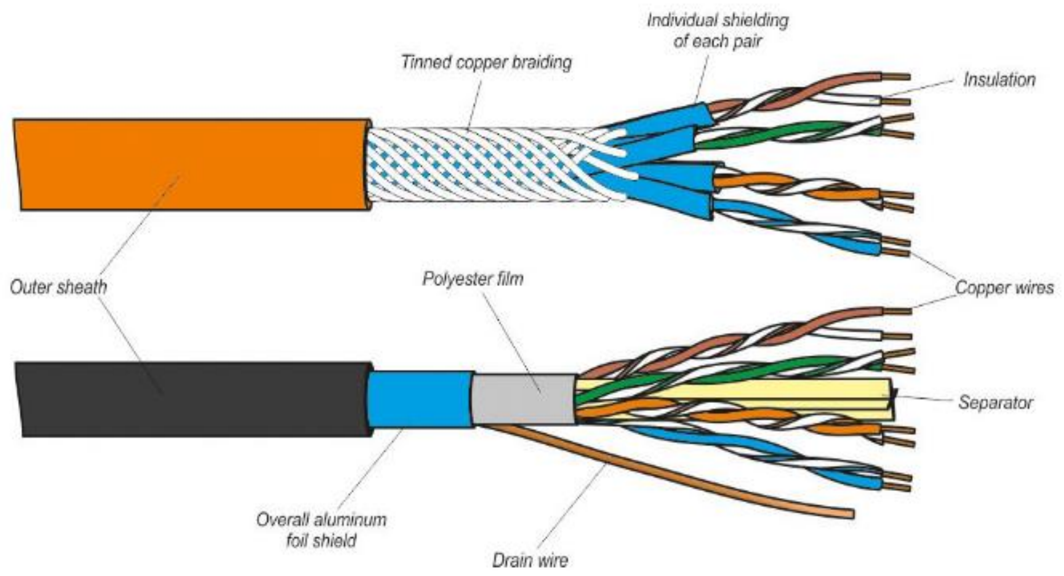
Specifiaction of Coaxial Cables –

Type	Ohms	AWG	Conductor	Description
RG-6	75	18	Solid copper	Used in cable network to provide cable Internet service and cable TV over long distances.
RG-8	50	10	Solid copper	Used in the earliest computer networks. This cable was used as the backbone cable in the bus topology. In Ethernet standards, this cable is documented as the 10base5 Thicknet cable.
RG-58	50	24	Several thin strands of copper	This cable is thinner, easier to handle and install than the RG-8 cable. This cable was used to connect a system with the backbone cable. In Ethernet standards, this cable is documented as the 10base2 Thinnet cable.
RG-59	75	20 - 22	Solid copper	Used in cable networks to provide short-distance service.

2) Twisted Pair Cable:

These are a type of guided media. It was invented by Alexander Graham Bell. Twisted pair cables have two conductors that are generally made up of copper and each conductor has insulation. These two conductors are twisted together, thus giving the name twisted pair cables.

One of the conductors is used to carry the signal and the other is used as a ground reference only. The receiver uses the difference of signals between these two conductors. The noise or crosstalk in the two parallel conductors is high but this is greatly reduced in twisted pair cables due to the twisting characteristic. In the first twist, one conductor is near to noise source and the other is far from the source but in the next twist the reverse happens and the resultant noise is very less and hence the balance in signal quality is maintained and the receiver receives very less or no noise. The quality of signal in twisted pair cables greatly depends upon the number of twists per unit length of the cable.

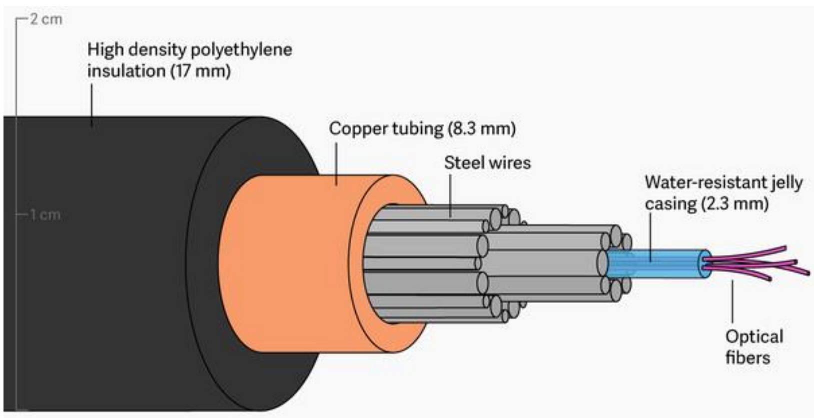


Specifiaction of Coaxial Cables –

Category/ name of the cable	Maximum supported speed	Bandwidth/support signals rate	Ethernet standard	Description
Cat 1	1Mbps	1MHz	Not used for data	This cable contains only two pairs (4 wires). This cable was used in the telephone network for voice transmission.
Cat 2	4Mbps	10MHz	Token Ring	This cable and all further cables have a minimum of 8 wires (4 pairs). This cable was used in the token-ring network.
Cat 3	10Mbps	16MHz	10BASE-T Ethernet	This is the first Ethernet cable that was used in LAN networks.
Cat 4	20Mbps	20MHz	Token Ring	This cable was used in advanced Token-ring networks.
Cat 5	100Mbps	100MHz	100BASE-T Ethernet	This cable was used in advanced (fast) LAN networks.
Cat 5e	1000Mbps	100MHz	1000BASE-T Ethernet	This cable/category is the minimum requirement for all modern LAN networks.
Cat 6	10Gbps	250MHz	10GBASE-T Ethernet	This cable uses a plastic core to prevent cross-talk between twisted-pair. It also uses a fire-resistant plastic sheath.
Cat 6a	10Gbps	500MHz	10GBASE-T Ethernet	This cable reduces attenuation and cross-talk. This cable also potentially removes the length limit. This is the recommended cable for all modern Ethernet LAN networks.
Cat 7	10Gbps	600MHz	Not drafted yet	This cable sets a base for further development. This cable uses multiple twisted-pair and shields each pair by its plastic sheath.

3) Fibre Optic Cables:

A fibre optic cable is made of glass or plastic and transmits signals in the structure of light signals. The structure of an optical fibre cable is displayed in the figure. It involves an inner glass core surrounded by a glass cladding that reflects the light into the core. Each fibre is encircled by a plastic jacket.



In fibre optics, semiconductor lasers transmit data in the form of light along with hair thin glass (optical) fibres at the speed of light (186000 miles/second) with no significant loss of intensity over very long distances. The system includes fibre optic cables that are made of tiny threads of glass or plastic.

Network Devices-

1. <u>Repeater:</u>

A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy it bit by bit and regenerate it at its star topology connectors connecting if original strength. It is a 2-port device.

2. <u>Hubs:</u>

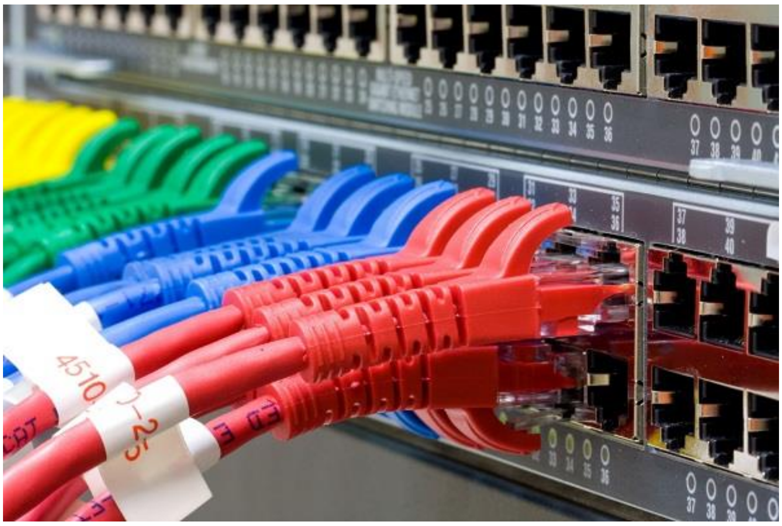
A hub is a basically multi-port repeater. A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations. Hubs cannot filter data, so data packets are sent to all connected devices. In other words, the collision domain of all hosts connected through Hub remains one. Also, they do not have the intelligence to find out the best path for data packets which leads to inefficiencies and wastage.

3. <u>Switch:</u>

Switch is a network device that connects other devices to **Ethernet** networks through **twisted pair** cables. It uses **packet switching** technique to **receive,**

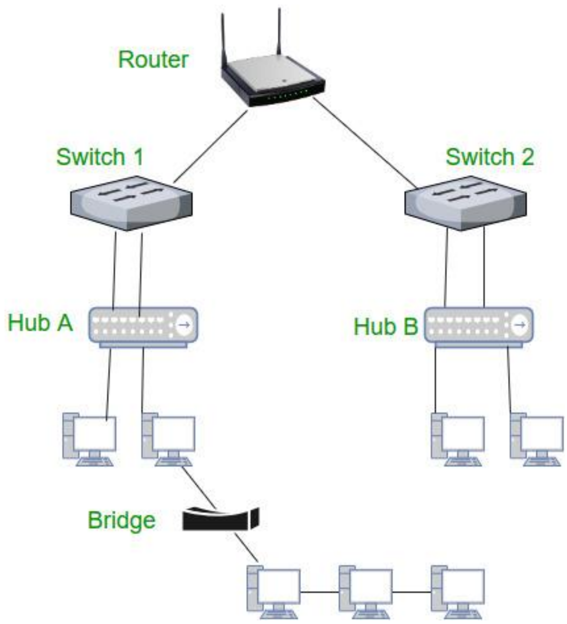
store and **forward data packets** on the network. The switch maintains a list of network addresses of all the devices connected to it.

On receiving a packet, it checks the destination address and transmits the packet to the correct port. Before forwarding, the packets are checked for collision and other network errors. The data is transmitted in full duplex mode. Data transmission speed in switches can be double that of other network devices like hubs used for networking. This is because switch shares its maximum speed with all the devices connected to it. This helps in maintaining network speed even during high traffic. In fact, higher data speeds are achieved on networks through use of multiple switches.



4. <u>Router:-</u>

A router is a device like a switch that routes data packets based on their IP addresses. The router is mainly a Network Layer device. Routers normally connect LANs and WANs and have a dynamically updating routing table based on which they make decisions on routing the data packets. The router divides the broadcast domains of hosts connected through it. There are several types of routers, but most routers pass data between LANs(Local Area Networks) and WANs(Wide Area Networks).



A LAN is a group of connected devices restricted to a specific geographic area. A LAN usually requires a single router. A WAN, by contrast, is a large network spread out over a vast geographic area. Large organizations and companies that operate in multiple locations across the country, for instance, will need separate LANs for each location, which then connect to the other LANs to form a WAN.

Because a WAN is distributed over a large area, it often necessitates multiple routers and switches.

Experiment No. 2

Aim: -

Installation and Introduction to Packet Tracer

Material Required:-

Good internet connection, login credentials to netacad.com.

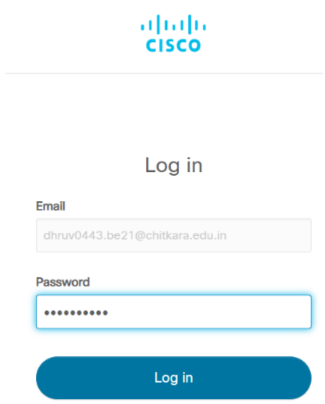
Theory:-

Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface.

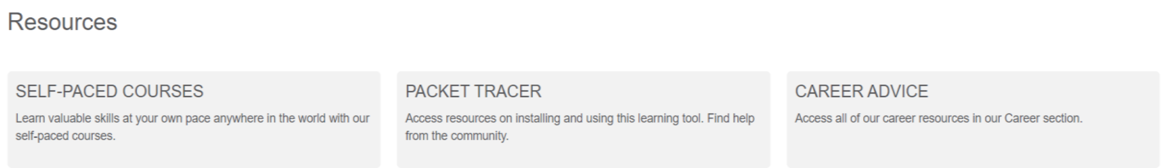
Packet Tracer makes use of a drag and drop user interface, allowing users to add and remove simulated network. Packet Tracer can be run on Linux, Microsoft Windows, and macOS.
Similar Android and iOS apps are also available.

Procedure:-

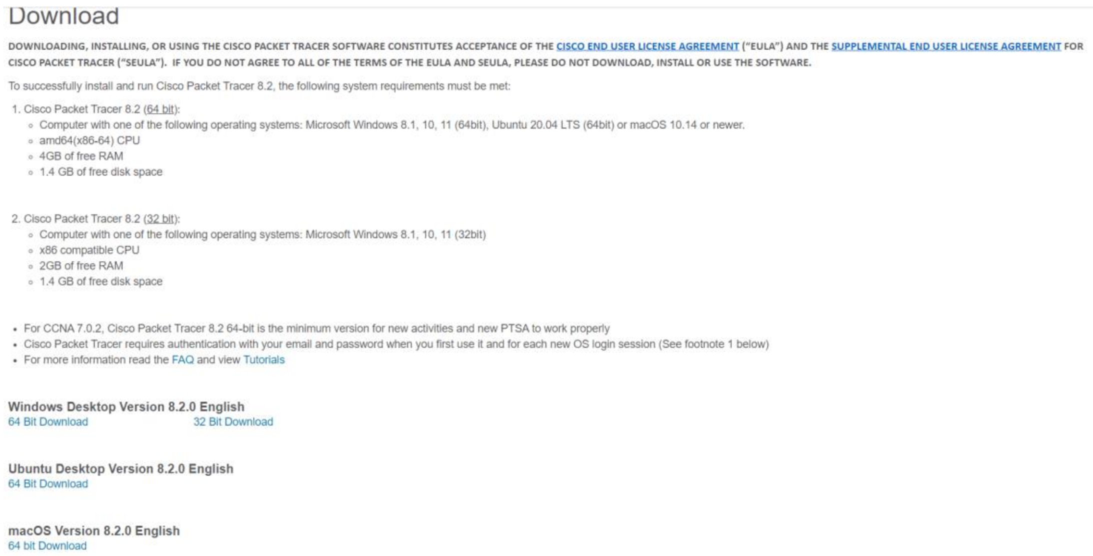
1. Login to netacad.com



2. Scroll down and select the card where packet tracer is written



3. Scroll down and then select your operating system and then click on download.



Download

DOWNLOADING, INSTALLING, OR USING THE CISCO PACKET TRACER SOFTWARE CONSTITUTES ACCEPTANCE OF THE CISCO END USER LICENSE AGREEMENT ("EULA") AND THE SUPPLEMENTAL END USER LICENSE AGREEMENT FOR CISCO PACKET TRACER ("SEULA"). IF YOU DO NOT AGREE TO ALL OF THE TERMS OF THE EULA AND SEULA, PLEASE DO NOT DOWNLOAD, INSTALL OR USE THE SOFTWARE.

To successfully install and run Cisco Packet Tracer 8.2, the following system requirements must be met:

1. Cisco Packet Tracer 8.2 (64 bit):
   - Computer with one of the following operating systems: Microsoft Windows 8.1, 10, 11 (64bit), Ubuntu 20.04 LTS (64bit) or macOS 10.14 or newer.
   - amd64(x86-64) CPU
   - 4GB of free RAM
   - 1.4 GB of free disk space

2. Cisco Packet Tracer 8.2 (32 bit):
   - Computer with one of the following operating systems: Microsoft Windows 8.1, 10, 11 (32bit)
   - x86 compatible CPU
   - 2GB of free RAM
   - 1.4 GB of free disk space

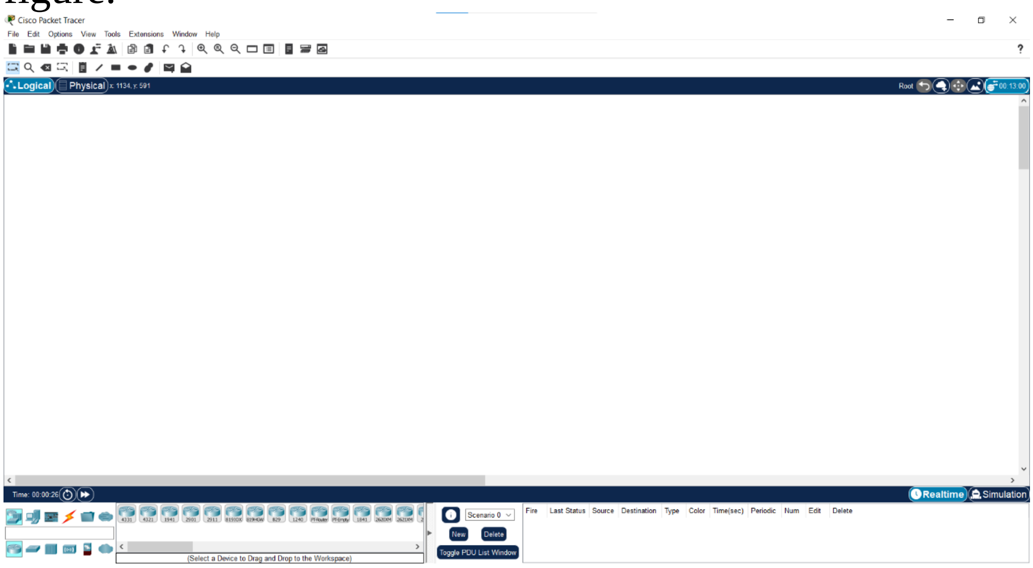
- For CCNA 7.0.2, Cisco Packet Tracer 8.2 64-bit is the minimum version for new activities and new PTSA to work properly
- Cisco Packet Tracer requires authentication with your email and password when you first use it and for each new OS login session (See footnote 1 below)
- For more information read the FAQ and view Tutorials

Windows Desktop Version 8.2.0 English
64 Bit Download 32 Bit Download

Ubuntu Desktop Version 8.2.0 English
64 Bit Download

macOS Version 8.2.0 English
64 bit Download

4. After successful installation, the initial screen would be as shown in the figure.



Experiment No. 3

Aim:-

Simulation of Network Devices (HUB, Switches, Router) and connect more than two computers using Switch to Topologies like Star, Mesh, Ring, Bus, and Hybrid.

Material Required:-

Cisco Packet Tracer Tool installed.

Theory:-

Hub: An Ethernet hub, active hub, network hub, repeater hub, multiport repeater, or simply hub is a network hardware device for connecting multiple Ethernet devices together and making them act as a single network segment.

Switches: are electronic components that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another.

Routers: A router is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions between networks and on the global Internet. Data sent through a network, such as a web page or email, is in the form of data packets.

Star Topology: Star topology is a network topology in which each network component is physically connected to a central node such as a router, hub or switch.

In a star topology, the central hub acts like a server and the connecting nodes act like clients. When the central node receives a packet from a connecting node, it can pass the packet on to other nodes in the network. A star topology is also known as a star network.

Ring Topology: Ring topology is a type of network topology in which each device is connected to two other devices on either side via an RJ-45 cable or coaxial cable. This forms a circular ring of connected devices which gives it its name.

Data is commonly transferred in one direction along the ring, known as a unidirectional ring. The data is forwarded from one device to the next, until it reaches the intended destination. In a bidirectional ring, data can travel in either direction.

Bus Topology: Alternatively called line topology, bus topology is a network setup where each computer and network device is connected to a single cable or backbone. Depending on the type of computer network card, a coaxial cable or an RJ-45 network cable is used to connect them together.

Mesh Topology: A mesh topology is a network setup where each computer and network device is interconnected with one another. This topology setup allows for most transmissions to be distributed even if one of the connections goes down. It is a topology commonly used for wireless networks. Below is a visual example of a simple computer setup on a network using a mesh topology.

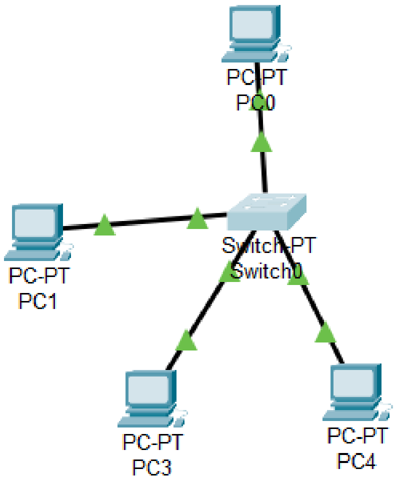
Tree Topology- Tree topology is a sort of structure in which each node is related to the others in a hierarchy. In a topological hierarchy, there are at least three distinct levels. Sometimes it is also called hierarchical topology as in this topology, all elements are arranged like the branches of a tree. It is a lot like the star and bus topologies. Tree topologies are commonly used to arrange data in databases and workstations in corporate networks. In a tree topology, any two linked nodes can only have one mutual connection, hence there can only be one link between them.

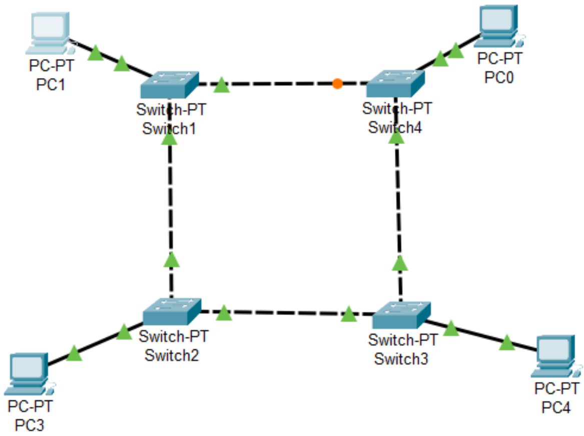
Hybrid Topology-

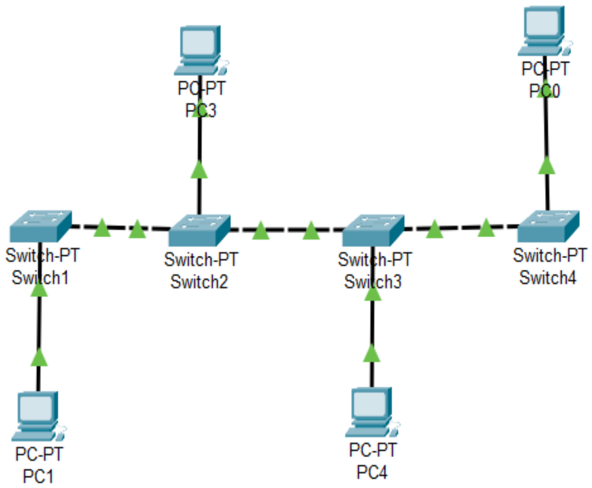
Hybrid topology is an integration of two or more different topologies to form a resultant topology which has many advantages (as well as disadvantages) of all the constituent basic topologies rather than having characteristics of one specific topology.

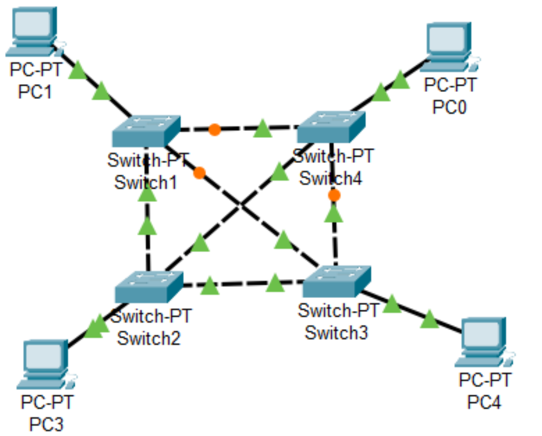
Procedure:-

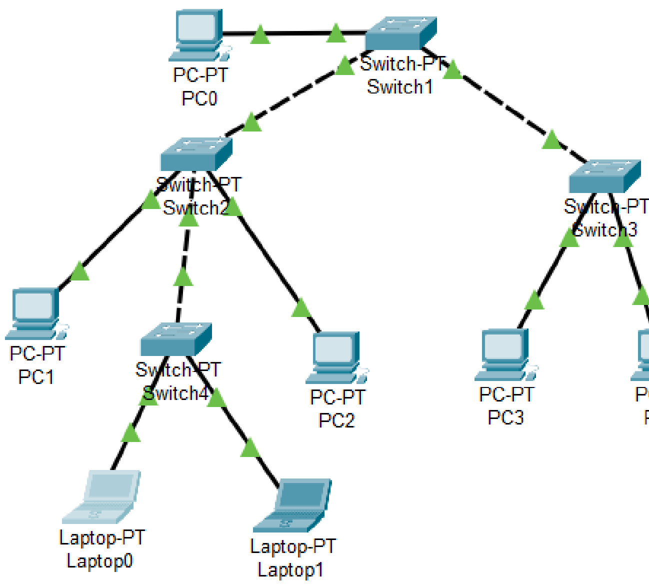
Step 1 - We will select devices and switch according to the required topology as shown in the figure below.



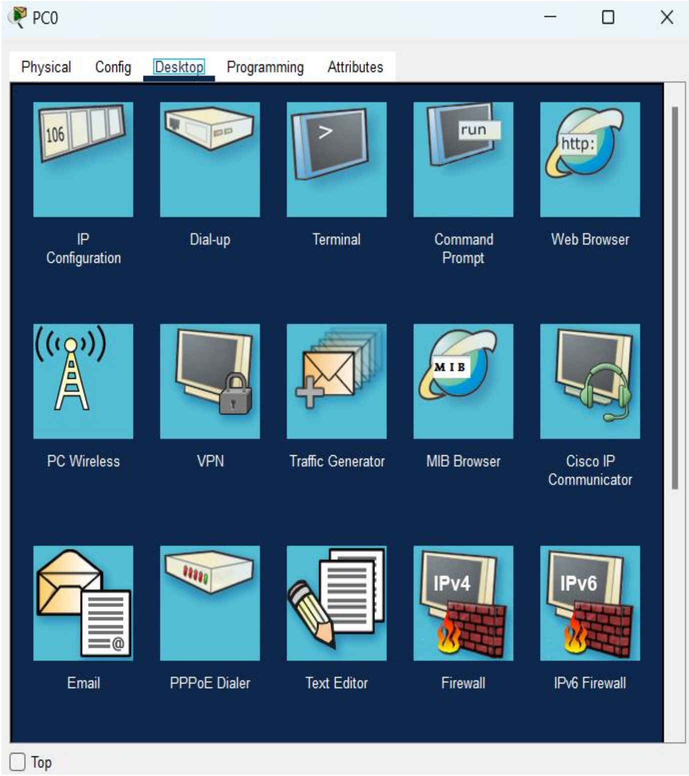




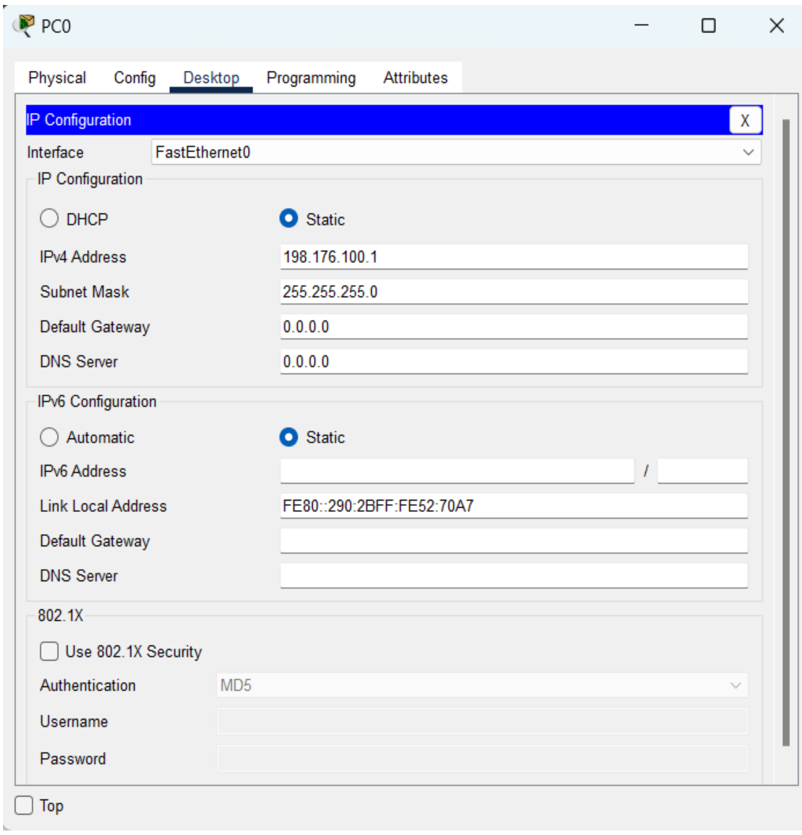




Step 2 - Now, give an IP address to the device by clicking on the devices and selecting desktop from the top and then choosing IP configuration option.

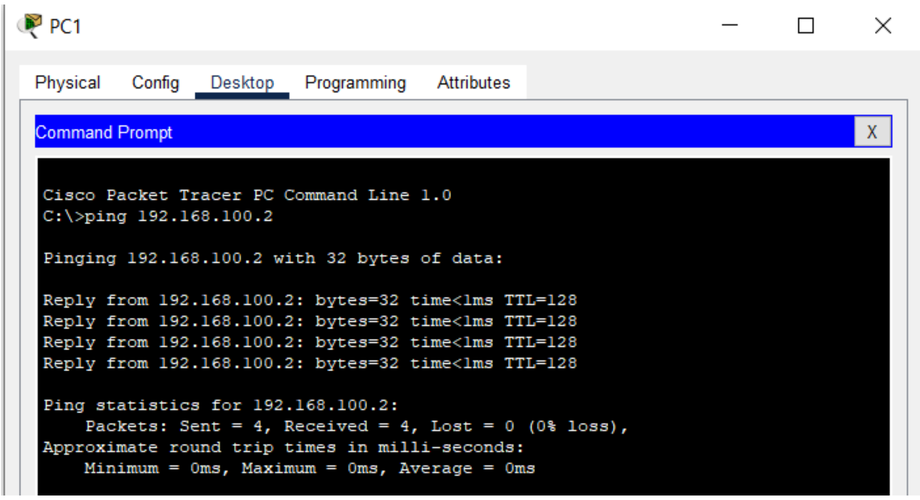


Step 3 - Provide IP address to all the devices.



Step 4 - Now, we will run ping command to check whether the reply id coming from the target device or not and if reply successfully comes then it means all connections are properly connected.

Syntax for ping command - *ping <ip address_target>*



Experiment No. 4

Aim:-

Basic commands of Routers: hostname, password, Show Run, Show IP int brief, Assigning IP addresses to interfaces

Material Required:-

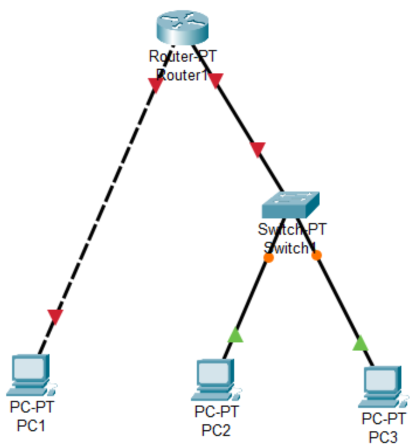
Cisco packet tracer tool installed on your machine.

Theory:-

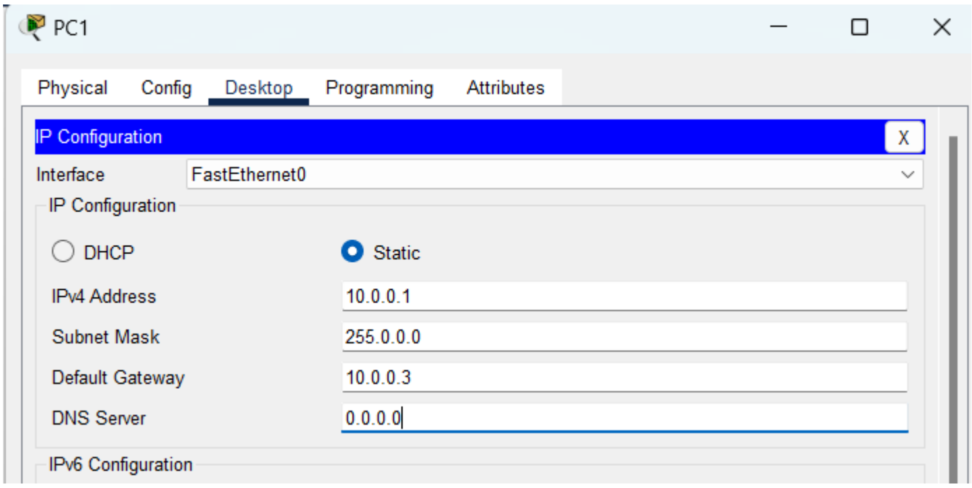
Routers guide and direct network data, using packets that contain various kinds of data—such as files, communications, and simple transmissions like web interactions.The data packets have several layers, or sections, one of which carries identifying information such as sender, data type, size, and most importantly, the destination IP (Internet protocol) address. The router reads this layer, prioritizes the data, and chooses the best route to use for each transmission.

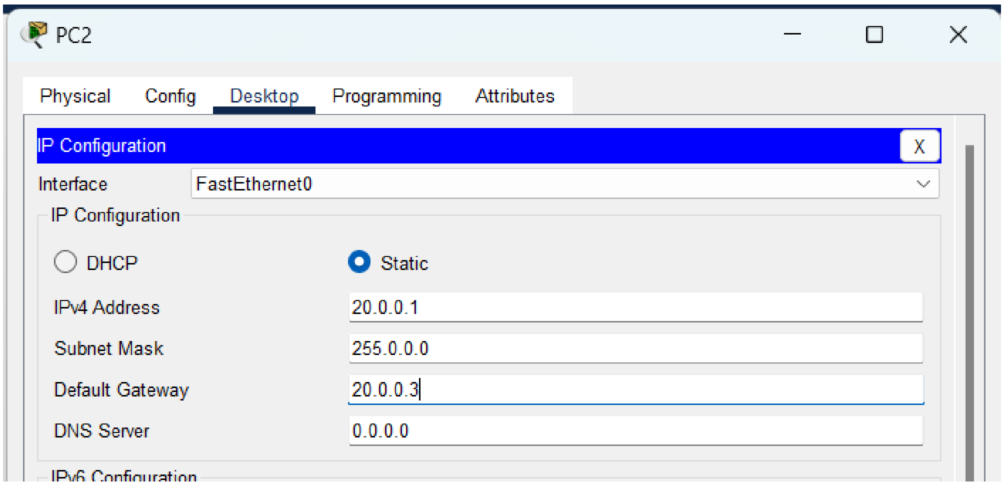
Procedure:-

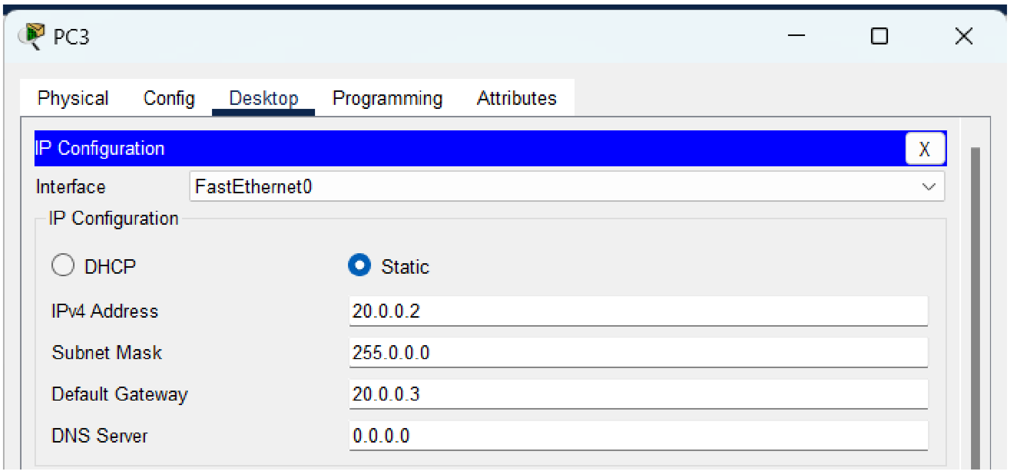
1. First make connections as shown in the figure.



2. Next give ip addresses and the gateway address to all the 3 pcs.







3. Different modes in router are:-

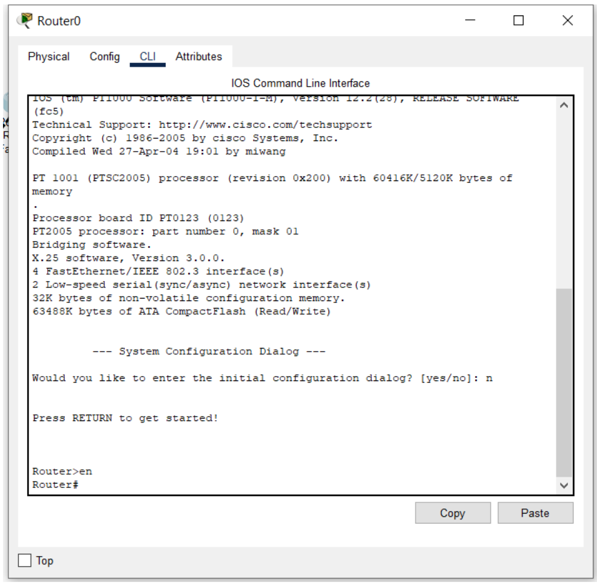
1) User Execution Mode

2) Configuration/privilege Mode

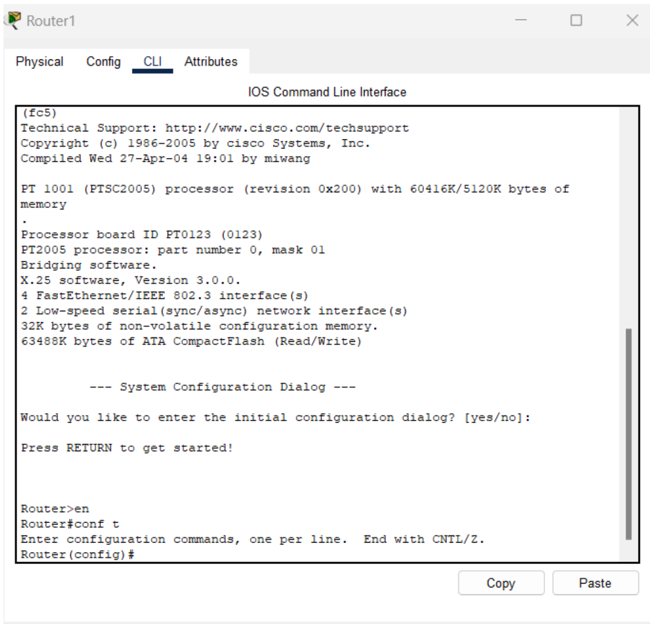
3) Global Conf Mode

4) Subconf Mode

- User Execution Mode - Enable router with the help of *en* command

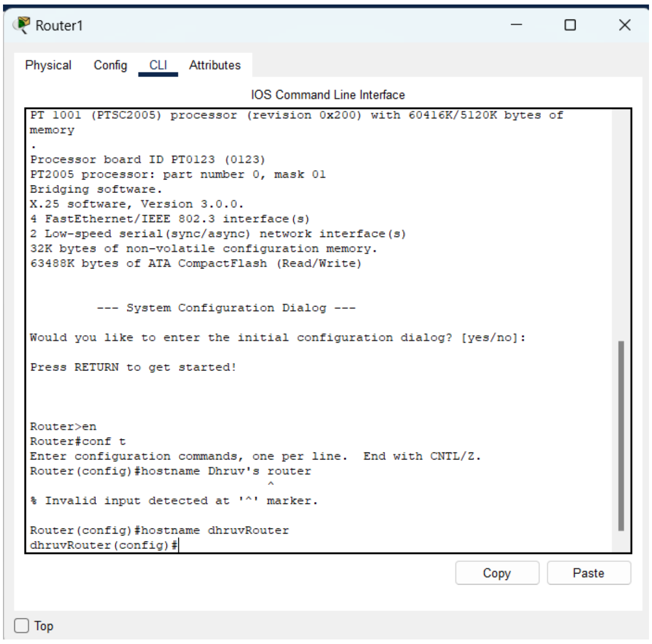


- Configuration/privilege mode - Enter command as *conf t* to enable configuration or privilege mode.



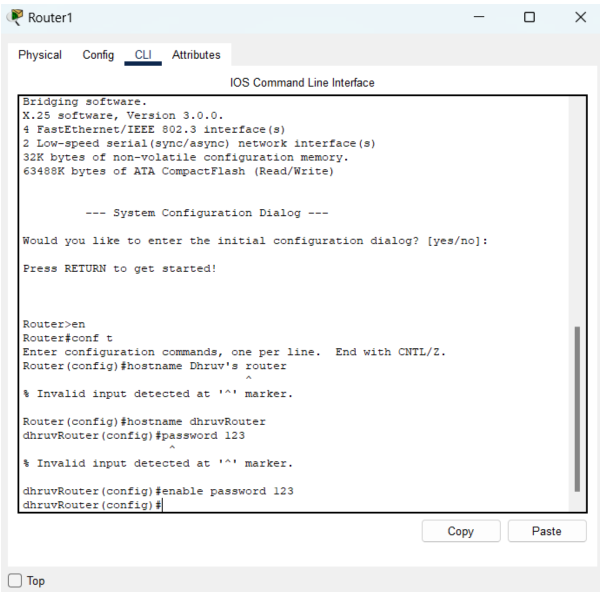
- <u>Commands in router:-</u>

  Change name of your router – *hostname <name>*



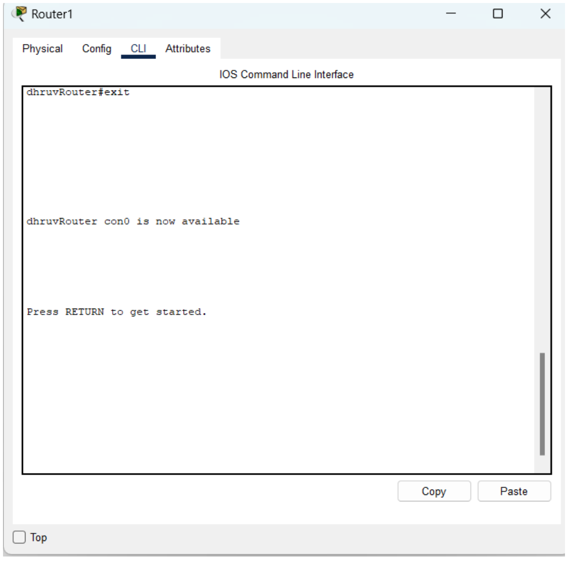
- Add Password –

- To set a password for your router – *enable password <abc>*

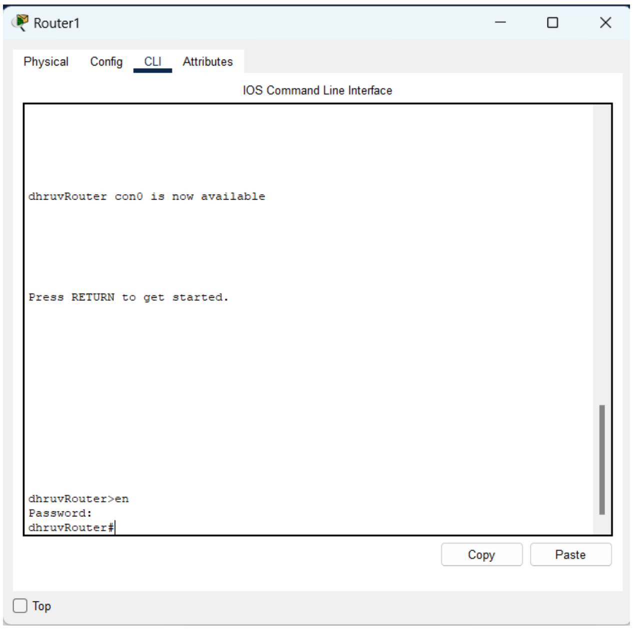


–

To return back, use *exit* command as shown below:



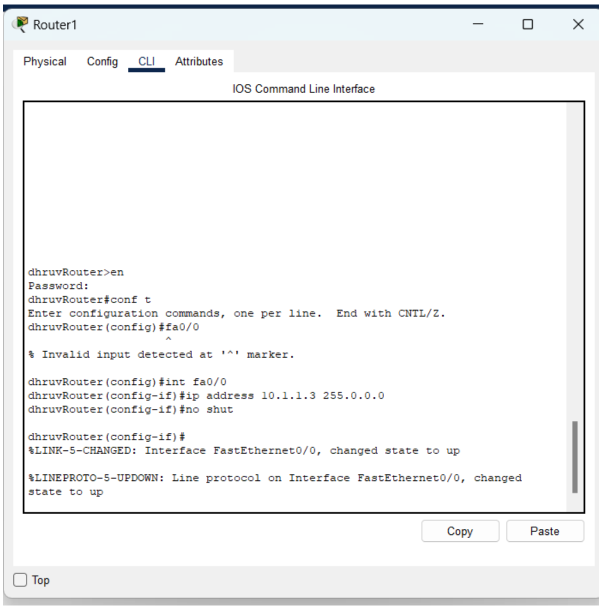
After exit if we start enabling again it asks password set by us previously.

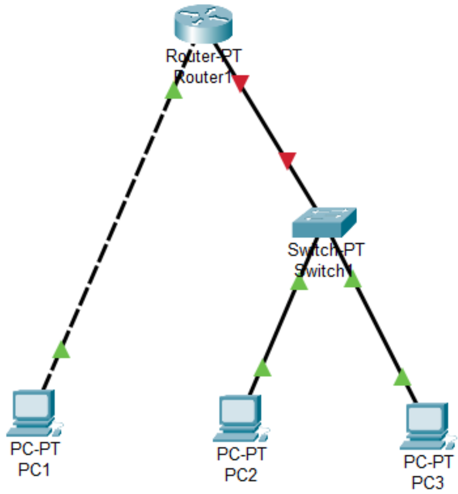


4. Configure ports of router:-
   1)Fast ethernet 0/0

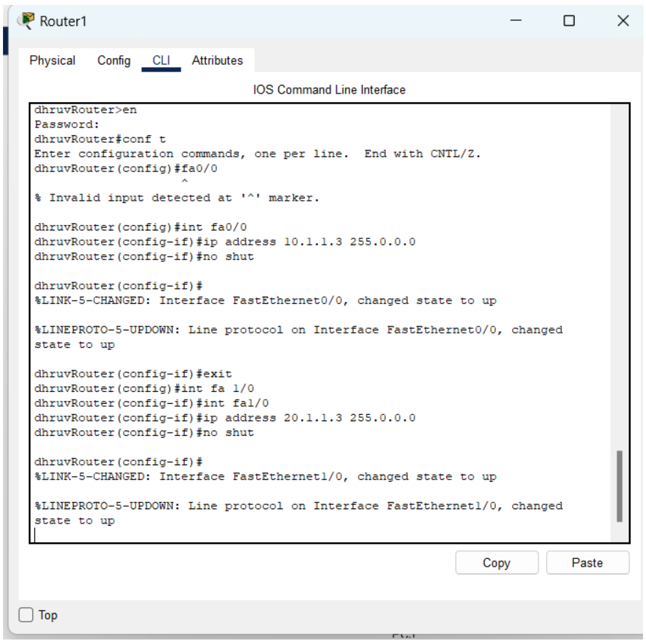
   2) Fast ethernet 1/0

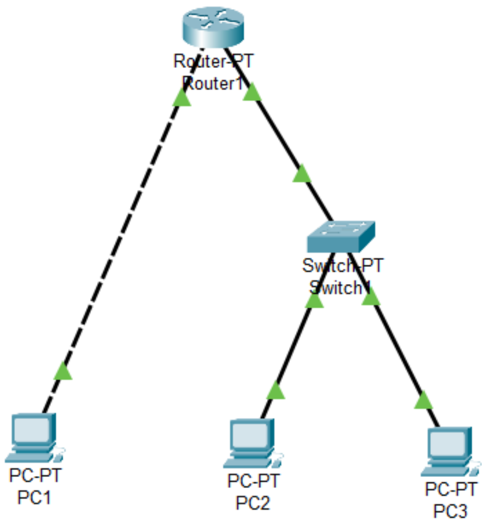
- 1st port running successfully–


Router1
Physical
Config
CLI
Attributes
IOS Command Line Interface
dhruvRouter>en
Password:
dhruvRouter#conf t
Enter configuration commands, one per line. End with CNTL/Z.
dhruvRouter(config)#fa0/0
^
% Invalid input detected at '^' marker.
dhruvRouter(config)#int fa0/0
dhruvRouter(config-if)#ip address 10.1.1.3 255.0.0.0
dhruvRouter(config-if)#no shut
dhruvRouter(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
Copy
Paste
Top


Router-PT
Router1
Switch-PT
Switch1
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3

- 2nd Port –


Router1
Physical
Config
CLI
Attributes
IOS Command Line Interface
dhruvRouter>en
Password:
dhruvRouter#conf t
Enter configuration commands, one per line. End with CNTL/Z.
dhruvRouter(config)#fa0/0
^
% Invalid input detected at '^' marker.
dhruvRouter(config)#int fa0/0
dhruvRouter(config-if)#ip address 10.1.1.3 255.0.0.0
dhruvRouter(config-if)#no shut
dhruvRouter(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
dhruvRouter(config-if)#exit
dhruvRouter(config)#int fa 1/0
dhruvRouter(config-if)#int fa1/0
dhruvRouter(config-if)#ip address 20.1.1.3 255.0.0.0
dhruvRouter(config-if)#no shut
dhruvRouter(config-if)#
%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
Copy
Paste
Top


Router-PT
Router1
Switch-PT
Switch1
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3

Experiment No. 5

Aim:-

To do peer to peer connectivity, assign the IP address and share the resources.

Material Required:-

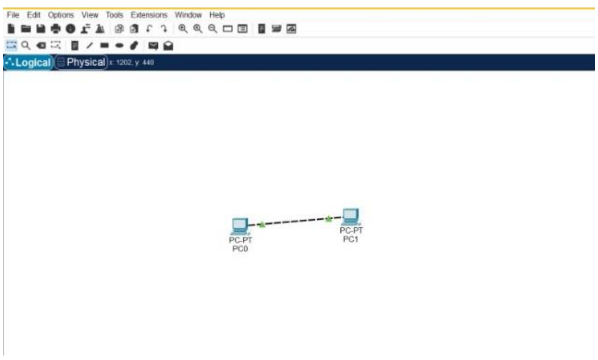
2 PCs and cross over cable.

Theory:-

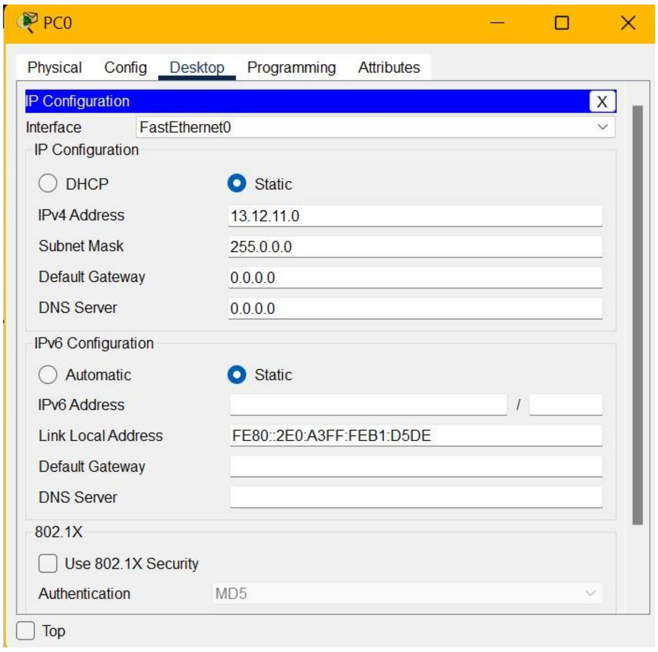
A peer-to-peer network is a simple network of computers. It first came into existence in the late 1970s. Here each computer acts as a node for file sharing within the formed network. Here each node acts as a server and thus there is no central server in the network. This allows the sharing of a huge amount of data. The tasks are equally divided amongst the nodes. Each node connected in the network shares an equal workload. For the network to stop working, all the nodes need to individually stop working. This is because each node works independently.

Procedure-

1. Take 2 pc's in cisco packet tracer.
2. Connect the pc's with cross over cable.

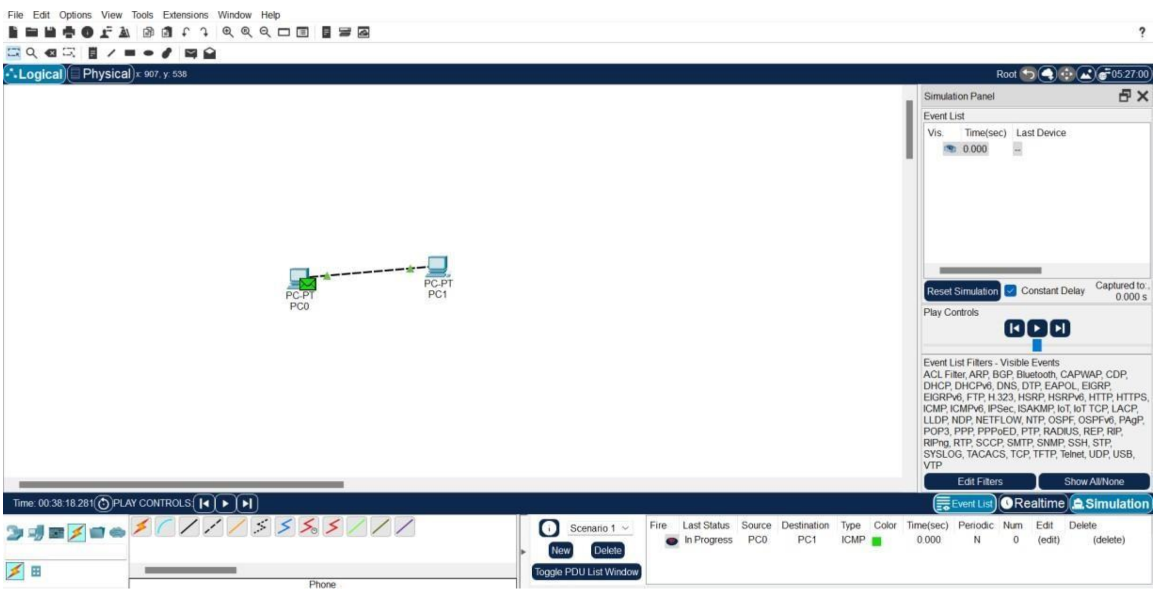


3. Click on pc and go to desktop and then to ip configuration and configure all pc's by assigning them ip addresses. Repeat the same for the second pc.

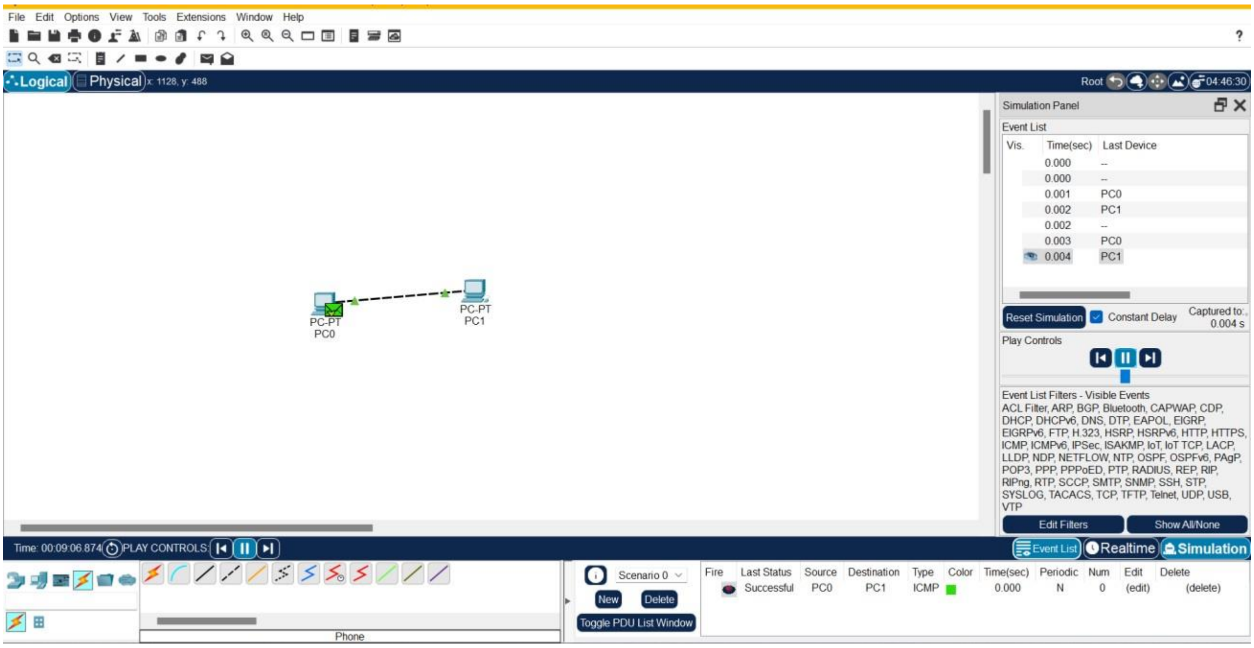


Simulation of peer to peer:

1. Select the simulation option in the cisco packet tracer.
2. Drop a PDU on source and target PC



3. Click on play and wait for packet to reach the target pc successfully i.e. last status shows Successful.



Real-time for router:

1. Click on the source PC and go to command prompt.
2. Write the command ping *ip address of target pc*.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 13.12.11.1

Pinging 13.12.11.1 with 32 bytes of data:

Reply from 13.12.11.1: bytes=32 time<1ms TTL=128
Reply from 13.12.11.1: bytes=32 time<1ms TTL=128
Reply from 13.12.11.1: bytes=32 time<1ms TTL=128
Reply from 13.12.11.1: bytes=32 time<1ms TTL=128

Ping statistics for 13.12.11.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

1. If we receive a reply this means they are connected.

Result- Peer to Peer network is created.

Experiment No. 6

Aim:-

Subnetting with Class A, B, C with different IP addresses.

Material Required:-

Cisco Packet Tracer Tool installed.

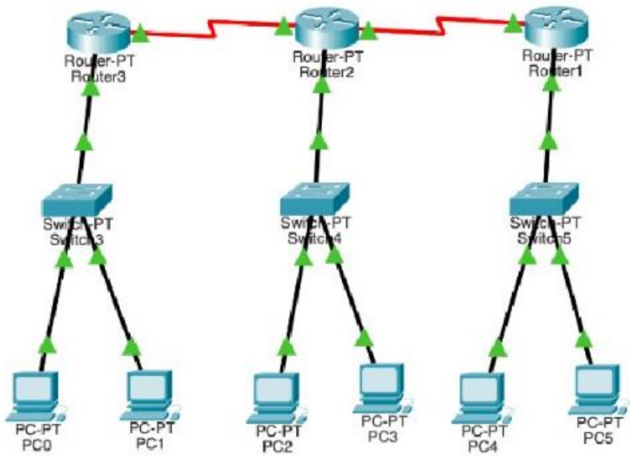
Theory:-

An IP subnet, often called a subnetwork, is a subdivision of an IP network. Subnets are implemented by borrowing bits from the host end of an IP address in order to divide the larger network into smaller subnetworks. Classes A, B, and C of subnetworks are used the most often by different networks.

- Class A networks use a default subnet mask of 255.0.0.0 and have 0-127 as their first octet.
- Class B networks use a default subnet mask of 255.255.0.0 and have 128-191 as their first octet.
- Class C networks use a default subnet mask of 255.255.255.0 and have 192223 as their first octet.

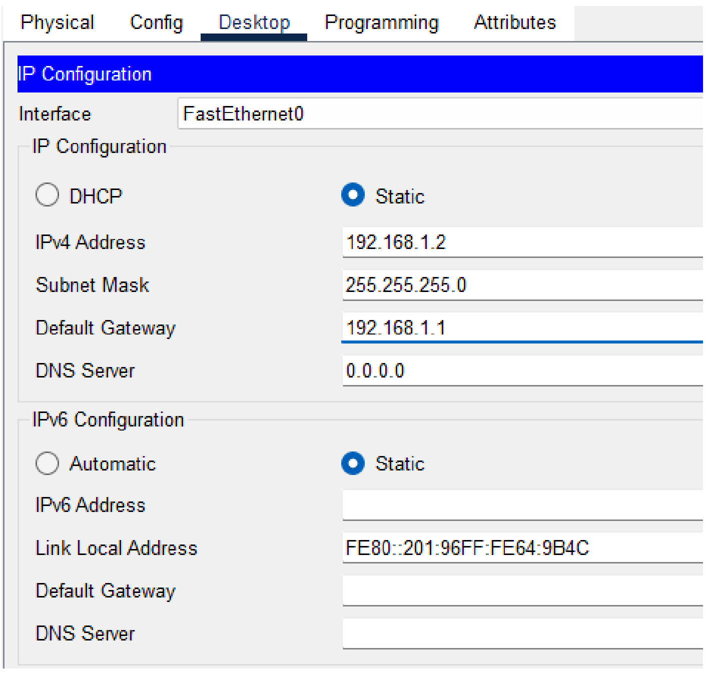
Procedure:-

1. Select 6 PCs, 3 switches and 3 routers (PT-Router). Connect them using the 'Automatically choose connection type' option in Connections as the given figure.



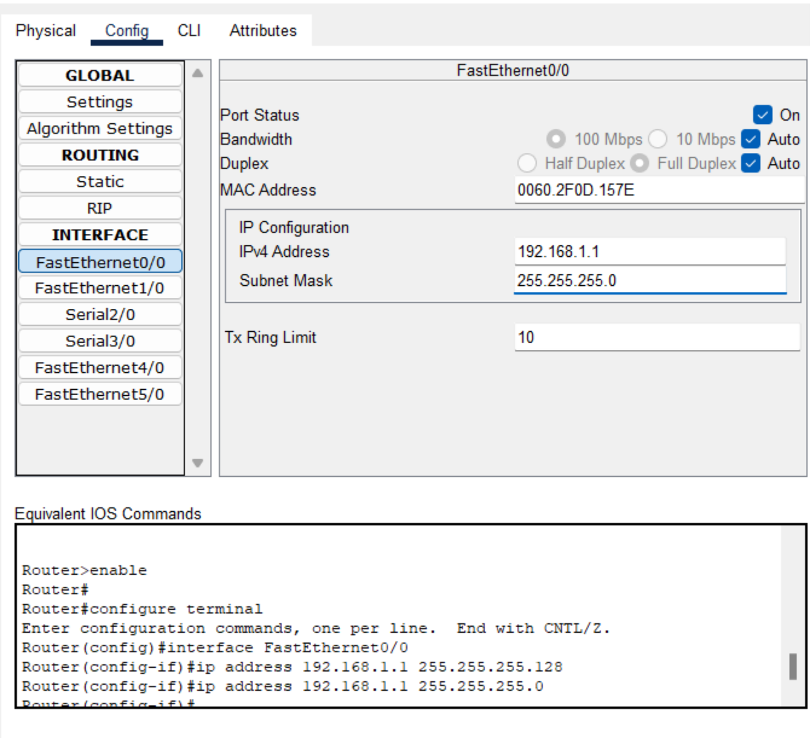
2. Configure all the PCs with their IP address, subnet and default gateway.

	IP Address	Subnet Mask	Default Gateway
PC0	192.168.1.2	255.255.255.0	192.168.1.1
PC1	192.168.1.3	255.255.255.0	192.168.1.1
PC2	192.168.2.2	255.255.255.0	192.168.2.1
PC3	192.168.2.3	255.255.255.0	192.168.2.1
PC4	192.168.3.2	255.255.255.0	192.168.3.1
PC5	192.168.3.3	255.255.255.0	192.168.3.1

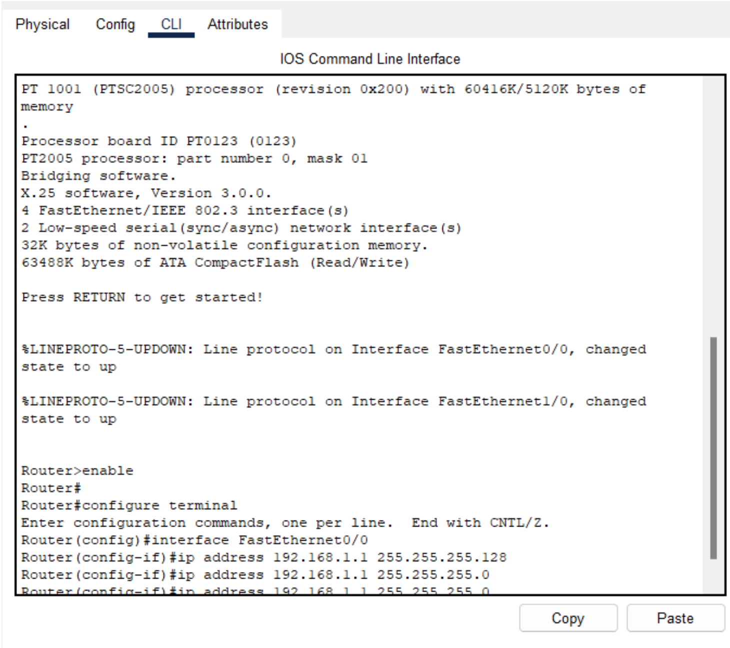


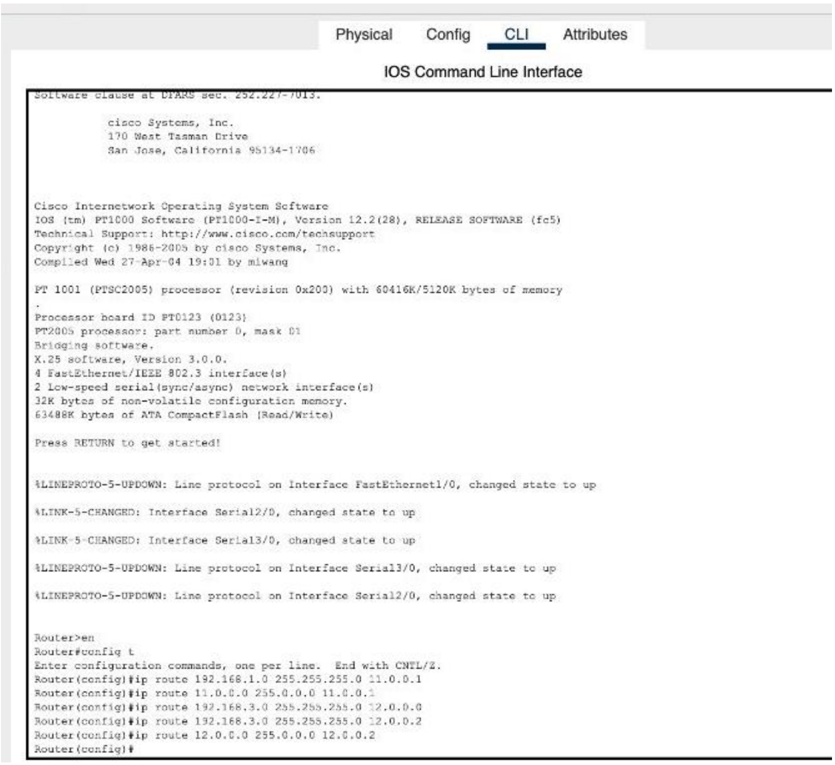
3. Configure the routers with IP Address and subnet mask.

	Interface	IP Address	Subnet Mask
Router0	FastEthernet0/0	192.168.1.1	255.255.255.0
	Serial 2/0	11.0.0.1	255.0.0.0
Router1	Serial 2/0	11.0.0.2	255.0.0.0
	Serial 3/0	12.0.0.1	255.0.0.0
Router2	FastEthernet0/0	192.168.3.1	255.255.255.0
	Serial 2/0	12.0.0.2	255.0.0.0



4. After configuring all devices, assign the routes toh the routers. For this open the command line interface of each router and write ip route <network id> <subnet mask> <next hop> The routes of all the three routers are given below:





5. Verify the connection between any PC using ping.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.100.2

Pinging 192.168.100.2 with 32 bytes of data:

Reply from 192.168.100.2: bytes=32 time=1ms TTL=128
Reply from 192.168.100.2: bytes=32 time=1ms TTL=128
Reply from 192.168.100.2: bytes=32 time<1ms TTL=128
Reply from 192.168.100.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.100.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Experiment No. 7

Aim:-

Subnetting of Class A, B and C using FLSM.

Material Required:-

Cisco Packet Tracer Tool installed.

Theory:-

Subnetting in FLSM (Fixed Length Subnet Mask) refers to the process of dividing a larger network into smaller subnetworks or subnets, each with its own unique network address and subnet mask. In FLSM, the subnet mask for all subnets is fixed, meaning that each subnet has the same number of hosts. For example, if a network has a subnet mask of 255.255.255.0, each subnet will have up to 254 hosts.

To subnet a network in FLSM, you need to determine the number of subnets required and the number of hosts needed for each subnet. This will help you calculate the subnet mask and the network address for each subnet. For example, if you have a network with the IP address 192.168.1.0 and you want to create four subnets with 30 hosts each, you would need to use a subnet mask of 255.255.255.224. This would give you four subnets with network addresses of:

192.168.1.0/27

192.168.1.32/27

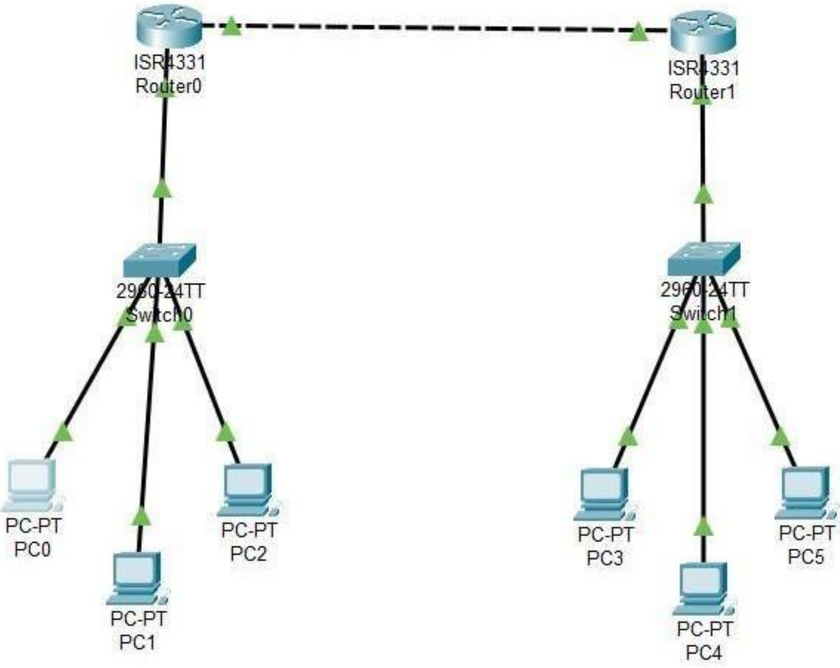
192.168.1.64/27

192.168.1.96/27

Each subnet would have up to 30 hosts, and the remaining addresses in each subnet would be reserved for network and broadcast addresses.

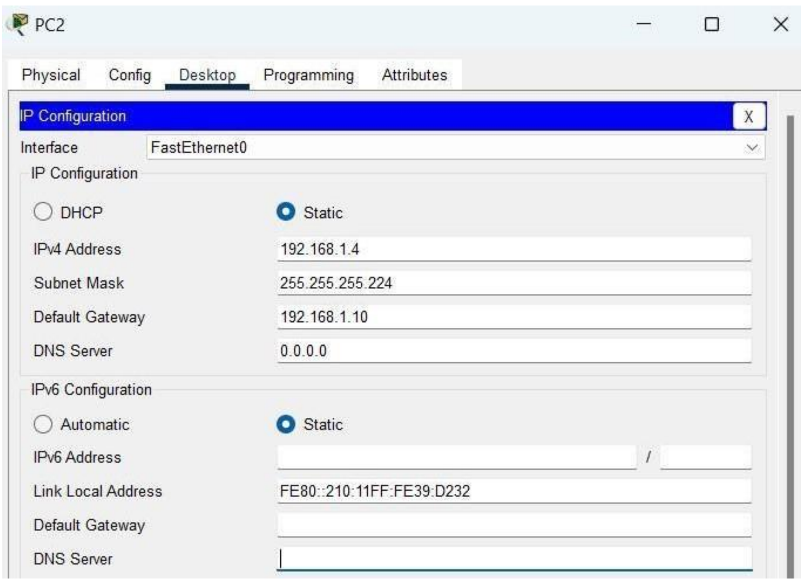
Procedure:-

Step 1: First, open the cisco packet tracer desktop and select 3 PCs, 3 Switches, 3Routers.



Step 2: Configure the PCs (hosts) with IPv4 address and Subnet Mask

- To assign an IP address in PC2, click on PC2.
- Then, go to desktop and then IP configuration and there you will IPv4configuration.
- Add IPv4 address and subnet mask.

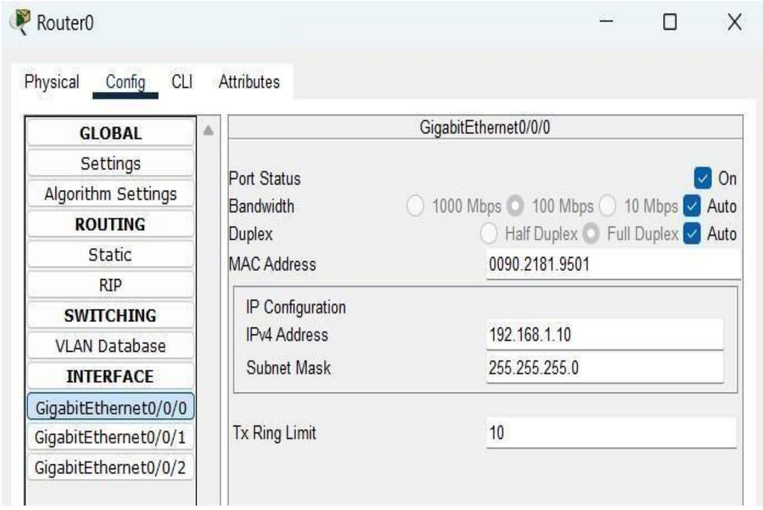


Step 3: Configure router with IP address and subnet mask.

- To assign an IP address in router0, click on router0.
- Then, go to config and then Interfaces.
- Then, configure the IP address in Fast Ethernet

and serial ports

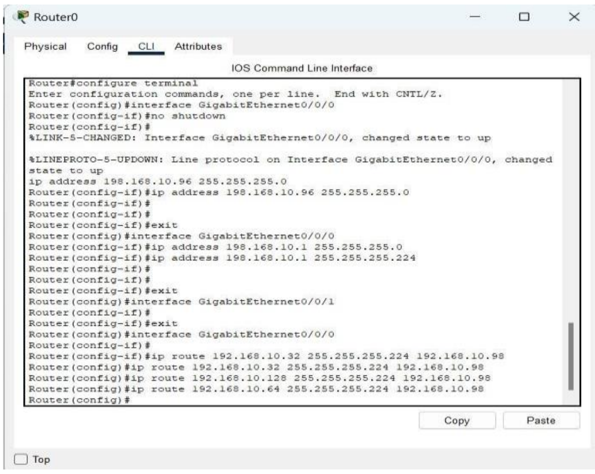
- Add IPv4address and subnet mask.



- Repeat the same procedure with other routers to configure themthoroughly.

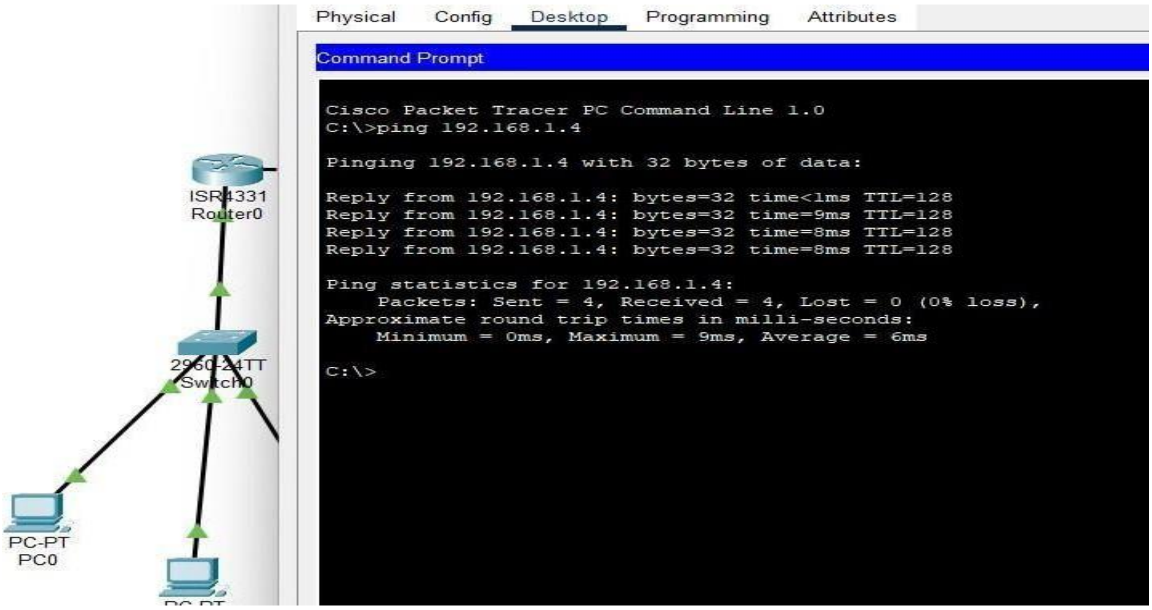
Step 4: After configuring all of the devices we need to assign the routes to the routers.
To assign static routes to the particular router

- First, click on router0 then Go to CLI.
- Then type the commands and IP information given below.



- then type ping <IP address of targeted node>
- as we can see in the below image, we are getting replies which means theconnection is working very fine

Example: ping 192.168.1.4


Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.4
Pinging 192.168.1.4 with 32 bytes of data:
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=9ms TTL=128
Reply from 192.168.1.4: bytes=32 time=8ms TTL=128
Reply from 192.168.1.4: bytes=32 time=8ms TTL=128
Ping statistics for 192.168.1.4:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 9ms, Average = 6ms
C:\>
ISR4331
Router0
2960-24TT
Switch0
PC-PT
PC0

Experiment No. 8

Aim:-

Subnetting of Class A, B and C using VLSM.

Material Required:-

Cisco Packet Tracer Tool installed.

Theory:-

VLSM stands for Variable Length Subnet Mask where the subnet design uses more than one mask in the same network which means more than one mask is used for different subnets of a single class A, B, C or a network. It is used to increase the usability of subnets as they can be of variable size. It is also defined as the process of subnetting of a subnet.

In VLSM, subnets use block size based on requirement so subnetting is required multiple times. Suppose there is an administrator that has four departments to manage. These are sales and purchase department with 120 computers, development department with 50 computers, accounts department with 26 computers and management department with 5 computers.

If the administrator has IP 192.168.1.0/24, department wise IPs can be allocated by following these steps:

1. For each segment select the block size that is greater than or equal to the actual requirement which is the sum of host addresses, broadcast addresses and network addresses. Make a list of subnets possible:

SLASH NOTATION	HOSTS/SUBNETS
/24	254
/25	126
/26	62
/27	30
/28	14
/29	6
/30	2

table – possible subnets list

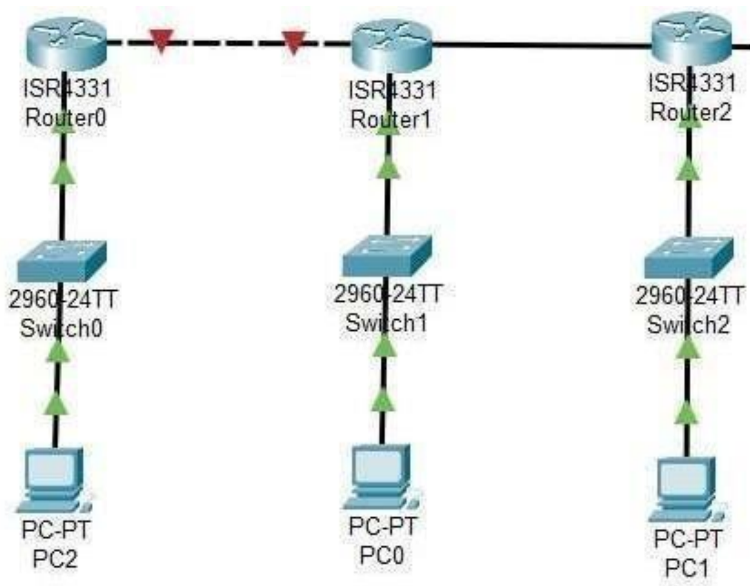
2. Arrange all the segments in descending order based on the block size that is from highest to lowest requirement.
3. Sales and Purchase: 120
4. Development :50
   Accounts :26
   Management :5

Procedure-

1. The highest IP available has to be allocated to highest requirement so the sales and purchase department gets 192.168.1.0/25 which has 126 valid addresses that can easily be available for 120 hosts. The subnet mask used is 255.255.255.128
2. The next segment requires an IP to handle 50 hosts. The IP subnet with network number 192.168.1.128/26 is the next highest which can be assigned to 62 hosts thus fulfilling the requirement of development department. The subnet mask used is 255.255.255.192
3. Similarly, the next IP subnet 192.168.1.192/27 can fulfill the requirements of the accounts department as it has 30 valid hosts IP which can be assigned to 26 computers. The mask used is 255.255.255.224
4. The last segment requires 5 valid hosts IP which can be fulfilled by the subnet 192.168.1.224/29 which has the mask as 255.255.255.248 is chosen as per the requirement. The IP with the mask 255.255.255.240 could be chosen but it has 14 valid host IPs and the requirement is less in comparison so the one that is comparable with the requirement is chosen. Thus, there is less IP wastage in VLSM as compared to FLSM.

Steps to Configure and Verify VLSM:

Step 1: First, open the cisco packet tracer desktop and select 3 PCs, 3 Switches, 3 Routers.



Step 2: Configure the PCs (hosts) with IPv4 address and Subnet Mask to assign an IP address in PC2, click on PC2.

- Then, go to desktop and then IP configuration and there you will IPv4 configuration.
- Add IPv4 address and subnet mask.

Step 3: Configure router with IP address and subnet mask.

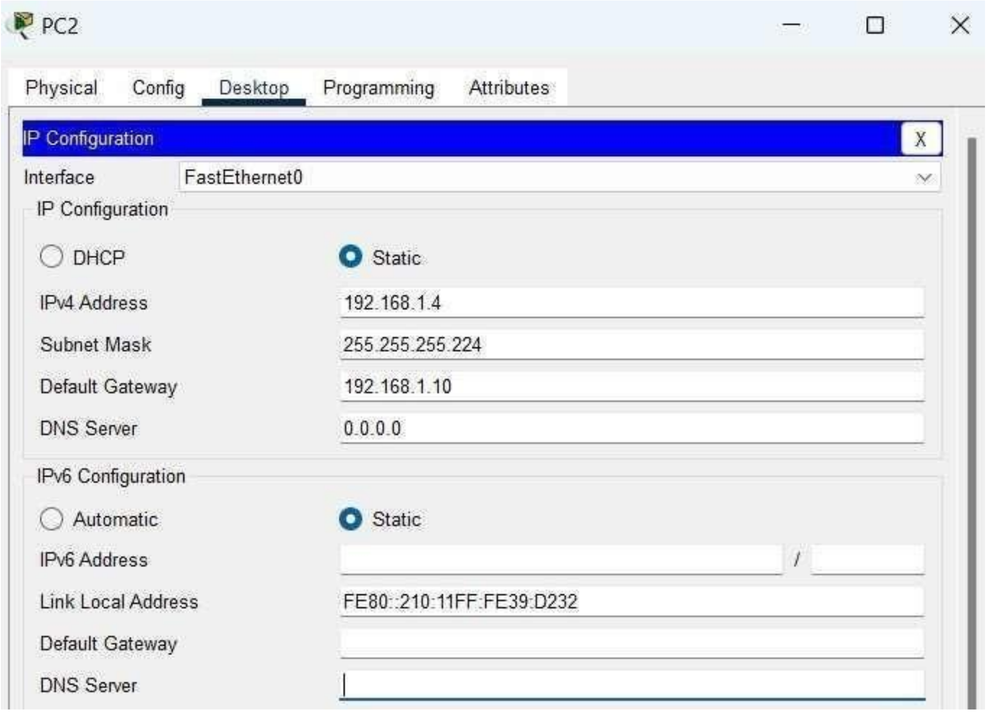
- To assign an IP address in router0, click on router0.
- Then, go to config and then Interfaces.
- Then, configure the IP address in Fast Ethernet and serial ports Add IPv4 address and subnet mask.
- Repeat the same procedure with other routers to configure them thoroughly.

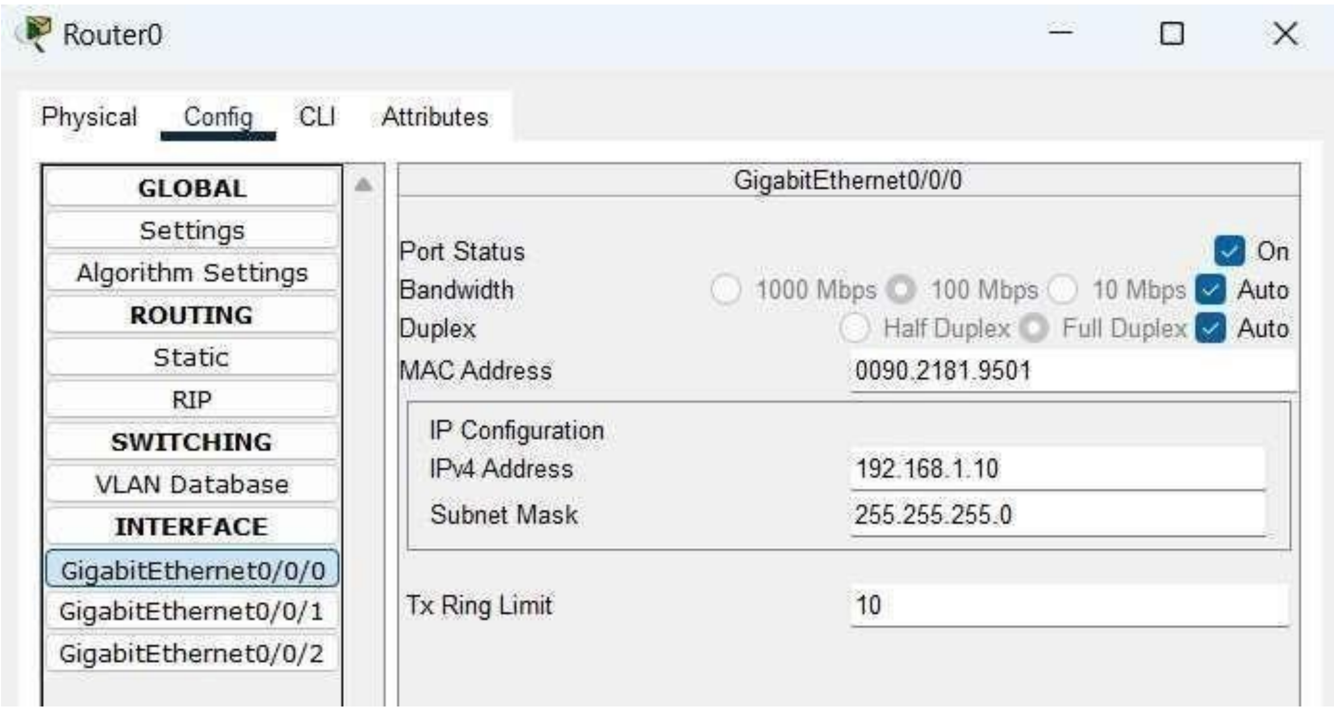
Step 4: After configuring all of the devices we need to assign the routes to the routers. To assign static routes to the particular router:

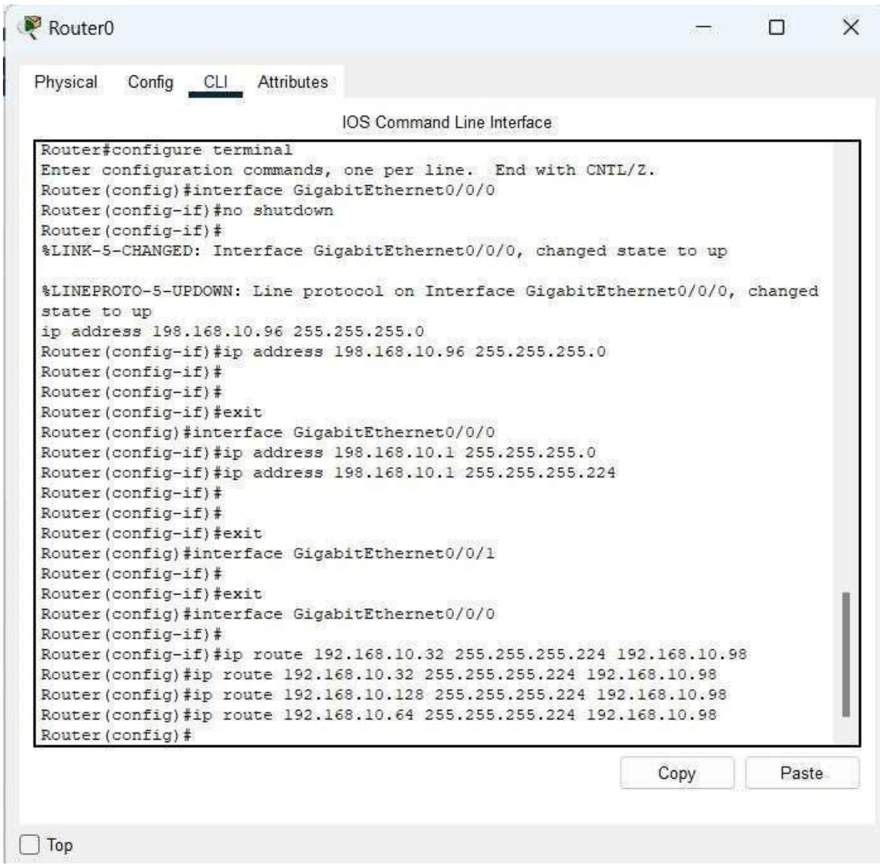
- First, click on router0 then Go to CLI.
- Then type the commands and IP information given below. CLI command: ip route <network id> <subnet mask><next hop>

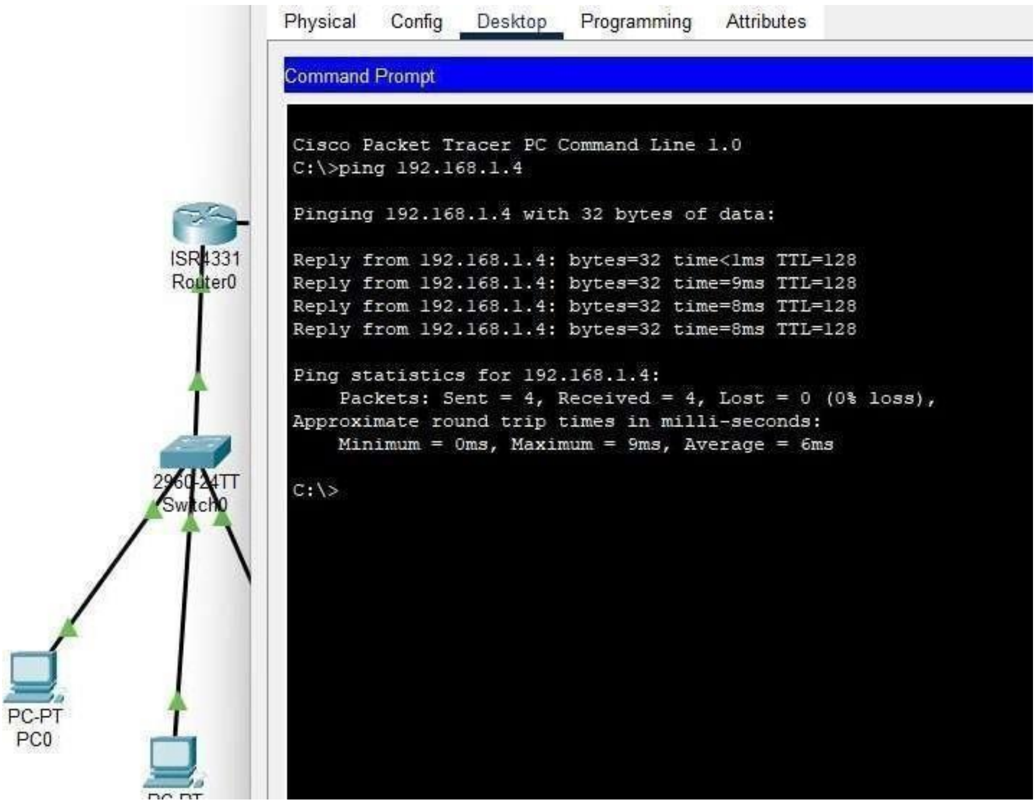
Step 5: Verifying the network by pinging the IP address of any PC. we'll use the ping command to do so.

- First, click on PC0 then Go to the command prompt
- Type ping <IP address of targeted node>
- As we can see in the below image, we are getting replies which means the connection is working very fine.


PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.1.4
Subnet Mask
255.255.255.224
Default Gateway
192.168.1.10
DNS Server
0.0.0.0
IPv6 Configuration
Automatic
Static
IPv6 Address
/
Link Local Address
FE80::210:11FF:FE39:D232
Default Gateway
DNS Server


Router0
Physical
Config
CLI
Attributes
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
INTERFACE
GigabitEthernet0/0/0
GigabitEthernet0/0/1
GigabitEthernet0/0/2
GigabitEthernet0/0/0
Port Status
On
Bandwidth
1000 Mbps
100 Mbps
10 Mbps
Auto
Duplex
Half Duplex
Full Duplex
Auto
MAC Address
0090.2181.9501
IP Configuration
IPv4 Address
192.168.1.10
Subnet Mask
255.255.255.0
Tx Ring Limit
10


Router0
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up
ip address 198.168.10.96 255.255.255.0
Router(config-if)#ip address 198.168.10.96 255.255.255.0
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#ip address 198.168.10.1 255.255.255.0
Router(config-if)#ip address 198.168.10.1 255.255.255.224
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#
Router(config-if)#ip route 192.168.10.32 255.255.255.224 192.168.10.98
Router(config)#ip route 192.168.10.32 255.255.255.224 192.168.10.98
Router(config)#ip route 192.168.10.128 255.255.255.224 192.168.10.98
Router(config)#ip route 192.168.10.64 255.255.255.224 192.168.10.98
Router(config)#
Copy
Paste
Top


ISR4331
Router0
2960-24TT
Switch0
PC-PT
PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.4
Pinging 192.168.1.4 with 32 bytes of data:
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=9ms TTL=128
Reply from 192.168.1.4: bytes=32 time=8ms TTL=128
Reply from 192.168.1.4: bytes=32 time=8ms TTL=128
Ping statistics for 192.168.1.4:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 9ms, Average = 6ms
C:\>

Experiment No. 9

Aim:-

To Perform Static Routing, Default Routing by using 2 and 3 routers.

Material Required:-

Cisco Packet Tracer Tool installed.

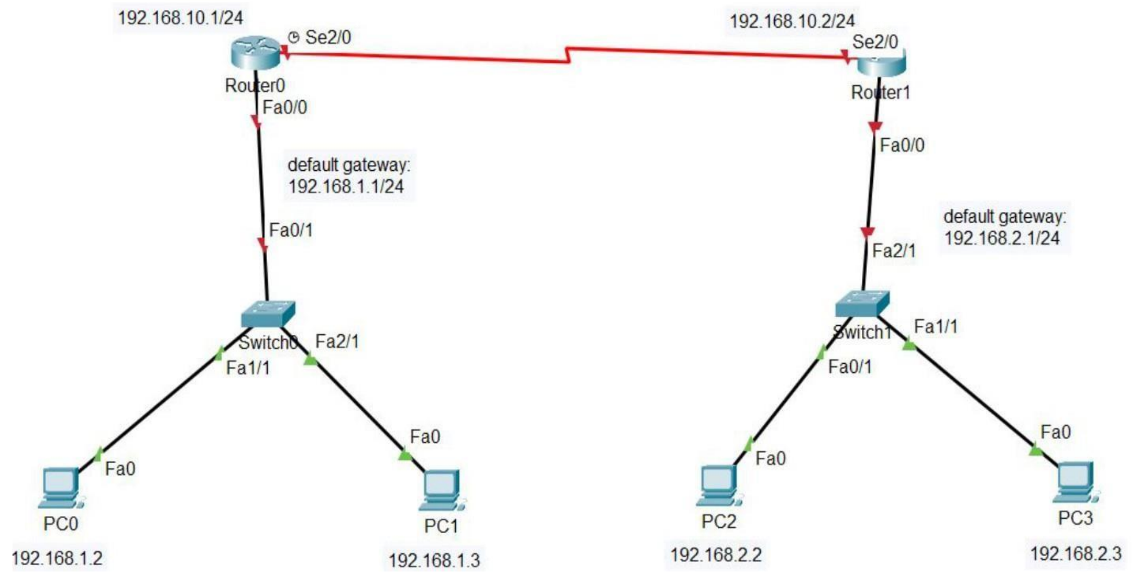
Theory:-

Static routing between two routers is preconfigured manually by the network administrator. It is more effective in smaller networks. As the network size increases, it is difficult to manage every router manually.
Default Routing is a method wherein a router is configured to ship all of the packets to the equal hop tool, and it would not be counted whether or not it belongs to a specific community or not. When the destination network id is unknown to the router, the router will use a default route and will send all the incoming traffic to that route, by default.

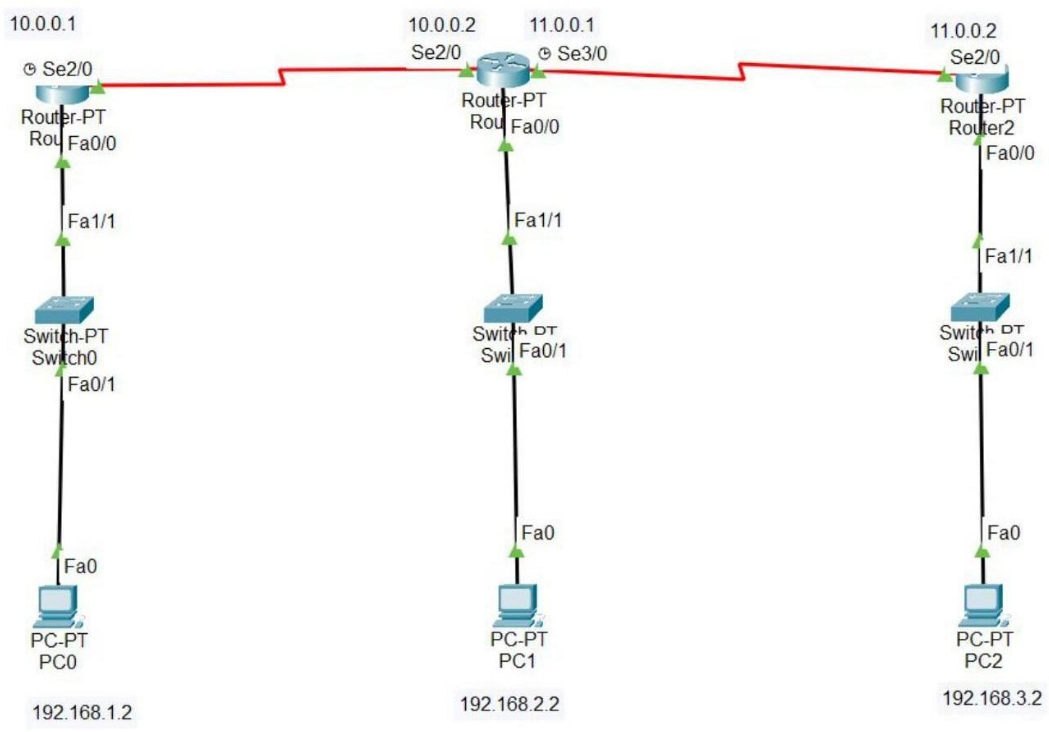
Procedure :-

Step 1: First, create a network topology:

(a)



(b)



Step 2: Configuring Hosts (PCs) with IP addresses and Default Gateway using IP Addressing table given below:

(a)

Device name	IPv4 Address	Subnet Mask	Default Gateway
PC0	192.168.1.2	255.255.255.0	192.168.1.1
PC1	192.168.1.3	255.255.255.0	192.168.1.1
PC2	192.168.2.2	255.255.255.0	192.168.2.1
PC3	192.168.2.3	255.255.255.0	192.168.2.1

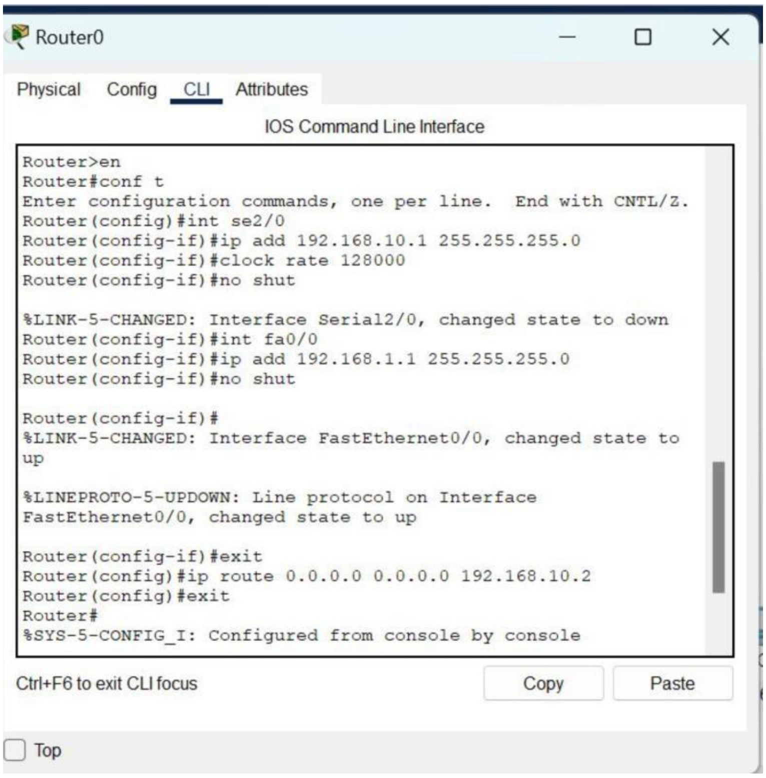
(b)

S.NO	Device	IPv4 Address	Subnet mask	Default gateway
1	pc0	192.168.1.2	255.255.255.0	192.168.1.1
2	pc1	192.168.2.2	255.255.255.0	192.168.2.1
3	pc2	192.168.3.2	255.255.255.0	192.168.3.1

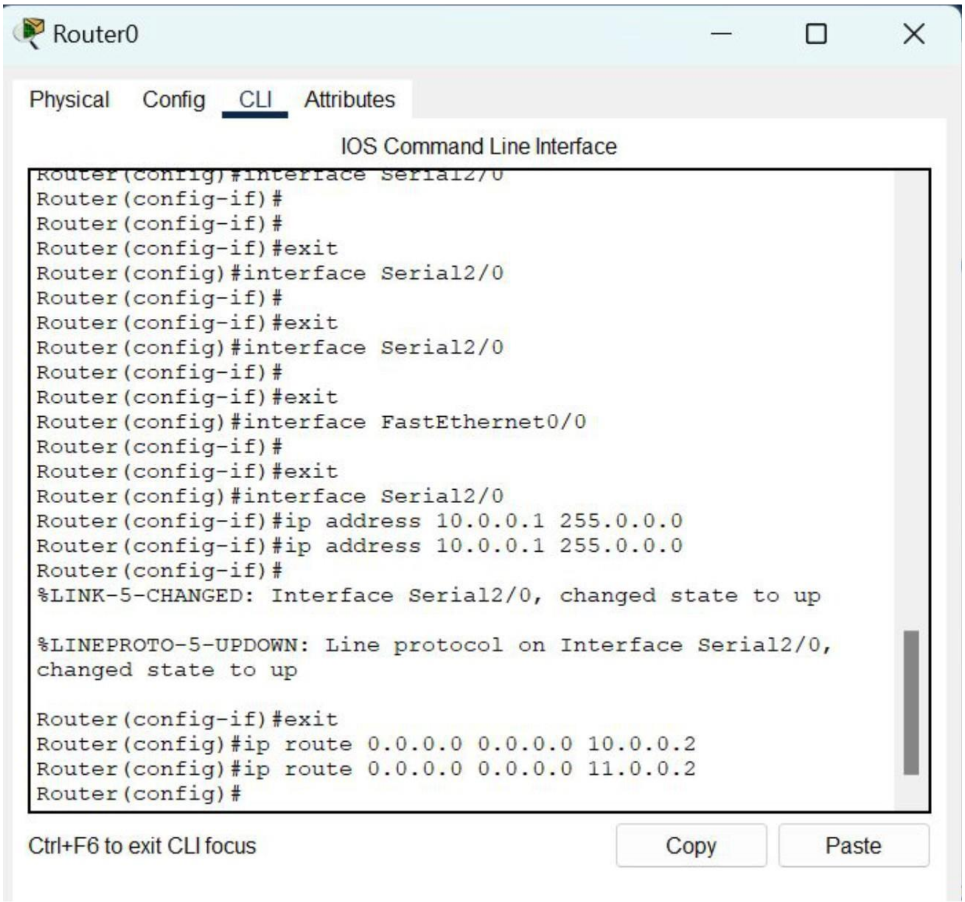
Step 3: Configuring the Interfaces (routers) with IP Addresses and Default gateways and assigning the default routes.

Router0 Configuration:

(a)



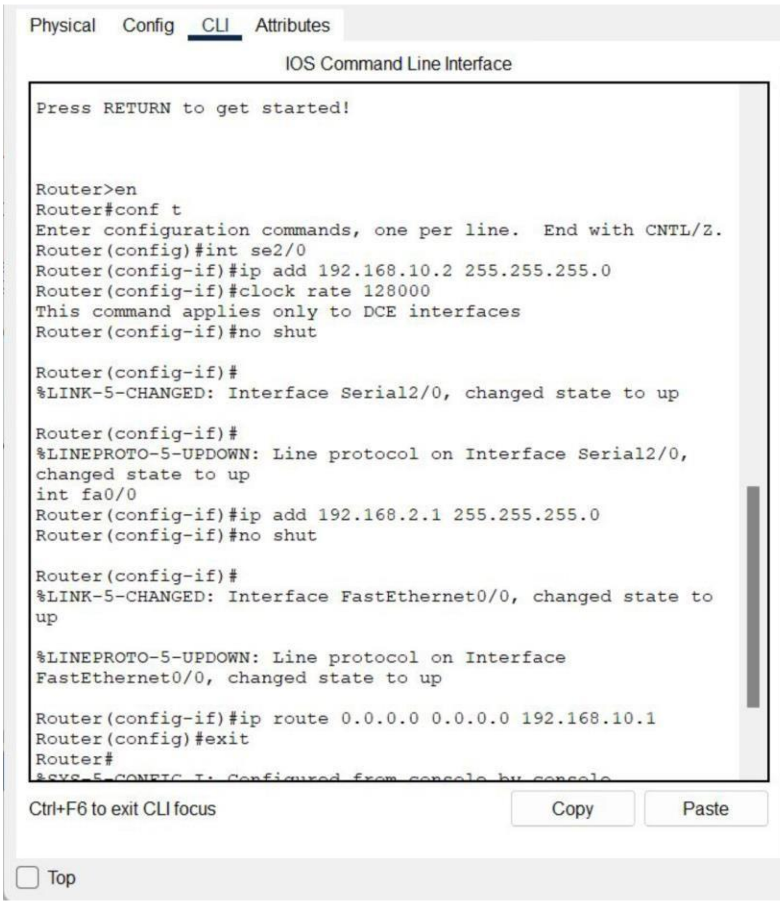
(b)




```
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0,
changed state to up

Router(config-if)#exit
Router(config)#ip route 0.0.0.0 0.0.0.0 10.0.0.2
Router(config)#ip route 0.0.0.0 0.0.0.0 11.0.0.2
Router(config)#
```

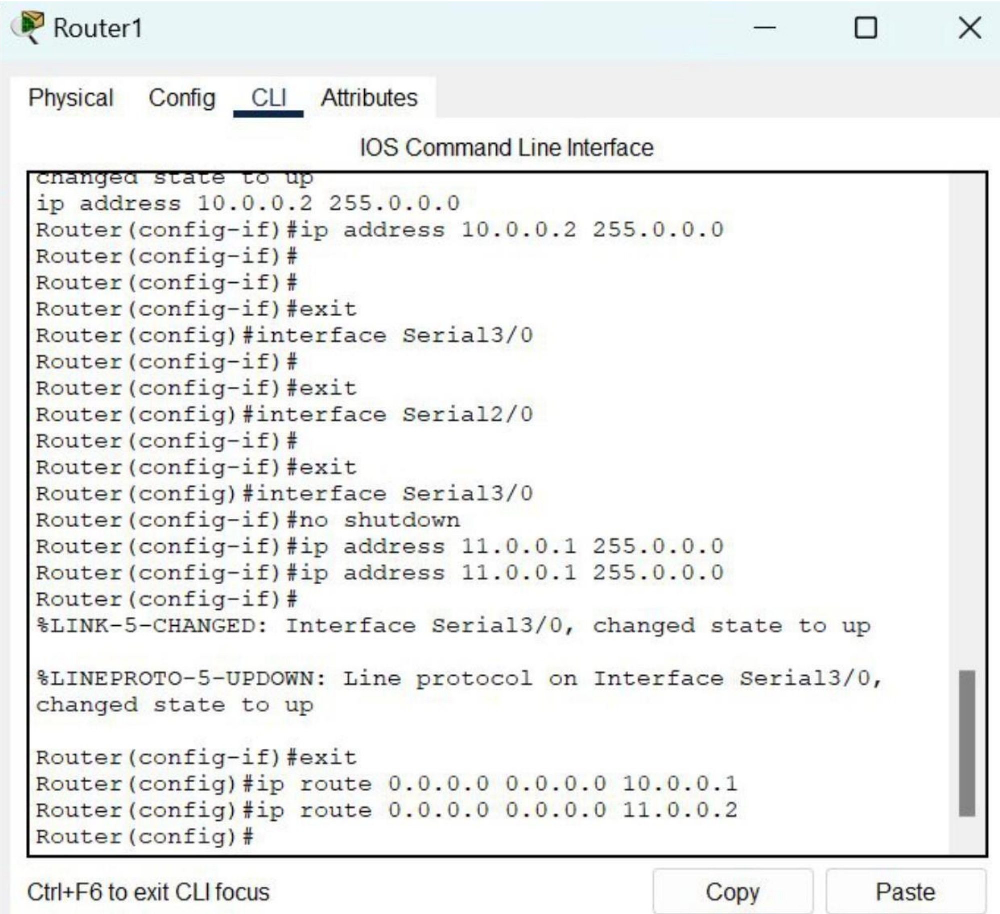
Router1 Configuration:

(a)

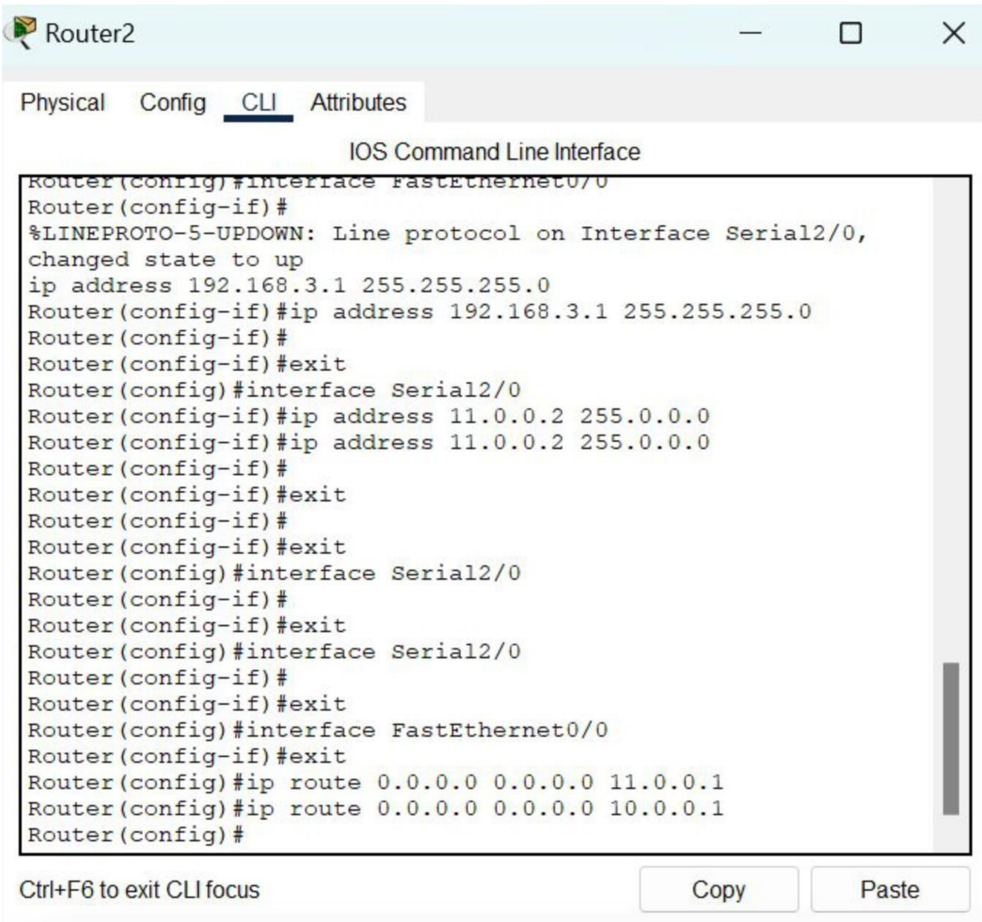



```
Press RETURN to get started!


Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int se2/0
Router(config-if)#ip add 192.168.10.2 255.255.255.0
Router(config-if)#clock rate 128000
This command applies only to DCE interfaces
Router(config-if)#no shut

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
int fa0/0
Router(config-if)#ip add 192.168.2.1 255.255.255.0
Router(config-if)#no shut

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)#ip route 0.0.0.0 0.0.0.0 192.168.10.1
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

(a),(b)

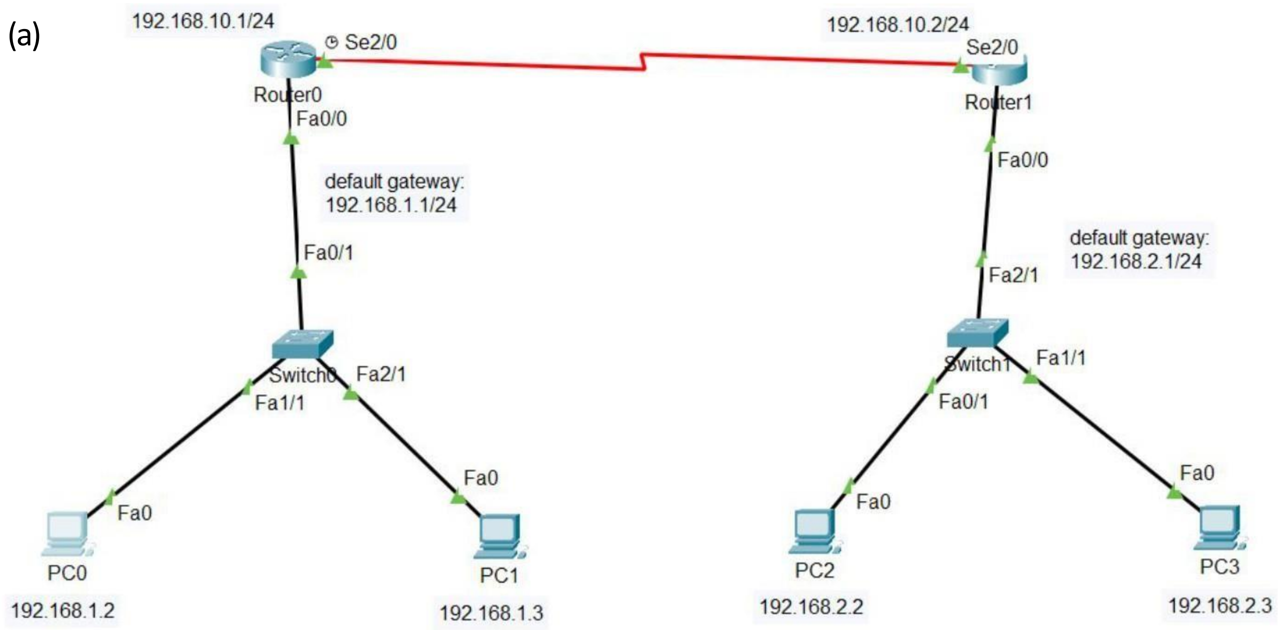

Router1
Physical
Config
CLI
Attributes
IOS Command Line Interface
changed state to up
ip address 10.0.0.2 255.0.0.0
Router(config-if)#ip address 10.0.0.2 255.0.0.0
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial3/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial3/0
Router(config-if)#no shutdown
Router(config-if)#ip address 11.0.0.1 255.0.0.0
Router(config-if)#ip address 11.0.0.1 255.0.0.0
Router(config-if)#
%LINK-5-CHANGED: Interface Serial3/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up
Router(config-if)#exit
Router(config)#ip route 0.0.0.0 0.0.0.0 10.0.0.1
Router(config)#ip route 0.0.0.0 0.0.0.0 11.0.0.2
Router(config)#
Ctrl+F6 to exit CLI focus
Copy
Paste

(b)

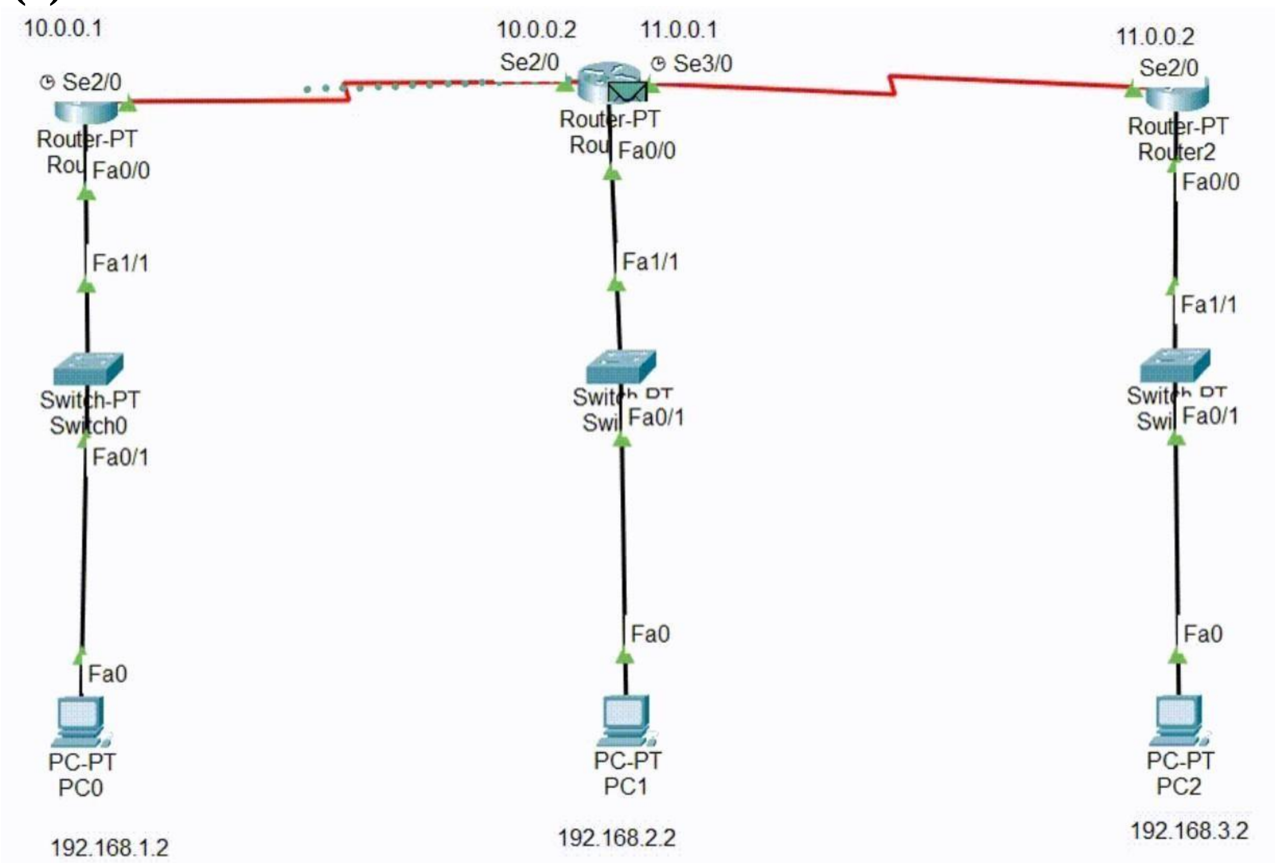

Router2
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router(config)#interface FastEthernet0/0
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up
ip address 192.168.3.1 255.255.255.0
Router(config-if)#ip address 192.168.3.1 255.255.255.0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#ip address 11.0.0.2 255.0.0.0
Router(config-if)#ip address 11.0.0.2 255.0.0.0
Router(config-if)#
Router(config-if)#exit
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#exit
Router(config)#ip route 0.0.0.0 0.0.0.0 11.0.0.1
Router(config)#ip route 0.0.0.0 0.0.0.0 10.0.0.1
Router(config)#
Ctrl+F6 to exit CLI focus
Copy
Paste

Step 4: After configuring all the devices red indicator turns into green and the network is live so we can send and receive packets.

(a)



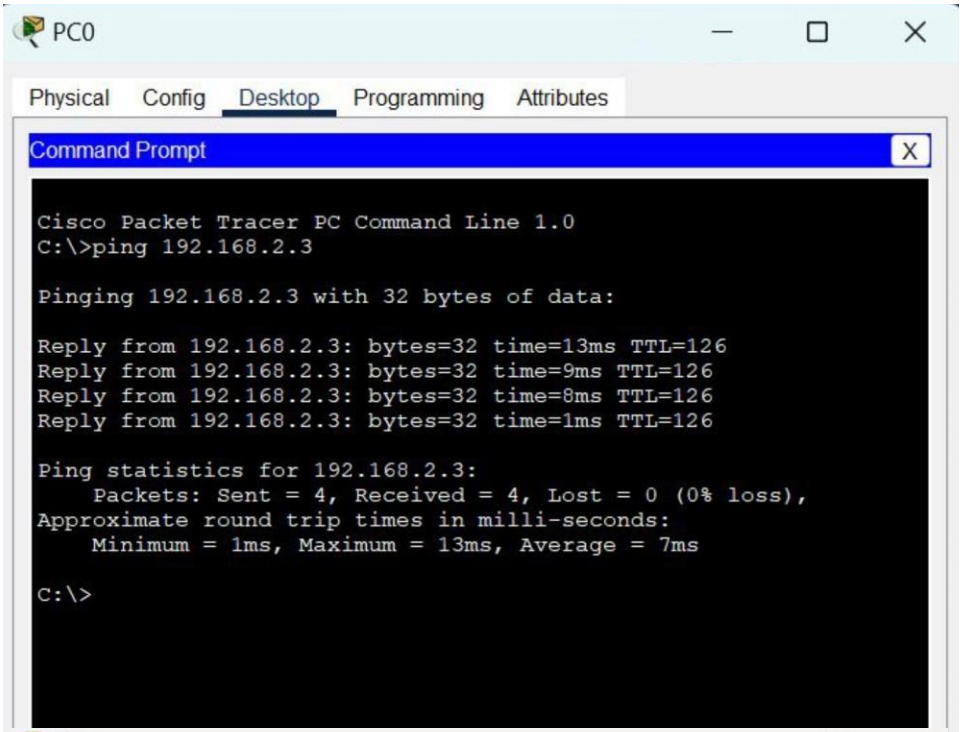
(b)



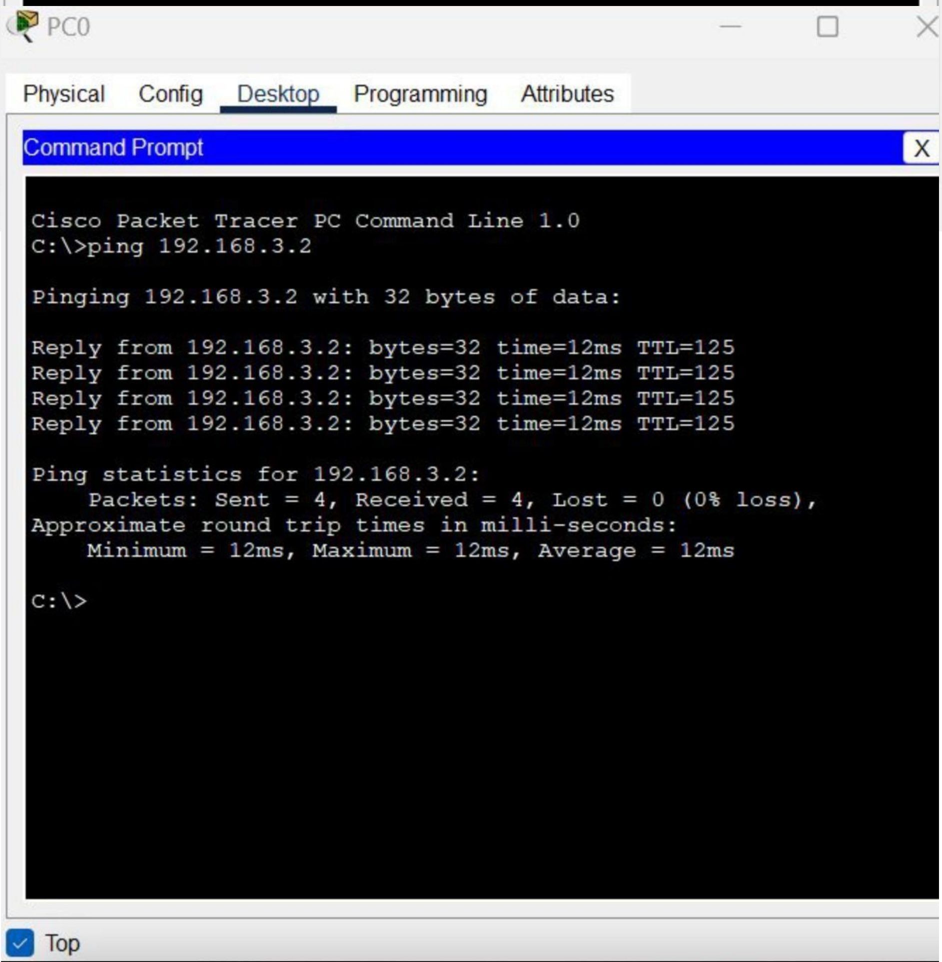
To verify the network we'll verify the network by pinging the IP address of the target node in any Host.

- Click on PC0 then, Go to the desktop.
- Click on Command Prompt, and types this command "**ping 192.168.2.3**"
- Getting replies from a targeted node means the connection is established successfully.

(a)

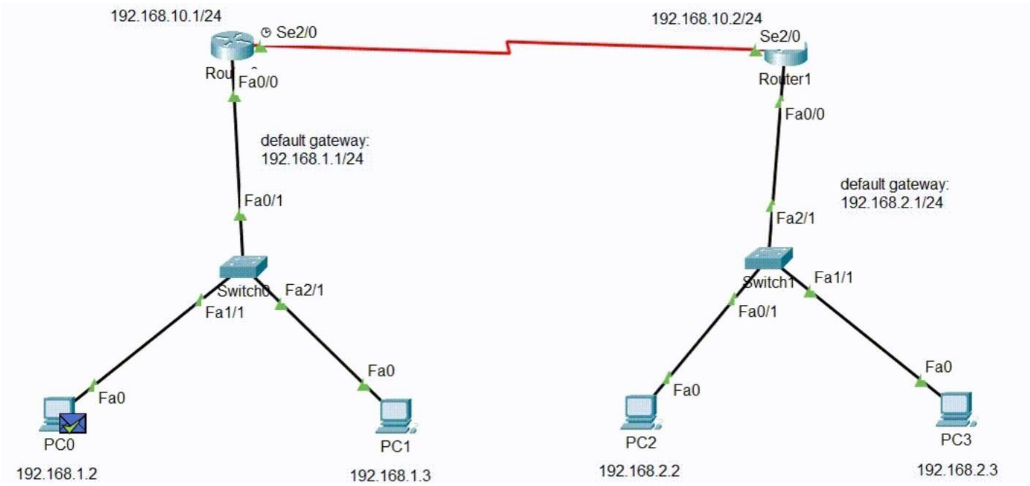


(b)

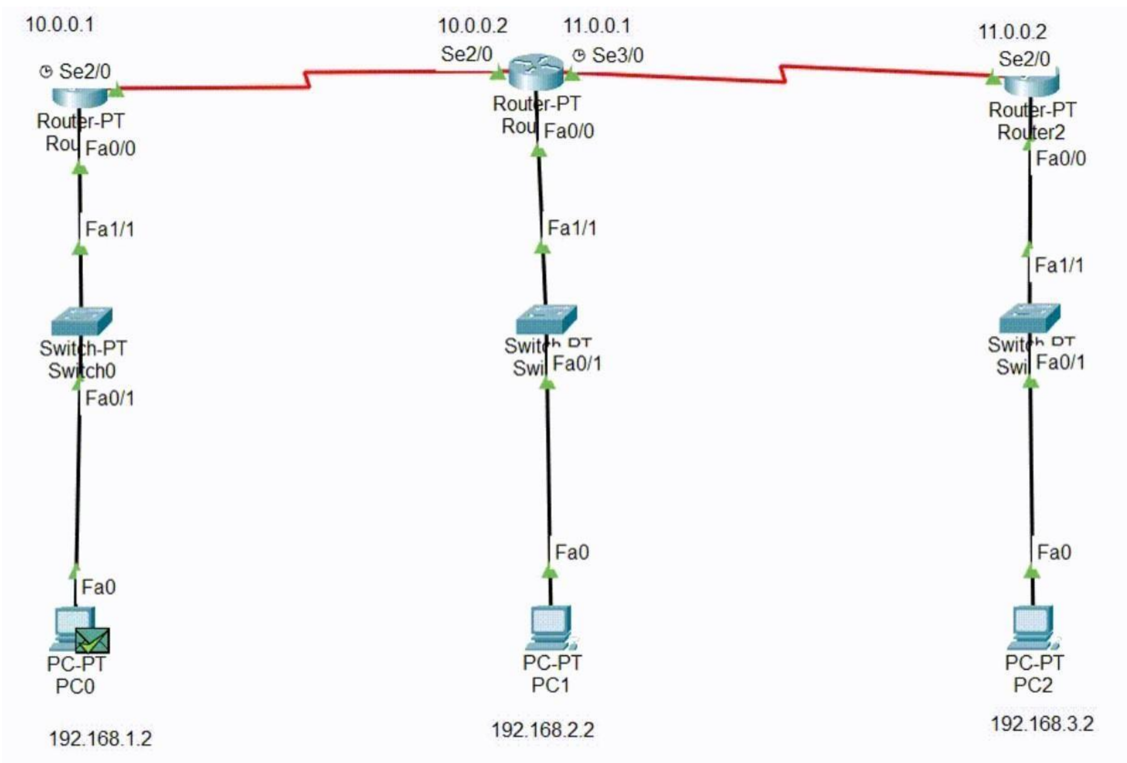


How the packets are moving?
The PDU packet started moving from PC0 to PC3 and then came backward green tick shows that we are getting replies successfully.

(a)



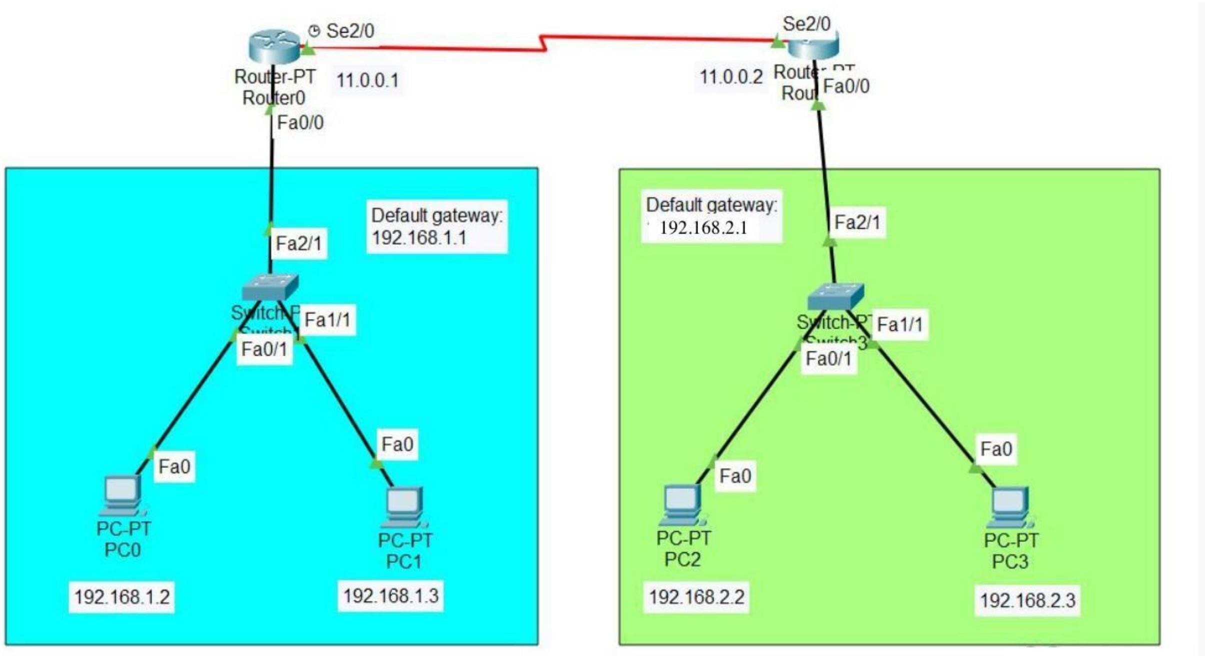
(b)



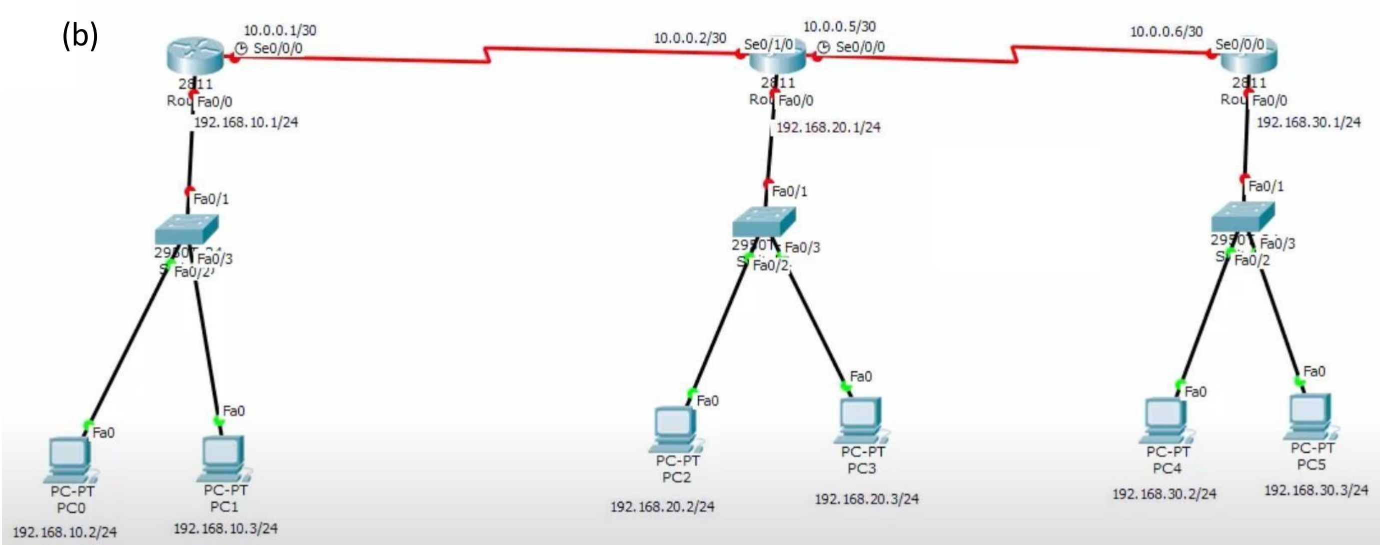
Steps to Configure the Routing in Cisco packet Tracer:

Step 1: First, create a network topology

(a)

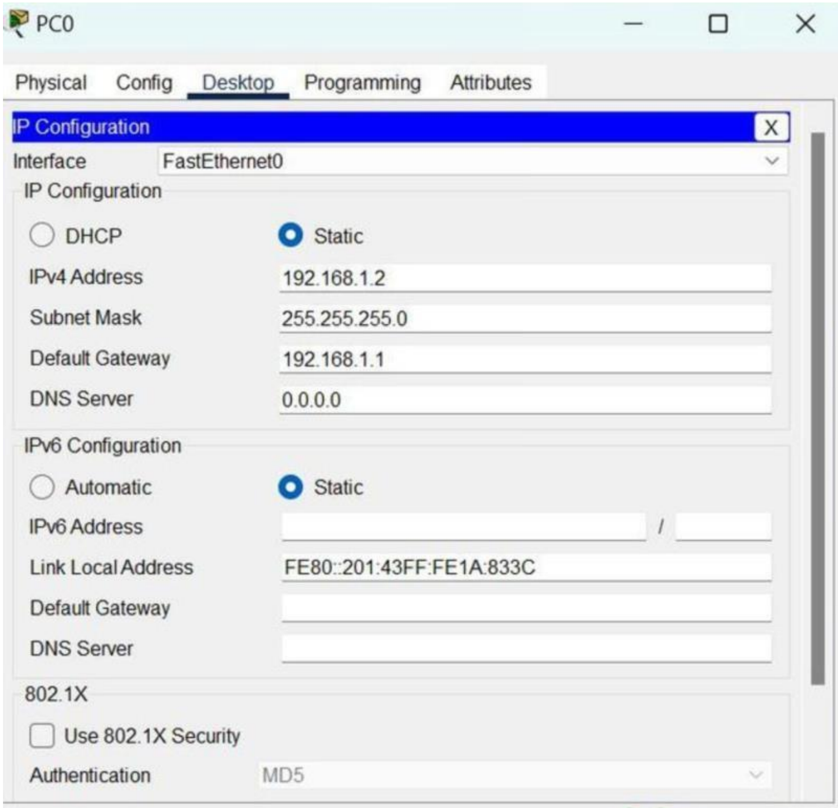


(b)

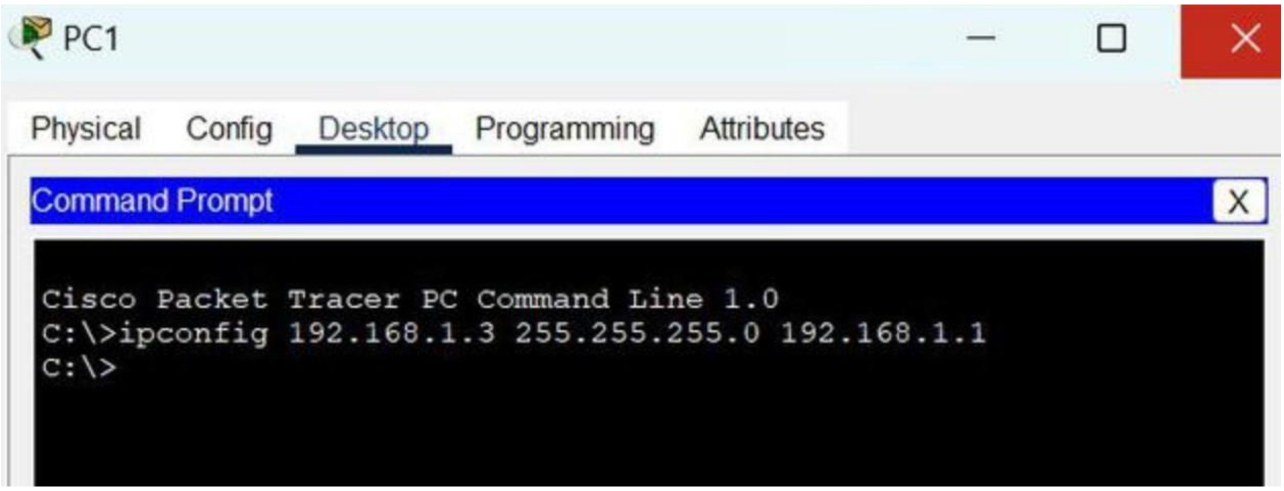


Step 2: Configure the PCs (hosts) with IPv4 address and Subnet Mask according to the IP addressing table given above.

(a)

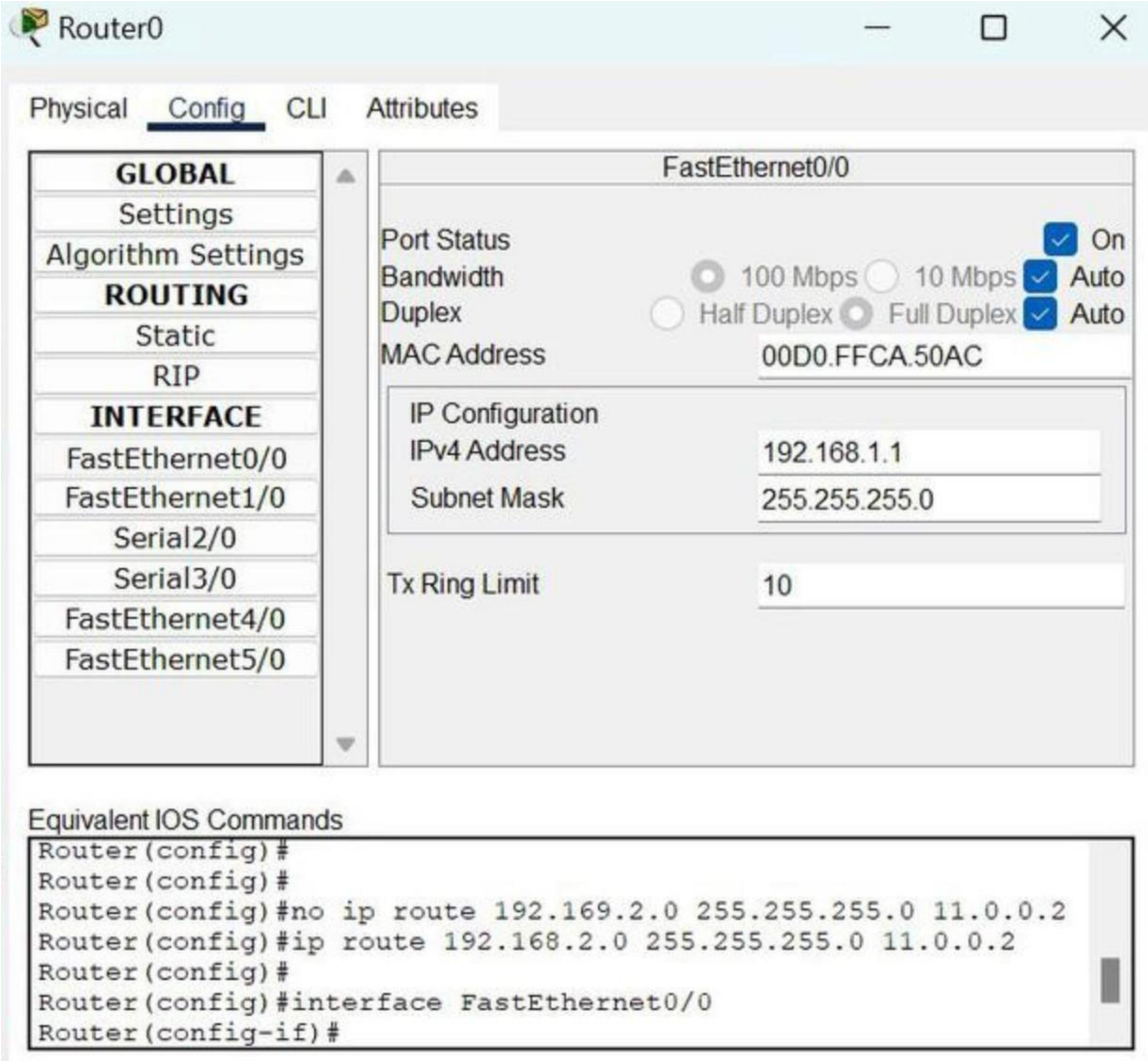


Step 3: Assigning IP address using the ipconfig command.



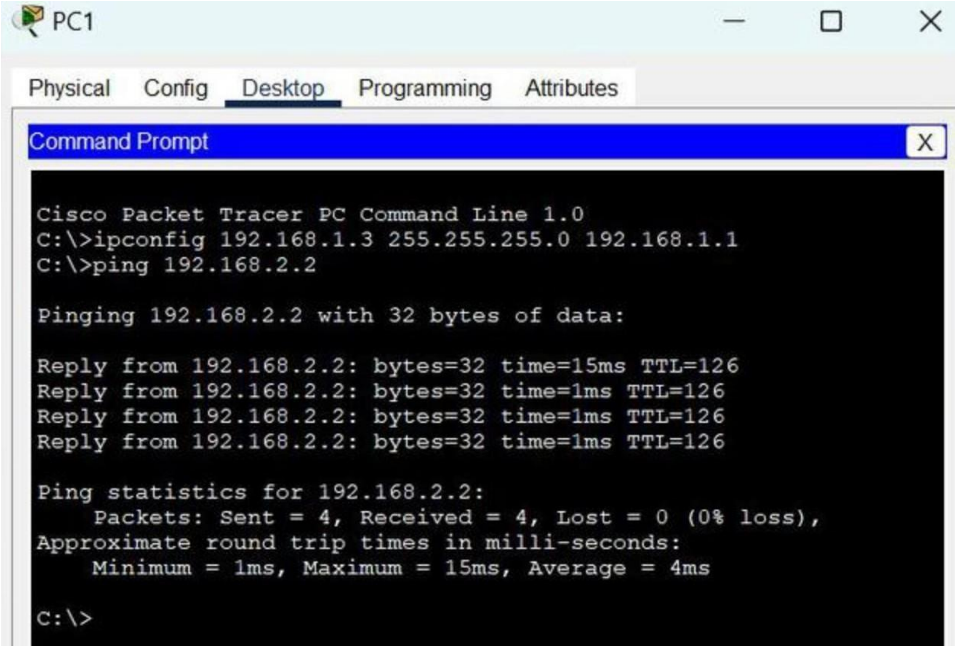
- Repeat the same procedure with other PCs to configure them thoroughly.

Step 4: Configure router with IP address and subnet mask.



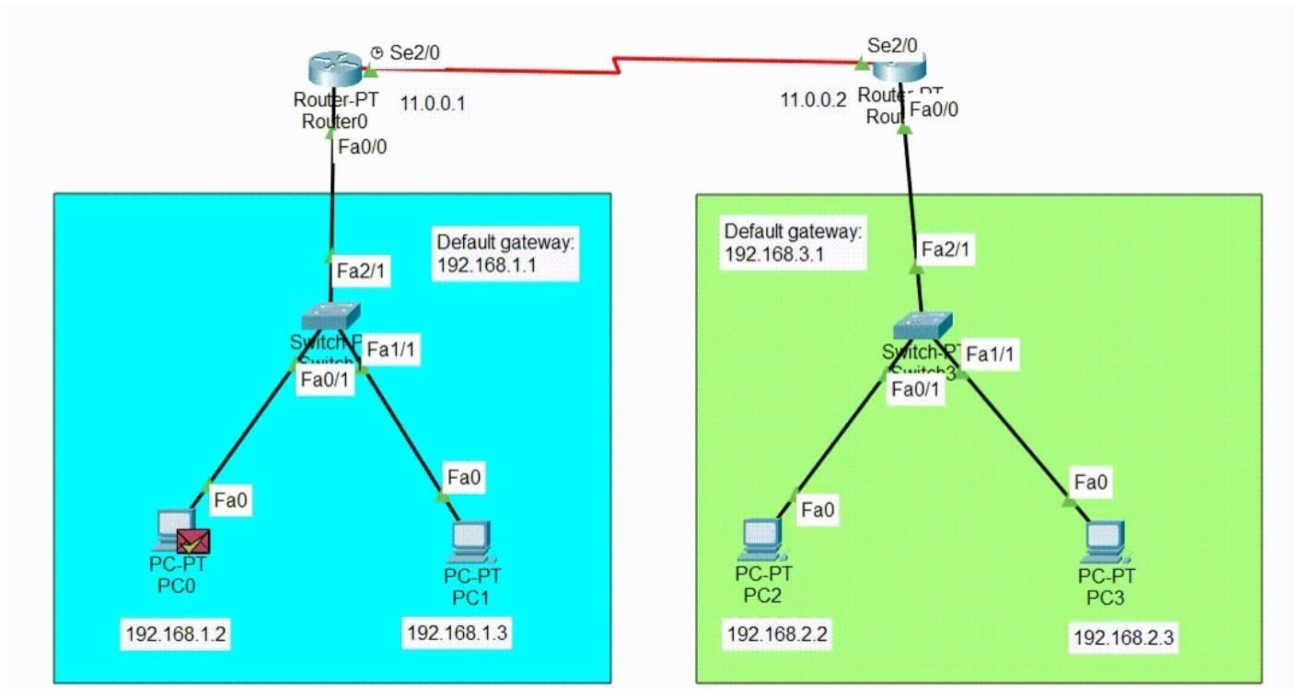
Step 5: After configuring all of the devices we need to assign the routes to the routers.
CLI command : ip route <network id> <subnet mask><next hop>
Static Routes for Router0 are given below:
Router(config)#ip route 192.168.2.0 255.255.255.0 11.0.0.2
Static Routes for Router1 are given below:
Router(config)#ip route 192.168.1.0 255.255.255.0 11.0.0.1

Step 6: Verifying the network by pinging the IP address of any PC. We will use the ping command to do so.



Simulation:

We are sending PDU from PC0 to PC2.



Similarly Static routing could be done using 3 routes as well by following the same steps.

Experiment No. 10

Aim:-

To Perform Dynamic Routing using RIP (RIP-V1 and RIP-V2).

Material Required:-

Cisco Packet Tracer Tool installed.

Procedure:-

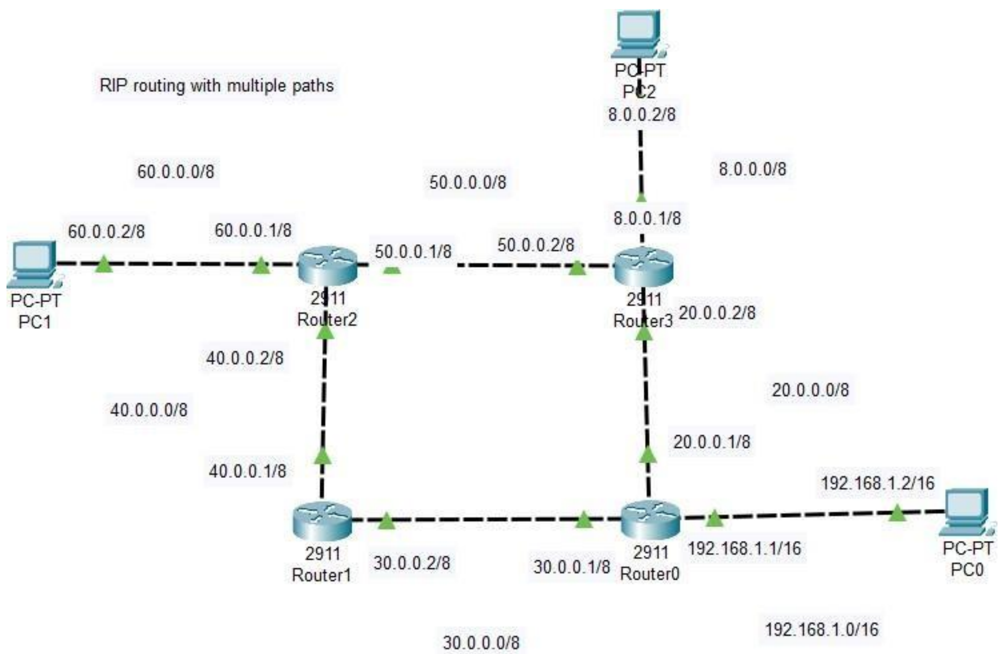
<u>RIP v1</u>

Step 1: Open Cisco Packet Tracer (log in if not already done so).

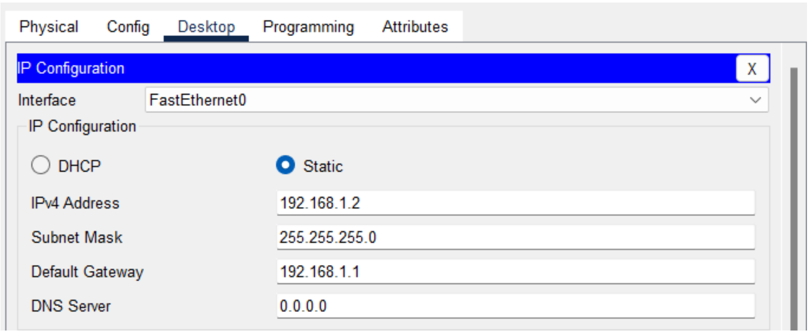
Step 2: From the Network Devices category, select routers, and from the devices drag 4 2911 routers into the workspace (we can choose any Routers, but we're choosing 2911 for the number of ports available so that modules aren't required)

Step 3: Select the End Devices sub-category from End Devices, and drag 3 PCs into the workspace.

Step 4: Connect all the devices using crossover cables.



Step 5: Assign IP addresses to PCs and Router interfaces according to the topology in the above image.



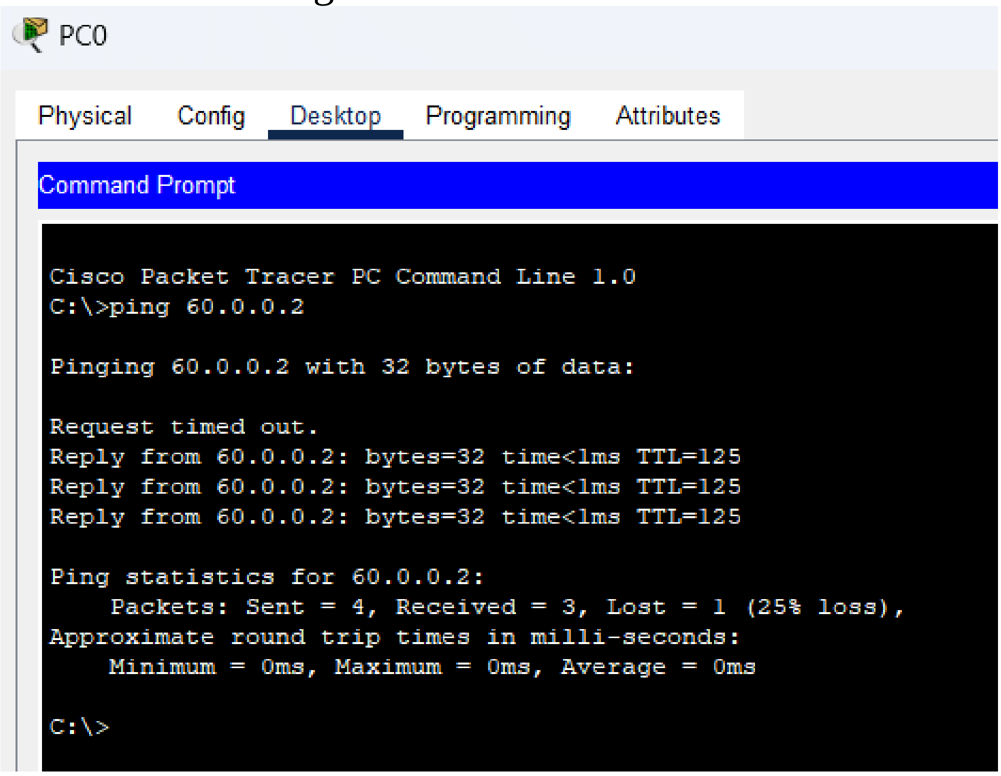
Step 6: Now for configuring routing, first click Router 0, navigate to the CLI tab, enter no for entering initial configuration mode if prompted, and then enter the following commands on the CLI prompt to configure RIP version 1.

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 30.0.0.0
Router(config-router)#network 20.0.0.0
```

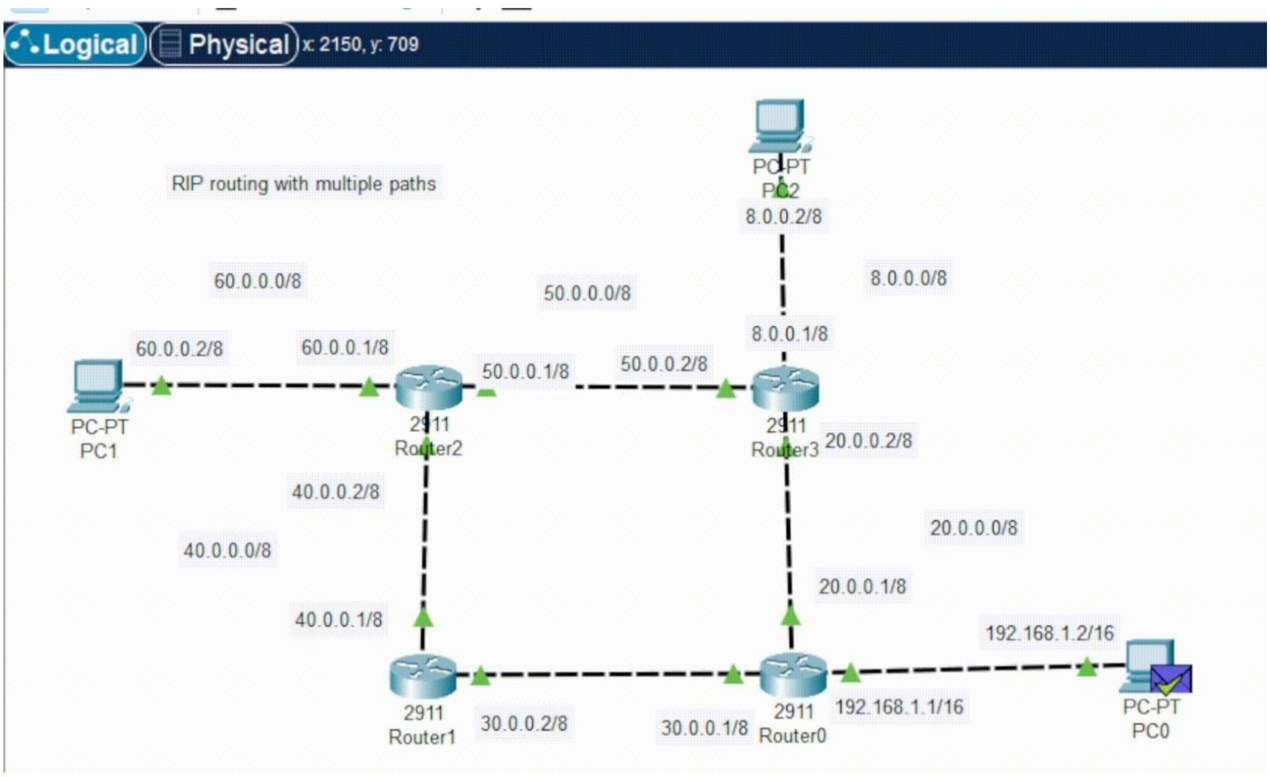
For enabling RIP for a particular connected network:
network neighbour_network_ip

Step 7: Similarly configure other routers, Router1, Router2, and Router3 according to connected networks using the above commands as a reference and using their specific neighbor network IPs in the above-mentioned syntax.

Step 8: Test the connection by using the ping utility in the command prompt in a PC to reach another PC in other networks, the first packet might possibly not reach as it takes time for config to apply. The output might be similar to the image shown below.



Step 9: Simulation: the packet takes the route according to the RIP metric of least hop count in the illustration below.

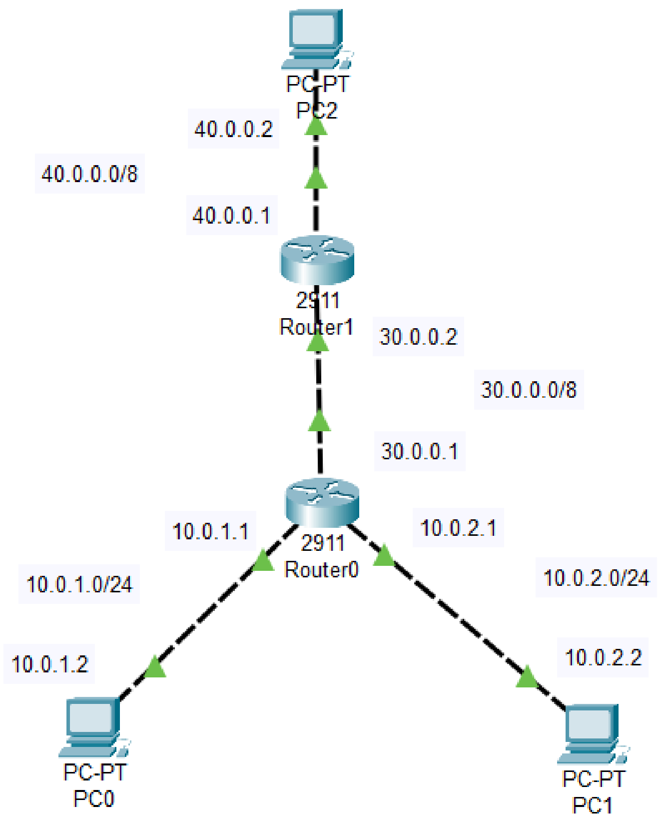


RIP v2

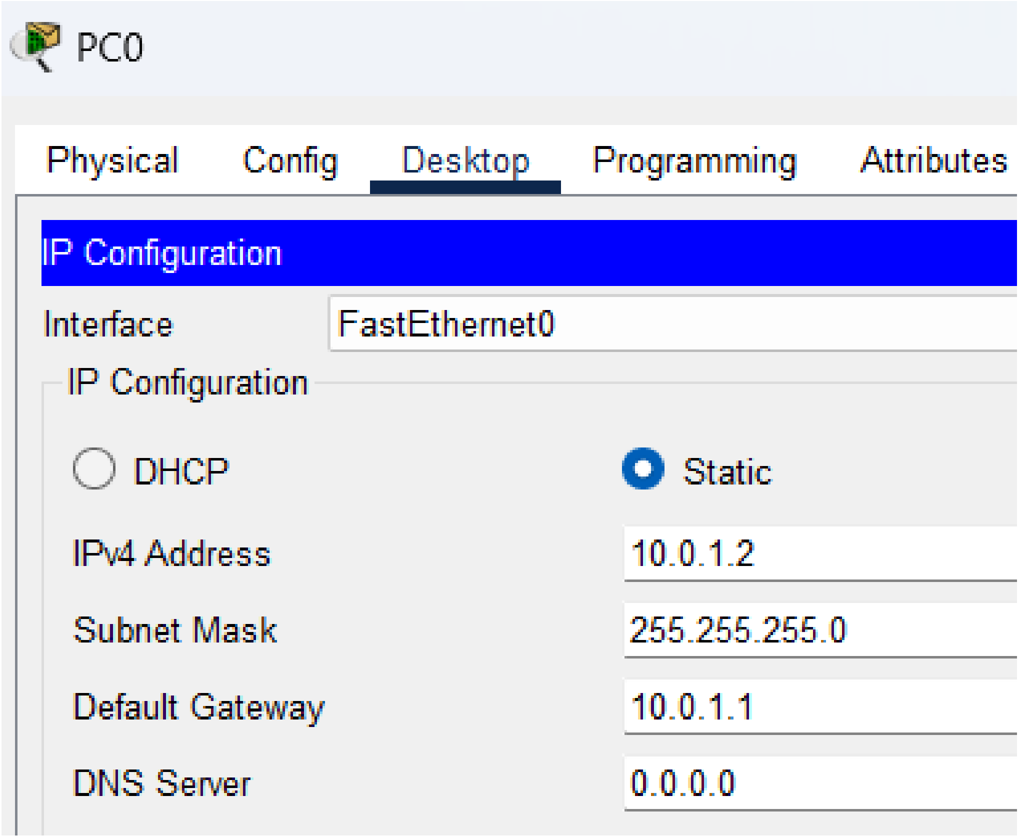
Step 1: Select the End Devices category and in the End Devices sub-category, select and drag 3 PCs as shown in the illustration below in the workspace.

Step 2: Select the Network Devices category and drag 2 2911 routes from the Router sub-category into the workspace.

Step 3: Connect all devices using crossover with the cables as shown below.



Step 4: Assign IPs to PCs using the same method as described in the previous section.



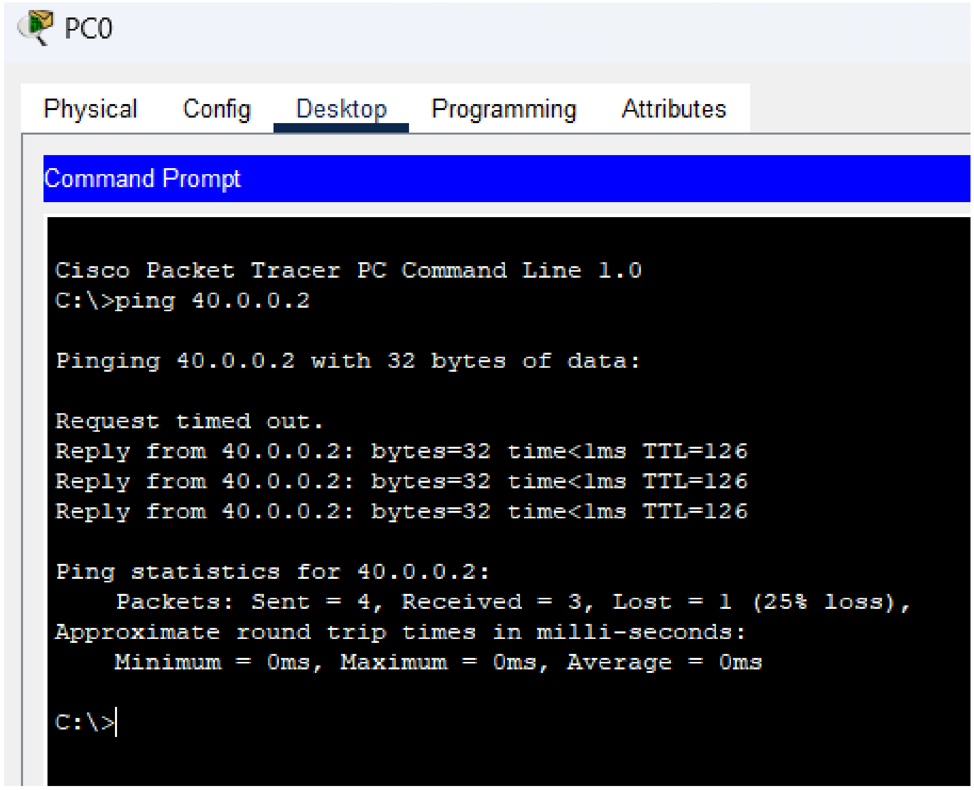
Step 5: Configure Router interface IPs according to the above topology diagram using the same commands described in the previous section.

Step 6: Now for Routing using RIP v2, open the CLI in routers and enter the following commands, for Router 0.

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 10.0.1.0
Router(config-router)#network 10.0.2.0
Router(config-router)#network 30.0.0.0
Router(config-router)#version 2
```

and similarly, configure RIPv2 on other routers using the same syntax with their directly connected networks.

Step 7: Connectivity can be confirmed by ping utility, below is an example where we ping PC2 using PC0.



We can see the only difference in configuring RIPv1 and RIPv2 is the command version 2, which enables RIP version 2 in rip config mode.

Experiment No. 11

Aim:-

To Perform Dynamic Routing using EIGRP.

Material Required:-

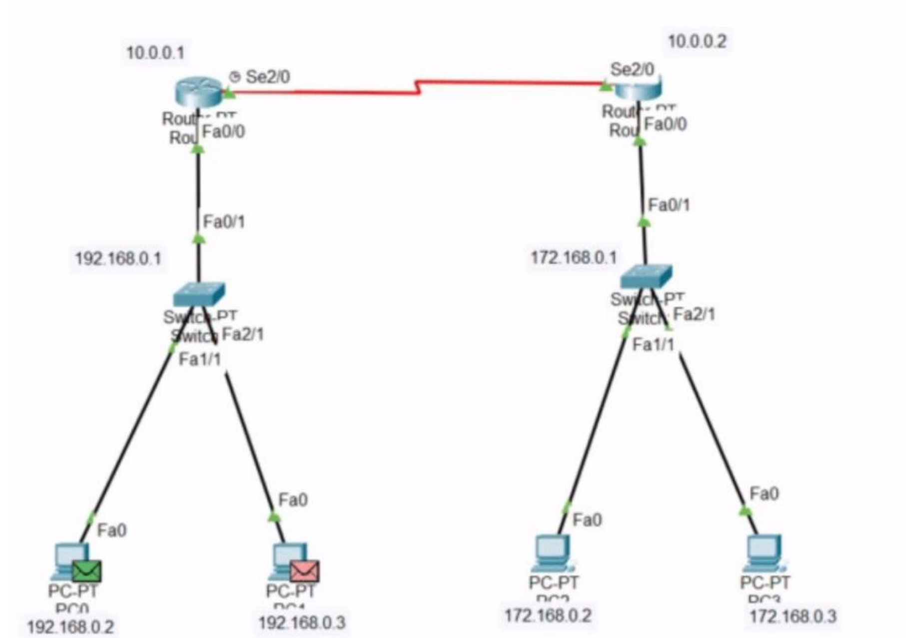
Cisco Packet Tracer Tool installed.

Theory:-

Enhanced Interior Gateway Routing Protocol (EIGRP) is a dynamic routing protocol that is used to find the best path between any two-layer 3 devices to deliver the packet. EIGRP uses the minimum bandwidth on the path to a destination network and the total delay to compute routing metrics.

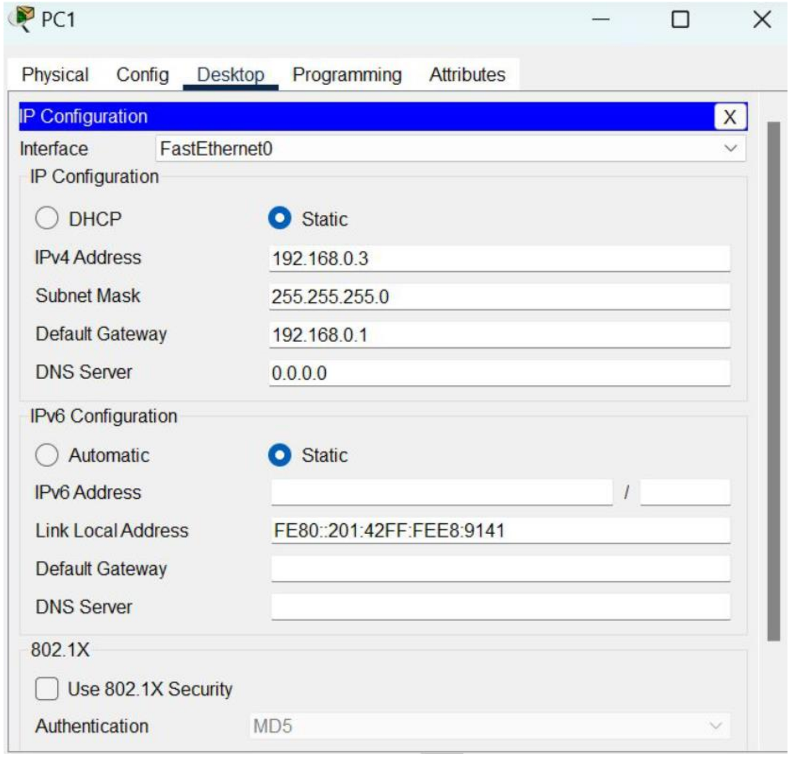
Procedure:-

1. Select 4 PCs, 2 switches and 2 routers. Connect them according to the given topology. Use ‘Automatically choose connection type’ to connect the devices to each other.

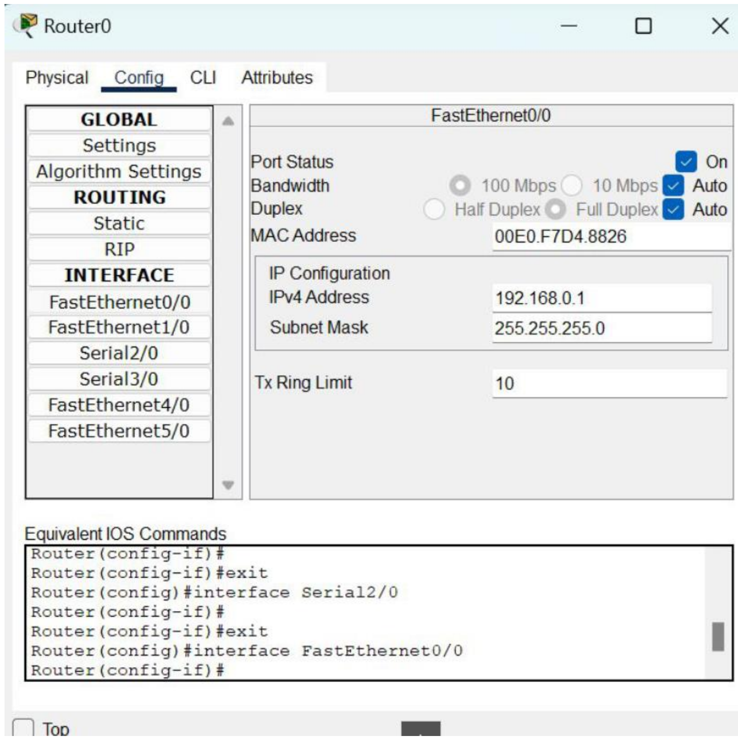


2. Configure the PC's and routers according to the IP Addressing given below:

	IP Address	Subnet Mask	Default Gateway
PC0	192.168.0.2	255.255.255.0	192.168.0.1
PC1	192.168.0.3	255.255.255.0	192.168.0.1
PC2	172.168.0.2	255.255.255.0	172.168.0.1
PC3	172.168.0.3	255.255.255.0	172.168.0.1



	Interface	IP Address	Subnet Mask
Router0	FastEthernet0/0	192.168.0.1	255.255.255.0
	Serial2/0	10.0.0.1	255.0.0.0
Router 1	FastEthernet0/0	172.168.0.1	255.255.255.0
	Serial2/0	10.0.0.2	255.0.0.0



3. After configuring all of the devices we need to configure EIGRP protocols to the routers. For this, write the following command on the router's CLI.

router eigrp 10

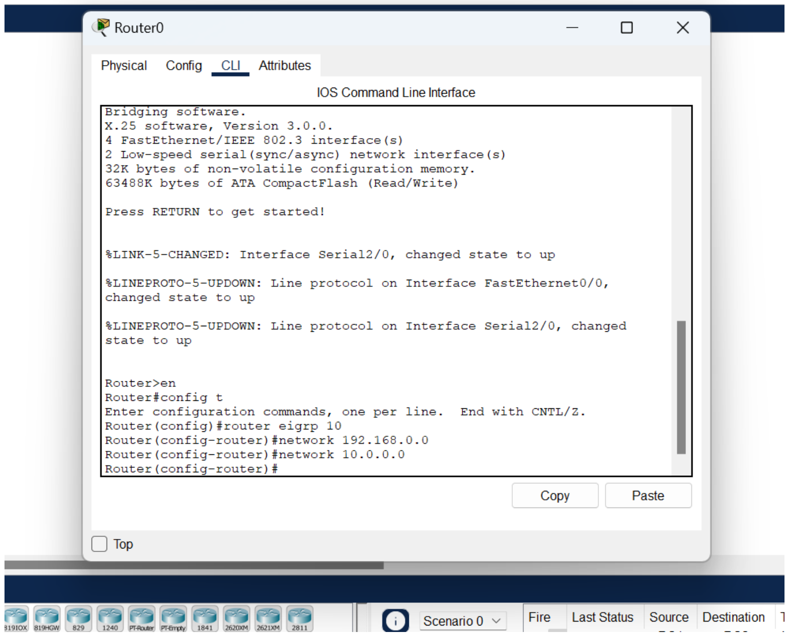
network <network id>

Example for Router0, the command would be:

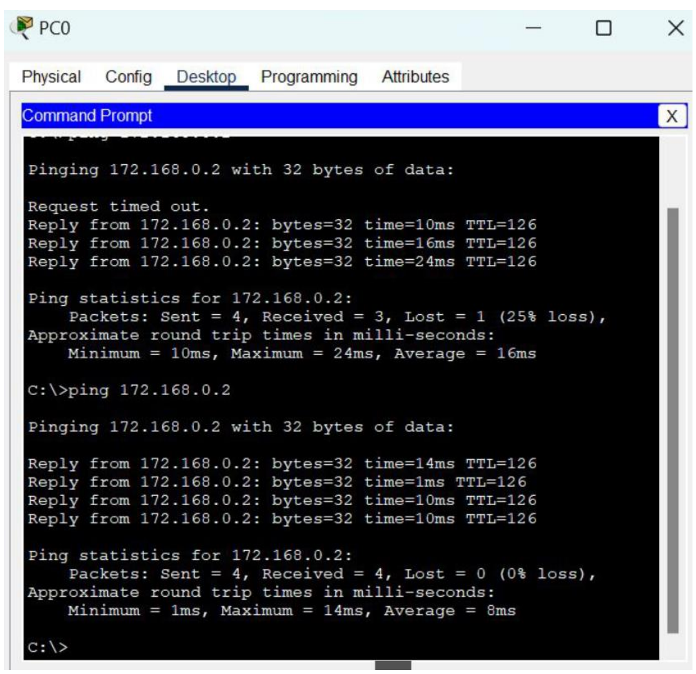
Router (config) # router eigrp 10

Router (config-router) # network 192.168.0.0

Router (config-router) # network 10.0.0.0



4. Verify the network by pinging IP address of any PC.



Experiment No. 12

Aim:-

To Perform Dynamic Routing using OSPF with Single area concept and Multiple Area Concept.

Material Required:-

Cisco Packet Tracer Tool installed.

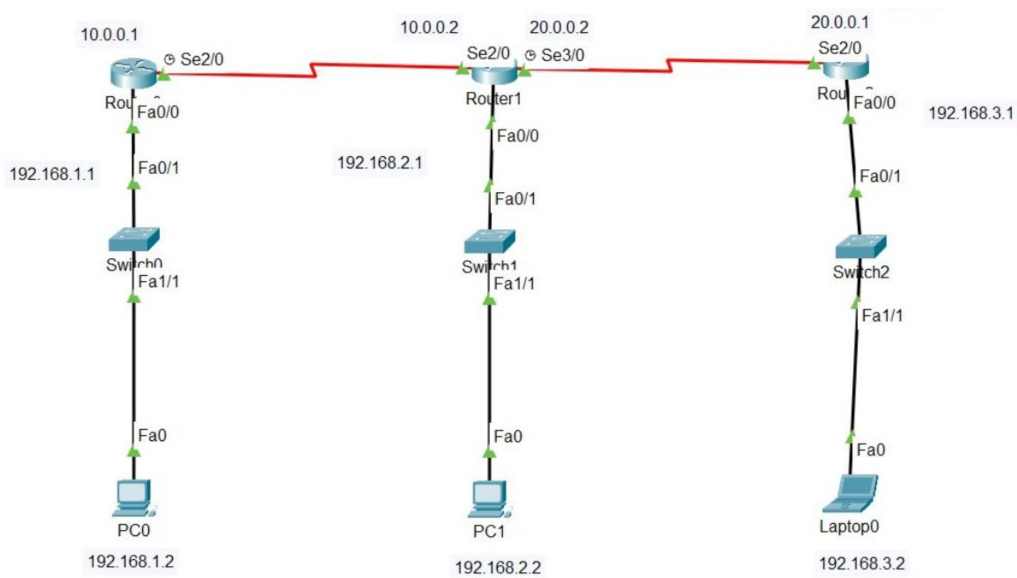
Theory:-

OSPF stands for Open Shortest Path First a link-state protocol and as the name itself justifies that it is used to find the best and the optimal pathway between the starting point and the destination target router using its own shortest path first algorithm. OSPF creates or constructs a topological map of the network from the available router by gathering link-state routing protocol.

Procedure :-

1. Select 3 end devices (PC or Laptop), 3 switches and 3 routers. Connect them according to the given topology.

   Use ‘Automatically choose connection type’ to connect the devices to each other.
   Configure the PC’s and routers with their respective IP addresses.



2. After configuring all the devices, write the following command on each router’s CLI to implement OSPF.

Router (config) # router ospf 1

Router (config-router) # network <network id> <wildcard mask> area <area id>

Example for Router0, the command would be:

Router (config) # router ospf 1

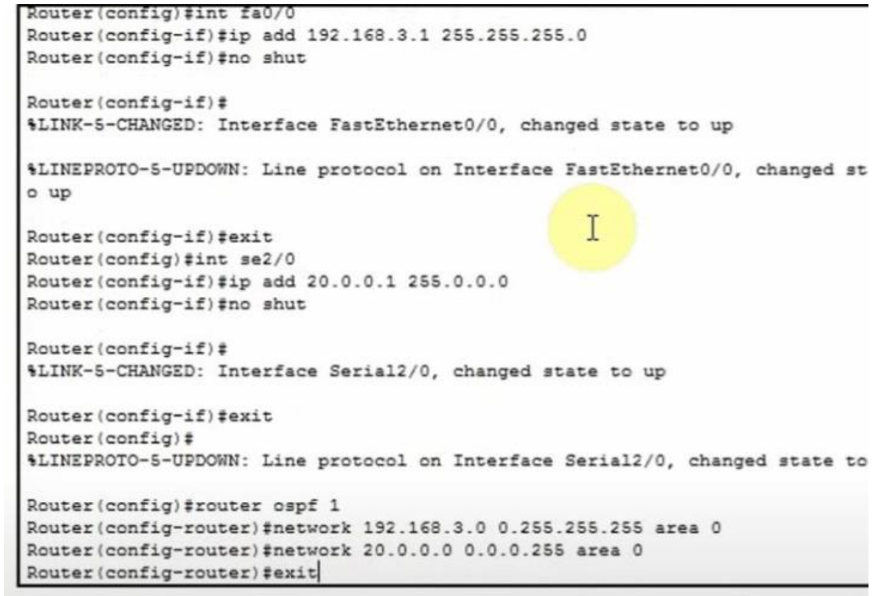
Router (config-router) # network 192.168.1.0 0.255.255.255 area 0

Router (config-router) # network 10.0.0.0 0.0.0.255 area 0

CLI configuration of the 3 routers is given below:

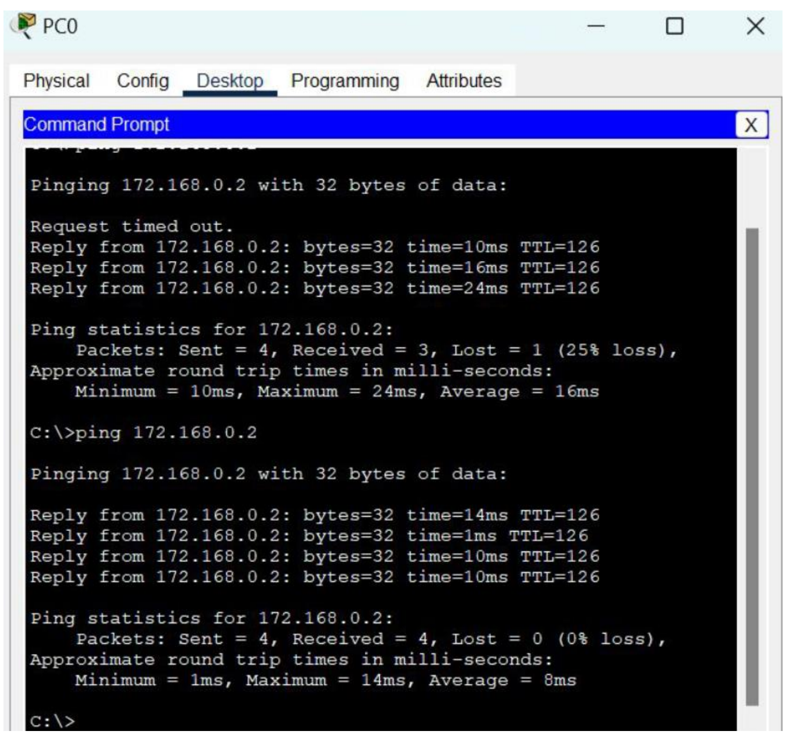
```
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0
o up

Router(config-if)#exit
Router(config)#int se2/0
Router(config-if)#ip add 10.0.0.1 255.0.0.0
Router(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, chan

Router(config)#router ospf 1
Router(config-router)#network 192.168.1.0 0.255.255.255 area 0
Router(config-router)#network 10.0.0.0 0.0.0.255 area 0
Router(config-router)#exit
Router(config)#
```

```
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

Router(config-if)#exit
Router(config)#int se3/0
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed sta
Router(config)#int se3/0
Router(config-if)#ip add 20.0.0.2 255.0.0.0
Router(config-if)#no shut

%LINK-5-CHANGED: Interface Serial3/0, changed state to down
Router(config-if)#no shut
Router(config-if)#exit
Router(config)#
%LINK-5-CHANGED: Interface Serial3/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed sta

Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.0.0.255 area 0
Router(config-router)#network 20.0.0.0 0.0.0.255 area
00:11:00: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial2/0 from
o FULL, Loading Done
Router(config-router)#network 20.0.0.0 0.0.0.255 area 0
Router(config-router)#network 192.168.2.0 0.255.255.255 area 0
Router(config-router)#exit
```



```
Router(config)#int fa0/0
Router(config-if)#ip add 192.168.3.1 255.255.255.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed st
o up

Router(config-if)#exit
Router(config)#int se2/0
Router(config-if)#ip add 20.0.0.1 255.0.0.0
Router(config-if)#no shut

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

Router(config-if)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to

Router(config)#router ospf 1
Router(config-router)#network 192.168.3.0 0.255.255.255 area 0
Router(config-router)#network 20.0.0.0 0.0.0.255 area 0
Router(config-router)#exit
```

3. Verify the network by pinging IP address of any PC.




```
Pinging 172.168.0.2 with 32 bytes of data:

Request timed out.
Reply from 172.168.0.2: bytes=32 time=10ms TTL=126
Reply from 172.168.0.2: bytes=32 time=16ms TTL=126
Reply from 172.168.0.2: bytes=32 time=24ms TTL=126

Ping statistics for 172.168.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 24ms, Average = 16ms

C:\>ping 172.168.0.2

Pinging 172.168.0.2 with 32 bytes of data:

Reply from 172.168.0.2: bytes=32 time=14ms TTL=126
Reply from 172.168.0.2: bytes=32 time=1ms TTL=126
Reply from 172.168.0.2: bytes=32 time=10ms TTL=126
Reply from 172.168.0.2: bytes=32 time=10ms TTL=126

Ping statistics for 172.168.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 14ms, Average = 8ms

C:\>
```