

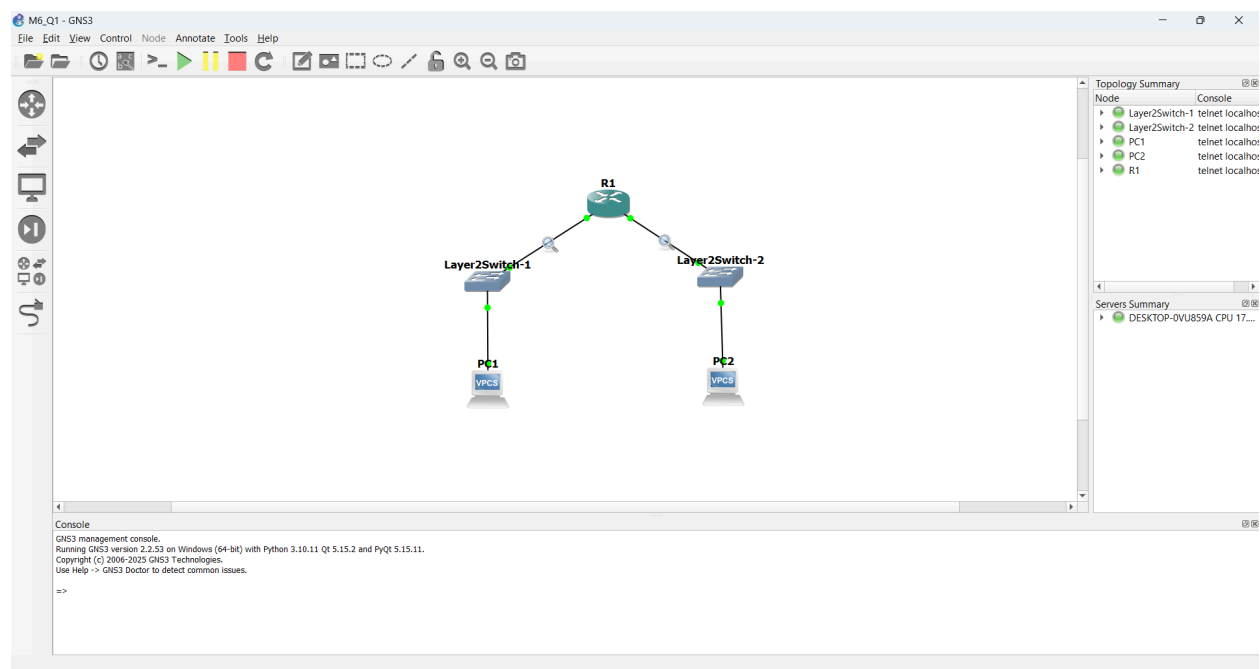


Networking Assessment 4 - Module 6

Name	T K Gowtham
Email ID	gowthamkamalasekar@gmail.com
College	VIT Chennai

1. Capture and analyze ARP packets using Wireshark. Inspect the ARP request and reply frames when your device attempts to find the router's MAC address. Discuss the importance of ARP in packet forwarding.

Configure the Network topology in GNS3 as given below, in the Switch make sure to add two ports :



Configure the IP address and default gateway of PC1 and PC2 :

```
PC1> ip 192.168.1.1 192.168.1.254
Checking for duplicate address...
PC1 : 192.168.1.1 255.255.255.0 gateway 192.168.1.254

PC1> show ip

NAME       : PC1[1]
IP/MASK    : 192.168.1.1/24
GATEWAY    : 192.168.1.254
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 10020
RHOST:PORT : 127.0.0.1:10021
MTU        : 1500
```

```
PC2> ip 192.168.2.1
Checking for duplicate address...
PC1 : 192.168.2.1 255.255.255.0

PC2> ip 192.168.2.1 192.168.2.254
Checking for duplicate address...
PC1 : 192.168.2.1 255.255.255.0 gateway 192.168.2.254

PC2> show ip

NAME       : PC2[1]
IP/MASK    : 192.168.2.1/24
GATEWAY    : 192.168.2.254
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 10022
RHOST:PORT : 127.0.0.1:10023
MTU        : 1500
```

Configure the Router with IP address of each of its interfaces with IP address which will be the default gateway :

```
PC1 PC2 R1
R1#
R1#en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.1.254 255.255.255.0
R1(config-if)#desc
R1(config-if)#description ## to SW1 ##
R1(config-if)#no shutdown
R1(config-if)#
*Mar 1 00:02:44.747: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:02:45.747: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config-if)#
R1(config-if)#interface fa0/1
R1(config-if)#ip address 192.168.2.254 255.255.255.0
R1(config-if)#desc
R1(config-if)#description ## to SW2 ##
R1(config-if)#no shutdown
R1(config-if)#
*Mar 1 00:03:36.935: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:03:37.935: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R1(config-if)#
R1(config-if)#exit
R1(config)#exit
R1#
R1#
*Mar 1 00:03:45.211: %SYS-5-CONFIG_I: Configured from console by console
R1#exit
```

You can view the IP address configured as given below :

```
PC1 PC2 R1
R1 con0 is now available

Press RETURN to get started.

R1#
R1#
R1#sh ip
% Incomplete command.

R1#sh ip int br
Interface                IP-Address      OK? Method Status      Protocol
FastEthernet0/0          192.168.1.254   YES manual up          up
FastEthernet0/1          192.168.2.254   YES manual up          up
FastEthernet1/0          unassigned      YES unset up          down
FastEthernet1/1          unassigned      YES unset up          down
FastEthernet1/2          unassigned      YES unset up          down
FastEthernet1/3          unassigned      YES unset up          down
FastEthernet1/4          unassigned      YES unset up          down
FastEthernet1/5          unassigned      YES unset up          down
FastEthernet1/6          unassigned      YES unset up          down
FastEthernet1/7          unassigned      YES unset up          down
FastEthernet1/8          unassigned      YES unset up          down
R1#
```

Ping from PC1 to PC2:

```
PC1> ping 192.168.2.1
192.168.2.1 icmp_seq=1 timeout
84 bytes from 192.168.2.1 icmp_seq=2 ttl=63 time=32.418 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=63 time=31.886 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=63 time=37.580 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=63 time=31.945 ms
```

You will be able to see the ARP request from PC1 side, between Switch 1 and Router that PC1 is requesting for Router's MAC address.

Request :

The screenshot shows a Wireshark packet capture on the FastEthernet0/0 interface of R1. The packet list shows an ARP request (No. 12) from 192.168.2.1 to the broadcast address 192.168.1.1. The packet details pane shows the Ethernet II header and the ARP request structure. The packet bytes pane shows the raw data of the ARP request.

No.	Time	Source	Destination	Protocol	Length	Info
9	14.000130	c0:01:39:9c:00:00	c0:01:39:9c:00:00	LOOP	60	Reply
10	14.810767	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
11	17.085348	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
12	17.155473	Private_66:68:00	Broadcast	ARP	64	Who has 192.168.1.254? Tell 192.168.1.1
13	17.169308	c0:01:39:9c:00:00	Private_66:68:00	ARP	60	192.168.1.254 is at c0:01:39:9c:00:00
14	17.190149	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0401, seq=1/256, ttl=64 (no response found!)
15	18.496455	c0:01:39:9c:00:00	CDP/VTP/DTP/PagP/UDLD	CDP	357	Device ID: R1 Port ID: FastEthernet0/0
16	19.205984	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0601, seq=2/512, ttl=64 (reply in 17)
17	19.235388	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0601, seq=2/512, ttl=63 (request in 16)
18	19.322945	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
19	20.158107	0c:33:ae:64:00:01	0c:33:ae:64:00:01	LOOP	60	Reply
20	20.262714	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0701, seq=3/768, ttl=64 (reply in 21)
21	20.291493	192.168.1.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0701, seq=3/768, ttl=63 (request in 20)
22	21.319408	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0801, seq=4/1024, ttl=64 (reply in 23)
23	21.348901	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0801, seq=4/1024, ttl=63 (request in 22)
24	21.684558	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
25	22.374836	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0901, seq=5/1280, ttl=64 (reply in 26)
26	22.404571	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0901, seq=5/1280, ttl=63 (request in 25)

> Frame 12: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0
> Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Address Resolution Protocol (request)
Hardware type: Ethernet (1)
Protocol type: IPv4 (0x0800)
Hardware size: 6
Protocol size: 4
Opcode: request (1)
Sender MAC address: Private_66:68:00 (00:50:79:66:68:00)
Sender IP address: 192.168.1.1
Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)
Target IP address: 192.168.1.254

Reply :

The screenshot shows a Wireshark packet capture on the FastEthernet0/0 interface of R1. The packet list shows an ARP reply (No. 13) from the broadcast address 192.168.1.1 to 192.168.2.1. The packet details pane shows the Ethernet II header and the ARP reply structure. The packet bytes pane shows the raw data of the ARP reply.

No.	Time	Source	Destination	Protocol	Length	Info
9	14.000130	c0:01:39:9c:00:00	c0:01:39:9c:00:00	LOOP	60	Reply
10	14.810767	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
11	17.085348	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
12	17.155473	Private_66:68:00	Broadcast	ARP	64	Who has 192.168.1.254? Tell 192.168.1.1
13	17.169308	c0:01:39:9c:00:00	192.168.2.1	ARP	60	192.168.1.254 is at c0:01:39:9c:00:00
14	17.190149	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0401, seq=1/256, ttl=64 (no response found!)
15	18.496455	c0:01:39:9c:00:00	CDP/VTP/DTP/PagP/UDLD	CDP	357	Device ID: R1 Port ID: FastEthernet0/0
16	19.205984	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0601, seq=2/512, ttl=64 (reply in 17)
17	19.235388	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0601, seq=2/512, ttl=63 (request in 16)
18	19.322945	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
19	20.158107	0c:33:ae:64:00:01	0c:33:ae:64:00:01	LOOP	60	Reply
20	20.262714	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0701, seq=3/768, ttl=64 (reply in 21)
21	20.291493	192.168.1.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0701, seq=3/768, ttl=63 (request in 20)
22	21.319408	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0801, seq=4/1024, ttl=64 (reply in 23)
23	21.348901	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0801, seq=4/1024, ttl=63 (request in 22)
24	21.684558	0c:33:ae:64:00:01	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:33:ae:64:00:00 Cost = 0 Port = 0x8002
25	22.374836	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x0901, seq=5/1280, ttl=64 (reply in 26)
26	22.404571	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x0901, seq=5/1280, ttl=63 (request in 25)

> Frame 13: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface -, id 0
> Ethernet II, Src: c0:01:39:9c:00:00 (c0:01:39:9c:00:00), Dst: Private_66:68:00 (00:50:79:66:68:00)
Address Resolution Protocol (reply)
Hardware type: Ethernet (1)
Protocol type: IPv4 (0x0800)
Hardware size: 6
Protocol size: 4
Opcode: reply (2)
Sender MAC address: c0:01:39:9c:00:00 (c0:01:39:9c:00:00)
Sender IP address: 192.168.1.254
Target MAC address: Private_66:68:00 (00:50:79:66:68:00)
Target IP address: 192.168.1.1

Similarly, between Switch 2 and Router, PC2 is requesting and getting reply for Router's MAC Address

Request :

Standard input [R1 FastEthernet0/1 to Layer2Switch-2 Ethernet1]

No.	Time	Source	Destination	Protocol	Length	Info
7	5.975303	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
8	6.962770	c0:01:39:9c:00:01	CDP/VTP/DTP/PagP/UDLD	CDP	357	Device ID: R1 Port ID: FastEthernet0/1
9	8.724903	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
10	11.327490	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
11	13.019825	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x9801, seq=1/256, ttl=63 (reply in 21)
12	13.025260	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.2.254? Tell 192.168.2.1
13	13.035262	c0:01:39:9c:00:01	Private_66:68:01	ARP	60	192.168.2.254 is at c0:01:39:9c:00:01
14	13.547676	c0:01:39:9c:00:01	c0:01:39:9c:00:01	LOOP	60	Reply
15	14.029802	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.2.254? Tell 192.168.2.1
16	14.044803	c0:01:39:9c:00:01	Private_66:68:01	ARP	60	192.168.2.254 is at c0:01:39:9c:00:01
17	14.085809	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
18	15.041668	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x9a01, seq=2/512, ttl=63 (reply in 22)
19	15.043669	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.2.254? Tell 192.168.2.1
20	15.057064	c0:01:39:9c:00:01	Private_66:68:01	ARP	60	192.168.2.254 is at c0:01:39:9c:00:01
21	16.052860	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x9801, seq=1/256, ttl=64 (request in 11)
22	16.052860	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x9a01, seq=2/512, ttl=64 (request in 18)
23	16.716005	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
24	17.064473	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x9c01, seq=3/768, ttl=63 (reply in 25)

> Frame 12: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0
> Ethernet II, Src: Private_66:68:01 (00:50:79:66:68:01), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
▼ Address Resolution Protocol (request)
 Hardware type: Ethernet (1)
 Protocol type: IPv4 (0x0800)
 Hardware size: 6
 Protocol size: 4
 Opcode: request (1)
 Sender MAC address: Private_66:68:01 (00:50:79:66:68:01)
 Sender IP address: 192.168.2.1
 Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)
 Target IP address: 192.168.2.254

0000 ff ff ff ff ff ff 00 50 79 66 68 01 00 00 01P yfh.....
0010 08 00 06 04 00 01 00 50 79 66 68 01 c0 a8 02 01P yfh.....
0020 ff ff ff ff ff ff c0 a8 02 fe 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Reply:

Standard input [R1 FastEthernet0/1 to Layer2Switch-2 Ethernet1]

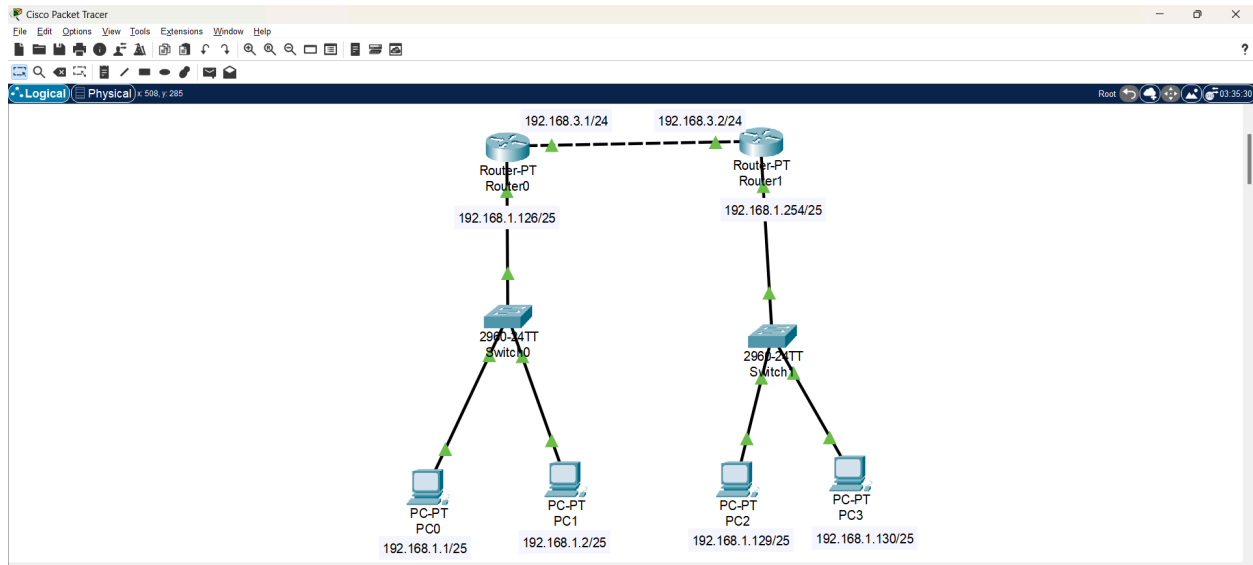
No.	Time	Source	Destination	Protocol	Length	Info
7	5.975303	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
8	6.962770	c0:01:39:9c:00:01	CDP/VTP/DTP/PagP/UDLD	CDP	357	Device ID: R1 Port ID: FastEthernet0/1
9	8.724903	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
10	11.327490	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
11	13.019825	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x9801, seq=1/256, ttl=63 (reply in 21)
12	13.025260	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.2.254? Tell 192.168.2.1
13	13.035262	c0:01:39:9c:00:01	Private_66:68:01	ARP	60	192.168.2.254 is at c0:01:39:9c:00:01
14	13.547676	c0:01:39:9c:00:01	c0:01:39:9c:00:01	LOOP	60	Reply
15	14.029802	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.2.254? Tell 192.168.2.1
16	14.044803	c0:01:39:9c:00:01	Private_66:68:01	ARP	60	192.168.2.254 is at c0:01:39:9c:00:01
17	14.085809	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
18	15.041668	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x9a01, seq=2/512, ttl=63 (reply in 22)
19	15.043669	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.2.254? Tell 192.168.2.1
20	15.057064	c0:01:39:9c:00:01	Private_66:68:01	ARP	60	192.168.2.254 is at c0:01:39:9c:00:01
21	16.052860	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x9801, seq=1/256, ttl=64 (request in 11)
22	16.052860	192.168.2.1	192.168.1.1	ICMP	98	Echo (ping) reply id=0x9a01, seq=2/512, ttl=64 (request in 18)
23	16.716005	0c:d0:c6:86:00:01	Spanning-tree (for-bridges)_00	STP	60	Conf. Root = 32768/1/0c:d0:c6:86:00:00 Cost = 0 Port = 0x8002
24	17.064473	192.168.1.1	192.168.2.1	ICMP	98	Echo (ping) request id=0x9c01, seq=3/768, ttl=63 (reply in 25)

> Frame 13: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface -, id 0
> Ethernet II, Src: c0:01:39:9c:00:01 (c0:01:39:9c:00:01), Dst: Private_66:68:01 (00:50:79:66:68:01)
▼ Address Resolution Protocol (reply)
 Hardware type: Ethernet (1)
 Protocol type: IPv4 (0x0800)
 Hardware size: 6
 Protocol size: 4
 Opcode: reply (2)
 Sender MAC address: c0:01:39:9c:00:01 (c0:01:39:9c:00:01)
 Sender IP address: 192.168.2.254
 Target MAC address: Private_66:68:01 (00:50:79:66:68:01)
 Target IP address: 192.168.2.1

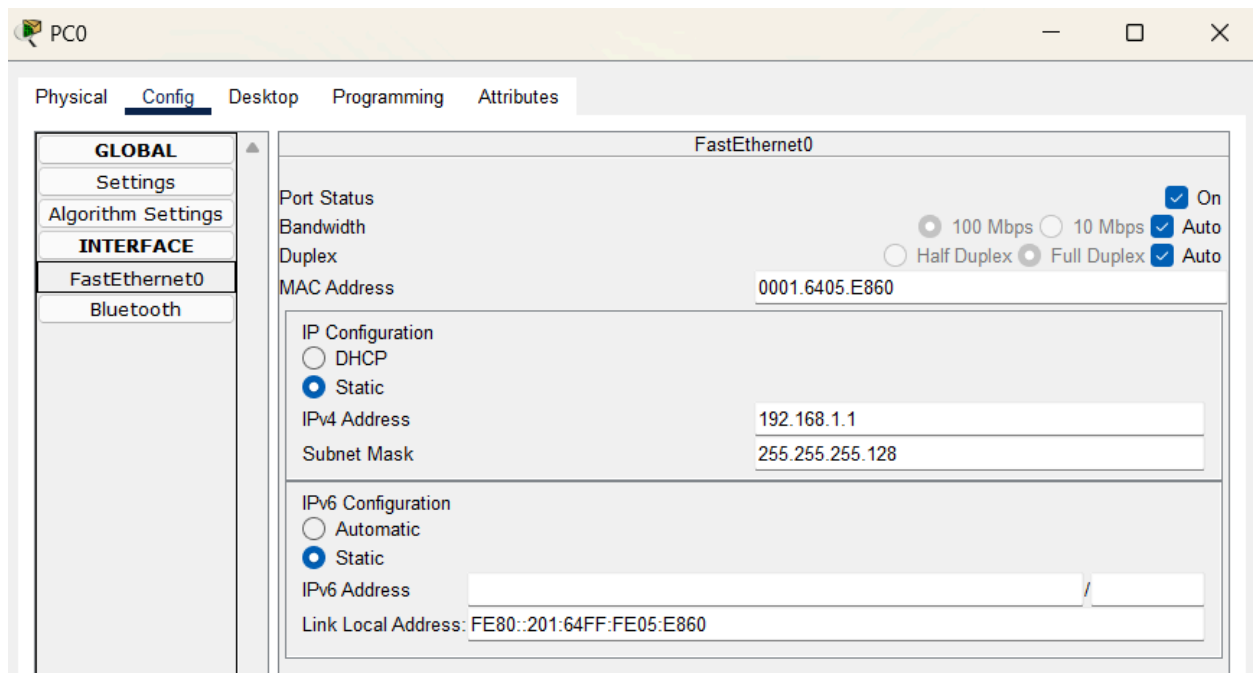
0000 00 50 79 66 68 01 c0 01 39 9c 00 01 00 00 01P yfh... 9.....
0010 08 00 06 04 00 02 c0 01 39 9c 00 01 c0 a8 02 fe 9.....
0020 00 50 79 66 68 01 c0 a8 02 01 00 00 00 00 00P yfh... 9.....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

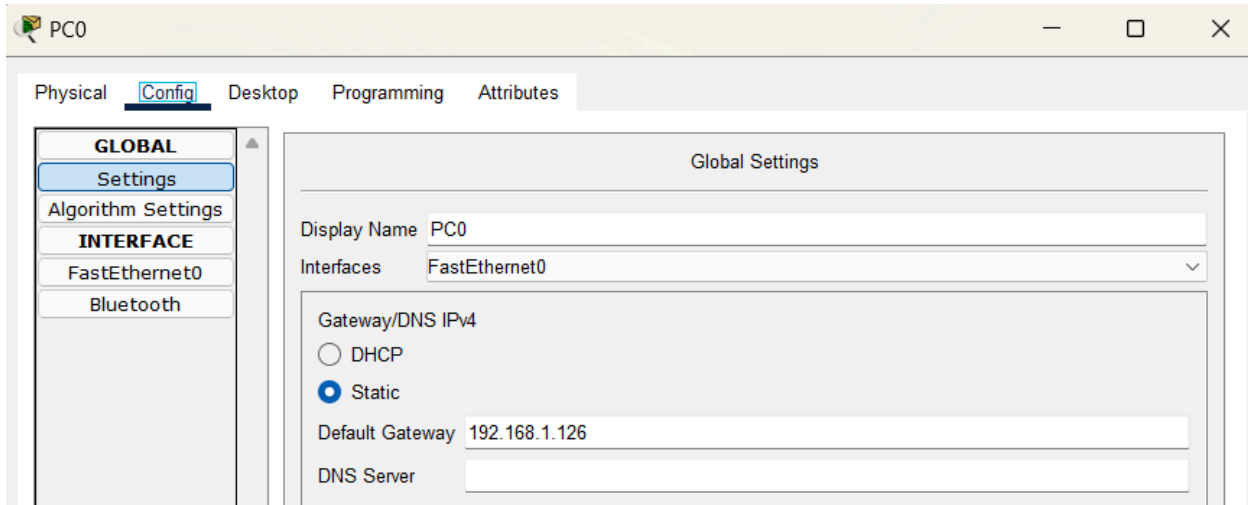
2. Manually configure static routes on a router to direct packets to different subnets. Use the ip route command and verify connectivity using ping and traceroute.

Configure the Network Topology in Cisco Packet Tracer :

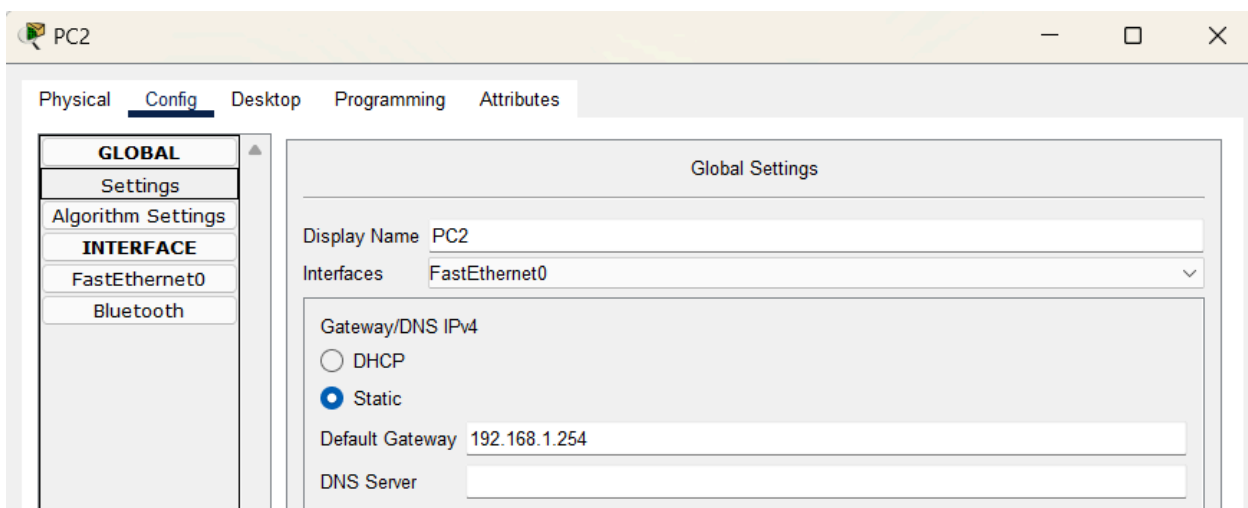
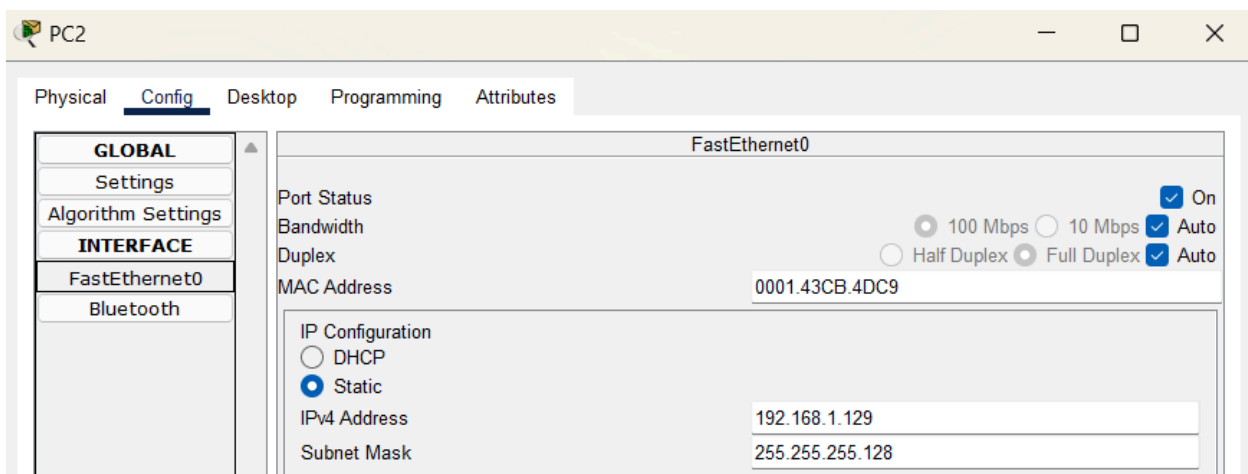


Configure PC0 (and similarly for PC1) with IP address, Subnet mask and default gateway. We have divided the 192.168.1.0/24 into 2 subnets.

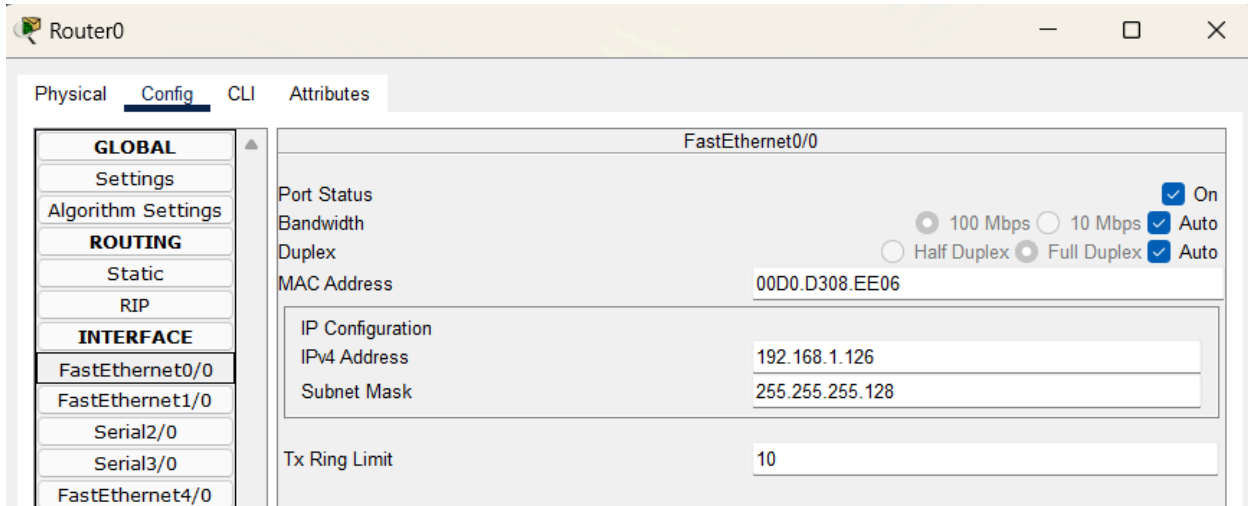




Use the second subnet and configure PC2 (similarly for PC3) with IP address, subnet mask and default gateway :

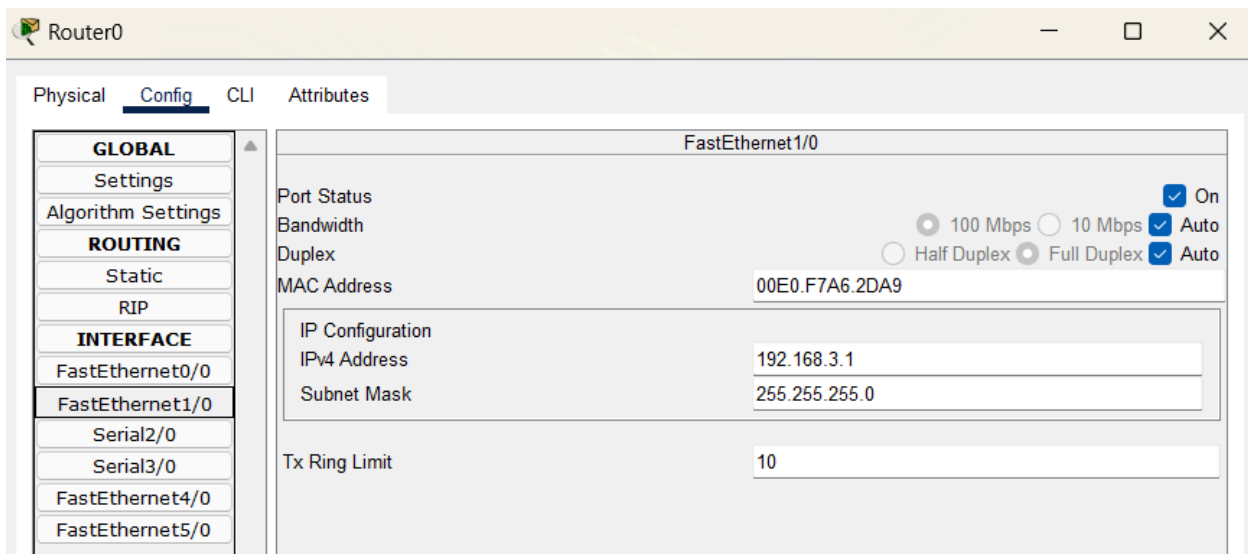


In the Router configure the Default gateway IP address with its IP addresses for respective interfaces :



The screenshot shows the configuration window for the FastEthernet0/0 interface on Router0. The left sidebar contains a tree view with categories: GLOBAL (Settings, Algorithm Settings), ROUTING (Static, RIP), and INTERFACE (FastEthernet0/0, FastEthernet1/0, Serial2/0, Serial3/0, FastEthernet4/0). The main area is titled 'FastEthernet0/0' and contains the following settings:

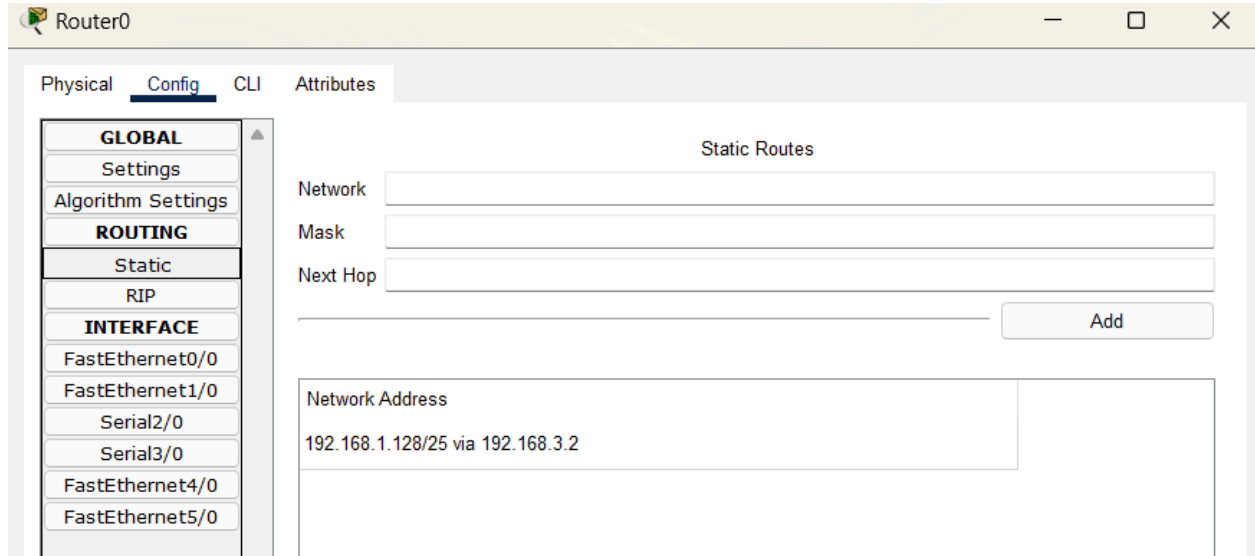
Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input checked="" type="radio"/> 100 Mbps <input type="radio"/> 10 Mbps <input checked="" type="checkbox"/> Auto
Duplex	<input type="radio"/> Half Duplex <input checked="" type="radio"/> Full Duplex <input checked="" type="checkbox"/> Auto
MAC Address	00D0.D308.EE06
IP Configuration	
IPv4 Address	192.168.1.126
Subnet Mask	255.255.255.128
Tx Ring Limit	10



The screenshot shows the configuration window for the FastEthernet1/0 interface on Router0. The left sidebar is identical to the previous window, but the 'FastEthernet1/0' option is selected under the INTERFACE category. The main area is titled 'FastEthernet1/0' and contains the following settings:

Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input checked="" 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.F7A6.2DA9
IP Configuration	
IPv4 Address	192.168.3.1
Subnet Mask	255.255.255.0
Tx Ring Limit	10

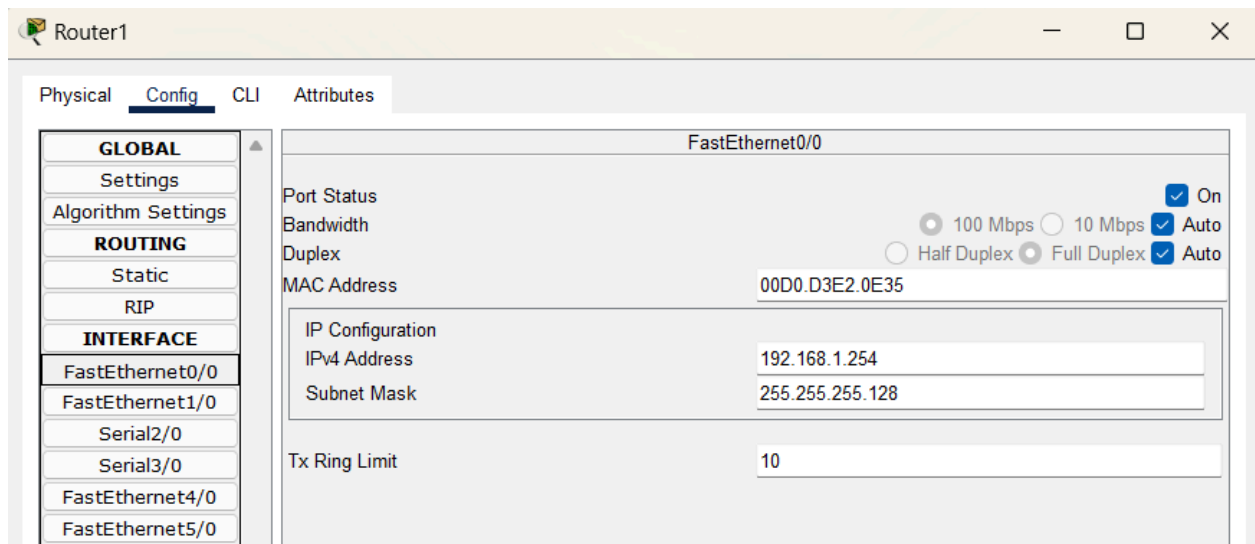
Add the static route for the packets to travel from Router 1 to Router 2 :



The image shows the configuration window for Router0. The 'Config' tab is selected, and the 'Static Routes' section is active. The left sidebar shows the configuration tree with 'Static' selected under 'ROUTING'. The main area has three input fields: 'Network', 'Mask', and 'Next Hop'. Below these is an 'Add' button. A table below the 'Add' button shows the configured static route: '192.168.1.128/25 via 192.168.3.2'.

Network Address
192.168.1.128/25 via 192.168.3.2

Similarly configure Router 2 with IP address for its Interfaces and also add the static route for it send packets from Router 1 to Router 2 :



The image shows the configuration window for Router1. The 'Config' tab is selected, and the 'FastEthernet0/0' interface is selected. The left sidebar shows the configuration tree with 'FastEthernet0/0' selected under 'INTERFACE'. The main area shows the configuration for the interface. The 'Port Status' is 'On'. The 'Bandwidth' is '100 Mbps'. The 'Duplex' is 'Full Duplex'. The 'MAC Address' is '00D0.D3E2.0E35'. The 'IP Configuration' section shows 'IPv4 Address' as '192.168.1.254' and 'Subnet Mask' as '255.255.255.128'. The 'Tx Ring Limit' is '10'.

IP Configuration	
IPv4 Address	192.168.1.254
Subnet Mask	255.255.255.128

Router1

PhysicalConfigCLIAttributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

INTERFACE

FastEthernet0/0

FastEthernet1/0

Serial2/0

Serial3/0

FastEthernet4/0

FastEthernet5/0

FastEthernet1/0

Port Status

100 Mbps

10 Mbps

Auto

Bandwidth

Half Duplex

Full Duplex

Duplex

On

Auto

MAC Address0001.42A2.B1A6

IP Configuration

IPv4 Address192.168.3.2

Subnet Mask255.255.255.0

Tx Ring Limit10

Router1

PhysicalConfigCLIAttributes

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

INTERFACE

FastEthernet0/0

FastEthernet1/0

Serial2/0

Serial3/0

FastEthernet4/0

Static Routes

Network

Mask

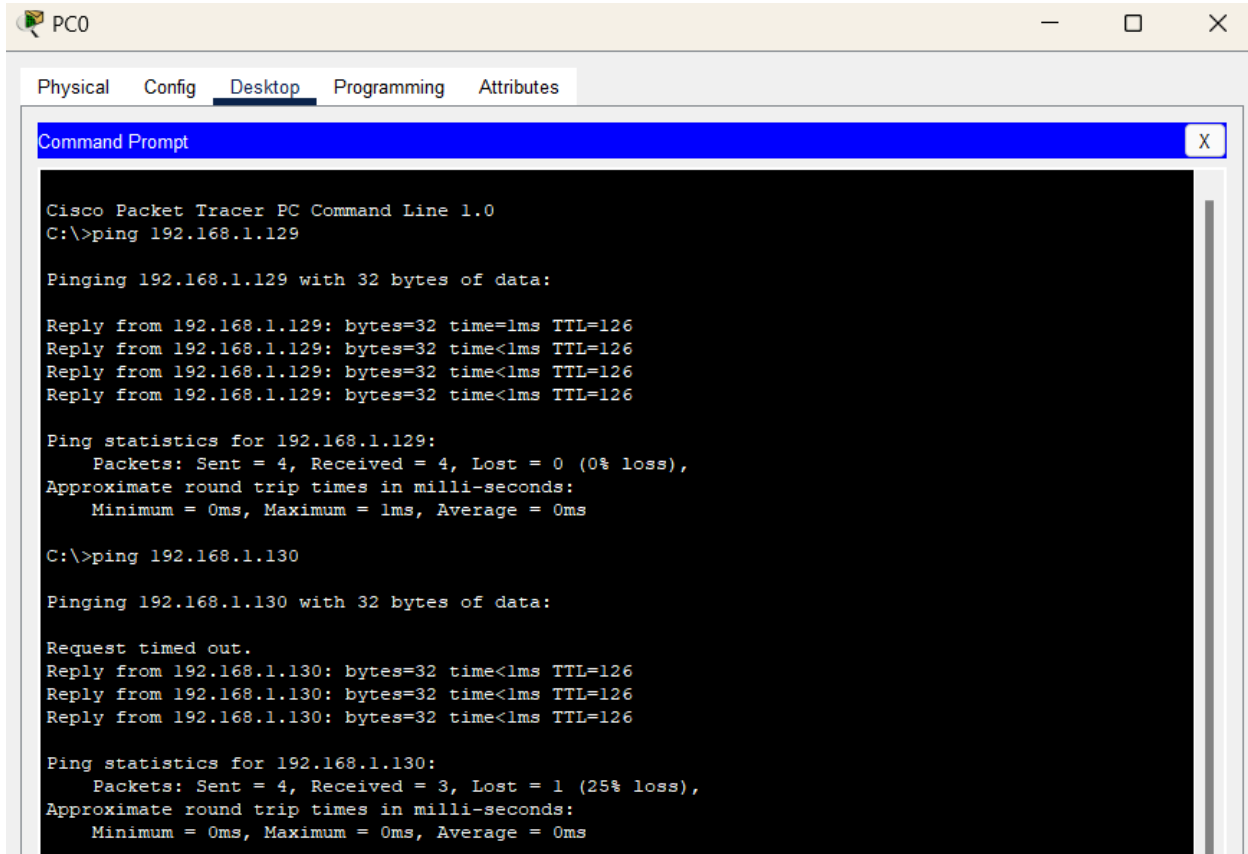
Next Hop

Add

Network Address

192.168.1.0/25 via 192.168.3.1

Now Ping from PC0 to PC2 and PC 0 to PC3, we that it successfully sends the packets :



The screenshot shows a Cisco Packet Tracer PC window for PC0. The 'Desktop' tab is selected, and a 'Command Prompt' window is open. The command prompt shows the following output:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.129

Pinging 192.168.1.129 with 32 bytes of data:

Reply from 192.168.1.129: bytes=32 time=1ms TTL=126
Reply from 192.168.1.129: bytes=32 time<1ms TTL=126
Reply from 192.168.1.129: bytes=32 time<1ms TTL=126
Reply from 192.168.1.129: bytes=32 time<1ms TTL=126

Ping statistics for 192.168.1.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

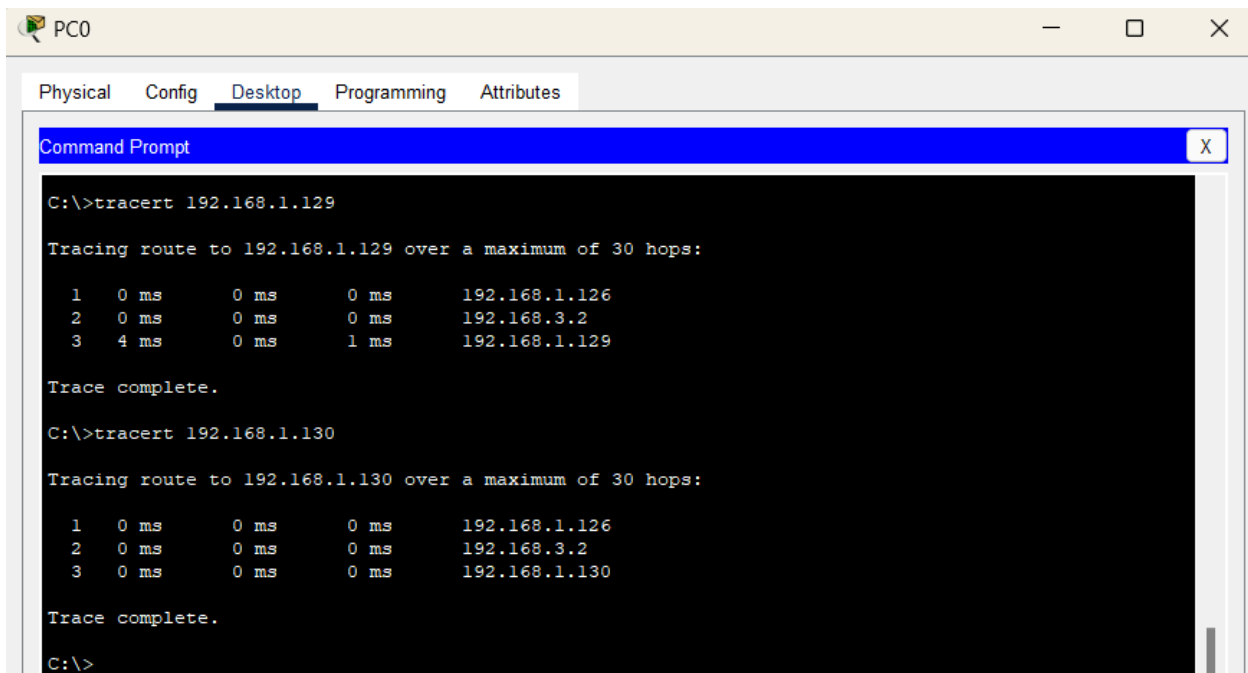
C:\>ping 192.168.1.130

Pinging 192.168.1.130 with 32 bytes of data:

Request timed out.
Reply from 192.168.1.130: bytes=32 time<1ms TTL=126
Reply from 192.168.1.130: bytes=32 time<1ms TTL=126
Reply from 192.168.1.130: bytes=32 time<1ms TTL=126

Ping statistics for 192.168.1.130:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Similarly, use tracert for trace route the PC 0 to PC2 and PC 0 to PC3 and we see the routes :



The screenshot shows the same PC0 Command Prompt window. The following output is shown after running the 'tracert' command:

```
C:\>tracert 192.168.1.129

Tracing route to 192.168.1.129 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    192.168.1.126
  2  0 ms    0 ms    0 ms    192.168.3.2
  3  4 ms    0 ms    1 ms    192.168.1.129

Trace complete.

C:\>tracert 192.168.1.130

Tracing route to 192.168.1.130 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    192.168.1.126
  2  0 ms    0 ms    0 ms    192.168.3.2
  3  0 ms    0 ms    0 ms    192.168.1.130

Trace complete.

C:\>
```

3. Given a network address of 10.0.0.0/24, divide it into 4 equal subnets. Calculate the new subnet mask. Determine the valid host range for each subnet. Assign IP addresses to devices in Packet Tracer and verify connectivity.

Dividing the 10.0.0.0/24 into 4 equal subnets :

10.0.0.00000000/26 → 10.0.0.0/26

10.0.0.01000000/26 → 10.0.0.64/26

10.0.0.10000000/26 → 10.0.0.128/26

10.0.0.11000000/26 → 10.0.0.192/26

Ranges and Usable valid host of the subnets :

1. 10.0.0.0/26 → 10.0.0.63/26

Valid Host are 10.0.0.1/26 → 10.0.0.62/26

2. 10.0.0.64/26 → 10.0.0.127/26

Valid hosts are 10.0.0.65/26 → 10.0.0.126/26

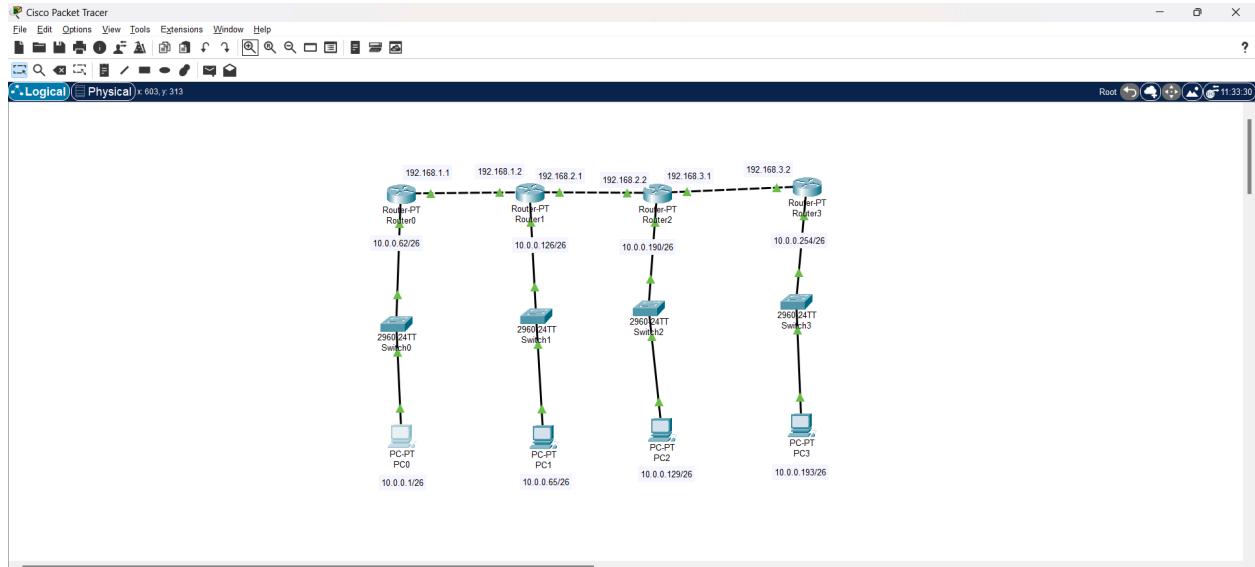
3. 10.0.0.128/26 → 10.0.0.191/26

Valid hosts are 10.0.0.129/26 → 10.0.0.190/26

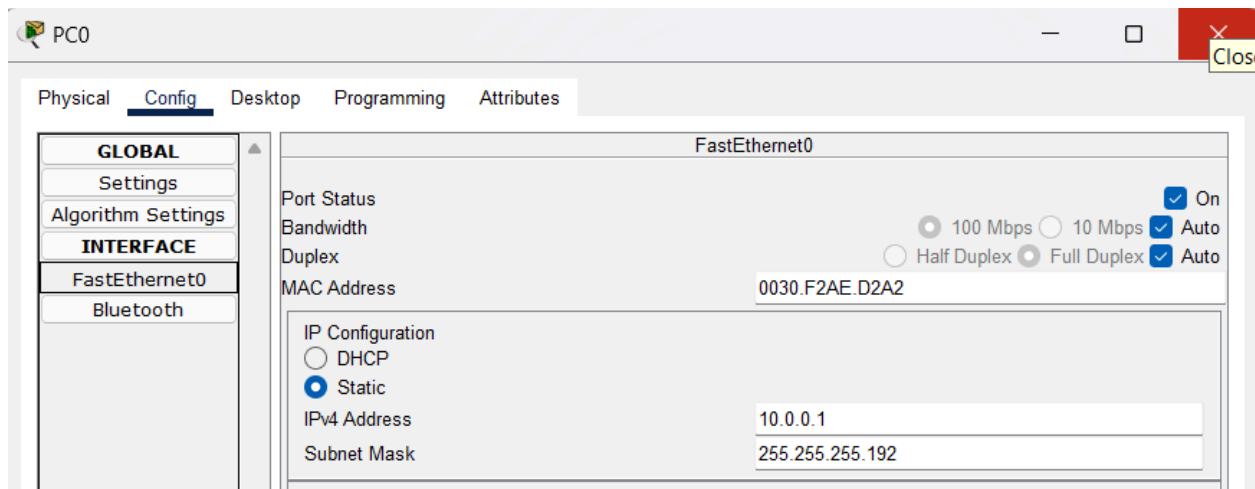
4. 10.0.0.192/26 → 10.0.0.255/26

Valid hosts are 10.0.0.193/26 → 10.0.0.254/26

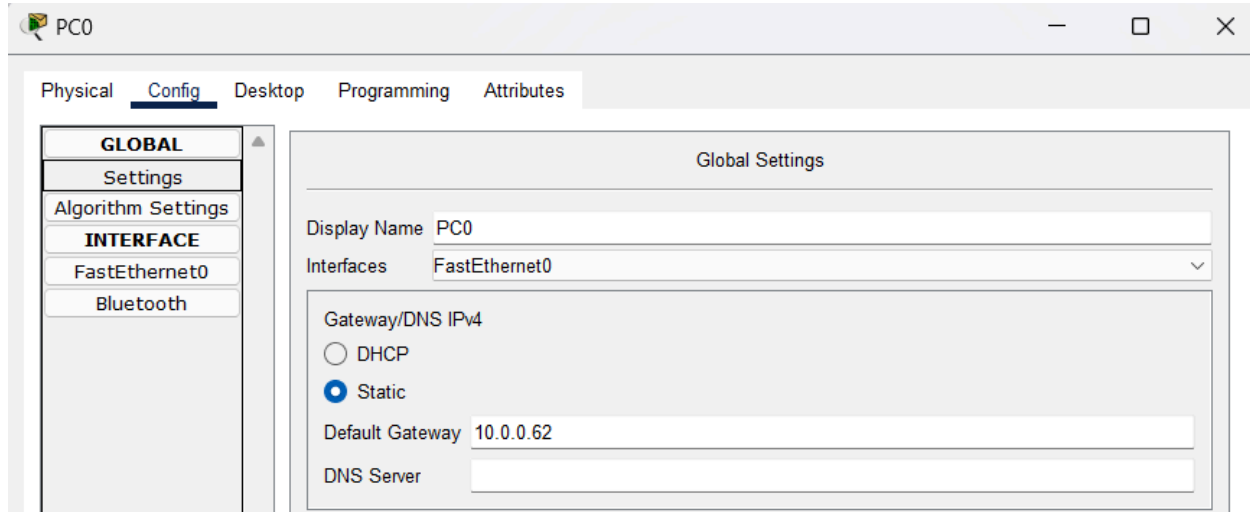
Now configure the Network topology as given below in the Cisco Packet Tracer :



Configure the PC with IP address and Subnet mask as given below and do it for the other PCs as well similarly :



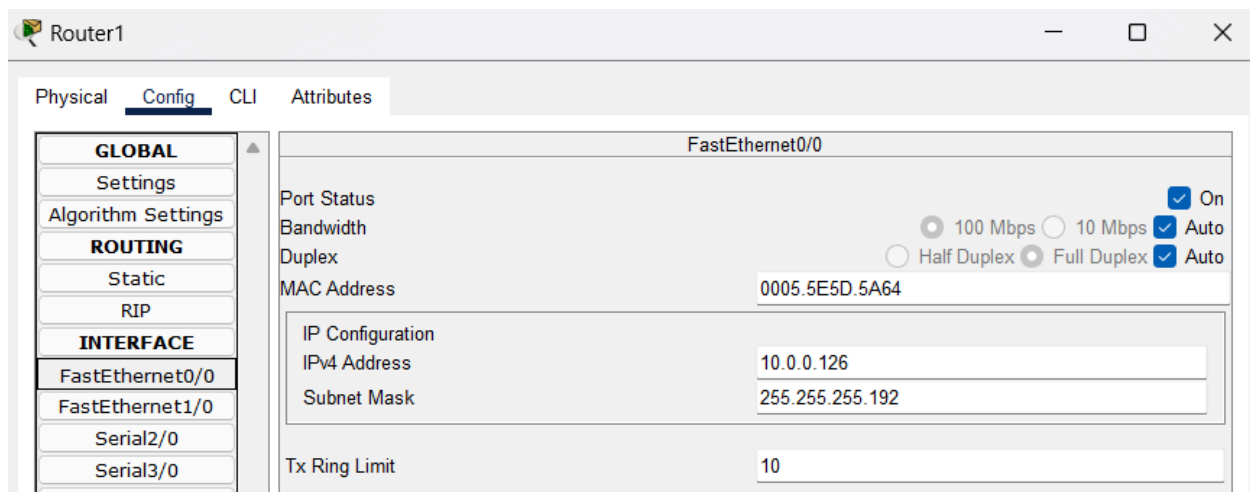
Configure the default gateway for every PC :



The screenshot shows the configuration window for PC0. The 'Config' tab is selected. In the left sidebar, under the 'INTERFACE' section, 'FastEthernet0' is selected. The main area displays 'Global Settings' for this interface. The 'Display Name' is 'PC0' and the 'Interfaces' dropdown is set to 'FastEthernet0'. Under 'Gateway/DNS IPv4', the 'Static' radio button is selected. The 'Default Gateway' is set to '10.0.0.62' and the 'DNS Server' field is empty.

Global Settings	
Display Name	PC0
Interfaces	FastEthernet0
Gateway/DNS IPv4	
<input type="radio"/> DHCP	
<input checked="" type="radio"/> Static	
Default Gateway	10.0.0.62
DNS Server	

Go to each router and the IP address to its respective interfaces which will be the default gateway to its respective networks :



The screenshot shows the configuration window for Router1. The 'Config' tab is selected. In the left sidebar, under the 'INTERFACE' section, 'FastEthernet0/0' is selected. The main area displays the configuration for 'FastEthernet0/0'. The 'Port Status' is 'On'. The 'Bandwidth' is '100 Mbps'. The 'Duplex' is 'Full Duplex'. The 'MAC Address' is '0005.5E5D.5A64'. The 'IP Configuration' section shows the 'IPv4 Address' as '10.0.0.126' and the 'Subnet Mask' as '255.255.255.192'. The 'Tx Ring Limit' is '10'.

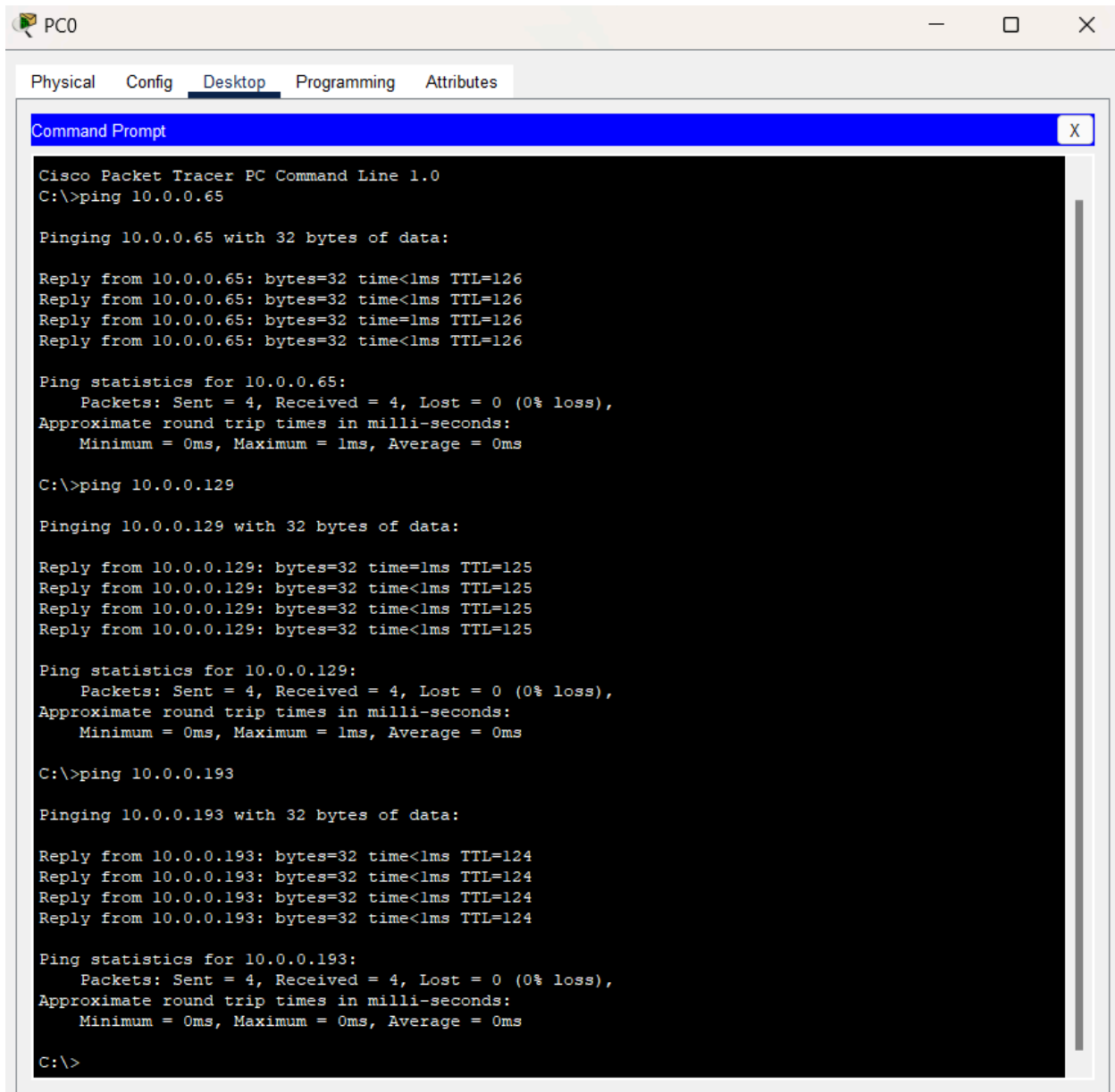
FastEthernet0/0	
Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input checked="" type="radio"/> 100 Mbps <input type="radio"/> 10 Mbps
Duplex	<input type="radio"/> Half Duplex <input checked="" type="radio"/> Full Duplex
MAC Address	0005.5E5D.5A64
IP Configuration	
IPv4 Address	10.0.0.126
Subnet Mask	255.255.255.192
Tx Ring Limit	10

Add the Static routes the network has to reach by its Packets, and do it for all the unconnected networks to the router itself. Similarly do for all the Routers and given below is for Router1:

The screenshot shows the configuration interface for Router1. The 'Config' tab is active, and the 'Static Routes' section is selected in the left-hand menu. The main area displays the 'Static Routes' configuration form. It includes input fields for 'Network', 'Mask', and 'Next Hop', followed by an 'Add' button. Below these fields, a table lists the configured static routes.

Network Address
10.0.0.0/26 via 192.168.1.1
10.0.0.128/26 via 192.168.2.2
10.0.0.192/26 via 192.168.2.2

To verify the connectivity, let's Ping from PC0 to all the other PCs and we see that it is successfully pinging :



```
PC0
Physical Config Desktop Programming Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.65

Pinging 10.0.0.65 with 32 bytes of data:

Reply from 10.0.0.65: bytes=32 time<1ms TTL=126
Reply from 10.0.0.65: bytes=32 time<1ms TTL=126
Reply from 10.0.0.65: bytes=32 time<1ms TTL=126
Reply from 10.0.0.65: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.0.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.129

Pinging 10.0.0.129 with 32 bytes of data:

Reply from 10.0.0.129: bytes=32 time<1ms TTL=125
Reply from 10.0.0.129: bytes=32 time<1ms TTL=125
Reply from 10.0.0.129: bytes=32 time<1ms TTL=125
Reply from 10.0.0.129: bytes=32 time<1ms TTL=125

Ping statistics for 10.0.0.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.193

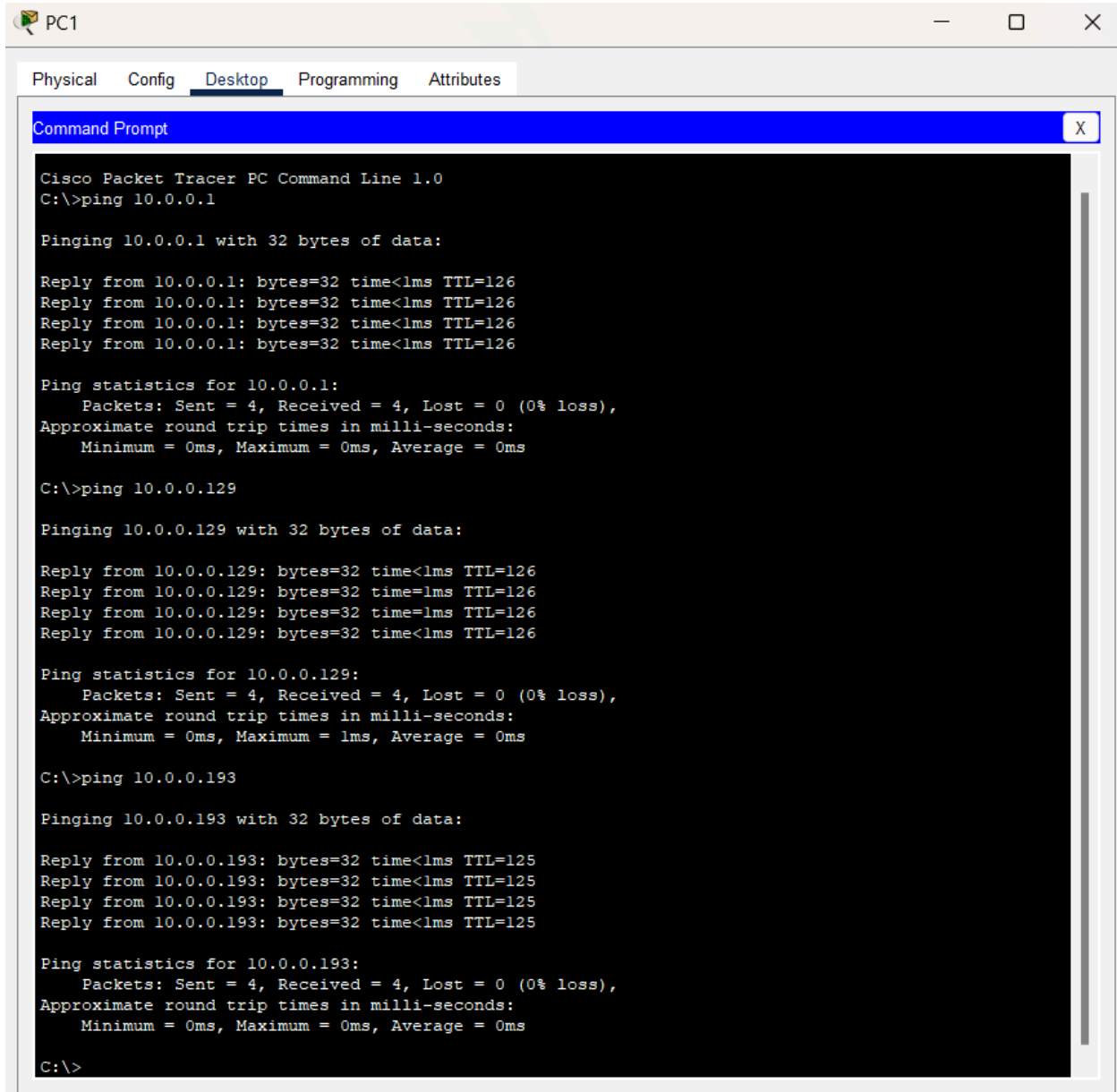
Pinging 10.0.0.193 with 32 bytes of data:

Reply from 10.0.0.193: bytes=32 time<1ms TTL=124
Reply from 10.0.0.193: bytes=32 time<1ms TTL=124
Reply from 10.0.0.193: bytes=32 time<1ms TTL=124
Reply from 10.0.0.193: bytes=32 time<1ms TTL=124

Ping statistics for 10.0.0.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```


Similarly ping and check from PC1 :



The screenshot shows a Cisco Packet Tracer PC Command Line window for PC1. The window has tabs for Physical, Config, Desktop (selected), Programming, and Attributes. The Command Prompt displays the output of three ping commands. The first command is 'ping 10.0.0.1', which shows four successful replies with 32 bytes of data, a time of less than 1ms, and a TTL of 126. The second command is 'ping 10.0.0.129', which also shows four successful replies with 32 bytes of data, a time of less than 1ms, and a TTL of 126. The third command is 'ping 10.0.0.193', which shows four successful replies with 32 bytes of data, a time of less than 1ms, and a TTL of 125. Ping statistics for each command show 4 packets sent, 4 received, and 0% loss.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time<1ms TTL=126
Reply from 10.0.0.1: bytes=32 time<1ms TTL=126
Reply from 10.0.0.1: bytes=32 time<1ms TTL=126
Reply from 10.0.0.1: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.0.0.129

Pinging 10.0.0.129 with 32 bytes of data:

Reply from 10.0.0.129: bytes=32 time<1ms TTL=126
Reply from 10.0.0.129: bytes=32 time<1ms TTL=126
Reply from 10.0.0.129: bytes=32 time<1ms TTL=126
Reply from 10.0.0.129: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.0.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.193

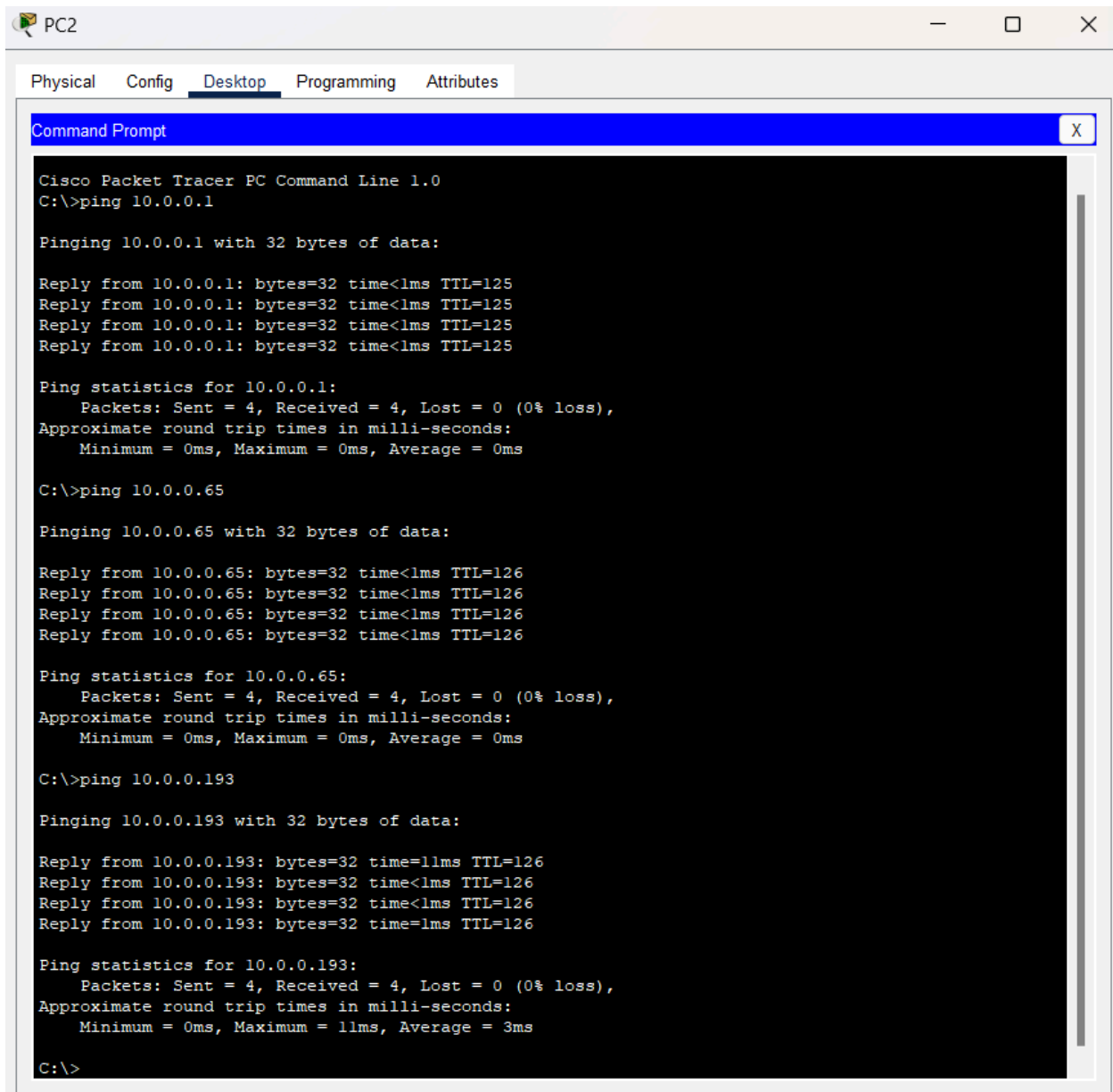
Pinging 10.0.0.193 with 32 bytes of data:

Reply from 10.0.0.193: bytes=32 time<1ms TTL=125
Reply from 10.0.0.193: bytes=32 time<1ms TTL=125
Reply from 10.0.0.193: bytes=32 time<1ms TTL=125
Reply from 10.0.0.193: bytes=32 time<1ms TTL=125

Ping statistics for 10.0.0.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Similarly ping and check from PC2 :



The screenshot shows a Cisco Packet Tracer window titled "PC2" with tabs for Physical, Config, Desktop, Programming, and Attributes. The "Desktop" tab is active, displaying a "Command Prompt" window. The Command Prompt shows the output of three ping commands from PC2 to three different IP addresses. Each ping command is followed by four replies and a summary of ping statistics.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time<1ms TTL=125
Reply from 10.0.0.1: bytes=32 time<1ms TTL=125
Reply from 10.0.0.1: bytes=32 time<1ms TTL=125
Reply from 10.0.0.1: bytes=32 time<1ms TTL=125

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.0.0.65

Pinging 10.0.0.65 with 32 bytes of data:

Reply from 10.0.0.65: bytes=32 time<1ms TTL=126
Reply from 10.0.0.65: bytes=32 time<1ms TTL=126
Reply from 10.0.0.65: bytes=32 time<1ms TTL=126
Reply from 10.0.0.65: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.0.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.0.0.193

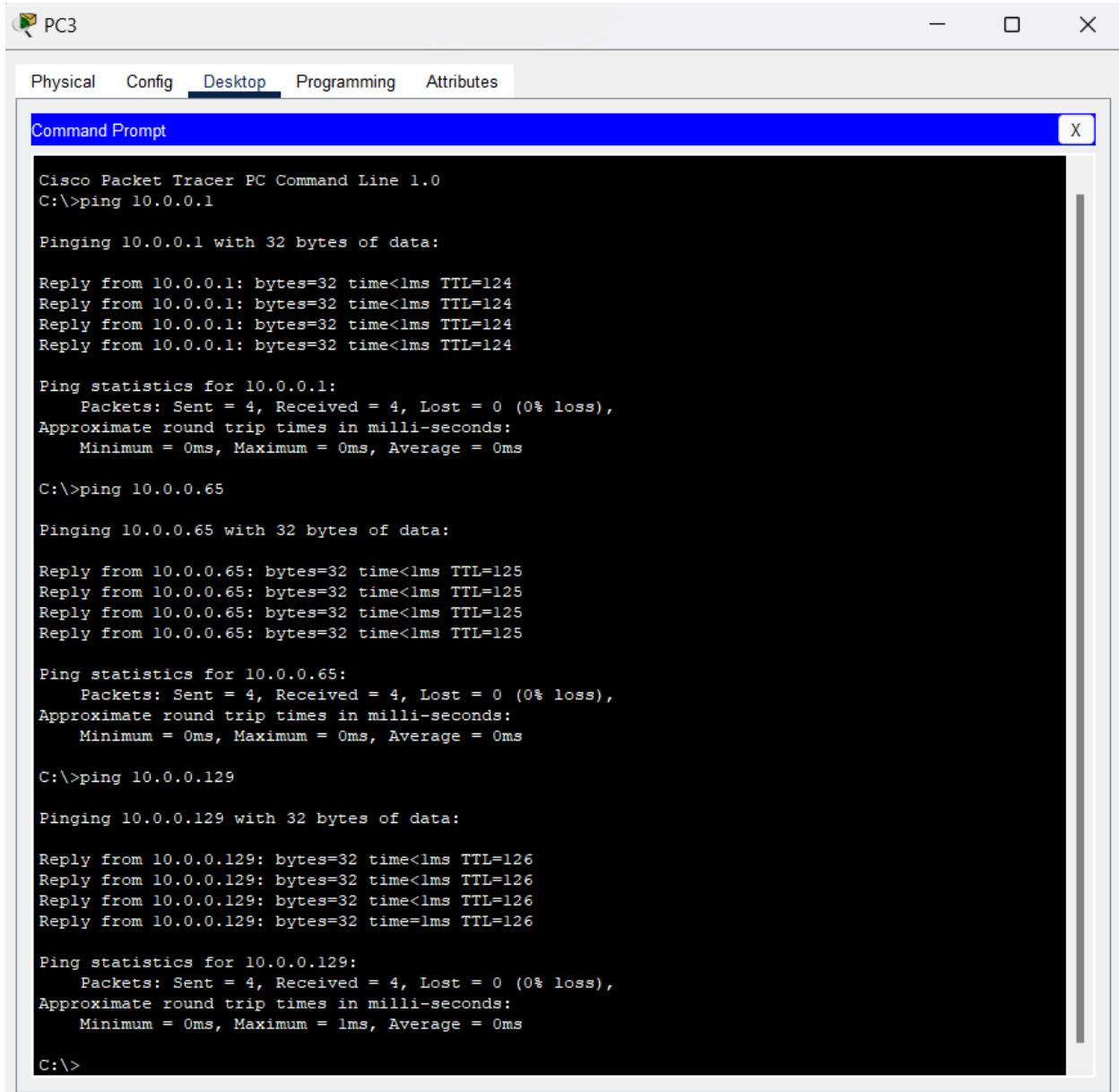
Pinging 10.0.0.193 with 32 bytes of data:

Reply from 10.0.0.193: bytes=32 time=11ms TTL=126
Reply from 10.0.0.193: bytes=32 time<1ms TTL=126
Reply from 10.0.0.193: bytes=32 time<1ms TTL=126
Reply from 10.0.0.193: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.0.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms

C:\>
```

Similarly ping and check from PC3 :



The screenshot shows a Cisco Packet Tracer window for PC3. The 'Desktop' tab is selected, displaying a 'Command Prompt' window. The command prompt shows the execution of three ping commands from the PC's perspective. Each command is successful, with 4 packets sent and received, 0% loss, and 0ms round trip times. The first ping is to 10.0.0.1 (TTL=124), the second to 10.0.0.65 (TTL=125), and the third to 10.0.0.129 (TTL=126).

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time<1ms TTL=124
Reply from 10.0.0.1: bytes=32 time<1ms TTL=124
Reply from 10.0.0.1: bytes=32 time<1ms TTL=124
Reply from 10.0.0.1: bytes=32 time<1ms TTL=124

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.0.0.65

Pinging 10.0.0.65 with 32 bytes of data:

Reply from 10.0.0.65: bytes=32 time<1ms TTL=125
Reply from 10.0.0.65: bytes=32 time<1ms TTL=125
Reply from 10.0.0.65: bytes=32 time<1ms TTL=125
Reply from 10.0.0.65: bytes=32 time<1ms TTL=125

Ping statistics for 10.0.0.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.0.0.129

Pinging 10.0.0.129 with 32 bytes of data:

Reply from 10.0.0.129: bytes=32 time<1ms TTL=126
Reply from 10.0.0.129: bytes=32 time<1ms TTL=126
Reply from 10.0.0.129: bytes=32 time<1ms TTL=126
Reply from 10.0.0.129: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.0.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

4. You are given three IP addresses: 192.168.10.5, 172.20.15.1, and 8.8.8.8. Identify the class of each IP address. Determine if it is private or public. Explain how NAT would handle a private IP when accessing the internet.

Given IP Address	Class of IP Address	Private / Public IP Address
192.168.10.5	Class C	Private
172.20.15.1	Class B	Private
8.8.8.8	Class A	Public

Classful Addressing :

There are 5 classes of IP addressing, A to E. Where A to C are Unicast, D is Multicast, E is reserved.

0.0.0.0 → 127.255.255.255 → Class A

128.0.0.0 → 191.255.255.255 → Class B

192.0.0.0 → 223.255.255.255 → Class C

Private IP address :

These are reserved within private network usage and not accessible to the Internet. These fall in the range specified by RFC 1918 as given below :

10.0.0.0 → 10.255.255.255 (10.0.0.0/8)

172.16.0.0 → 172.31.255.255 (172.16.0.0/12)

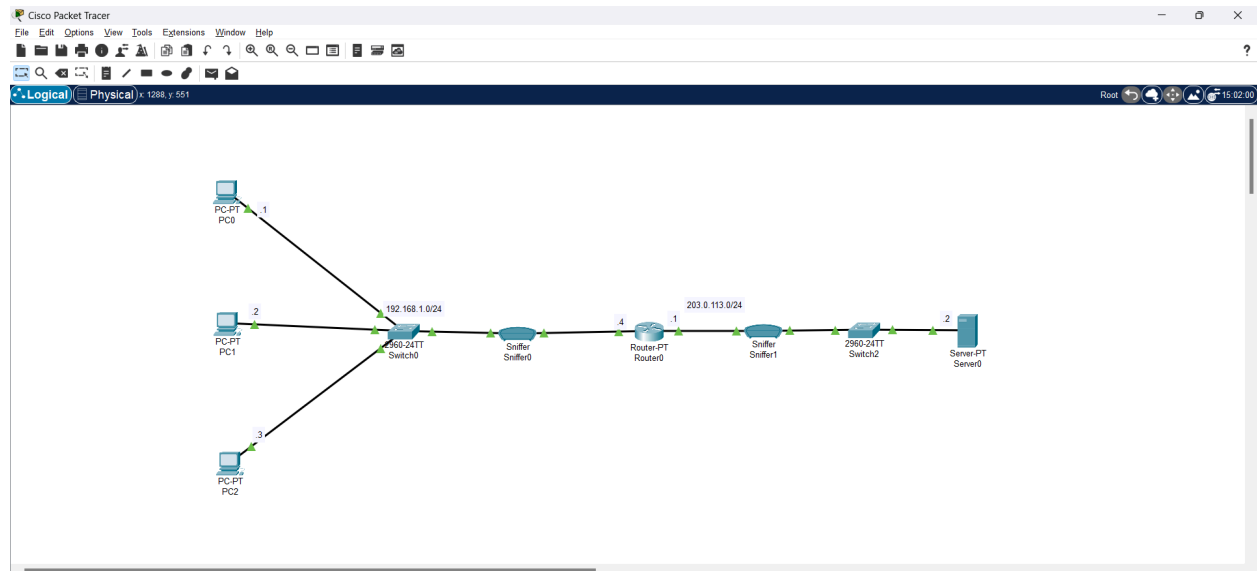
192.168.0.0 → 192.168.255.255 (192.168.0.0/16)

NAT Address :

Network Address Translation is used to allow private IP addresses to communicate with the Internet using Public IP addresses. A device sends a Request to the Internet with a Private IP address and the router will convert it to a Public IP address of its own. When it gets a reply, the NAT in the router will convert it back to private IP and send it to the device.

5. In Cisco Packet Tracer, configure NAT on a router to allow internal devices (192.168.1.x) to access the internet. Test connectivity by pinging an external public IP. Capture the traffic in Wireshark and analyze the source IP before and after NAT translation.

Configure the network topology in Cisco Packet Tracer :



Configure the PC side (FastEthernet0/0) as Inside of NAT and Server Side (FastEthernet1/0) as Outside of NAT, followed by which add the static NAT source IP for each PC IP which will be converted to its NAT IP, then you will be able to see the NAT translations :

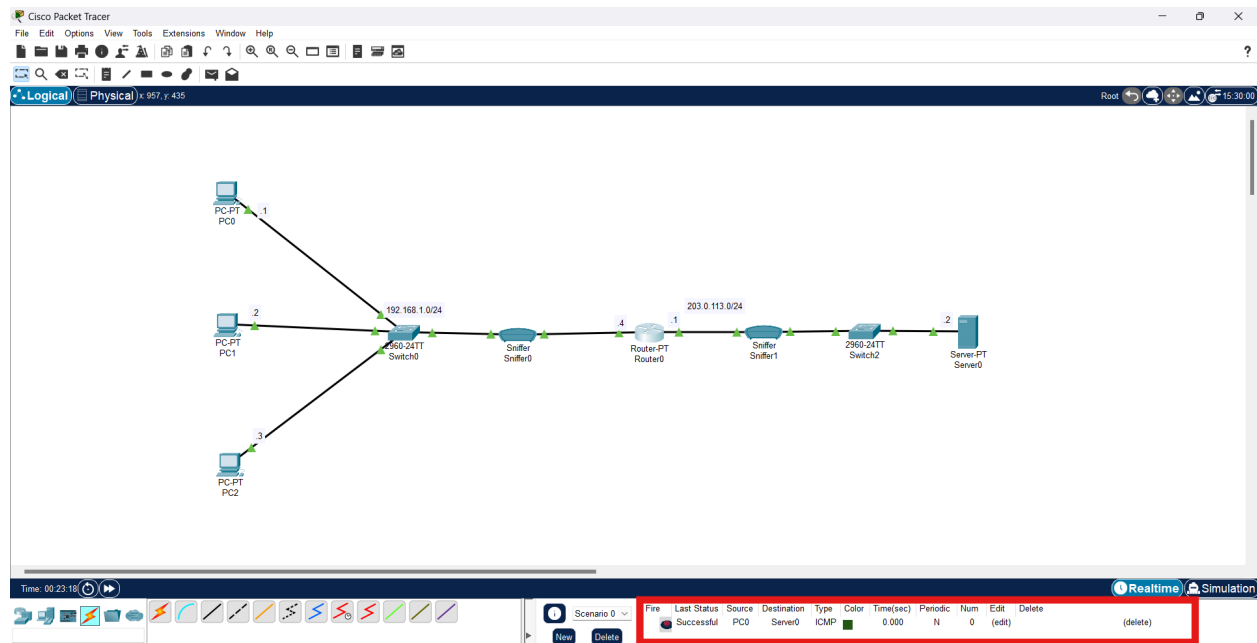
```
Router0
Physical Config CLI Attributes
IOS Command Line Interface

Router(config-if)#int fa1/0
Router(config-if)#ip nat outside
Router(config-if)#int fa0/0
Router(config-if)#ip nat inside
Router(config-if)#
Router(config-if)#exit
Router(config)#
Router(config)#ip nat inside source static 192.168.1.1 100.0.0.1
Router(config)#ip nat inside source static 192.168.1.2 100.0.0.2
Router(config)#ip nat inside source static 192.168.1.3 100.0.0.3
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#show ip nat trans
Router#show ip nat translations
Pro Inside global      Inside local      Outside local      Outside global
--- 100.0.0.1          192.168.1.1      ---               ---
--- 100.0.0.2          192.168.1.2      ---               ---
--- 100.0.0.3          192.168.1.3      ---               ---

Router#show ip nat stat
Total translations: 3 (3 static, 0 dynamic, 0 extended)
Outside Interfaces: FastEthernet1/0
Inside Interfaces: FastEthernet0/0
Hits: 0 Misses: 0
Expired translations: 0
Dynamic mappings:
Router#
```

Let's check using PDU from PC1 to server and its successfully working :



Pinging from PC0 to server also we are able to see the successful connection with Server :

The screenshot shows a Windows Command Prompt window titled "PC0". The command prompt displays the output of a ping command executed from PC0 to the server (203.0.113.2). The output shows four successful replies with 32 bytes of data, a time of 11ms, and a TTL of 127. The ping statistics show 4 packets sent, 4 received, and 0% loss.

```
C:\>ping 203.0.113.2

Pinging 203.0.113.2 with 32 bytes of data:

Reply from 203.0.113.2: bytes=32 time=11ms TTL=127
Reply from 203.0.113.2: bytes=32 time=1ms TTL=127
Reply from 203.0.113.2: bytes=32 time<1ms TTL=127
Reply from 203.0.113.2: bytes=32 time=1ms TTL=127

Ping statistics for 203.0.113.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 11ms, Average = 3ms

C:\>
```

Since we don't have Wireshark in Cisco Packet Tracer, as it is a simulation tool by itself, we can use the Sniffer device to view the Packets that are sent through the network and we see the ICMP packet in the NAT Inside, that the source IP is same as the PC's IP :

The screenshot displays the Sniffer0 GUI with the 'GUI' tab selected. The interface includes a 'Service' section with 'On' selected, an 'Incoming Packets' section with 'Port0' selected, and a 'Buffer Size' slider set to 256. A list of protocols is shown on the left, with 'ICMP' highlighted. The main display area shows a packet capture for 'EthernetII' and 'IP'. The Ethernet II header includes a preamble, destination address (0006.2A16.2A72), source address (0050.0FA7.A191), type (0x0800), and FCS (0x00000000). The IP header includes version (4), IHL (5), DSCP (0x00), TTL (128), ID (0x0012), flags (0x0), frag offset (0x000), and checksum. The packet data is highlighted with a red box, showing the source IP (192.168.1.1) and destination IP (203.0.113.2). A 'Clear' button is located at the bottom right.

Service: ☒ On ☐ Off

Incoming Packets: ☒ Port0 ☐ Port1

Buffer Size:

Protocol List:

- STP
- STP
- STP
- STP
- STP
- CDP
- DTP
- STP
- ICMP
- ICMP
- STP
- ICMP
- ICMP
- STP
- STP
- STP
- STP
- STP
- STP
- STP
- STP
- STP
- STP

EthernetII

Bytes			
PREAMBLE: 101010..10	SF D	DEST ADDR: 0006.2A16.2A72	
SRC ADDR: 0050.0FA7.A191	TYPE: 0x0800	DATA (VARIABLE LENGTH)	FCS: 0x00000000

IP

Bits			
VER: 4	IHL: 5	DSCP: 0x00	TTL: 128
ID: 0x0012		FLAGS: 0x0	FRAG OFFSET: 0x000
TTL: 128	PRO: 0x01	CHKSUM	
SRC IP: 192.168.1.1			
DST IP: 203.0.113.2			
DATA (VARIABLE LENGTH)			

ICMP

Clear

Similarly, in the NAT outside, we are able to see that the Source IP has successfully changed by the NAT in the router as configured by the static NAT using the CLI, from the PC's IP to 100.0.0.1 which was configured. Hence the NAT translation is successful :

The image shows the Sniffer1 GUI with the 'GUI' tab selected. The 'Service' is set to 'On' and 'Incoming Packets' is set to 'Port0'. The 'Buffer Size' is set to 256. A list of protocols is shown on the left, with 'ICMP' selected. The main display shows the packet structure for 'Ethernet II' and 'IP'.

Ethernet II

0		4		8		Bytes	
PREAMBLE: 101010...10				SF D		DEST ADDR: 00D0.58C8.4E80	
SRC ADDR: 0040.0B39.9850				TYPE: 0x0800		DATA (VARIABLE LENGTH)	

IP

0		4		8		16		20		24		Bits	
VER: 4		IHL: 5		DSCP: 0x00		TL: 128							
ID: 0x0012						FLAGS: 0x0		FRAG OFFSET: 0x000					
TTL: 127				PRO: 0x01				CHKSUM					
SRC IP: 100.0.0.1													
DST IP: 203.0.113.2													
DATA (VARIABLE LENGTH)													

ICMP

Clear