INSTITUTE OF ENGINEERING
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COMPUTER NETWORK

LAB #6

To Introduce the Concept of Subnetting, Subnet Mask, VLSM and CIDR

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Question 2

1 Title

To Introduce the Concept of Subnetting, Subnet Mask, VLSM and CIDR

2 Objective

- To be familiar with subnetting, subnet mask and its use
- To be familiar with VLSM and CIDR

3 Requirement

- Network simulation tool: Packet Tracer

4 Procedure

With the help of Cisco Packet Tracer we simulated Subnetting of different IP ranges also explored VLSM (Variable Length Subnet Mask) and CIDR (Classless Inter-Domain Routing). We performed Ping Operation to visualize the concept of Subnet and prove that to communicate between different network Router is required.

5 Exercises:

5.1 Question -1

Observe and note down the output of each of the above mentioned task and comment on the result by explaining the reason in detail.

5.1.1 Activities A

A. Create the network topology as shown in figure 1 below, and note down the output by performing the following activities:

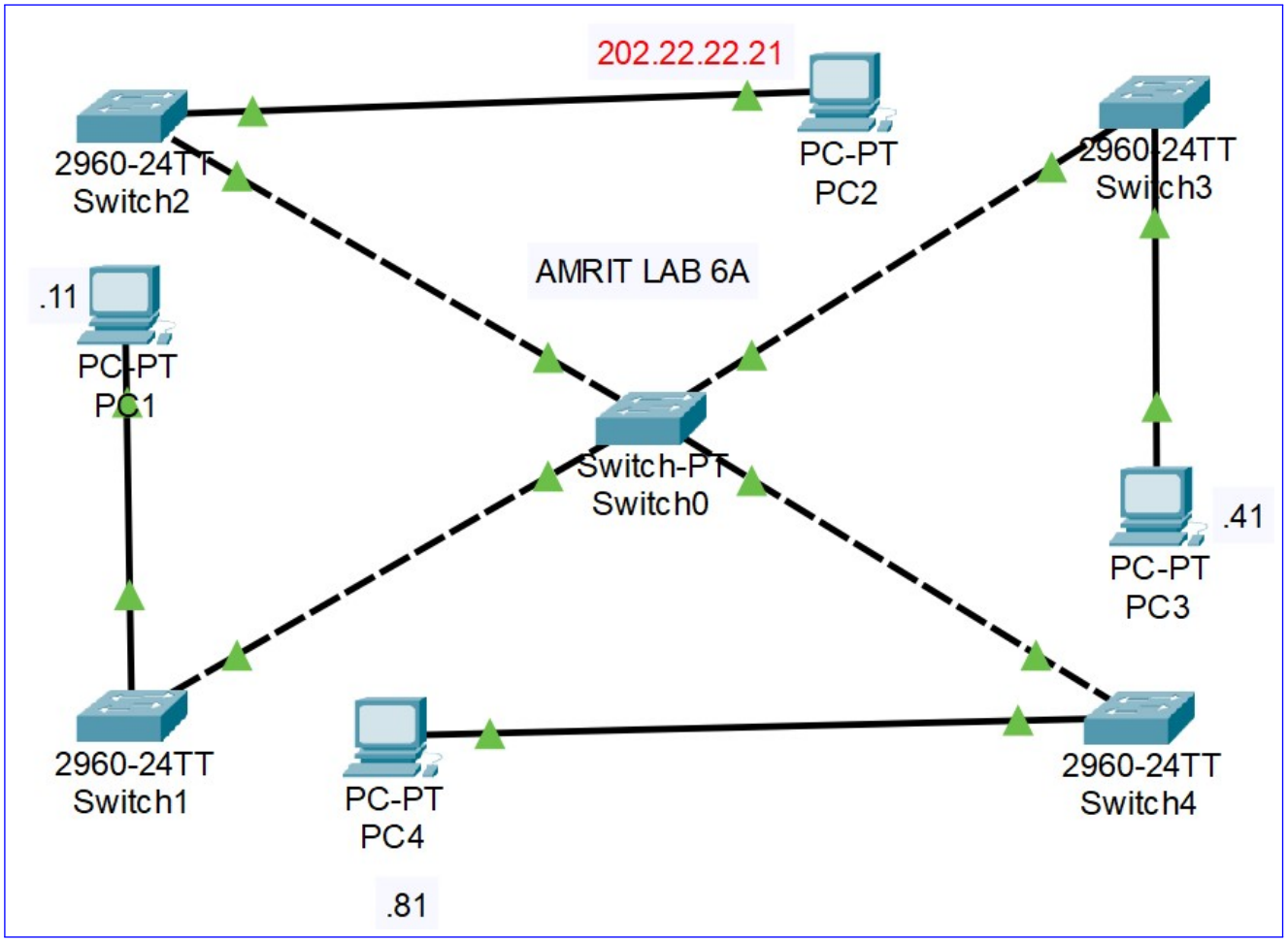

Figure 1: Network topology Lab 6A

1. **Assign the IP address of PC1, PC2, PC3 and PC4 as 202.22.22.11, 202.22.22.21, 202.22.22.41, 202.22.22.81 respectively with subnet mask of 255.255.255.0 and note down the result of following operations:**

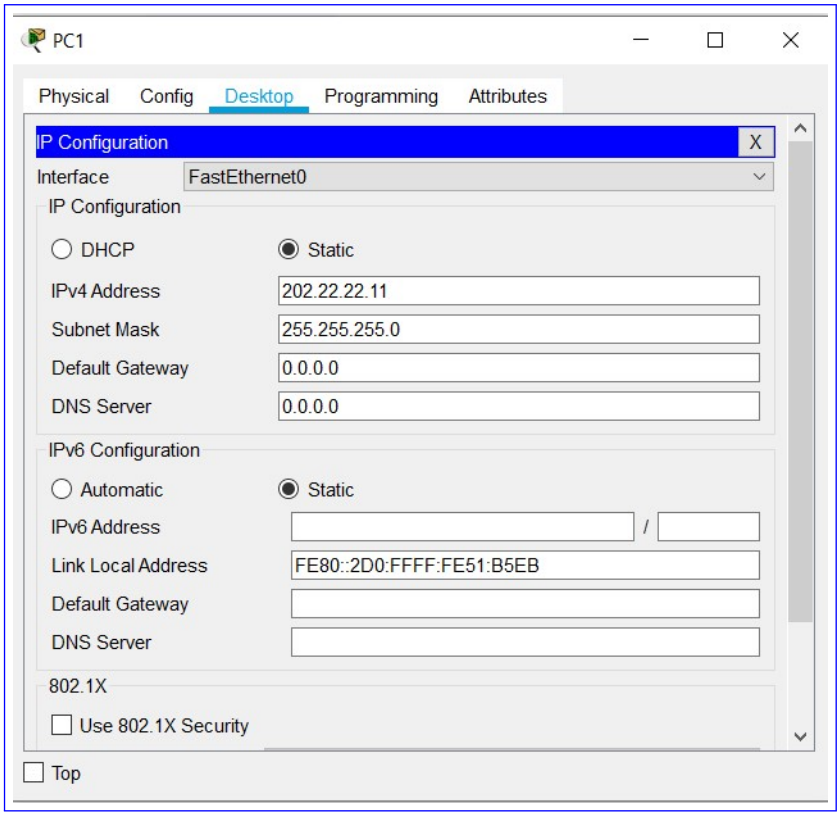

Figure 2: Assign IP address and subnet mask for PC1

2. **Test the connectivity from one computer to all another computers using ping.**

```
C:\>ping 202.22.22.81

Pinging 202.22.22.81 with 32 bytes of data:

Reply from 202.22.22.81: bytes=32 time<1ms TTL=128
Reply from 202.22.22.81: bytes=32 time<1ms TTL=128
Reply from 202.22.22.81: bytes=32 time<1ms TTL=128
Reply from 202.22.22.81: bytes=32 time<1ms TTL=128

Ping statistics for 202.22.22.81:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 1: Ping from PC1 to PC4

```
C:\>ping 202.22.22.11

Pinging 202.22.22.11 with 32 bytes of data:

Reply from 202.22.22.11: bytes=32 time<1ms TTL=128
Reply from 202.22.22.11: bytes=32 time<1ms TTL=128
Reply from 202.22.22.11: bytes=32 time=1ms TTL=128
Reply from 202.22.22.11: bytes=32 time=7ms TTL=128

Ping statistics for 202.22.22.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 7ms, Average = 2ms
```

Output 2: Ping from PC2 to PC1

```
C:\>ping 202.22.22.21

Pinging 202.22.22.21 with 32 bytes of data:

Reply from 202.22.22.21: bytes=32 time=1ms TTL=128
Reply from 202.22.22.21: bytes=32 time<1ms TTL=128
Reply from 202.22.22.21: bytes=32 time<1ms TTL=128
Reply from 202.22.22.21: bytes=32 time<1ms TTL=128

Ping statistics for 202.22.22.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 3: Ping from PC3 to PC2

```
C:\>ping 202.22.22.41

Pinging 202.22.22.41 with 32 bytes of data:

Reply from 202.22.22.41: bytes=32 time<1ms TTL=128
Reply from 202.22.22.41: bytes=32 time<1ms TTL=128
Reply from 202.22.22.41: bytes=32 time<1ms TTL=128
Reply from 202.22.22.41: bytes=32 time<1ms TTL=128

Ping statistics for 202.22.22.41:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 4: Ping from PC4 to PC3

Since subnet mask is (/24) it covers usable host from 202.22.22.0 - 202.22.22.254 in a single network so ping is possible between and among the PCs with the help of switching device only.

3. **Change the subnet mask to 255.255.255.192 and test the connectivity from one computer to all another computers using ping.**

```
C:\>ping 202.22.22.81

Pinging 202.22.22.81 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.81:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 5: Ping from PC1 to PC4

```
C:\>ping 202.22.22.11

Pinging 202.22.22.11 with 32 bytes of data:

Reply from 202.22.22.11: bytes=32 time=2ms TTL=128
Reply from 202.22.22.11: bytes=32 time<1ms TTL=128
Reply from 202.22.22.11: bytes=32 time<1ms TTL=128
Reply from 202.22.22.11: bytes=32 time<1ms TTL=128

Ping statistics for 202.22.22.11:
```

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

Output 6: Ping from PC2 to PC1

```
C:\>ping 202.22.22.21

Pinging 202.22.22.21 with 32 bytes of data:

Reply from 202.22.22.21: bytes=32 time=1ms TTL=128
Reply from 202.22.22.21: bytes=32 time<1ms TTL=128
Reply from 202.22.22.21: bytes=32 time=2ms TTL=128
Reply from 202.22.22.21: bytes=32 time<1ms TTL=128

Ping statistics for 202.22.22.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 7: Ping from PC3 to PC2

```
C:\>ping 202.22.22.41

Pinging 202.22.22.41 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.41:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 8: Ping from PC4 to PC3

All 4 of the Possible /26 Networks for 202.22.22.*

Network Address	Usable Host Range	Broadcast Address:
202.22.22.0	202.22.22.1 - 202.22.22.62	202.22.22.63
202.22.22.64	202.22.22.65 - 202.22.22.126	202.22.22.127
202.22.22.128	202.22.22.129 - 202.22.22.190	202.22.22.191
202.22.22.192	202.22.22.193 - 202.22.22.254	202.22.22.255

Figure 3: Possible subnets for /26

With subnet mask (/26) PC1, PC1 and PC3 falls under same subnet and PC4 under different subnet so ping failed to and from PC4 but successful among PC1, PC2, PC3.

4. **Change the subnet mask to 255.255.255.224 and test the connectivity from one computer to all another computers using ping.**

```
C:\>ping 202.22.22.81

Pinging 202.22.22.81 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.81:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 9: Ping from PC1 to PC4

```
C:\>ping 202.22.22.11

Pinging 202.22.22.11 with 32 bytes of data:

Reply from 202.22.22.11: bytes=32 time<1ms TTL=128
Reply from 202.22.22.11: bytes=32 time=1ms TTL=128
Reply from 202.22.22.11: bytes=32 time<1ms TTL=128
Reply from 202.22.22.11: bytes=32 time<1ms TTL=128

Ping statistics for 202.22.22.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 10: Ping from PC2 to PC1

```
C:\>ping 202.22.22.21

Pinging 202.22.22.21 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.21:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 11: Ping from PC3 to PC2

```
C:\>ping 202.22.22.41

Pinging 202.22.22.41 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.41:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 12: Ping from PC4 to PC3

All 8 of the Possible /27 Networks for 202.22.22.*

Network Address	Usable Host Range	Broadcast Address:
202.22.22.0	202.22.22.1 - 202.22.22.30	202.22.22.31
202.22.22.32	202.22.22.33 - 202.22.22.62	202.22.22.63
202.22.22.64	202.22.22.65 - 202.22.22.94	202.22.22.95
202.22.22.96	202.22.22.97 - 202.22.22.126	202.22.22.127
202.22.22.128	202.22.22.129 - 202.22.22.158	202.22.22.159
202.22.22.160	202.22.22.161 - 202.22.22.190	202.22.22.191
202.22.22.192	202.22.22.193 - 202.22.22.222	202.22.22.223
202.22.22.224	202.22.22.225 - 202.22.22.254	202.22.22.255

Figure 4: Possible subnets for /27

With subnet (/27) only PC1 and PC2 falls under a same subnet and ping is possible between them but as PC3 and PC4 falls under different subnet ping failed to and from (PC1, PC2) , PC3 and PC4.

5. **Change the subnet mask to 255.255.255.240 and test the connectivity from one computer to all another computers using ping.**

```
C:\>ping 202.22.22.41

Pinging 202.22.22.41 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.41:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 13: Ping from PC1 to PC4

```
C:\>ping 202.22.22.11

Pinging 202.22.22.11 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.11:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 14: Ping from PC2 to PC1

```
C:\>ping 202.22.22.21

Pinging 202.22.22.21 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.21:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 15: Ping from PC3 to PC2

```
C:\>ping 202.22.22.41

Pinging 202.22.22.41 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.22.22.41:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 16: Ping from PC4 to PC3

All 16 of the Possible /28 Networks for 202.22.22.*

Network Address	Usable Host Range	Broadcast Address:
202.22.22.0	202.22.22.1 - 202.22.22.14	202.22.22.15
202.22.22.16	202.22.22.17 - 202.22.22.30	202.22.22.31
202.22.22.32	202.22.22.33 - 202.22.22.46	202.22.22.47
202.22.22.48	202.22.22.49 - 202.22.22.62	202.22.22.63
202.22.22.64	202.22.22.65 - 202.22.22.78	202.22.22.79
202.22.22.80	202.22.22.81 - 202.22.22.94	202.22.22.95
202.22.22.96	202.22.22.97 - 202.22.22.110	202.22.22.111
202.22.22.112	202.22.22.113 - 202.22.22.126	202.22.22.127
202.22.22.128	202.22.22.129 - 202.22.22.142	202.22.22.143
202.22.22.144	202.22.22.145 - 202.22.22.158	202.22.22.159
202.22.22.160	202.22.22.161 - 202.22.22.174	202.22.22.175
202.22.22.176	202.22.22.177 - 202.22.22.190	202.22.22.191
202.22.22.192	202.22.22.193 - 202.22.22.206	202.22.22.207
202.22.22.208	202.22.22.209 - 202.22.22.222	202.22.22.223
202.22.22.224	202.22.22.225 - 202.22.22.238	202.22.22.239
202.22.22.240	202.22.22.241 - 202.22.22.254	202.22.22.255

Figure 5: Possible subnets for /28

With subnet mask (/28) all PCs falls under different subnet and Ping Failed between each PCs.

5.1.2 Activities B

B. For the situation given in 5 of activity A above, replace the central switch i.e. switch0 by a router and configure its interfaces with appropriate IP address and subnet mask. Also configure each computer with default gateway. Test the connectivity from one computer to all another computers using ping.

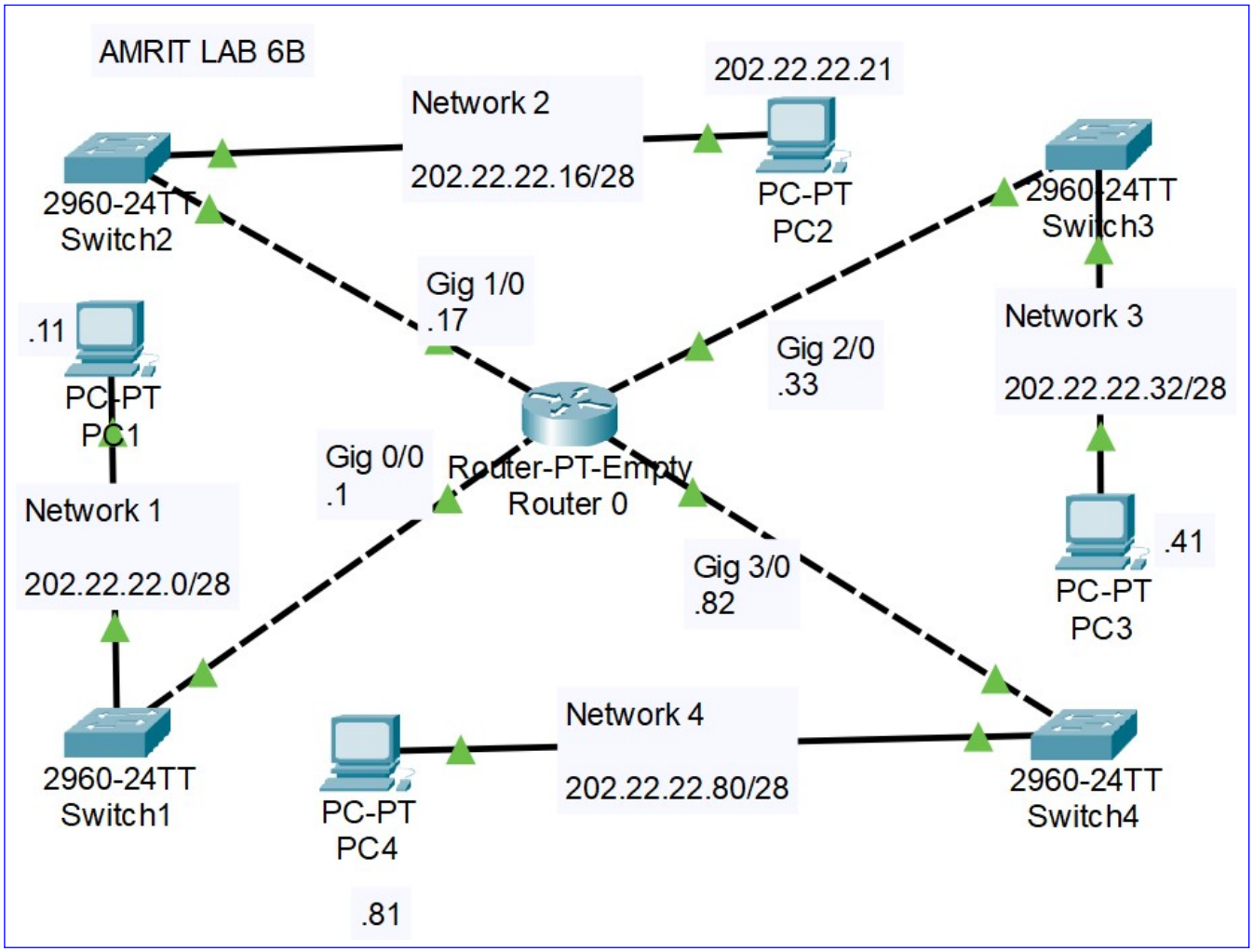

Figure 6: Network topology Lab 6B

```
C:\>ping 202.22.22.81

Pinging 202.22.22.81 with 32 bytes of data:

Reply from 202.22.22.81: bytes=32 time=1ms TTL=127
Reply from 202.22.22.81: bytes=32 time<1ms TTL=127
Reply from 202.22.22.81: bytes=32 time=3ms TTL=127
Reply from 202.22.22.81: bytes=32 time<1ms TTL=127

Ping statistics for 202.22.22.81:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
```

Output 17: Ping from PC1 to PC4

```
C:\>ping 202.22.22.1

Pinging 202.22.22.1 with 32 bytes of data:

Reply from 202.22.22.1: bytes=32 time<1ms TTL=255
Reply from 202.22.22.1: bytes=32 time<1ms TTL=255
Reply from 202.22.22.1: bytes=32 time<1ms TTL=255
Reply from 202.22.22.1: bytes=32 time<1ms TTL=255

Ping statistics for 202.22.22.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 18: Ping from PC2 to PC1

```
C:\>ping 202.22.22.21

Pinging 202.22.22.21 with 32 bytes of data:

Reply from 202.22.22.21: bytes=32 time<1ms TTL=127
Reply from 202.22.22.21: bytes=32 time<1ms TTL=127
Reply from 202.22.22.21: bytes=32 time<1ms TTL=127
Reply from 202.22.22.21: bytes=32 time=1ms TTL=127

Ping statistics for 202.22.22.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 19: Ping from PC3 to PC2

```
C:\>ping 202.22.22.41

Pinging 202.22.22.41 with 32 bytes of data:

Reply from 202.22.22.41: bytes=32 time=2ms TTL=127
Reply from 202.22.22.41: bytes=32 time<1ms TTL=127
Reply from 202.22.22.41: bytes=32 time<1ms TTL=127
Reply from 202.22.22.41: bytes=32 time=3ms TTL=127

Ping statistics for 202.22.22.41:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
```

Output 20: Ping from PC4 to PC3

In the Activity A.5 we illustrate that all PCs falls under different subnet and as we know Router is needed to communicate between different network. Here in this activity we used Router between the PCs of different Network which makes the Ping Successful from any PCS to any other PCs.

5.1.3 Activities C

C. Create the network topology as shown in figure 1 above and Assign the IP address of PC1, PC2, PC3 and PC4 as 202.44.8.2, 202.44.9.2, 202.44.10.2 and 202.44.11.2 respectively with subnet mask of 255.255.255.0 and note down the result of following operations

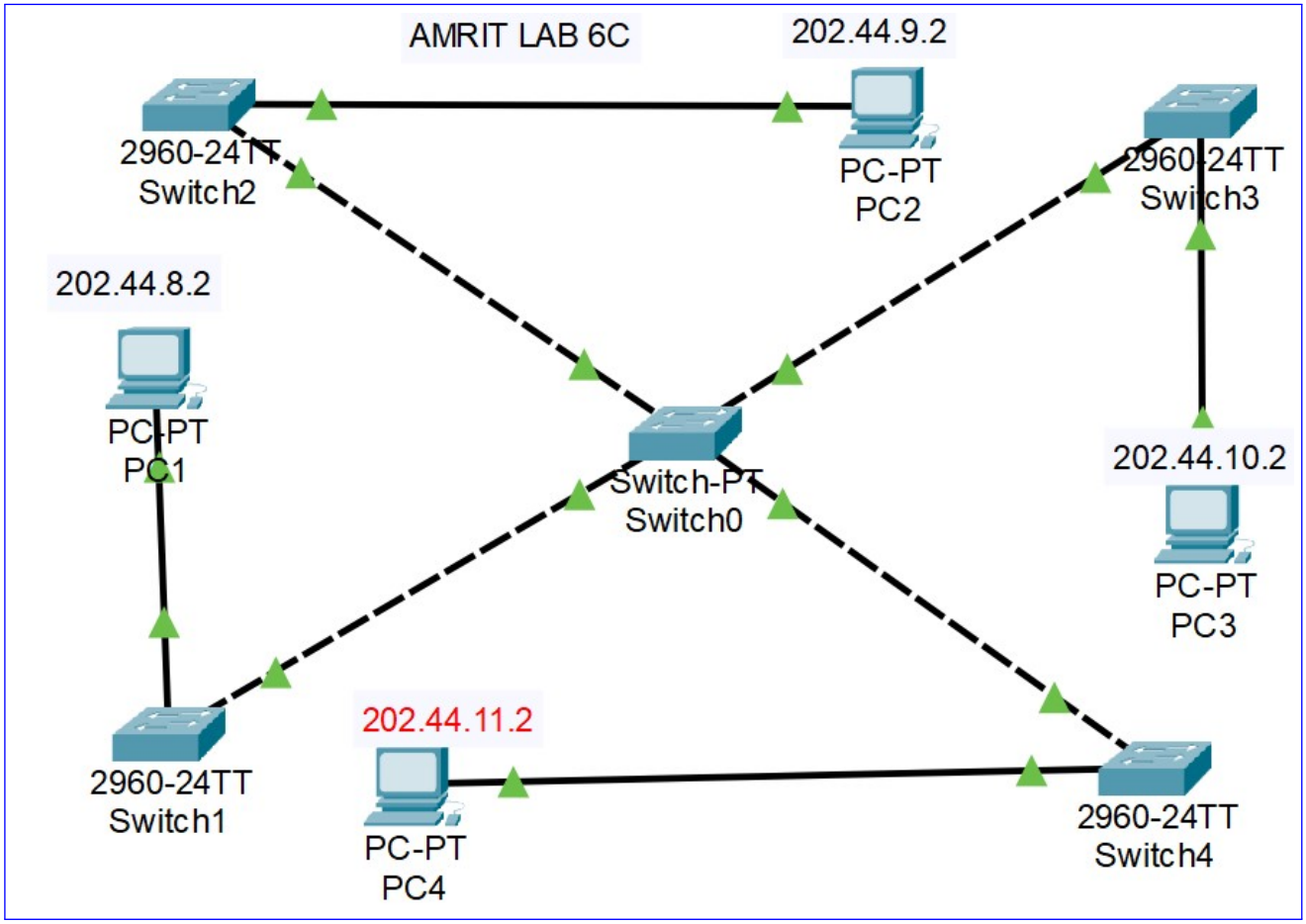

Figure 7: Network topology Lab 6C

1. **Test the connectivity from one computer to another using ping.**

```
C:\>ping 202.44.11.2

Pinging 202.44.11.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.44.11.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 21: Ping from PC1 to PC4

```
C:\>ping 202.44.8.2

Pinging 202.44.8.2 with 32 bytes of data:

Request timed out.
Request timed out.
```

```
Request timed out.
Request timed out.

Ping statistics for 202.44.8.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 22: Ping from PC2 to PC1

```
C:\>ping 202.44.9.2

Pinging 202.44.9.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.44.9.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 23: Ping from PC3 to PC2

```
C:\>ping 202.44.10.2

Pinging 202.44.10.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.44.10.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 24: Ping from PC4 to PC3

With subnet mask (/24) all PCs falls under different subnet and with the help of Switch communication between the PCs of different subnet is impossible so Ping Failed between all PCs.

2. **Change the subnet mask to 255.255.254.0 and test the connectivity from one computer to another using ping.**

```
C:\>ping 202.44.11.2

Pinging 202.44.11.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.44.11.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 25: Ping from PC1 to PC4

```
C:\>ping 202.44.8.2

Pinging 202.44.8.2 with 32 bytes of data:

Reply from 202.44.8.2: bytes=32 time<1ms TTL=128
Reply from 202.44.8.2: bytes=32 time=1ms TTL=128
Reply from 202.44.8.2: bytes=32 time=1ms TTL=128
```

```
Reply from 202.44.8.2: bytes=32 time<1ms TTL=128

Ping statistics for 202.44.8.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 26: Ping from PC2 to PC1

```
C:\>ping 202.44.9.2

Pinging 202.44.9.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 202.44.9.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 27: Ping from PC3 to PC2

```
C:\>ping 202.44.10.2

Pinging 202.44.10.2 with 32 bytes of data:

Reply from 202.44.10.2: bytes=32 time=1ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128
Reply from 202.44.10.2: bytes=32 time=14ms TTL=128

Ping statistics for 202.44.10.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 14ms, Average = 3ms
```

Output 28: Ping from PC4 to PC3

All 128 of the Possible /23 Networks for 202.44.*.*

Network Address	Usable Host Range	Broadcast Address:
202.44.0.0	202.44.0.1 - 202.44.1.254	202.44.1.255
202.44.2.0	202.44.2.1 - 202.44.3.254	202.44.3.255
202.44.4.0	202.44.4.1 - 202.44.5.254	202.44.5.255
202.44.6.0	202.44.6.1 - 202.44.7.254	202.44.7.255
202.44.8.0	202.44.8.1 - 202.44.9.254	202.44.9.255
202.44.10.0	202.44.10.1 - 202.44.11.254	202.44.11.255
202.44.12.0	202.44.12.1 - 202.44.13.254	202.44.13.255
202.44.14.0	202.44.14.1 - 202.44.15.254	202.44.15.255
202.44.16.0	202.44.16.1 - 202.44.17.254	202.44.17.255
202.44.18.0	202.44.18.1 - 202.44.19.254	202.44.19.255
202.44.20.0	202.44.20.1 - 202.44.21.254	202.44.21.255
202.44.22.0	202.44.22.1 - 202.44.23.254	202.44.23.255

Figure 8: Possible subnets for /23

With subnet mask (/23) PC1 and PC2 falls under one subnet similarly PC3 and PC4 falls under different subnet. So ping is possible between between PC1 and PC2 and similarly between PC3 and PC4 but ping failed between different subnet.

3. **Change the subnet mask to 255.255.252.0 and test the connectivity from one computer to another using ping.**

```
C:\>ping 202.44.11.2

Pinging 202.44.11.2 with 32 bytes of data:

Reply from 202.44.11.2: bytes=32 time=2ms TTL=128
Reply from 202.44.11.2: bytes=32 time=2ms TTL=128
Reply from 202.44.11.2: bytes=32 time<1ms TTL=128
Reply from 202.44.11.2: bytes=32 time=1ms TTL=128

Ping statistics for 202.44.11.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms
```

Output 29: Ping from PC1 to PC4

```
C:\>ping 202.44.8.2

Pinging 202.44.8.2 with 32 bytes of data:

Reply from 202.44.8.2: bytes=32 time=2ms TTL=128
```

```
Reply from 202.44.8.2: bytes=32 time<1ms TTL=128
Reply from 202.44.8.2: bytes=32 time<1ms TTL=128
Reply from 202.44.8.2: bytes=32 time<1ms TTL=128

Ping statistics for 202.44.8.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 30: Ping from PC2 to PC1

```
C:\>ping 202.44.9.2

Pinging 202.44.9.2 with 32 bytes of data:

Reply from 202.44.9.2: bytes=32 time=2ms TTL=128
Reply from 202.44.9.2: bytes=32 time<1ms TTL=128
Reply from 202.44.9.2: bytes=32 time<1ms TTL=128
Reply from 202.44.9.2: bytes=32 time=11ms TTL=128

Ping statistics for 202.44.9.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms
```

Output 31: Ping from PC3 to PC2

```
C:\>ping 202.44.10.2

Pinging 202.44.10.2 with 32 bytes of data:

Reply from 202.44.10.2: bytes=32 time=1ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128

Ping statistics for 202.44.10.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 32: Ping from PC4 to PC3

All 64 of the Possible /22 Networks for 202.44.*.*

Network Address	Usable Host Range	Broadcast Address:
202.44.0.0	202.44.0.1 - 202.44.3.254	202.44.3.255
202.44.4.0	202.44.4.1 - 202.44.7.254	202.44.7.255
202.44.8.0	202.44.8.1 - 202.44.11.254	202.44.11.255
202.44.12.0	202.44.12.1 - 202.44.15.254	202.44.15.255
202.44.16.0	202.44.16.1 - 202.44.19.254	202.44.19.255
202.44.20.0	202.44.20.1 - 202.44.23.254	202.44.23.255
202.44.24.0	202.44.24.1 - 202.44.27.254	202.44.27.255

Figure 9: Possible subnets for /22

With Subnet mask (/22) we can clearly see from above table that all PCs falls under same subnet hence Ping is possible between any two PCs.

4. **Change the subnet mask to 255.255.248.0 and test the connectivity from one computer to another using ping.**

```
C:\>ping 202.44.11.2

Pinging 202.44.11.2 with 32 bytes of data:

Reply from 202.44.11.2: bytes=32 time<1ms TTL=128
Reply from 202.44.11.2: bytes=32 time<1ms TTL=128
Reply from 202.44.11.2: bytes=32 time<1ms TTL=128
Reply from 202.44.11.2: bytes=32 time<1ms TTL=128

Ping statistics for 202.44.11.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 33: Ping from PC1 to PC4

```
C:\>ping 202.44.8.2

Pinging 202.44.8.2 with 32 bytes of data:

Reply from 202.44.8.2: bytes=32 time<1ms TTL=128
Reply from 202.44.8.2: bytes=32 time<1ms TTL=128
Reply from 202.44.8.2: bytes=32 time<1ms TTL=128
Reply from 202.44.8.2: bytes=32 time=10ms TTL=128

Ping statistics for 202.44.8.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

Output 34: Ping from PC2 to PC1

```
C:\>ping 202.44.9.2

Pinging 202.44.9.2 with 32 bytes of data:

Reply from 202.44.9.2: bytes=32 time<1ms TTL=128
Reply from 202.44.9.2: bytes=32 time=12ms TTL=128
Reply from 202.44.9.2: bytes=32 time<1ms TTL=128
Reply from 202.44.9.2: bytes=32 time<1ms TTL=128

Ping statistics for 202.44.9.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms
```

Output 35: Ping from PC3 to PC2

```
C:\>ping 202.44.10.2

Pinging 202.44.10.2 with 32 bytes of data:

Reply from 202.44.10.2: bytes=32 time<1ms TTL=128
Reply from 202.44.10.2: bytes=32 time=4ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128
Reply from 202.44.10.2: bytes=32 time<1ms TTL=128

Ping statistics for 202.44.10.2:
```

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

Output 36: Ping from PC4 to PC3

All 32 of the Possible /21 Networks for 202.44.*.*

Network Address	Usable Host Range	Broadcast Address:
202.44.0.0	202.44.0.1 - 202.44.7.254	202.44.7.255
202.44.8.0	202.44.8.1 - 202.44.15.254	202.44.15.255
202.44.16.0	202.44.16.1 - 202.44.23.254	202.44.23.255
202.44.24.0	202.44.24.1 - 202.44.31.254	202.44.31.255
202.44.32.0	202.44.32.1 - 202.44.39.254	202.44.39.255
202.44.40.0	202.44.40.1 - 202.44.47.254	202.44.47.255
202.44.48.0	202.44.48.1 - 202.44.55.254	202.44.55.255
202.44.56.0	202.44.56.1 - 202.44.63.254	202.44.63.255
202.44.64.0	202.44.64.1 - 202.44.71.254	202.44.71.255

Figure 10: Possible subnets for /21

With Subnet mask (/21) we can clearly see from above table that all PCs falls under same subnet hence Ping is possible between any two PCs.

5.1.4 Activities D

D. You have given IP addresses of 202.20.20.0/24 from your ISP. You are assigned to divide this address range equally for five different departments A, B, C, D, E and two networks F and G for interconnection of routers, which are connected as shown in given figure 2 below. Allocate the IP address range for each of the departments with their network address, broadcast address and subnet mask. Also list out the unused range of IP addresses (if any). Also enable static routing in between each of the department's network as well as to Internet via ISP Router.

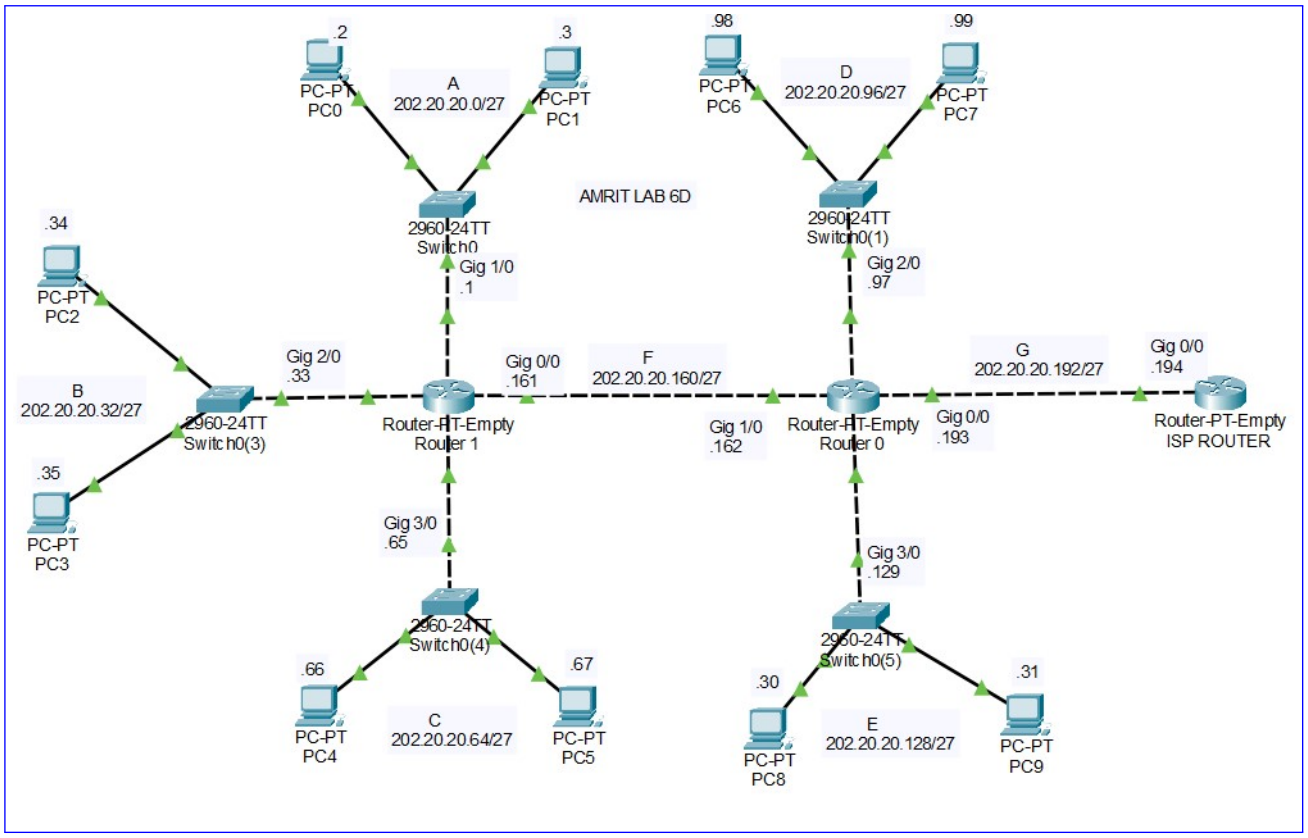

Figure 11: Network topology Lab 6D

As we are asked to divide the given Ip range into 7 different network equally , I divide it into 30 usable host for each subnet with the help of subnet mask 255.255.255.224 . There is still unused range of IP from 202.20.20.224 - 202.20.20.255 .

All 8 of the Possible /27 Networks for 202.20.20.*

Network Address	Usable Host Range	Broadcast Address:
202.20.20.0	202.20.20.1 - 202.20.20.30	202.20.20.31
202.20.20.32	202.20.20.33 - 202.20.20.62	202.20.20.63
202.20.20.64	202.20.20.65 - 202.20.20.94	202.20.20.95
202.20.20.96	202.20.20.97 - 202.20.20.126	202.20.20.127
202.20.20.128	202.20.20.129 - 202.20.20.158	202.20.20.159
202.20.20.160	202.20.20.161 - 202.20.20.190	202.20.20.191
202.20.20.192	202.20.20.193 - 202.20.20.222	202.20.20.223
202.20.20.224	202.20.20.225 - 202.20.20.254	202.20.20.255

Figure 12: Possible subnets for /27

I have used Default route and static route configuration for Static routing. In Router 1 all the outgoing traffic is forwarded to Router 0 (Gig 1/0) . For Router 0 Static route configuration is used for Network A, B and C , forwarded Router 1(Gig 0/0) where as for Isp Router Default Route is used by forwarding all unknown destination to (ISP ROUTER Gig 0/0) . Similarly for ISP Router default route config is used to forward all unknown to Router 0(Gig 0/0). To prove my point I have attached the Output of ping command from different PCs of different Network.

```
C:\>ping 202.20.20.66

Pinging 202.20.20.66 with 32 bytes of data:

Request timed out.
Reply from 202.20.20.66: bytes=32 time<1ms TTL=127
Reply from 202.20.20.66: bytes=32 time<1ms TTL=127
Reply from 202.20.20.66: bytes=32 time<1ms TTL=127

Ping statistics for 202.20.20.66:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 37: Ping from PC1 to PC4

```
C:\>ping 202.20.20.99

Pinging 202.20.20.99 with 32 bytes of data:

Request timed out.
Reply from 202.20.20.99: bytes=32 time=3ms TTL=126
Reply from 202.20.20.99: bytes=32 time<1ms TTL=126
Reply from 202.20.20.99: bytes=32 time=11ms TTL=126

Ping statistics for 202.20.20.99:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
```

```
    Minimum = 0ms, Maximum = 11ms, Average = 4ms
```

Output 38: Ping from PC4 to PC7

```
C:\>ping 202.20.20.194

Pinging 202.20.20.194 with 32 bytes of data:

Reply from 202.20.20.194: bytes=32 time<1ms TTL=253
Reply from 202.20.20.194: bytes=32 time=11ms TTL=253
Reply from 202.20.20.194: bytes=32 time<1ms TTL=253
Reply from 202.20.20.194: bytes=32 time<1ms TTL=253

Ping statistics for 202.20.20.194:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 2ms
```

Output 39: Ping from PC2 to ISP ROUTER

5.1.5 Activities E

E. You have given a IP addresses of 202.70.90.0/24. You have to divide this address range for different departments A, B, C, D and E interconnected as shown in figure 2 above, each department having 54, 27, 18, 12, 6 number of hosts. In addition to this there are two networks F and G having only two host in each. Allocate the IP address range for each of the sub- networks with their network address, broadcast address and subnet mask. Also list out the unused range of IP addresses (if any). Also enable static routing in between each of the department's network as well as to Internet via ISP Router.

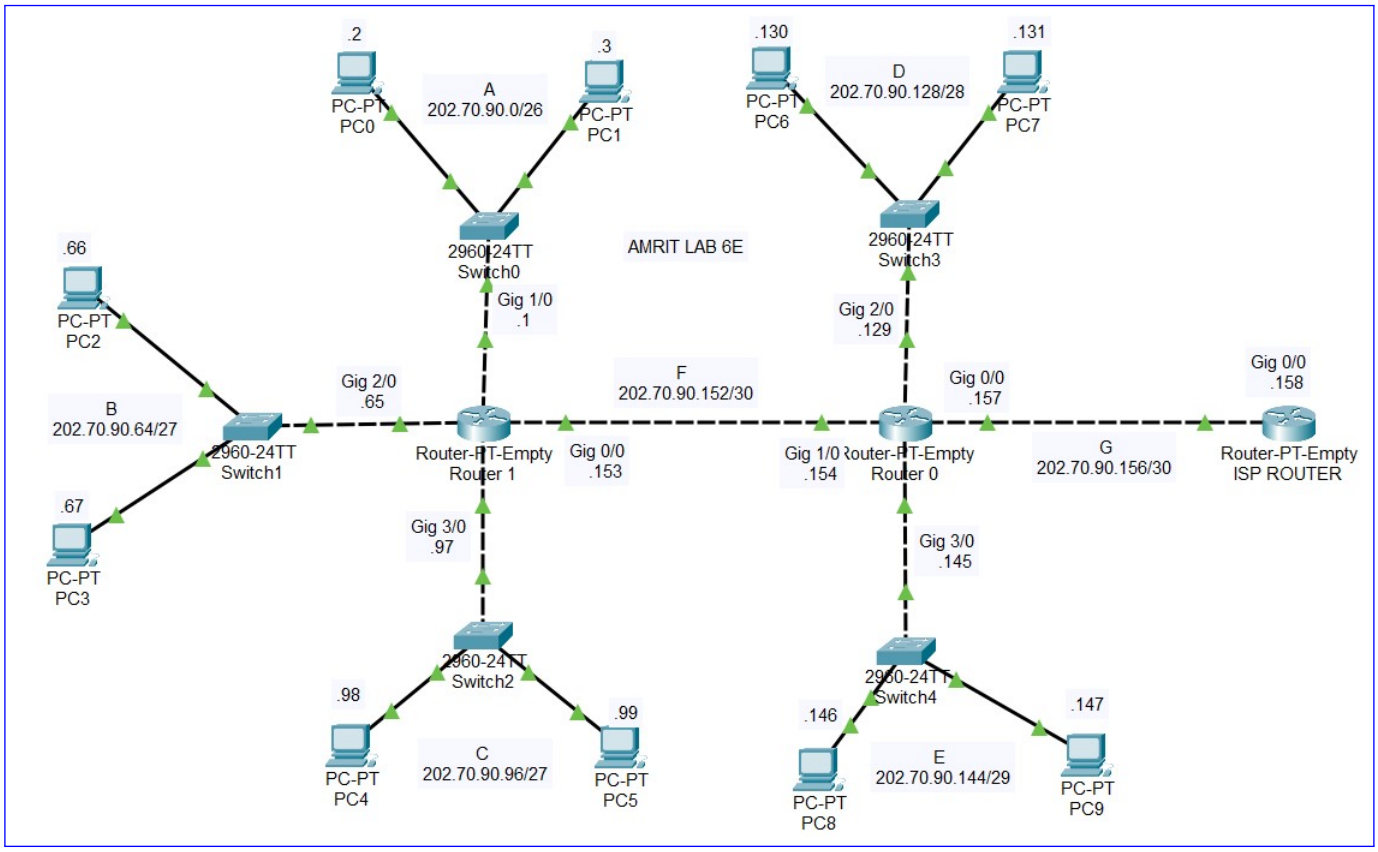

Figure 13: Network topology Lab 6E

Subnet Name	Needed Size	Allocated Size	Address	Mask	Dec Mask	Assignable Range	Broadcast
A	54	62	202.70.90.0	/26	255.255.255.192	202.70.90.1 - 202.70.90.62	202.70.90.63
B	27	30	202.70.90.64	/27	255.255.255.224	202.70.90.65 - 202.70.90.94	202.70.90.95
C	18	30	202.70.90.96	/27	255.255.255.224	202.70.90.97 - 202.70.90.126	202.70.90.127
D	12	14	202.70.90.128	/28	255.255.255.240	202.70.90.129 - 202.70.90.142	202.70.90.143
E	6	6	202.70.90.144	/29	255.255.255.248	202.70.90.145 - 202.70.90.150	202.70.90.151
F	2	2	202.70.90.152	/30	255.255.255.252	202.70.90.153 - 202.70.90.154	202.70.90.155
G	2	2	202.70.90.156	/30	255.255.255.252	202.70.90.157 - 202.70.90.158	202.70.90.159

Figure 14: Possible subnets with VLSM

There is unused IP Range from 202.70.90.160 - 202.70.90.255 .

I have used Default route and static route configuration for Static routing. In Router 1 all the outgoing traffic is forwarded to Router 0 (Gig 1/0) . For Router 0 Static route configuration is used

for Network A, B and C , forwarded Router 1(Gig 0/0) where as for Isp Router Default Route is used by forwarding all unknown destination to (ISP ROUTER Gig 0/0) . Similarly for ISP Router default route config is used to forward all unknown to Router 0(Gig 0/0). To prove my point I have attached the Output of ping command from different PCs of different Network.

```
C:\>ping 202.70.90.98

Pinging 202.70.90.98 with 32 bytes of data:

Request timed out.
Reply from 202.70.90.98: bytes=32 time<1ms TTL=127
Reply from 202.70.90.98: bytes=32 time<1ms TTL=127
Reply from 202.70.90.98: bytes=32 time<1ms TTL=127

Ping statistics for 202.70.90.98:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 40: Ping from PC1 to PC4

```
C:\>ping 202.70.90.131

Pinging 202.70.90.131 with 32 bytes of data:

Reply from 202.70.90.131: bytes=32 time<1ms TTL=126
Reply from 202.70.90.131: bytes=32 time<1ms TTL=126
Reply from 202.70.90.131: bytes=32 time=1ms TTL=126
Reply from 202.70.90.131: bytes=32 time<1ms TTL=126

Ping statistics for 202.70.90.131:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 41: Ping from PC4 to PC7

```
C:\>ping 202.70.90.158

Pinging 202.70.90.158 with 32 bytes of data:

Reply from 202.70.90.158: bytes=32 time=1ms TTL=253
Reply from 202.70.90.158: bytes=32 time=10ms TTL=253
Reply from 202.70.90.158: bytes=32 time<1ms TTL=253
Reply from 202.70.90.158: bytes=32 time<1ms TTL=253

Ping statistics for 202.70.90.158:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

Output 42: Ping from PC2 to ISP ROUTER

5.2 Question -2

Explain subnetting and VLSM with their importance in networking with suitable examples.

Answer:

Subnetting is the technique to prevent formation of complex large network and instead divide that network and create fast, efficient and secure network and routes. There are two subnetting techniques (VLSM) variable Length Subnet Mask and (FLSM) fixed length. In FLSM all subnet has equal host and uses same subnet mask wasting lot of IP whereas VLSM Subnet has variable host and uses different subnet mask with reduced ip wastage.

Some importance of subnetting are:

- Divides the broadcast domain improving the network performance
- The data intended for host within the same subnet will not leave the subnet thus reducing the congestion and improving security.
- It also helps to organize the complex network into subnets based on departments and location.

In the example below IOE was given 202.70.90.0/24 ranges of IPs.Without subnetting the whole IOE network become complex and unsecure as Student and Department are under same subnet (/24) but after the VLSM subnetting is done as Student has need of 120 host and Department has need of 50 host only so they are divided into two subnets using subnet mask (/25) and (/26) respectively. There is still unused IP range from 202.70.90.192 - 202.70.90.255 which wil be beneficial for further expansion of departments and future use.

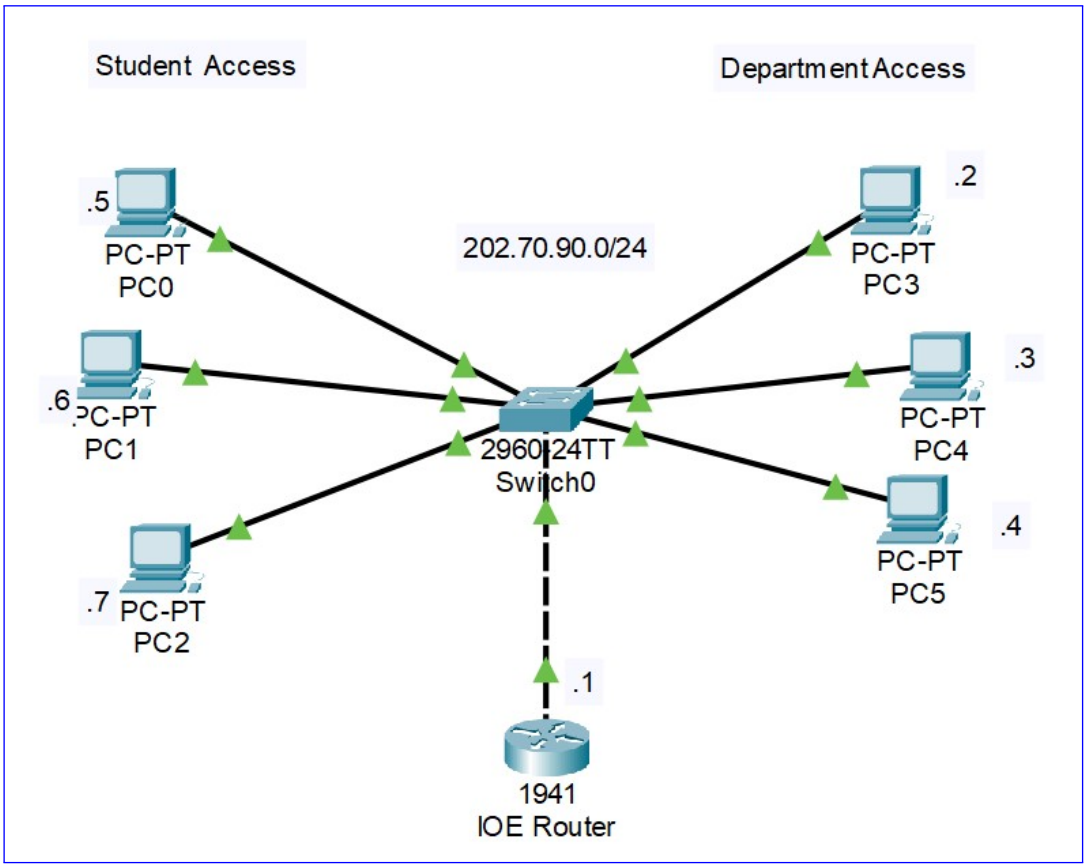

Figure 15: IOE network before subnetting

Subnet Name	Needed Size	Allocated Size	Address	Mask	Dec Mask	Assignable Range	Broadcast
Student Access	120	126	202.70.90.0	/25	255.255.255.128	202.70.90.1 - 202.70.90.126	202.70.90.127
Department Access	50	62	202.70.90.128	/26	255.255.255.192	202.70.90.129 - 202.70.90.190	202.70.90.191

Figure 16: Details of IOE Subnets

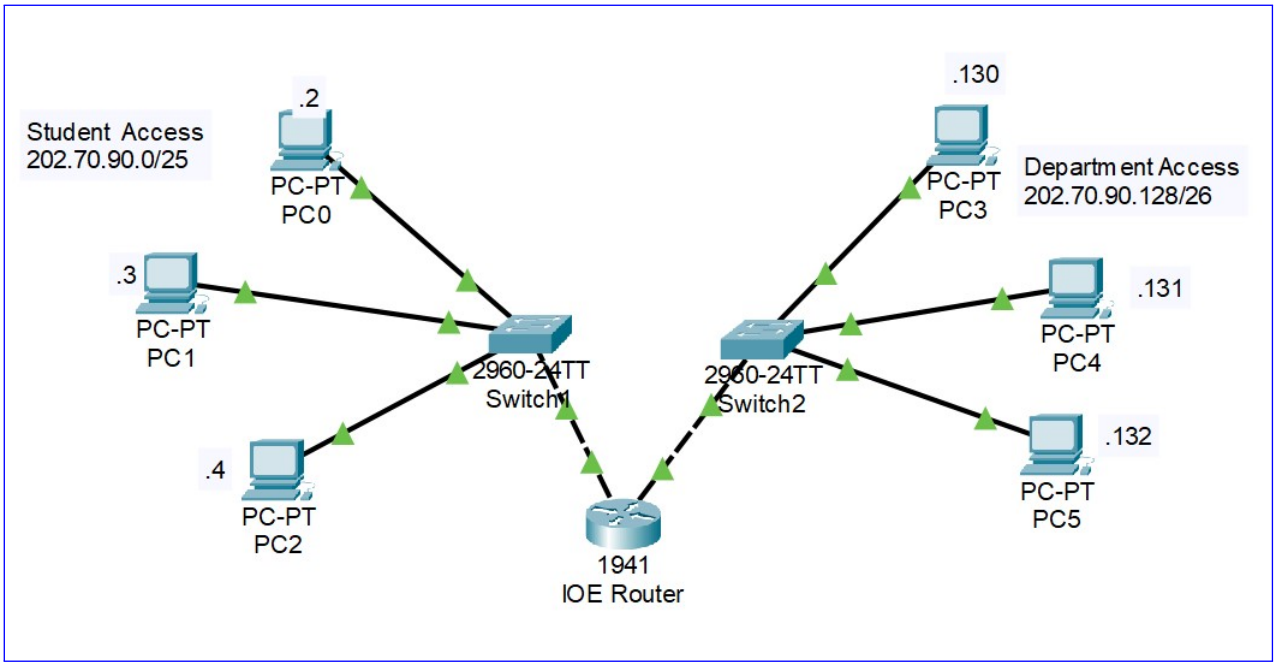

Figure 17: IOE network after subnetting

5.3 Question -3

What is classless routing? Why is it used in Internet system? Explain with suitable examples.

Answer:

In Classful Routing subnet mask are not sent with updates instead the default Subnet mask for particular class based on IP is used. But in Classless Routing Subnet mask are also sent along with IP. Classless Routing Supports VLSM (Variable Length Subnet Mask) is supported and also CIDR (Classless Inter-Domain Routing).

As we know :

- Class B with a mask of 255.255.0.0 can support 65, 534 addresses
- Class C with a mask of 255.255.255.0 can support 254 addresses

But if there is need of 600 or 5000 host just Class C will be insufficient and Class B will waste large no of IPs. However if Classless routing is implemented with VLSM it will prevent ip wastage and network collision.

6 Conclusion

In this lab we familiarize ourselves with Subnetting , VLSM ,CIDR and Subnet mask. In Activity A we created the subnet with the help of subnet mask and try to communicate between different subnet as switch as medium but failed However, In Activity B when central switch is replaced by Router Ping is successful. Similarly we explored the concept of subnet in Activity C even further . In Activity D we created 7 subnet of Equal host and configured the static route between the router . Similarly in Activity E VLSM technique is used.