LAB4: SUBNETTING AND SUPERNETTING USING CISCO PACKET TRACER

❖ OBJECTIVES:

- To understand the concepts of Subnetting and Supernetting and their role in efficient IP address management in computer networks.
- To design and implement Fixed Length Subnet Mask (FLSM) and/or Variable Length Subnet Mask (VLSM) schemes.
- To simulate a network topology using Cisco Packet Tracer and analyze packet flow between different subnets using a router.

❖ SOFTWARE AND HARDWARE REQUIREMENTS

- Cisco Packet Tracer (Version 6.2 or higher)
- Windows PC/Laptop

❖ THEORY:

1. Subnetting

- Subnetting is a network design technique used to divide a large IP network into multiple smaller logical networks called subnets.
- This is done by borrowing bits from the host portion of an IP address and adding them to the network portion using a subnet mask.

Working Principle:

- A subnet mask is applied to the IP address to define network and host boundaries.
- By increasing the number of network bits, multiple smaller subnets are created from a single network.
- Routers use this subnet information to correctly forward packets between different subnets.

Purpose and Advantages:

Subnetting improves network performance by reducing broadcast traffic, enhances security by isolating network segments, and allows better control and management of IP addressing within an organization.

2. Supernetting

Supernetting, also known as Classless Inter-Domain Routing (CIDR) or route aggregation, is the process of combining multiple smaller networks into a single larger network.

Working Principle:

- It is achieved by reducing the number of network bits in the subnet mask, effectively moving the network boundary to the left.
- This allows multiple contiguous IP networks to be represented by a single summarized route.

Purpose and Advantages:

Supernetting reduces routing table size, improves routing efficiency, lowers memory and CPU usage in routers, and enhances overall network performance, especially in large-scale networks such as the Internet.

❖ NETWORK DESIGN:

Calculations of Subnetting:

Base network: 192.168.1.0/24
Required number of subnets: 4
Number of IP address per subnet: 64 (Block size)
/26 (Borrowed 2 bits: 2^2 = 4 subnets)
Subnet Mask: 255.255.255.192

Subnet Table:

Subnet	Network Address	Boardcast Address	1st Usable IP	Last Usable IP
1	192.168.1.0	192.168.1.63	192.168.1.1	192.168.1.62
2	192.168.1.64	192.168.1.127	192.168.1.65	192.168.1.126
3	192.168.1.128	192.168.1.191	192.168.1.129	192.168.1.190
4	192.168.1.192	192.168.1.255	192.168.1.193	192.168.1.254

Implementation

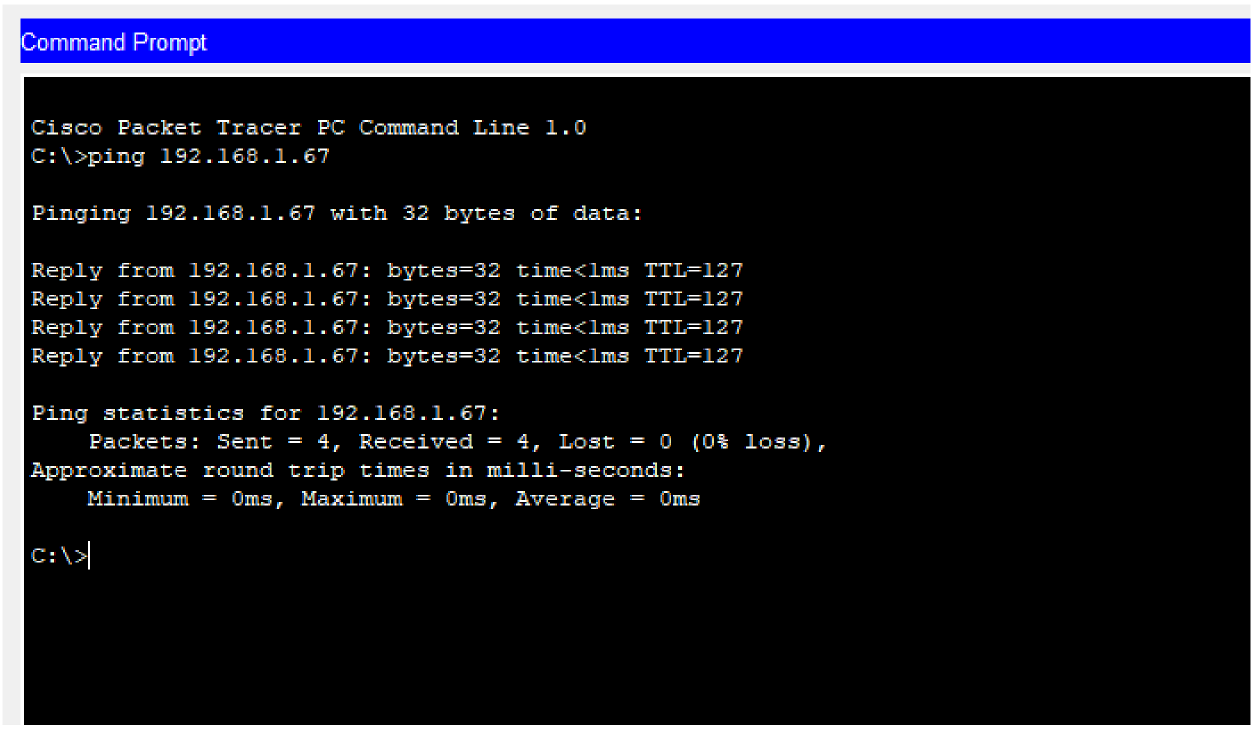
Subnetting:

A network topology was designed using **Router0** to interconnect two separate subnets: **192.168.1.0/26** and **192.168.1.64/26**.**Switch0** is used to connect **PC0, PC1, and PC2** within the first subnet, while **Switch1** connects **PC3, PC4, and PC5** in the second subnet. Each switch is linked to a different interface of the router, enabling communication between the two subnets through **Router0**.

Configuration Table:

Device	IPV4	Subnet mask	Default gateway
Router0 (Fast Ethernet 0/0)	192.168.1.1	255.255.255.192	N/A
Router0 (Fast Ethernet 0/1)	192.168.1.65	255.255.255.192	N/A
PC0(Subnet 1)	192.168.0.2	255.255.255.192	192.168.1.1
PC1(Subnet 1)	192.168.0.3	255.255.255.192	192.168.1.1
PC2(Subnet 1)	192.168.0.4	255.255.255.192	192.168.1.1
PC3(Subnet 2)	192.168.0.66	255.255.255.192	192.168.1.65
PC4(Subnet 2)	192.168.0.67	255.255.255.192	192.168.1.65
PC5(Subnet 2)	192.168.0.68	255.255.255.192	192.168.1.65

Ping from PC0 to PC4:


Command Prompt

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Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.67

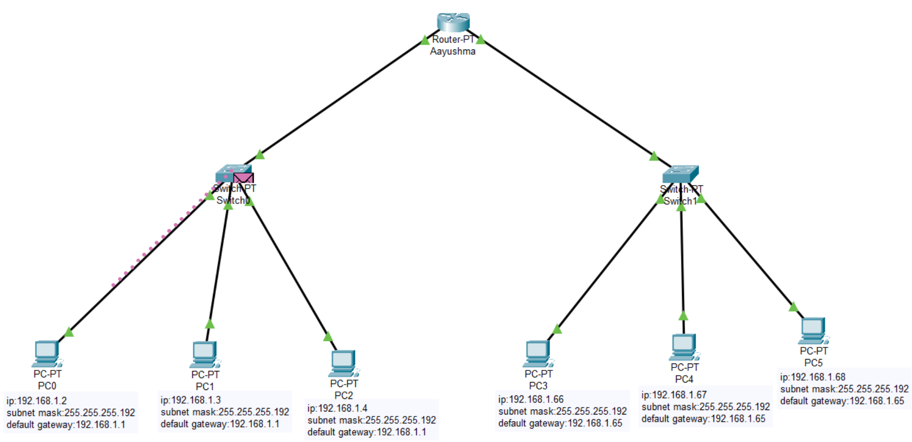
Pinging 192.168.1.67 with 32 bytes of data:

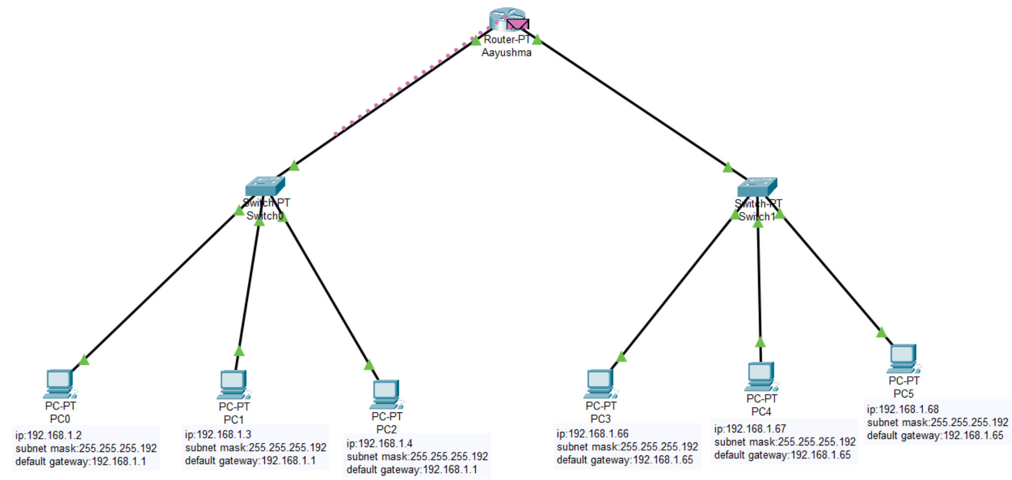
Reply from 192.168.1.67: bytes=32 time<1ms TTL=127
Reply from 192.168.1.67: bytes=32 time<1ms TTL=127
Reply from 192.168.1.67: bytes=32 time<1ms TTL=127
Reply from 192.168.1.67: bytes=32 time<1ms TTL=127

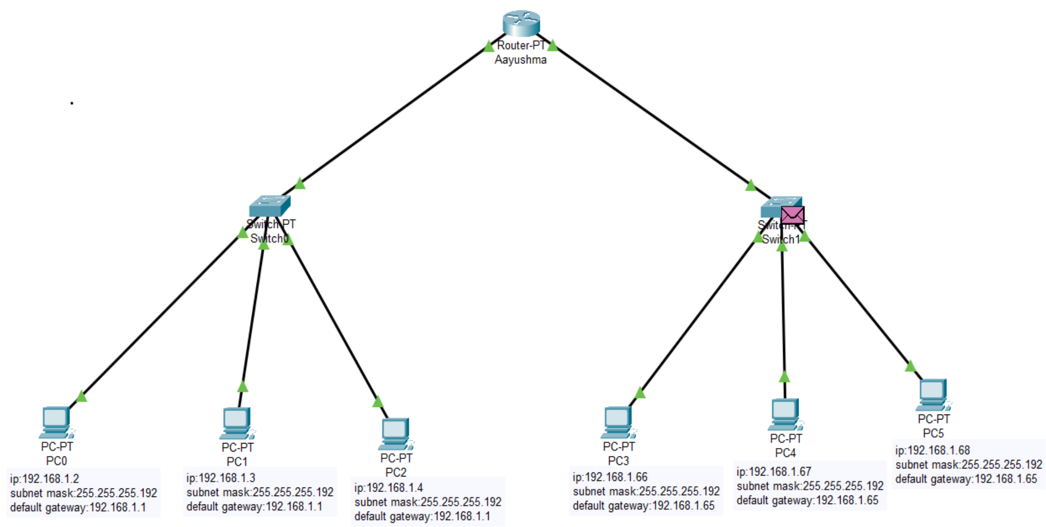
Ping statistics for 192.168.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

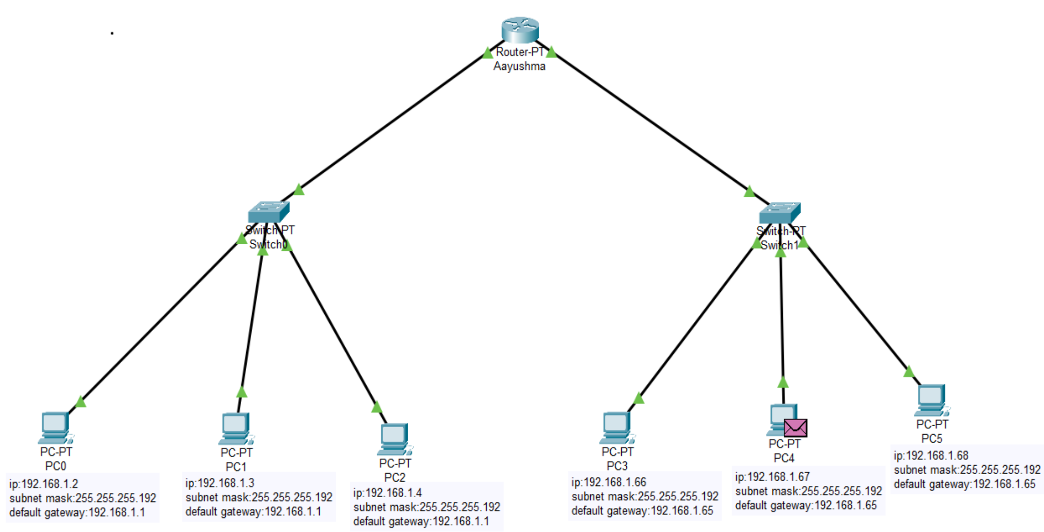
C:\>
```

Output:




Router-PT
Aayushma
Switch-PT
Switch0
Switch-PT
Switch1
PC-PT
PC0
ip:192.168.1.2
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC1
ip:192.168.1.3
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC2
ip:192.168.1.4
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC3
ip:192.168.1.66
subnet mask:255.255.255.192
default gateway:192.168.1.65
PC-PT
PC4
ip:192.168.1.67
subnet mask:255.255.255.192
default gateway:192.168.1.65
PC-PT
PC5
ip:192.168.1.68
subnet mask:255.255.255.192
default gateway:192.168.1.65


Router-PT
Aayushma
Switch-PT
Switch0
Switch-PT
Switch1
PC-PT
PC0
ip:192.168.1.2
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC1
ip:192.168.1.3
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC2
ip:192.168.1.4
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC3
ip:192.168.1.66
subnet mask:255.255.255.192
default gateway:192.168.1.65
PC-PT
PC4
ip:192.168.1.67
subnet mask:255.255.255.192
default gateway:192.168.1.65
PC-PT
PC5
ip:192.168.1.68
subnet mask:255.255.255.192
default gateway:192.168.1.65


Router-PT
Aayushma
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Switch0
Switch-PT
Switch1
PC-PT
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ip:192.168.1.2
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
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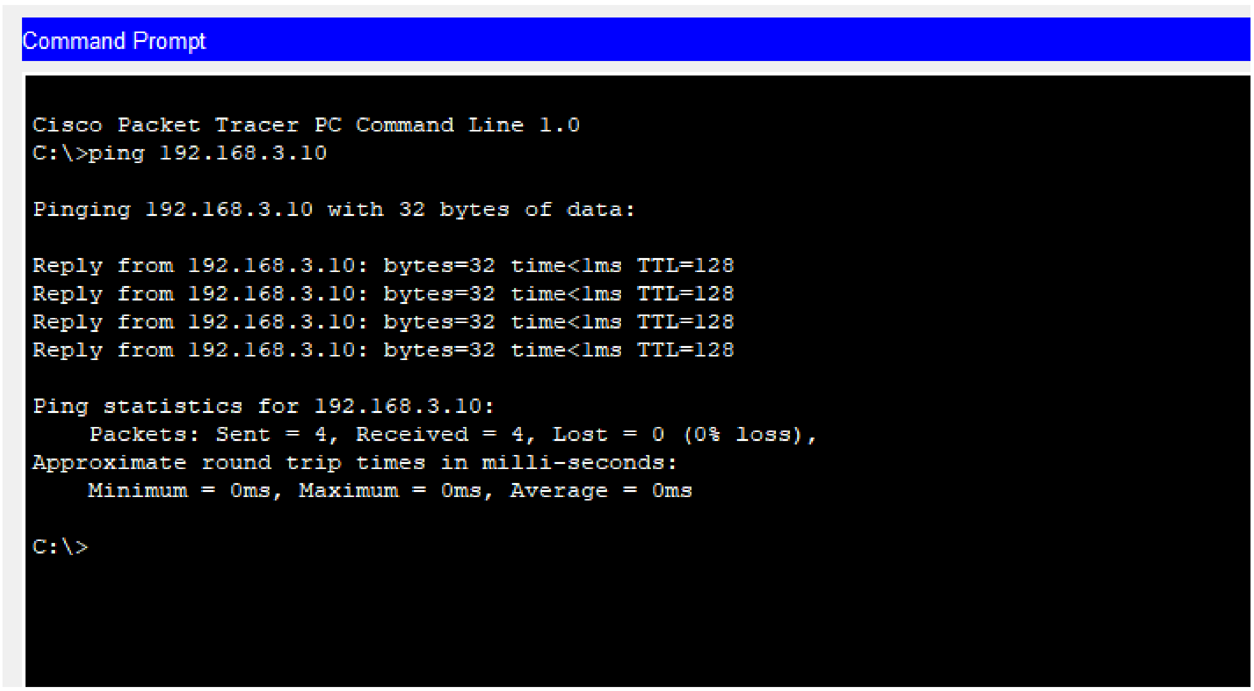
ip:192.168.1.3
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC2
ip:192.168.1.4
subnet mask:255.255.255.192
default gateway:192.168.1.1
PC-PT
PC3
ip:192.168.1.66
subnet mask:255.255.255.192
default gateway:192.168.1.65
PC-PT
PC4
ip:192.168.1.67
subnet mask:255.255.255.192
default gateway:192.168.1.65
PC-PT
PC5
ip:192.168.1.68
subnet mask:255.255.255.192
default gateway:192.168.1.65

Supernetting:

The topology is built using one router, one switch, and four computers (**PC0–PC3**). All the PCs are connected to the switch, which acts as a central device for local communication. The switch is then connected to the router, allowing the entire network to communicate as a single aggregated network.

Ping from PC0 to PC2:



```
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.3.10

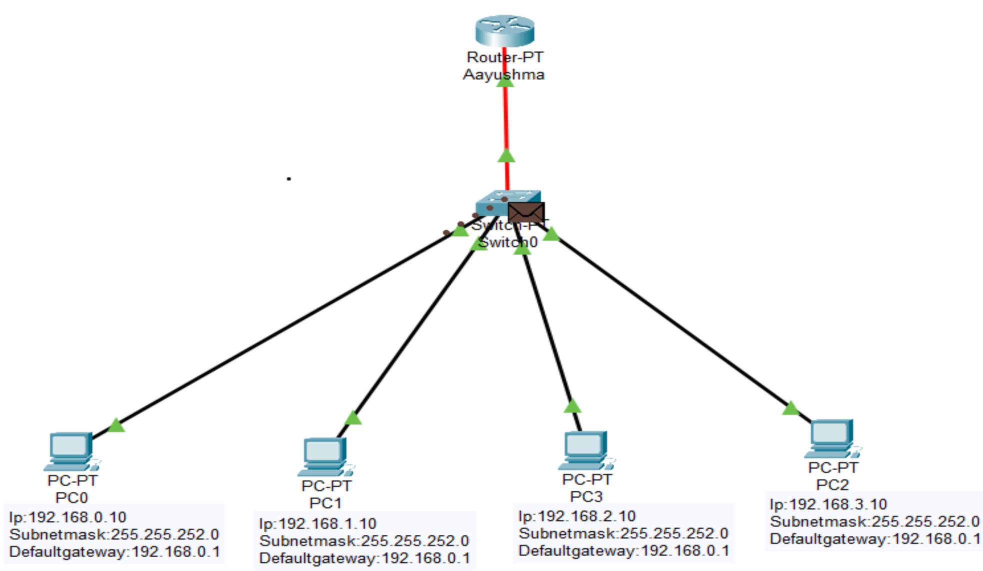
Pinging 192.168.3.10 with 32 bytes of data:

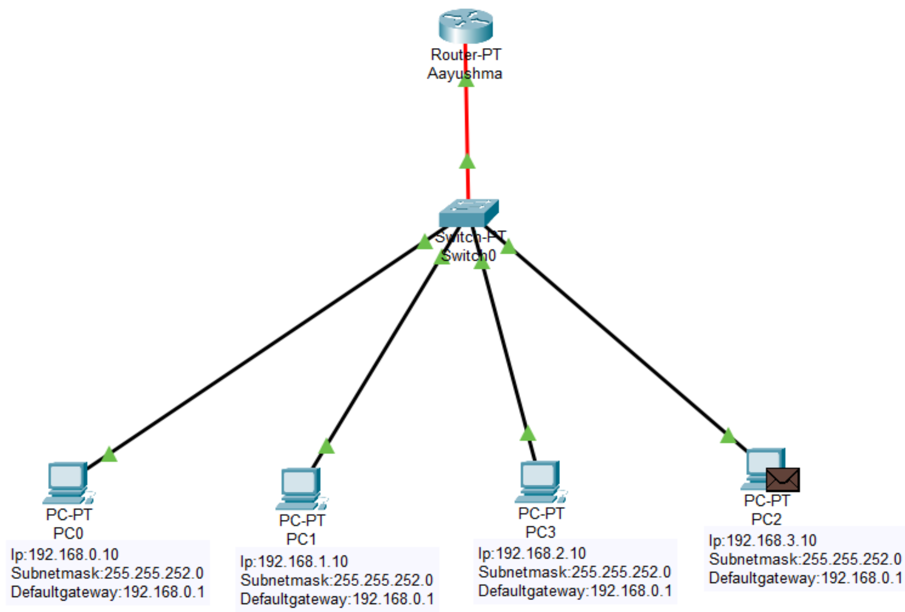
Reply from 192.168.3.10: bytes=32 time<1ms TTL=128
Reply from 192.168.3.10: bytes=32 time<1ms TTL=128
Reply from 192.168.3.10: bytes=32 time<1ms TTL=128
Reply from 192.168.3.10: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.3.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Output:





<u>Configuration Table:</u>

Device	IPV4	Subnet mask	Default gateway
Router0 (Fast Ethernet 0/0)	192.168.0.1	255.255.252.0	N/A
PC0	192.168.0.10	255.255.252.0	192.168.0.1
PC1	192.168.1.10	255.255.252.0	192.168.0.1
PC2	192.168.2.10	255.255.252.0	192.168.0.1
PC3	192.168.3.10	255.255.252.0	192.168.0.1

❖ <u>DISCUSSION AND CONCLUSION:</u>

In this lab, subnetting and supernetting were implemented using **Cisco Packet Tracer** to understand efficient IP address management and network design. **We** implemented subnetting by dividing a single IP network into smaller subnets using a subnet mask (/26). Two subnets, **192.168.1.0/26** and **192.168.1.64/26**, were created and connected through a router, enabling controlled communication between them. Each subnet used a switch to connect multiple PCs, showing how devices within the same subnet communicate directly, while inter-subnet communication requires routing.

Similarly, the supernetting topology demonstrated the opposite concept, where multiple devices were connected under a single larger network. **We** used a single router and switch to connect four PCs, forming one aggregated network structure. **As a result**, this setup showed how supernetting simplifies routing by reducing the number of network entries and improving routing efficiency. Through simulation, packet flow between devices was successfully observed, proving correct IP addressing, subnet mask configuration, and router interface setup.

Overall, the lab provided practical experience in network segmentation and aggregation, helping visualize how subnetting improves security and traffic management, while supernetting improves scalability and routing efficiency.