Documentation on Subnetting in Computer Networks

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1. Introduction

Subnetting is one of the most fundamental techniques in computer networks used to divide a large IP network into multiple smaller, manageable sub-networks (subnets). This process enhances security, improves network organization, reduces broadcast traffic, and allows more efficient utilization of IP addresses.

Initially, traditional classful addressing (Class A, B, C) offered fixed-size networks, which often led to inefficient use of addresses. Subnetting, introduced along with CIDR notation, gives administrators more control over how the network is divided. Instead of being confined to strict class boundaries, organizations can split networks based on actual departmental, security, or traffic requirements.

Subnetting works by borrowing host bits from the IP address and converting them into additional network bits. This increases the number of possible networks while reducing host capacity per network. The result is improved segmentation, enhanced performance, and improved routing efficiency.

In modern networking, subnetting plays a key role in hierarchical addressing, reducing routing table entries, and organizing internal networks in enterprises, ISPs, and cloud environments.

2. Purpose of Subnetting

The major objectives of subnetting include:

✓ Efficient IP Address Utilization

Subnetting allows administrators to divide a large network into smaller networks sized according to actual needs, preventing wastage of IP addresses.

✓ Enhanced Network Security

Each subnet can be isolated, allowing firewalls, filters, and access rules to be applied separately.

✓ Improved Routing Efficiency

Subnetting reduces broadcast domains, which helps routers process less unnecessary traffic.

✓ Better Network Management

Different departments or functions can be assigned separate subnets, making network management, monitoring, and troubleshooting easier.

✓ Supports Growth and Scalability

More subnets can be added easily as the network expands.

3. Working Principle of Subnetting

Subnetting works by manipulating bits in the subnet mask:

Step 1 – Borrowing Bits

Bits are taken (borrowed) from the host portion of the IP address.

Step 2 – Increasing the Number of Networks

Each borrowed bit doubles the number of available subnets.

Step 3 – Reducing Host Capacity

As network bits increase, host bits decrease, reducing the number of hosts per subnet.

Step 4 – Creating the Subnet Mask

The new subnet mask reflects the new prefix length (e.g., /26, /27, /28).

Step 5 – Calculating Subnet Ranges

Each subnet has a network address, usable range, and broadcast address.

Subnetting provides a structured way to design networks efficiently.

4. Advantages of Subnetting

1. Reduced Network Traffic

Smaller broadcast domains reduce unnecessary data traffic.

2. Better Network Performance

Efficient segmentation ensures smoother traffic flow and reduces congestion.

3. Improved Security

Each subnet can be protected independently.

4. Easier Maintenance

Subnets let administrators isolate problems and manage networks more easily.

5. Flexible IP Addressing

Subnetting ensures addresses are assigned based on requirements, preventing wastage.

5. Subnetting vs Supernetting

Feature	Subnetting	Supernetting
Purpose	Divide a large network	Combine multiple networks
Bits Borrowed	Borrow host bits → more networks	Borrow network bits → fewer networks
Network Size	Smaller subnets	Larger aggregated network
Used For	Internal network organization	Route aggregation by ISPs
Effect on Routing Tables	More entries	Fewer entries
Traffic Management	Reduces broadcast domains	Reduces routing complexity

Subnetting and supernetting are opposite techniques but both essential for modern network design.

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6. Steps for Subnetting in Cisco Packet Tracer

Below are the proper steps to create a subnetted network in Packet Tracer using switches, routers, and PCs.

Step 1: Create the Required Topology

Add the following devices:

Devices Needed

- **Switch:** 2960-24TT – 4 Switches
- **Router:** 2811 - 2 Routers
- **End Devices:** 8 PCs
- Use **Copper Straight-Through** cables to connect:
  - All PCs → Switch
  - Switch → Router (GigabitEthernet 0/0/0)

Step 2: Assign IP Addresses to Each PC

Go to **Desktop → IP Configuration** in every PC.

Default Gateway for all PCs:

192.168.1.1

Assign the following IP addresses:

PC	IP Address	Subnet Mask
PC1	192.168.1.2	255.255.255.0
PC2	192.168.1.3	255.255.255.0
PC3	192.168.2.1	255.255.255.0
PC4	192.168.2.2	255.255.255.0
PC5	192.168.3.1	255.255.255.0
PC6	192.168.3.2	255.255.255.0

This subnet mask (/22) covers all PCs from 192.168.1.0 to 192.168.3.255.

Step 3: Configure the Router

To test connectivity:

ping 192.168.2.1

If replies are received, routing is successful.

Step 4: Test Using Simulation Mode

1. Click **Simulation Mode**.
2. Select a **PDU (message)** and send from one PC to another.
3. You should see packets moving through the switch and router successfully.
4. If **ACK** is received → subnetting setup is successful.

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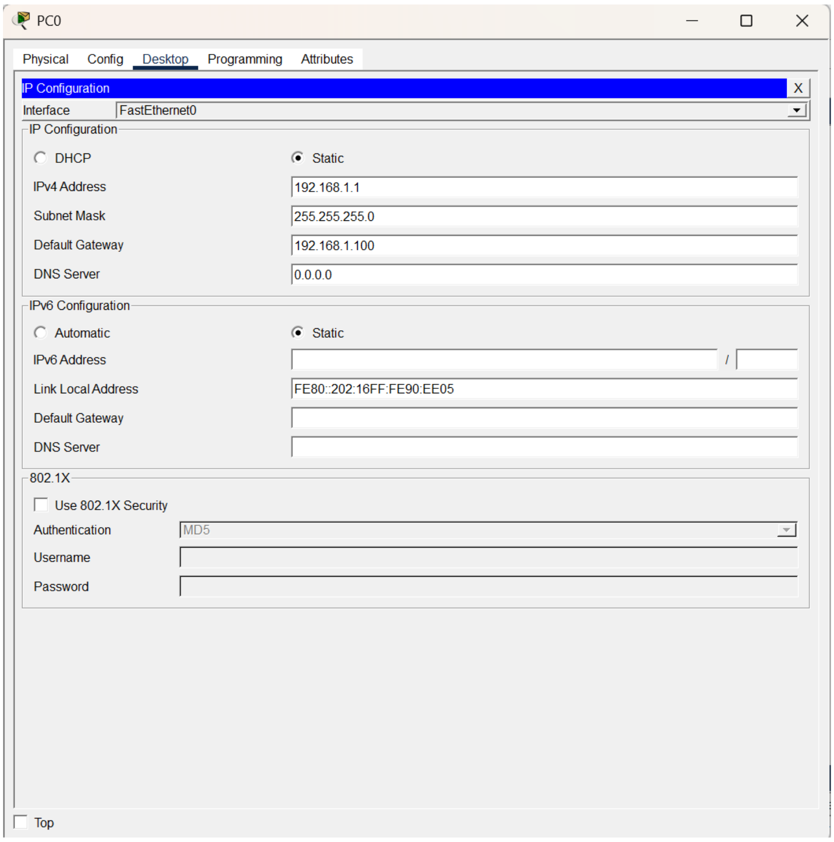
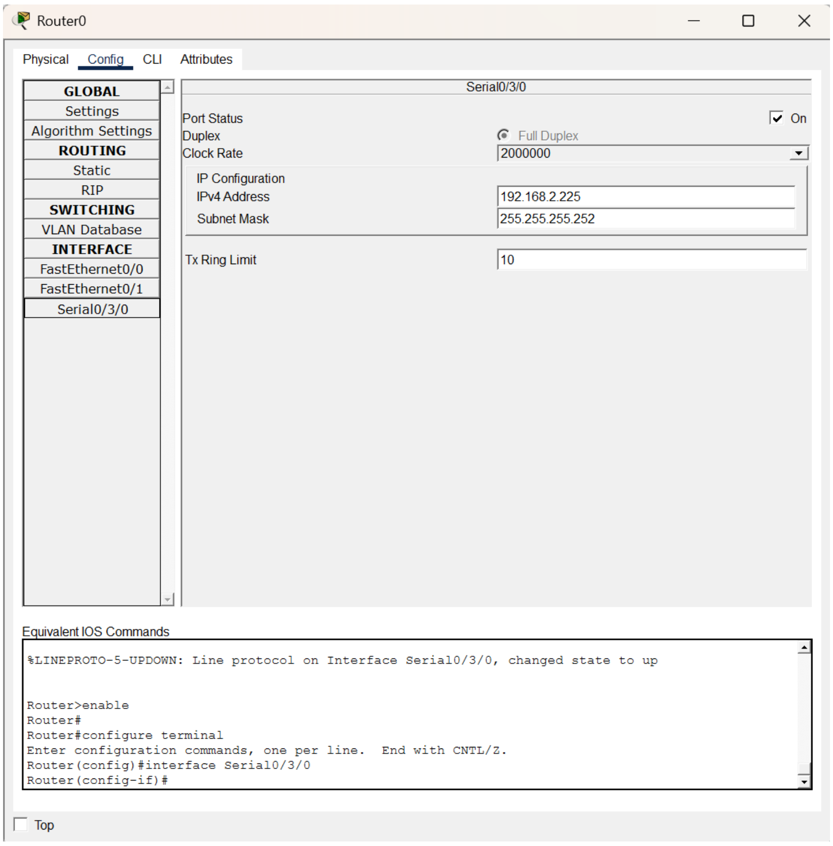
7. Output Screens

(Here you can insert your Packet Tracer screenshots:
• IP configuration of PCs
• Router CLI output
• Simulation packet flow
• Successful ping responses)

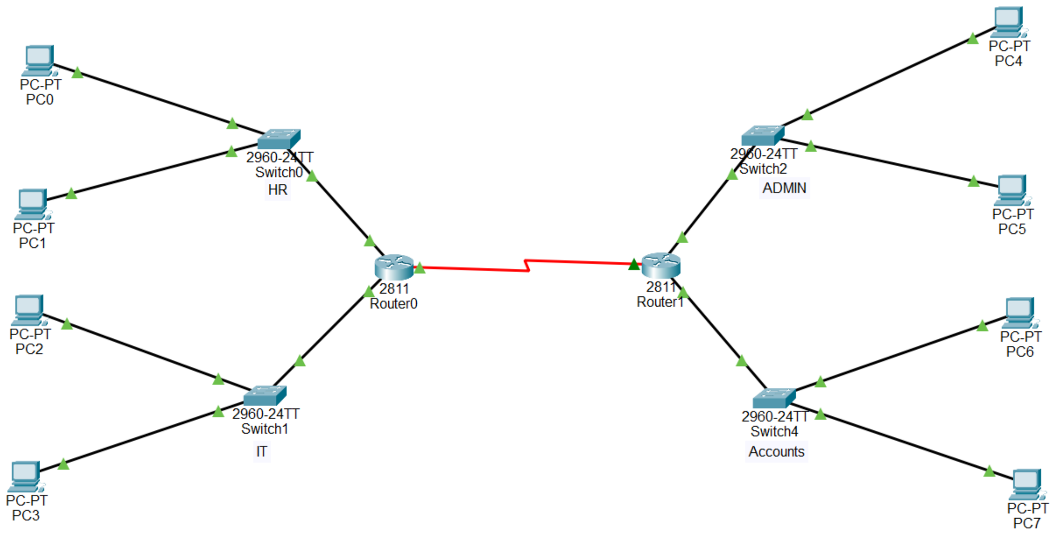
For Every PC Mark the IP Addressing as shown in below and give alternative IP Address



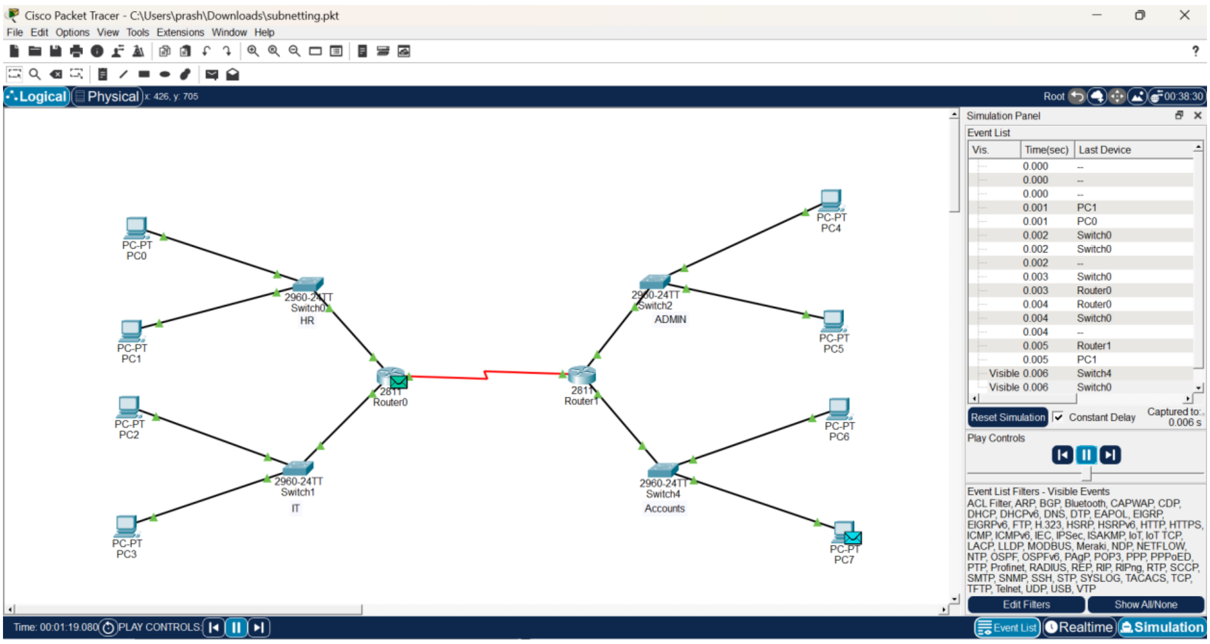
Router IP Addressing and These IP is Used as Default GateWay for All PC's



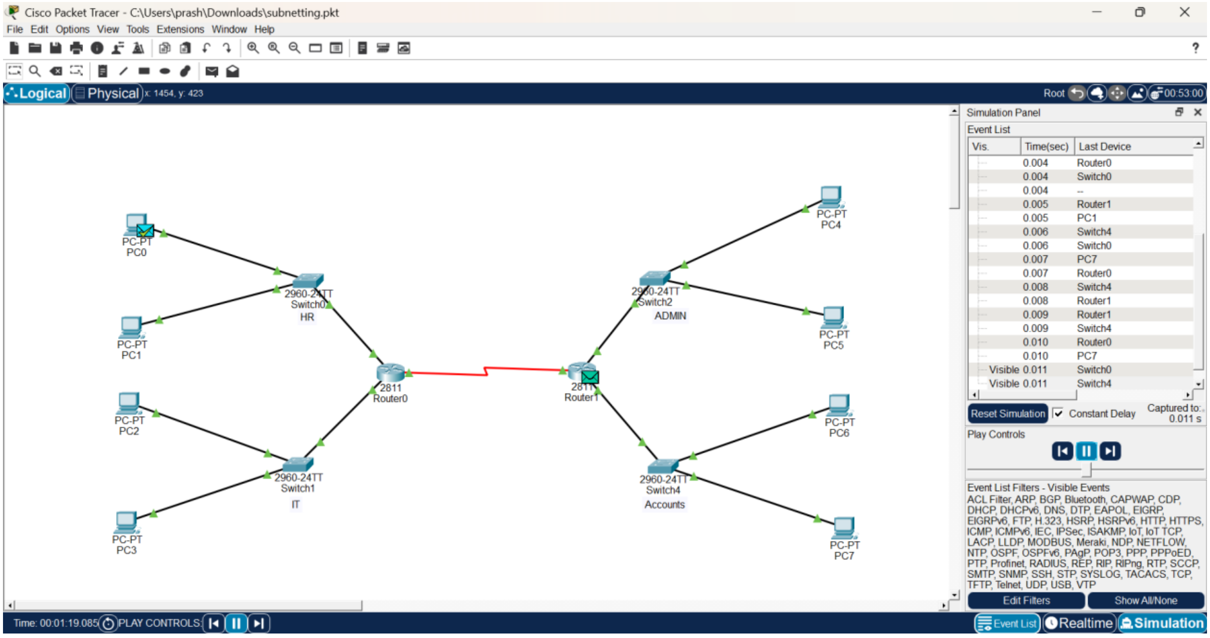
Structure Of Subneeting Network



Packet is Transfering from PC0 to PC7.



Successfully Packet Received After Sending from PC0 to PC7



8. Conclusion

Subnetting is a critical technique in modern computer networks used to efficiently divide IP address space, enhance network organization, and improve traffic management. It allows administrators to create smaller networks that are easier to control, more secure, and optimized for performance. Through subnetting, broadcast traffic is reduced, routing becomes faster, and overall network efficiency increases.

Practical implementation in tools like **Cisco Packet Tracer** helps students understand how subnet masks, IP ranges, broadcast addresses, and routing interact in real-world environments. Mastering subnetting is essential for network engineers, cybersecurity professionals, and anyone preparing for certifications such as CCNA.