Data Communication and Computers Lab

Lab – 03 & 04

Familiarization of Network IP & Sub netting & super netting

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IPv4 Overview

- **IPv4**: The fourth version of the Internet Protocol, used to identify devices on a network.
- **Size**: 32-bit address (e.g., 192.168.1.1), divided into four octets (0-255).
- **Address Classes**:
  - **Class A**: 0-126 (Large networks) - Subnet Mask: 255.0.0.0
  - **Class B**: 128-191 (Medium networks) - Subnet Mask: 255.255.0.0
  - **Class C**: 192-223 (Small networks) - Subnet Mask: 255.255.255.0
  - **Class D**: 224-239 (Multicast) - Not applicable
  - **Class E**: 240-255 (Experimental) - Not applicable
- **Loopback Range**: 127.0.0.0 - 127.255.255.255 (used for testing).

Private IP Ranges

- **Class A**: 10.0.0.0 - 10.255.255.255
- **Class B**: 172.16.0.0 - 172.31.255.255
- **Class C**: 192.168.0.0 - 192.168.255.255
- All other addresses are public.

Example of Private Addressing by Class

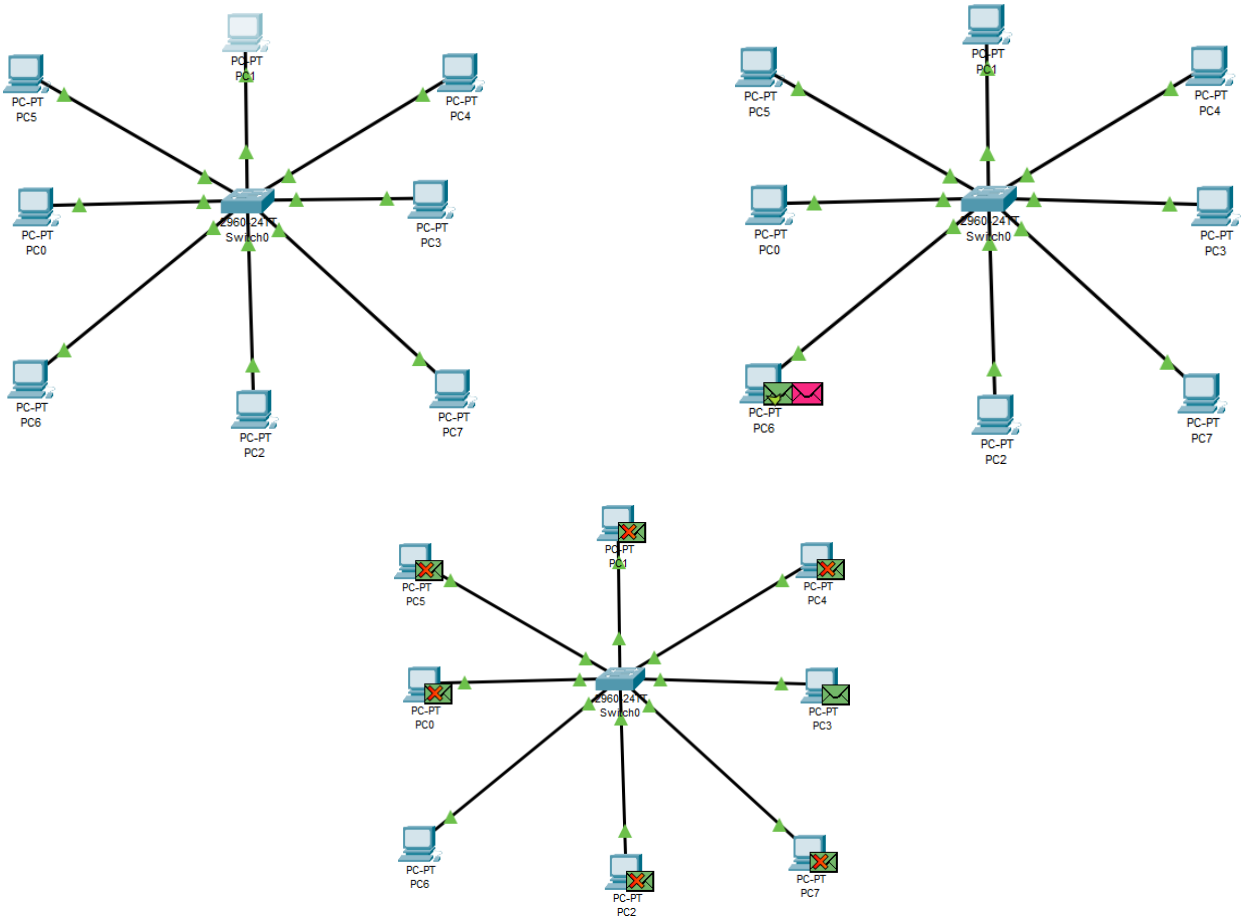
1. **Class A**:
   - **Range**: 10.0.0.0 - 10.255.255.255
   - **Hosts per Network**: 16,777,214
   - **Usable Range**: 10.0.0.1 - 10.255.255.254
2. **Class B**:
   - **Range**: 172.16.0.0 - 172.31.255.255
   - **Hosts per Network**: 65,534
   - **Usable Range**: 172.16.0.1 - 172.31.255.254
3. **Class C**:
   - **Range**: 192.168.0.0 - 192.168.255.255
   - **Hosts per Network**: 254
   - **Usable Range**: 192.168.0.1 - 192.168.0.254

Additional Concepts

- **Subnetting**: Divides networks using subnet masks (e.g., Class C mask: 255.255.255.0).
- **DHCP**: Automatically assigns IP addresses and network settings.
- **IPv4 Size**: 32-bit addressing.

Star Topology Network:

- **Star Topology**: A network setup where all devices (e.g., PCs) connect to a central hub or switch.
- **Central Switch**: Acts as the main point for communication between devices. Each PC has a direct connection to the switch.
- **Common Usage**: Widely used in LANs because it is simple to manage and troubleshoot.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC6	PC3	ICMP		0.000	N	0	(edit)	(delete)

Ethernet Frame Transmission in a Network Using a Switch:

1. **Initial Frame Transmission**:
    - **PC0** sends an Ethernet frame to the switch (**Switch0**).
    - The frame contains the **destination MAC address** (hardware address) of **PC1**.

2. **Switch Behavior**:
    - The switch examines the **destination MAC address** in the frame.
    - If the switch does not yet know which port is associated with **PC1**, it will **flood** the frame to all connected ports except the one from which it received the frame.
    - Every connected device receives the frame, but only **PC1** recognizes its own MAC address and processes the frame. Other devices ignore it.

3. **Learning Process**:
    - When **PC1** responds, the switch learns and records which port **PC1** is connected to. This is known as **building the MAC address table**.
    - The MAC address table stores the **MAC address** and corresponding **port number** for each device on the network.

4. **Subsequent Communications**:
    - For future transmissions, the switch uses its MAC address table to **directly forward** frames to the correct port associated with **PC1**, without flooding the network.
    - This makes communication more efficient, reducing unnecessary network traffic and improving overall network performance.

By following this process, a switch efficiently manages network traffic, optimizing data flow between devices.

Lab 04: 5th September

***ACTIVITY**: Class B Subnetting for 30,000 Devices*

Objective:

To perform subnetting for a network that needs to accommodate 30,000 devices using Class B IP addressing and implement it on Packet Tracer.

Network Requirements:

- Number of Devices: 30,000
- IP Class: Class B
- Class B Subnet Mask: 255.255.0.0 (or 11111111.11111111.00000000.00000000)

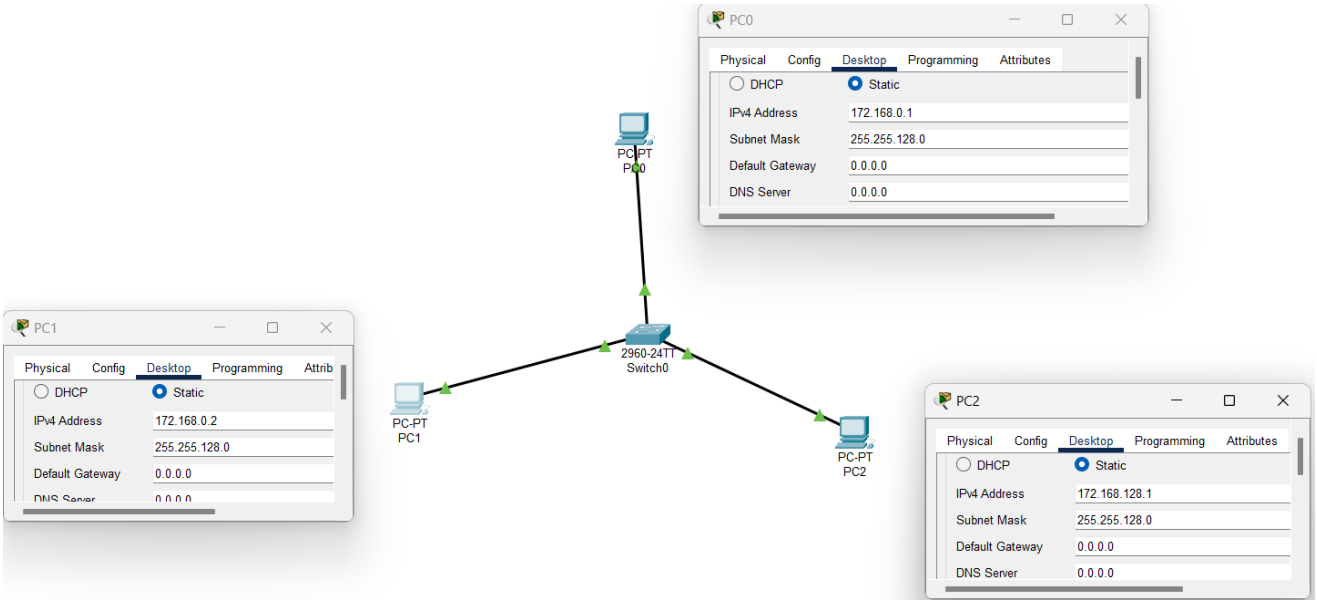
Steps for Subnetting:

1. Identifying the Need for Subnetting:
    - The number of devices (30,000) requires more than the default Class B configuration allows without subnetting.
2. Finding the Closest Power of 2:
    - The closest power of 2 that satisfies the requirement for 30,000 devices is 2^15 = 32,768 hosts.
    - We will need 15 bits for hosts and reduce 1 bit from the available bits for subnetting.
3. Subnet Mask Calculation:
    - Default Class B subnet mask: 11111111.11111111.00000000.00000000 (/16)
    - To accommodate 30,000 devices, we reduce 1 bit for subnetting:
        - New Subnet Mask: 11111111.11111111.10000000.00000000 (or /17)
        - Subnet Mask: 255.255.128.0
4. Subnetting Calculation:
    - Number of Subnets: 2^(number of changed bits) = 2^1 = 2 subnets
    - Number of Hosts per Subnet: 2^(unchanged bits) - 2 = 2^15 - 2 = 32,766 hosts (subtracting 2 for network and broadcast addresses)

Subnets:

With the new subnet mask, we can create 2 subnets, each capable of handling up to 32,766 hosts.

- Subnet 1 (SN1):
  - Network Address: 172.168.0.0
  - Broadcast Address: 172.168.127.255
  - Usable IP Range: 172.168.0.1 to 172.168.127.254
- Subnet 2 (SN2):
  - Network Address: 172.168.128.0
  - Broadcast Address: 172.168.255.255
  - Usable IP Range: 172.168.128.1 to 172.168.255.254
  - Test the connectivity between devices within the same subnet and across subnets to verify the configuration.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC1	ICMP		0.000	N	0	(edit)	(delete)
	Failed	PC0	PC2	ICMP		0.000	N	1	(edit)	(delete)
	Failed	PC1	PC2	ICMP		0.000	N	2	(edit)	(delete)

In the network setup shown above the PCs have the following IPs:

- **PC0:** 172.168.0.1
- **PC1:** 172.168.0.2
- **PC2:** 172.168.128.1

From the ping test results:

- **PC0 to PC1** is **successful** because they are in the same subnet (Subnet 1).
- **PC0 to PC2** and **PC1 to PC2** fail because **PC2** is in a different subnet (Subnet 2), and there is no router to handle inter-subnet