Lab number 3

Aim/Title: To study the basic LAN setup

Introduction

A Local Area Network (LAN) is a network infrastructure that enables devices within a limited geographical area, such as an office or home, to connect and communicate with each other. The basic LAN setup is fundamental in networking, providing the foundational understanding needed for more complex network configurations. A basic LAN can be setup using hubs and switches in Cisco Packet Tracer, a network simulation tool that allows users to create, configure, and analyze network topologies.

Theory

A Local Area Network (LAN) setup is fundamental in creating a network that enables communication between multiple devices, such as computers, printers, servers, and other network-enabled devices within a limited geographic area, like an office, home, or school. The primary goal of a LAN is to share resources (such as files, printers, and internet connections) and facilitate data communication among the connected devices. In this lab, we will focus on the setup and operation of two types of network devices: hubs and switches.

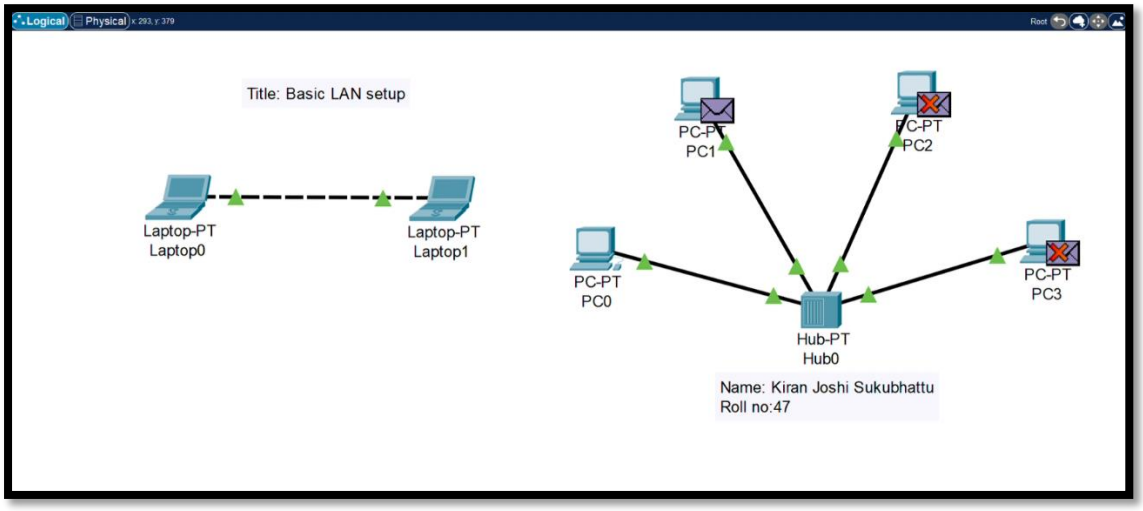
1. Hub: A hub is a basic networking device that serves as a central connection point for devices in a LAN. Operating at the physical layer (Layer 1) of the OSI model, a hub functions as a simple repeater, amplifying and transmitting electrical signals to all devices connected to its ports. When a data packet arrives at one of the hub's ports, it is broadcast to all other ports indiscriminately. This method of data transmission is inefficient, as it generates unnecessary traffic across the network, potentially leading to data collisions, where multiple devices attempt to send data simultaneously. Because hubs do not have the capability to filter traffic or understand the destination of the data, they are considered less efficient and are generally replaced by more advanced devices in modern networks.

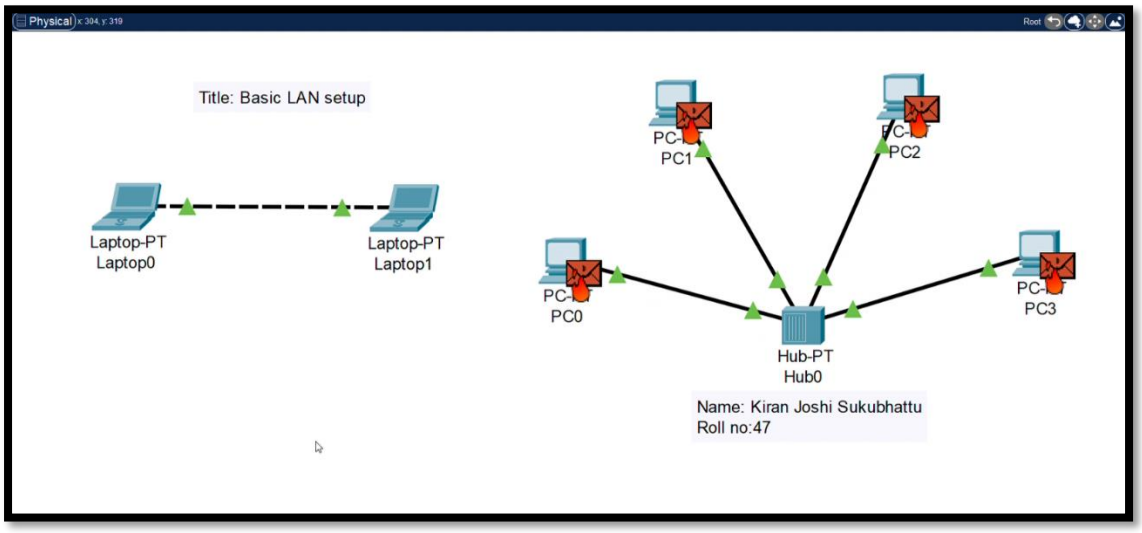
2. Switch: A switch is a more sophisticated networking device that significantly improves the efficiency and performance of a LAN. Operating at the data link layer (Layer 2) of the OSI model, a switch is capable of learning and storing the MAC (Media Access Control) addresses of the devices connected to its ports. When a data packet is received, the switch examines the destination MAC address and forwards the packet only to the specific port associated with that address, rather than broadcasting it to all ports as a hub does. This targeted approach minimizes unnecessary traffic and greatly reduces the likelihood of collisions, enhancing overall network performance. Additionally, switches can support full-duplex communication, allowing simultaneous data transmission and reception, further optimizing the speed and efficiency of the network. In more advanced implementations, switches can also operate at higher layers of the OSI model, providing features such as VLAN (Virtual LAN) segmentation and Quality of Service (QoS) management.

Overall, while both hubs and switches are used to connect multiple devices within a LAN, switches are generally preferred in modern networks due to their ability to manage traffic more intelligently and efficiently, reducing collisions and improving data transfer speeds.

Working Steps

1. **Analyzing the Network Setup with a Hub:**





The above two images depict a basic LAN setup using a hub.In this setup, multiple devices (such as PCs) are connected to a hub.When one device sends data, the hub broadcasts it to all connected devices, resulting in a higher chance of collisions if multiple devices try to communicate simultaneously.

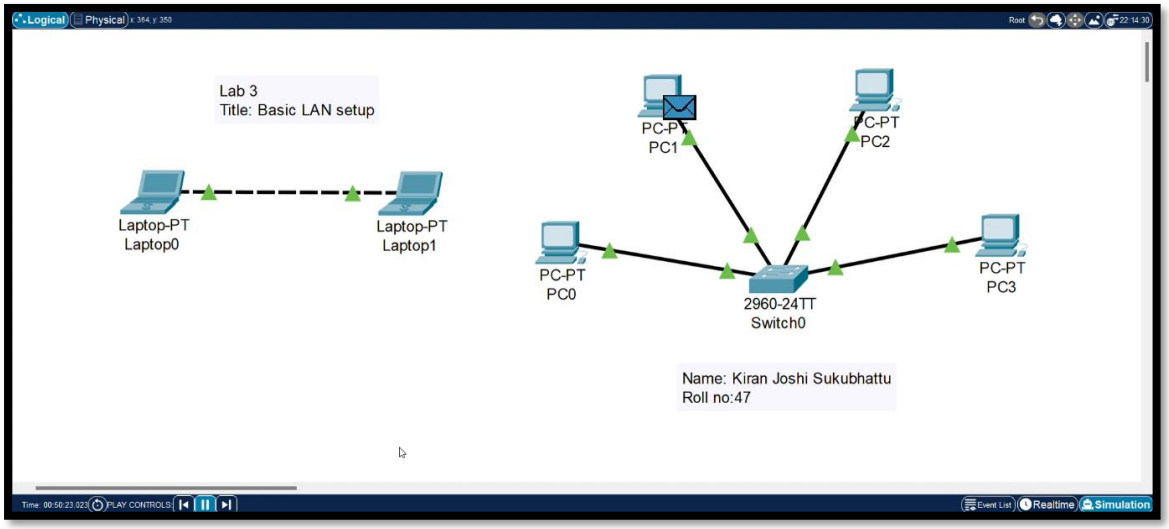
Setup Steps in Cisco Packet Tracer

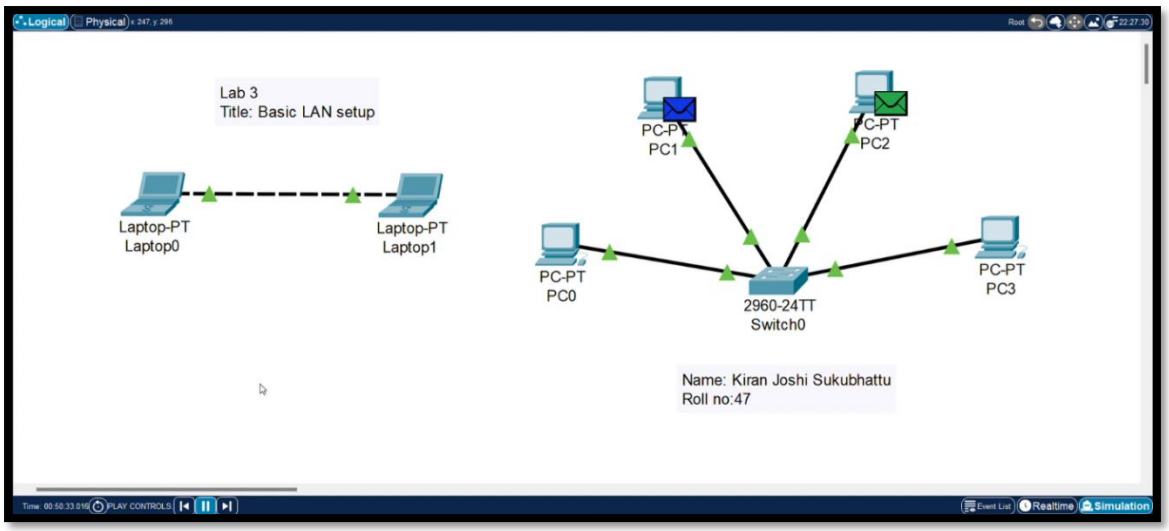
- Creating a LAN with a Hub:
- Open Cisco Packet Tracer and select the required network devices, including a hub and multiple PCs.
- Drag the devices onto the workspace.
- Connect each PC to the hub using Ethernet cables.
- Configure IP addresses for each PC to ensure they are in the same network (e.g., 192.168.1.1, 192.168.1.2, etc.).
- Test the network by using the "ping" command from one PC to another to check connectivity.

Working Procedure of the basic LAN with hub

The working procedure for the basic LAN setup using a hub, as shown in the first two images, involves connecting multiple devices (such as PCs) to a central hub using Ethernet cables. In this setup, the hub acts as a simple intermediary, broadcasting any data it receives from one device to all other connected devices. This process does not involve any intelligence in directing data to the intended recipient, leading to increased network traffic and a higher chance of data collisions, especially when multiple devices attempt to communicate simultaneously. Despite its simplicity, this setup allows for basic communication within the network, but with potential inefficiencies due to the broadcast nature of hubs. By configuring each device with an appropriate IP address within the same network range, connectivity between devices can be tested and verified using commands like "ping" to ensure they can communicate through the hub.

2. Analyzing the Network Setup with a Switch:





The above two images show a LAN setup using a switch. Devices are connected to the switch, which intelligently forwards data to the correct destination device. This setup reduces the possibility of collisions and enhances the network's performance and efficiency.

Setup Steps in Cisco Packet Tracer

Creating a LAN with a Switch:

- Repeat the above steps, but replace the hub with a switch.
- Again, connect each PC to the switch using Ethernet cables.
- Assign IP addresses to each PC.
- Test the connectivity using the "ping" command. Notice the more efficient data transmission compared to the hub setup.

Working procedure of the basic LAN setup using switch:

The working procedure for the basic LAN setup using a switch, as depicted in the above two images, involves connecting multiple devices (such as PCs) to a central switch using Ethernet cables. Unlike a hub, a switch is more intelligent in handling data traffic. When a device sends data, the switch identifies the destination device's MAC address and forwards the data directly to that specific device rather than broadcasting it to all devices on the network. This method significantly reduces network traffic and minimizes the chances of data collisions. Each device in the network is assigned a unique IP address within the same subnet, allowing them to communicate with one another efficiently. The switch, by learning the MAC addresses of connected devices, ensures that data is transmitted only to the intended recipient, optimizing network performance and enhancing overall communication within the LAN. Connectivity can be tested by using commands like "ping" to ensure that each device can successfully communicate through the switch without issues.

Conclusion

The hub-based network was simpler but less efficient due to the potential for collisions and unnecessary data traffic. The switch-based network, on the other hand, demonstrated more efficient data handling, reducing collisions and improving overall network performance. This exercise highlights the importance of choosing the right networking devices based on the requirements and scale of the network. Using Cisco Packet Tracer, we were able to simulate these setups, providing a practical understanding of basic LAN configurations and the differences between hubs and switches in a network environment. This foundational knowledge is essential for further studies in network design and management.

Discussion

In this lab, we set up LANs using both hubs and switches, demonstrating key differences in network performance. The hub-based network broadcasts data to all devices, leading to unnecessary traffic and potential collisions, which can slow down the network. In contrast, the switch-based network efficiently directs data only to the intended device, reducing traffic and minimizing collisions. This lab emphasizes that while hubs are simple, switches offer better performance, making them the preferred choice for modern networks due to their traffic management and scalability.