Mehran University of Engineering and Technology, Khairpur
Department of Software Engineering

Course: SWE-Computer Network Practical			
Instructor	Dr. Asad Raza Malik	Practical/Lab No.	05
Date	28-08-204	CLOs	03
Student's Roll no:		Point Scored:	
Date of Conduct:		Teacher's Signature:	

LAB PERFORMANCE INDICATOR	Subject Knowledge	Data Analysis and Interpretation	Ability to Conduct Experiment	Presentation	Calculation and Coding	Observation/ Result	Score

Topic	Configure a network topology using packet tracer software
Objective	• To understand configuring a basic network topology using Cisco Packet Tracer. • To learn how to set up and configure various network devices, including routers, switches, and PCs. • To practice assigning IP addresses, configuring interfaces, and verifying network connectivity.
Materials Required:	• Cisco Packet Tracer Software • A computer with Cisco Packet Tracer installed

Lab Discussion: Theoretical concepts and Procedural steps

Theoretical Background:

A network topology refers to the arrangement of different elements (links, nodes, etc.) in a computer network. The primary network topology includes bus, star, ring, mesh, and hybrid. In this lab. Students will use Cisco Packet Tracer to create and configure a basic network topology, including the connection of PCs to switches and routers, IP addressing, and basic network testing.

Network Topologies

Network topologies describe network devices' physical or logical arrangement and how they are interconnected. Understanding different topologies is fundamental to designing efficient and effective networks.

1. Bus Topology

Description:

- In bus topology, all devices are connected to a central cable, the bus or backbone. Data sent from a device is broadcast to all other devices on the network, but only the intended recipient accepts and processes it.

Advantages:

- Easy to implement and extend.
- Cost-effective for small networks.

Disadvantages:

- Difficult to troubleshoot.
- A failure in the central bus can bring down the entire network.
- Limited cable length and the number of devices.

Real-Life Example:

- **Early Ethernet Networks:** Older versions of Ethernet (10BASE2 and 10BASE5) used bus topology where computers were connected to a single coaxial cable.

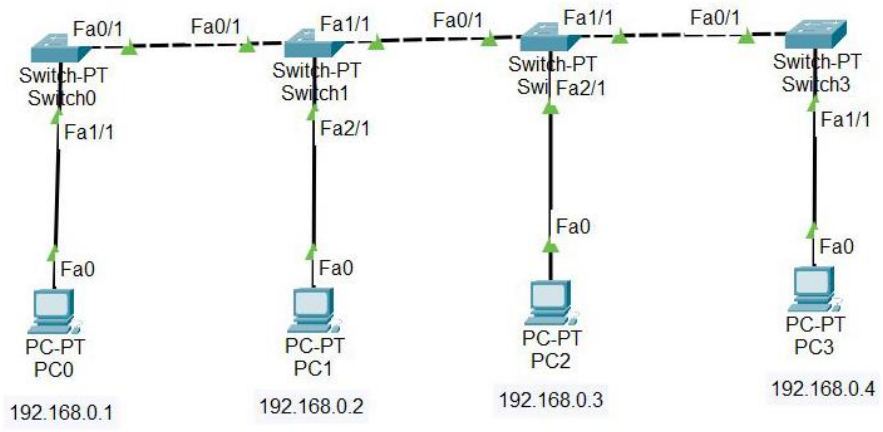


Fig1. Bus Topology in Cisco Packet Tracer diagram.

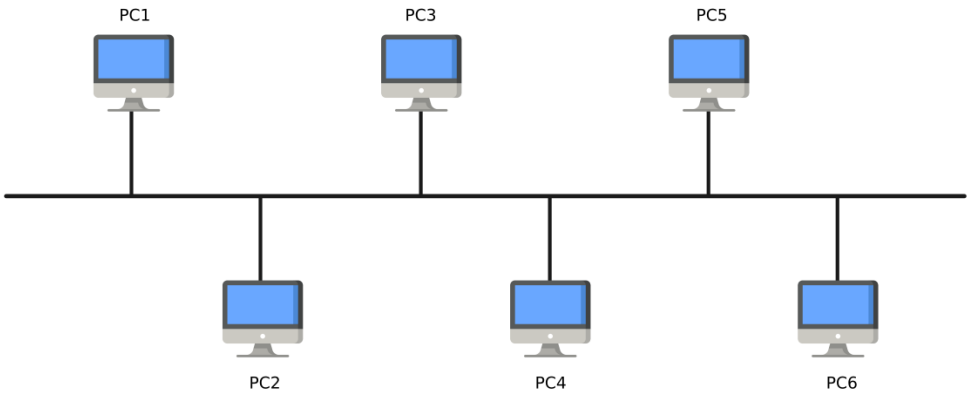


Fig 2. Bus Topology diagram.

2. Ring Topology

Description:

- In a ring topology, each device is connected to two other devices, forming a circular or ring-like structure. Data travels in one direction (or sometimes both) around the ring until it reaches its destination.

Advantages:

- Data is transferred in a predictable and orderly manner.
- Easier to identify faults and issues in the network.

Disadvantages:

- A break in the ring can cause the entire network to fail.
- Adding or removing devices can disrupt the network.

Real-Life Example:

- **Token Ring Networks:** IBM's Token Ring networks, used primarily in the 1980s and 1990s, are classic examples of ring topology.

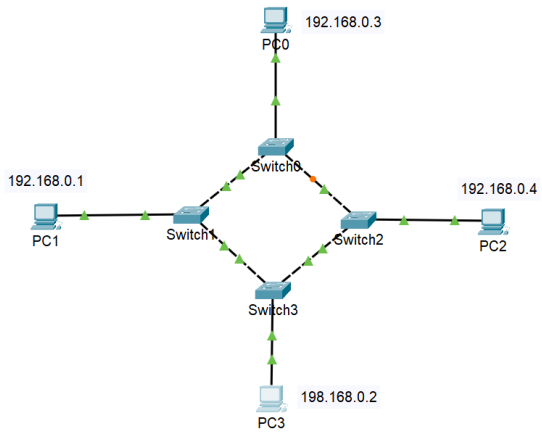


Fig3. Ring Topology in Cisco Packet Tracer diagram.

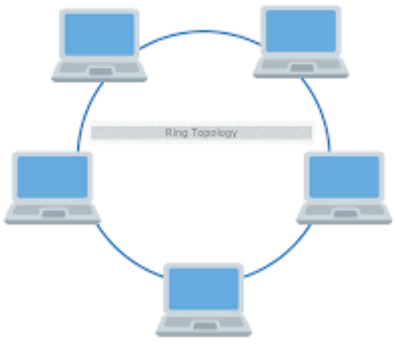


Fig 3. Bus Topology diagram.

3. Star Topology

Description:

- In star topology, all devices are connected to a central hub or switch. The hub acts as a repeater, relaying data from one device to another.

Advantages:

- Easy to install and manage.
- The failure of one cable does not affect the entire network.
- Centralized management makes troubleshooting easier.

Disadvantages:

- The hub or switch is a single point of failure; if it fails, the entire network is down.
- More cable is required compared to bus or ring topologies.

Real-Life Example:

- **Modern Ethernet Networks:** Most home and office networks use a star topology, connecting computers and devices to a central switch or router.

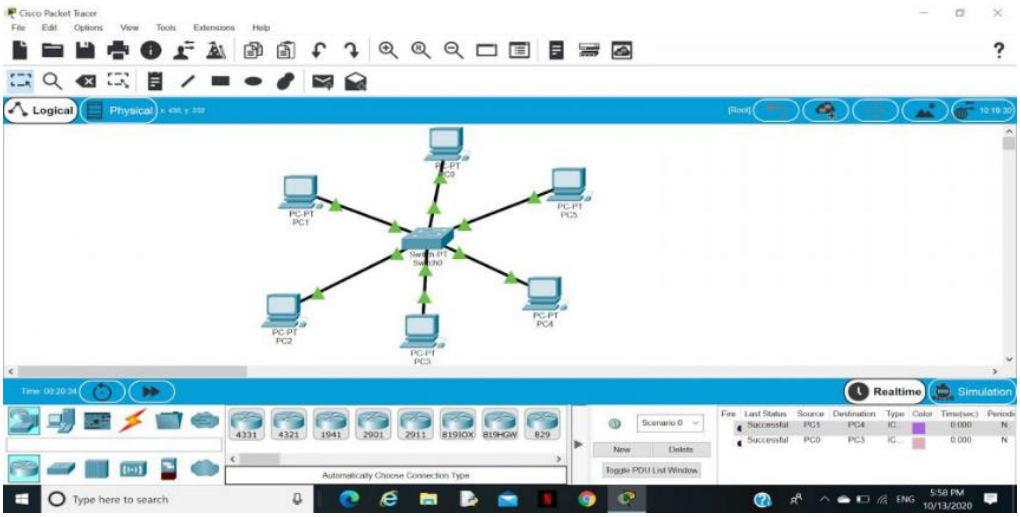


Fig 3. Star Topology in Cisco Packet Tracer diagram.

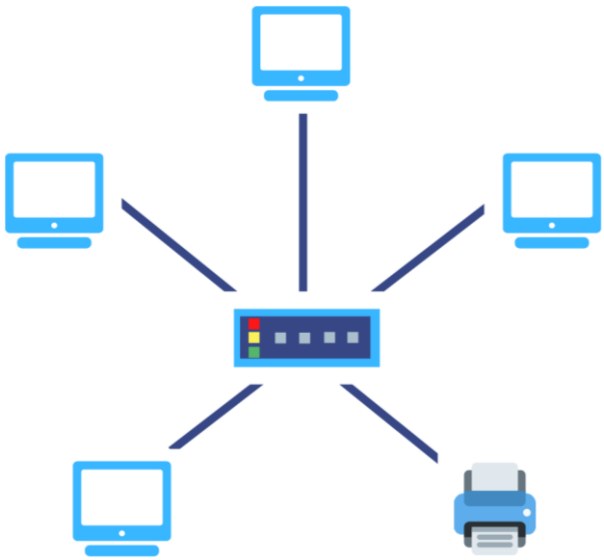


Fig 3. Star Topology diagram.

4. Mesh Topology

Description:

- In a mesh topology, every device is connected to another network device. This provides multiple paths for data to travel, ensuring that if one link fails, others can take over.

Advantages:

- High redundancy and reliability.
- Excellent fault tolerance.
- Can handle high-traffic loads.

Disadvantages:

- Complex and expensive to install and maintain.
- Requires more cabling and hardware than other topologies.

Real-Life Example:

- **Internet Backbone:** The internet's core is often considered a mesh topology, with multiple redundant paths between significant nodes.

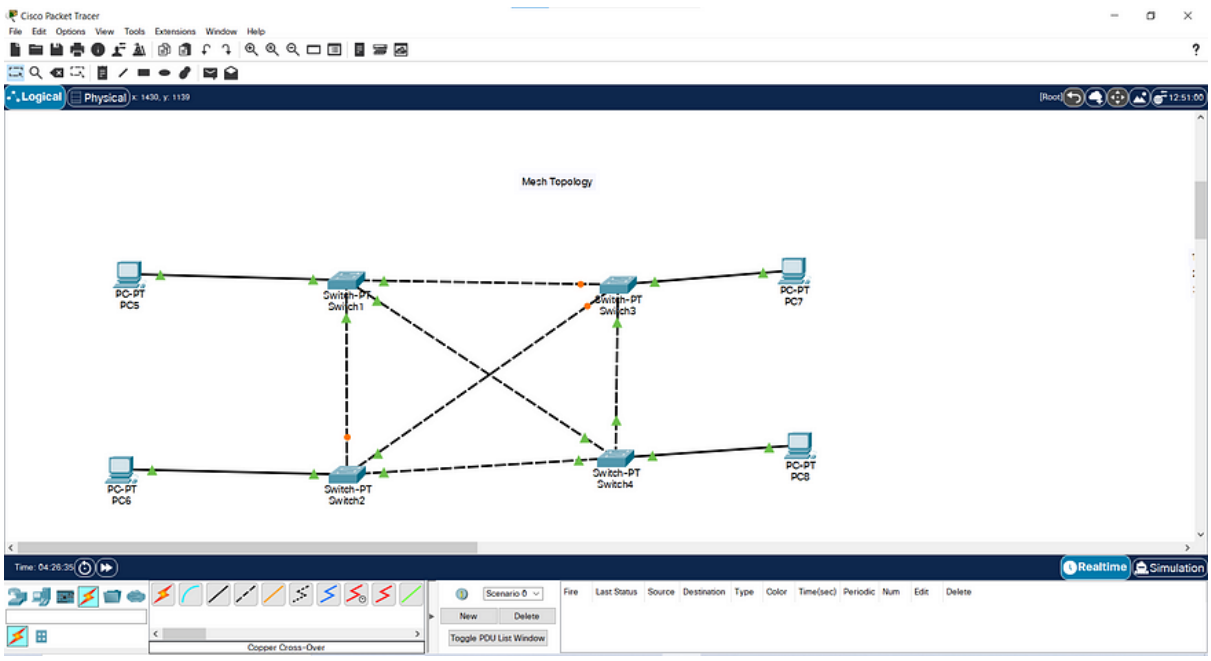


Fig 4. Mesh Topology in Cisco Packet Tracer diagram.

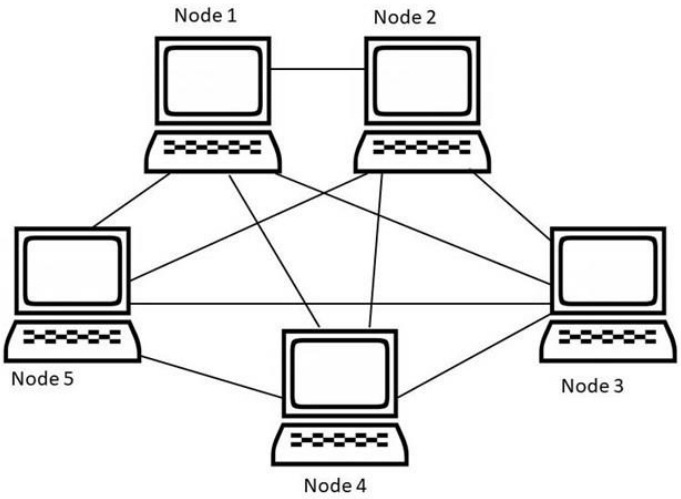


Fig 4. Mesh Topology diagram.

5. Hybrid Topology

Description:

- A hybrid topology is a combination of two or more different topologies. For example, a star-bus topology combines the star and bus topologies, connecting multiple star-configured networks via a central bus.

Advantages:

- Flexible and scalable.
- Combines the strengths of different topologies.
- Can be designed to meet specific network needs.

Disadvantages:

- Complex to design and manage.
- More expensive due to the need for different types of networking equipment.

Real-Life Example:

- **Enterprise Networks:** Large organizations often use hybrid topologies to connect different departments or floors within a building. For instance, each floor might use a star topology, with all floors connected via a bus topology.

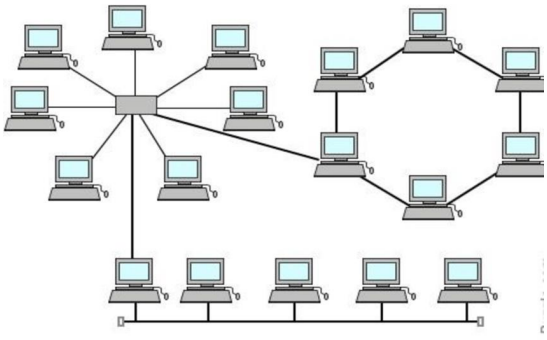


Fig 4. Hybrid Topology diagram.

Lab Activities:

Implementation of Bus Topology in Cisco Packet Tracer: Step-by-Step Guide

While Cisco Packet Tracer does not directly support the traditional bus topology as it uses Ethernet standards, typically implemented in a star topology using switches or hubs, we can simulate a bus-like environment using a linear arrangement of devices connected through a single switch or hub.

Step-by-Step Guide:

Step 1: Open the Cisco Packet Tracer

- Launch Cisco Packet Tracer.
- Create a new project by selecting **File > New**.

Step 2: Add Network Devices

- From the **Device-Type Selection** box on the left, select **End Devices**.
- Drag and drop **PC-PT** (PCs) onto the workspace. Add the number of PCs you need (for a basic setup, use at least 3 PCs).

Step 3: Add a Hub or Switch

- In a traditional bus topology, devices are connected along a single cable. However, since Packet Tracer doesn't have a bus cable, you can use a **Hub** or **Switch** to simulate this.
- From the **Network Devices** section, select **Hubs** or **Switches**.
- Drag and drop a **Generic Hub** (for hub) or **2960 Switch** onto the workspace.

Step 4: Connect Devices

- Select the **Connections** icon (the lightning bolt symbol) from the bottom-left corner.
- Choose **Copper Straight-Through Cable** (solid black line).
- Connect each PC to the Hub or Switch using the Copper Straight-Through Cable:
    - Click on a PC and choose the **FastEthernet0** port.
    - Click on the Hub or Switch and choose any available **FastEthernet** port.
    - Repeat this for all PCs.

Step 5: Assign IP Addresses to PCs

- Click on each PC to open the configuration window.
- Go to the **Desktop** tab and select **IP Configuration**.
- Assign a unique static IP address to each PC within the same network (e.g., 192.168.1.2, 192.168.1.3, 192.168.1.4).
- Subnet Mask should be automatically set to 255.255.255.0.

Step 6: Test Connectivity

- To ensure that the setup is working, you need to test the connectivity between the PCs.
- Click on a PC, go to the **Desktop** tab, and select **Command Prompt**.
- Use the ping command to ping other PCs (e.g., ping 192.168.1.3).
- If the ping is successful, it means the PCs can communicate with each other, simulating a bus topology where all devices are on the same network segment.

Step 7: Simulate Data Transmission

- You can further simulate data transmission between the PCs by sending PDU packets:
    - Click on the **Add Simple PDU** tool (envelope icon) from the toolbar.
    - Click on the source PC, then click on the destination PC.
    - Observe the packet movement through the hub/switch in the **Simulation** mode.

Step 8: Save the Project

- Once the setup and testing are complete, save your project by selecting **File > Save As** and giving your project a name.

Key Points:

- While a bus topology typically uses a single coaxial cable, the Cisco Packet Tracer simulates the same behavior using a hub or switch as a central connection point.
- Ensure all devices are in the same IP range to simulate the shared network segment of a bus topology.
- Hubs in Packet Tracer more closely mimic bus topology behavior because they broadcast the data to all devices, like how a bus network operates.

Implementation of Ring Topology in Cisco Packet Tracer: Step-by-Step Guide

Ring topology connects each device in a circular fashion, where each device has exactly two neighbors for communication purposes. Although the Cisco Packet Tracer doesn't have a direct option to create a physical ring topology due to the Ethernet standards it uses, you can simulate a logical ring topology by creating a linear sequence of connections and configuring the routing accordingly.

Step-by-Step Guide:

Step 1: Open the Cisco Packet Tracer

- Launch Cisco Packet Tracer.
- Create a new project by selecting **File > New**.

Step 2: Add Network Devices

- From the **Device-Type Selection** box on the left, select **End Devices**.

- Drag and drop **PC-PT** (PCs) onto the workspace. Add as many PCs as you need to form a ring (typically 4 or more PCs).

Step 3: Add Switches

- Since Cisco Packet Tracer uses Ethernet, which typically works with switches, we'll add switches to simulate the ring topology.
- From the **Network Devices** section, select **Switches**.
- Drag and drop the required number of **2960 Switches** onto the workspace (you can use one switch or multiple switches to simulate the ring).

Step 4: Connect Devices in a Ring-Like Fashion

- Select the **Connections** icon (the lightning bolt symbol) from the bottom-left corner.
- Choose **Copper Straight-Through Cable** (solid black line).
- Connect the devices in a ring-like sequence:
    1. Connect **PC1** to **Switch1**.
    2. Connect **Switch1** to **Switch2**.
    3. Connect **Switch2** to **PC2**.
    4. Connect **PC2** to **Switch3**.
    5. Connect **Switch3** back to **Switch1**.
- This will create a logical ring connection.

Step 5: Configure IP Addresses

- Click on each PC to open the configuration window.
- Go to the **Desktop** tab and select **IP Configuration**.
- Assign a unique static IP address to each PC within the same network (e.g., 192.168.1.2, 192.168.1.3, 192.168.1.4, etc.).
- Subnet Mask should be automatically set to 255.255.255.0.

Step 6: Test Connectivity

- To ensure that the ring topology works, test the PC connectivity.
- Click on a PC, go to the **Desktop** tab, and select **Command Prompt**.
- Use the ping command to ping the other PCs (e.g., ping 192.168.1.3).
- Ensure that the ping is successful to verify that the devices can communicate with each other.

Step 7: Simulate Data Transmission in Ring Topology

- You can further simulate data transmission between the PCs by sending PDU packets:

- Click on the **Add Simple PDU** tool (envelope icon) from the toolbar.
- Click on the source PC, then click on the destination PC.
- Observe the packet movement through the switches in the **Simulation** mode.
- The data will follow the path set by the logical ring structure.

Step 8: Save the Project

- Once the setup and testing are complete, save your project by selecting **File > Save As** and giving your project a name.

Key Points:

- In a physical ring topology, devices are connected circularly. While the Cisco Packet Tracer doesn't support physical rings directly, the logical ring setup helps simulate how data would flow in such a topology.
- Each device is connected sequentially to form a loop, ensuring that data can travel around the ring until it reaches its destination.
- Switches in Packet Tracer can help simulate the connections required for a ring topology.

Implementation of Star Topology in Cisco Packet Tracer: Step-by-Step Guide

Star topology is one of the most common network topologies where all devices are connected to a central device, such as a switch or hub. This central device acts as the hub through which all data is transmitted.

Step-by-Step Guide:

Step 1: Open the Cisco Packet Tracer

- Launch Cisco Packet Tracer.
- Start a new project by going to **File > New**.

Step 2: Add Network Devices

- From the **Device-Type Selection** box on the left, select **End Devices**.
- Drag and drop the required **PC-PT** (PCs) onto the workspace (e.g., 4 PCs).

Step 3: Add a Central Switch

- From the **Network Devices** section, select **Switches**.
- Drag a **2960 Switch** (or any other switch model) onto the workspace. This switch will act as the central hub of your star topology.

Step 4: Connect Devices to the Switch

- Select the **Connections** icon (the lightning bolt symbol) from the bottom-left corner.
- Choose **Copper Straight-Through Cable** (solid black line).

- Connect each PC to the switch:
    1. Click on a PC, then click on the switch port to establish a connection.
    2. Repeat this for all PCs, connecting each one to a different port on the switch.

Step 5: Configure IP Addresses

- Click on each PC to open the configuration window.
- Go to the **Desktop** tab and select **IP Configuration**.
- Assign a unique static IP address to each PC within the same network (e.g., 192.168.1.2, 192.168.1.3, 192.168.1.4, 192.168.1.5).
- The Subnet Mask should automatically be set to 255.255.255.0.

Step 6: Test Connectivity

- To verify the connectivity of your star topology:
    1. Click on any PC, go to the **Desktop** tab, and open **Command Prompt**.
    2. Use the ping command to ping other PCs in the network (e.g., ping 192.168.1.3).
    3. Ensure that the ping is successful to confirm that the devices can communicate with each other through the switch.

Step 7: Simulate Data Transmission

- You can simulate data transmission between PCs by sending PDU packets:
    1. Click on the **Add Simple PDU** tool (envelope icon) from the toolbar.
    2. Click on the source PC, then click on the destination PC.
    3. Switch to **Simulation** mode to observe the packet movement through the switch.

Step 8: Save the Project

- After completing the setup and testing, save your project by selecting **File > Save As** and naming your project.

Key Points:

- In a star topology, each device is connected to a central hub (switch), and all data passes through this hub before reaching its destination.
- This setup makes it easier to manage and troubleshoot since the central switch handles all the network traffic.
- Star topology is widely used in local area networks (LANs) due to its simplicity and effectiveness.

Implementation of Mesh Topology in Cisco Packet Tracer: Step-by-Step Guide

Mesh topology is a network configuration where each device is connected to every other device in the network. This provides multiple paths for data to travel, ensuring high redundancy and fault tolerance.

Step-by-Step Guide:

Step 1: Open Cisco Packet Tracer

- Launch Cisco Packet Tracer.
- Start a new project by selecting **File > New**.

Step 2: Add Network Devices

- From the **Device-Type Selection** box on the left, select **End Devices**.
- Drag and drop the required number of **PC-PT** (PCs) onto the workspace (e.g., 4 PCs).

Step 3: Connect Devices Using Cables

- Since a mesh topology requires each device to be connected to every other device, you will need multiple connections:
    1. Click on the **Connections** icon (the lightning bolt symbol) from the bottom-left corner.
    2. Choose **Copper Cross-Over Cable** (dotted black line).
    3. Connect each PC to every other PC:
        - For example, if you have 4 PCs (PC0, PC1, PC2, and PC3):
            - Connect PC0 to PC1, PC2, and PC3.
            - Connect PC1 to PC2 and PC3 (PC0 and PC1 are already connected).
            - Connect PC2 to PC3 (PC0 and PC1 are already connected).

Step 4: Configure IP Addresses

- Click on each PC to open the configuration window.
- Go to the **Desktop** tab and select **IP Configuration**.
- Assign a unique static IP address to each PC within the same network (e.g., 192.168.1.2, 192.168.1.3, 192.168.1.4, 192.168.1.5).
- The Subnet Mask should automatically be set to 255.255.255.0.

Step 5: Test Connectivity

- To verify the connectivity of your mesh topology:
    1. Click on any PC, go to the **Desktop** tab, and open **Command Prompt**.

2. Use the ping command to ping every other PC in the network (e.g., ping 192.168.1.3 from PC0, then ping 192.168.1.4, and so on).
3. Ensure that the ping is successful to confirm that all devices are interconnected.

Step 6: Simulate Data Transmission

- You can simulate data transmission between PCs by sending PDU packets:
    1. Click on the **Add Simple PDU** tool (envelope icon) from the toolbar.
    2. Click on the source PC, then click on the destination PC.
    3. Switch to **Simulation** mode to observe the packet movement between the PCs.

Step 7: Save the Project

- After completing the setup and testing, save your project by selecting **File > Save As** and naming your project.

Key Points:

- In a mesh topology, every device has a direct connection to every other device, ensuring that there are multiple paths for data to travel.
- This topology offers high fault tolerance because if one connection fails, data can still be routed through other connections.
- Mesh topology is often used in mission-critical applications where network reliability is paramount.

Implementation of Hybrid Topology in Cisco Packet Tracer: Step-by-Step Guide

A hybrid topology is a combination of two or more different types of network topologies, such as star, bus, ring, or mesh. In this guide, we'll create a hybrid topology combining star and bus topologies.

Step-by-Step Guide:

Step 1: Open Cisco Packet Tracer

- Launch Cisco Packet Tracer.
- Start a new project by selecting **File > New**.

Step 2: Add Network Devices

- From the **Device-Type Selection** box on the left, select **End Devices**.
- Drag and drop the required number of **PC-PT** (PCs) onto the workspace (e.g., 6 PCs).
- Select **Switches** from the same menu and drag one **Switch (e.g., 2960)** into the workspace.

Step 3: Set Up the Star Topology

- In the star topology, all devices connect to a central switch:
    1. Click on the **Connections** icon (lightning bolt symbol) from the bottom-left corner.
    2. Choose **Copper Straight-Through Cable**.
    3. Connect each of three PCs to the switch.

Step 4: Set Up the Bus Topology

- In the bus topology, devices are connected in a linear sequence using a common backbone cable:
    1. From the **Connections** icon, select **Copper Cross-Over Cable**.
    2. Connect the remaining three PCs in a daisy-chain fashion (PC1 to PC2, PC2 to PC3).

Step 5: Connect the Star and Bus Topologies

- To integrate both topologies into a hybrid setup:
    1. Use a **Copper Cross-Over Cable** to connect one of the PCs in the star topology (connected to the switch) to one of the PCs in the bus topology.

Step 6: Configure IP Addresses

- Assign IP addresses to all devices:
    1. Click on each PC, go to the **Desktop** tab, and select **IP Configuration**.
    2. Assign unique static IP addresses within the same subnet (e.g., 192.168.1.2 to 192.168.1.7).
    3. Ensure that the subnet mask is set to 255.255.255.0.

Step 7: Test Connectivity

- Test the connectivity between all devices to ensure the hybrid topology is functioning:
    1. Click on any PC, go to the **Desktop** tab, and open **Command Prompt**.
    2. Use the ping command to test connectivity with all other devices.
    3. Ensure successful communication between devices connected in both the star and bus topologies.

Step 8: Simulate Data Transmission

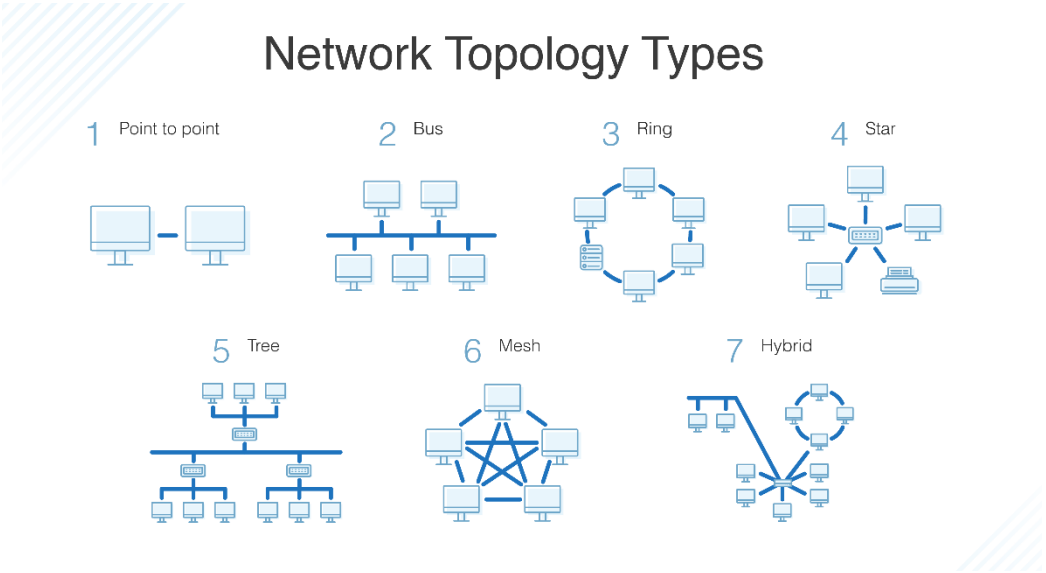
- Simulate data transmission to observe how data travels through the hybrid topology:
    1. Use the **Add Simple PDU** tool (envelope icon) to send data from one device to another across the network.
    2. Switch to **Simulation** mode to observe the packet movement and confirm data paths.

Step 9: Save the Project

- After verifying that the hybrid topology is functioning correctly, save your project by selecting **File > Save As** and naming your project.

Key Points:

- A hybrid topology combines the advantages of multiple topologies (e.g., the fault tolerance of a star and the simplicity of a bus).
- This setup is often used in large and complex networks where a single topology would not be sufficient to meet all requirements.
- Hybrid topologies are flexible and scalable, making them suitable for different environments.



Students Practical Assignment

Objective: Create a simulated network using Cisco Packet Tracer that demonstrates the following topologies:

1. **Star Topology:**

- Design a network where all devices are connected to a central hub.
- Simulate data transmission between devices and demonstrate how the failure of one connection (not the hub) does not affect the others.

2. **Mesh Topology:**
    - Create a network where each device is connected to every other device.
    - Highlight the redundancy and fault tolerance by simulating the failure of one connection and showing alternate data paths.
3. **Ring Topology:**
    - Set up a circular network where each device is connected to two others.
    - Demonstrate how data travels in one direction and how the failure of one device disrupts the entire network.
4. **Bus Topology:**
    - Construct a network using a single backbone cable to which all devices are connected.
    - Show how all devices share the same communication line and how a break in the cable affects the entire network.

Requirements:

- Each topology must include at least five devices (computers, routers, switches, or hub).
- Provide a brief explanation of the setup process for each topology.
- Include screenshots of the Packet Tracer simulations showing successful data transmissions and any failures.

Theoretical Assignment

Objective: Research and write a report on the characteristics, advantages, and disadvantages of each topology. **Guidelines:**

- **Star Topology:**
    - Discuss its structure, ease of installation, and the impact of hub failure.
    - Include real-world applications and scenarios where it is most effective.
- **Mesh Topology:**
    - Explain the full and partial mesh configurations.
    - Analyze its reliability and security aspects, along with the complexity and cost of implementation.

- **Ring Topology:**
    - Describe how data travels in a ring and the use of tokens for data transmission.
    - Evaluate its efficiency for high-volume traffic and the challenges posed by a single point of failure.
- **Bus Topology:**
    - Outline the simplicity and cost-effectiveness of bus topology.
    - Discuss its limitations in scalability and fault tolerance.

Report Requirements:

- The report should be 3-5 pages long, using appropriate headings and subheadings.
- Include diagrams to illustrate each topology.
- Cite at least three sources to support the analysis.

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