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

Course: SWE-Computer Network Practical			
Instructor	Dr. Asad Raza Malik	Practical/Lab No.	02
Date	22-07-2024	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	To design a peer-to-peer network
Objective	• Understand the concept of Peer-to-Peer Network • Design and implement a basic P2P network using Cisco Packet Tracer.
Materials Required:	**Hardware:** • Computers or Virtual Machines (at least two) • Network Interface Cards (NICs) • Ethernet Cables (CAT5e or higher) • Network Switch (optional for connecting multiple peers) **Software:** • Cisco Packet Tracer • Operating system: Windows, Linux, or macOS on the computer • P2P Software or Protocol (e.g., BitTorrent client) for simulation purposes **Miscellaneous:** • Power Supply for all hardware components • Networking Tools for testing connectivity (e.g., ping, traceroute) • Documentation Tools for recording configurations and results (e.g., notepad, word processor)
Course Outcomes (Cos)	**CO1: Understand P2P Network Topologies** • Grasp the structure and characteristics of Peer-to-Peer networks. **CO2: Configure Hardware and Software** • Identify and set up necessary components for a P2P network. **CO3: Design and Simulate Networks** • Use Cisco Packet Tracer for network design and testing. **CO4: Implement P2P Software** • Install and configure P2P applications like BitTorrent. **CO5: Troubleshoot Network Issues** • Diagnose and resolve common P2P network problems.

Program Outcomes (POs)	**PO1: Engineering Knowledge** • Apply foundational knowledge to complex problems. **PO2: Problem Analysis** • Analyze and solve network-related issues. **PO3: Design Solutions** • Design effective network systems. **PO4: Investigation** • Conduct experiments and analyze network performance. **PO5: Modern Tool Usage** • Use modern engineering tools and software. **PO6: Engineer and Society** • Consider societal and ethical implications in engineering. **PO7: Environment and Sustainability** • Promote sustainable practices in IT infrastructure. **PO9: Individual and Teamwork** • Collaborate effectively in teams. **PO10: Communication** • Communicate technical information clearly.

Lab Discussion: Theoretical concepts and Procedural steps

1. Overview of P2P Network

1.1 Definition and Characteristics

A Peer-to-Peer (P2P) network is a decentralized communication model in which each participant (peer) has equivalent capabilities and responsibilities. Unlike the traditional client-server model, where clients request services and servers provide them, P2P network all nodes to act as both client and servers.

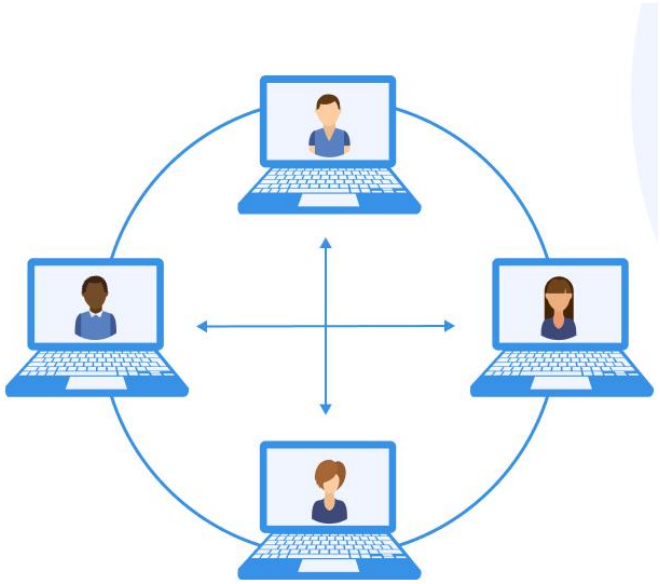

Fig. Peer-to-peer networks connect multiple computers.

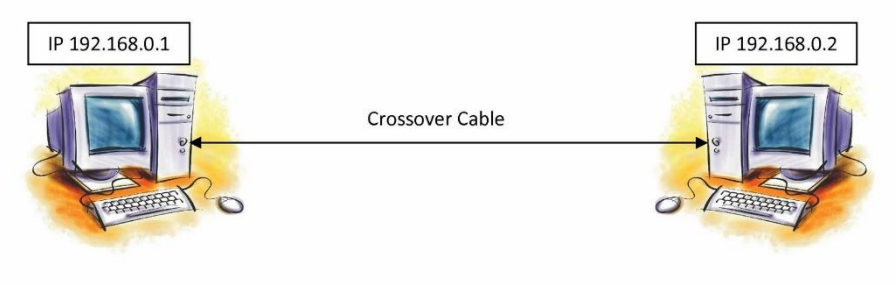

Fig. A peer-to-peer network connects two computers.

1.1.2Key Characteristics:

- **Decentralization:** There is no central authority or single point of control. Each peer is both a client and a server.
- **Scalability:** P2P networks can easily scale as more nodes join, since each node contributes resources.
- **Resource Sharing:** Resources such as files, processing power, and bandwidth are distributed among peers.
- **Resilience:** The network is more resilient to failures as there is no central point that can be targeted for attacks or outages.

1.1.3 Comparison with Client-Server Network

Feature	Client-Server Network	Peer-to-Peer Network
Architecture	Centralized (with dedicated servers and client nodes)	Decentralized (all nodes are equal, acting as peers)
Scalability	Limited by server capacity	High, as each new peer adds resources
Reliability	Single point of failure at the server	More resilient, as multiple nodes provide redundancy
Resource Utilization	Server resources are dedicated; clients consume resources	Resources are shared across peers
Cost	Higher cost for maintaining and upgrading servers	Lower cost due to distributed resource sharing
Performance	Potential bottlenecks at the server	Can distribute load more evenly across peers
Management	Easier to manage and secure centrally	More complex due to distributed nature.

2. Real-World Applications of P2P Networks

1. **File Sharing:**
   - **BitTorrent:** A popular protocol for sharing large files. It breaks files into smaller pieces, which are distributed among peers. Each peer downloads and

uploads pieces simultaneously, improving download speed and reducing the load on any single source.
    - **Gnutella:** Another P2P file sharing protocol that allows users to search for and share files directly between peers without a central directory.
2. **VoIP (Voice over Internet Protocol):**
    - **Skype:** Initially used a P2P architecture to manage calls and messaging. Each client was part of the network, helping to route calls and share data.
3. **Distributed Computing:**
    - **SETI@home:** A project where volunteers installed software on their computers to analyze radio signals from space for signs of extraterrestrial intelligence. The computation was distributed across many personal computers.
4. **Blockchain and Cryptocurrencies:**
    - **Bitcoin:** Uses a P2P network to manage a decentralized ledger of transactions. Each peer (node) maintains a copy of the blockchain and validates transactions, providing security and transparency.
    -
5. **Decentralized Storage:**
    - **IPFS (InterPlanetary File System):** A P2P network for storing and sharing files. Files are divided into small chunks, which are distributed and stored across multiple nodes, ensuring redundancy and availability.
6. **Collaboration Platforms:**
    - **Peer-to-Peer Video Conferencing:** Some platforms use P2P technology to enable direct communication between participants without routing through a central server, reducing latency and improving call quality.

3. Designing a Basic Peer-to-Peer Network

1. **Network Topology:**
    a. **Description:** In a P2P network, each peer is connected to several other peers. The connections form a mesh-like structure where data can be transmitted from one peer to another directly.
2. **Hardware Requirements:**
    a. Computers or virtual machines (at least two for a basic P2P network).
    b. Network interface cards (NICs).
    c. Ethernet cables (CAT5e or higher recommended).
    d. Network switch (optional, for connecting multiple peers).
3. **Software Requirements:**
    a. Cisco Packet Tracer
    b. P2P software or protocol (e.g., BitTorrent client).

4. Lab Activities

Activity 1: Setting Up a Basic P2P Network in Cisco Packet Tracer

Step 1: Create a New Project

- Open Cisco Packet Tracer and create a new project.

Step 2: Add Devices

- Add two or more PCs to the workspace.

Step 3: Connect the Devices

- Use Ethernet cables to connect the PCs directly or through a switch.
- Configure the connections to ensure proper communication.

Step 4: Configure IP Addresses

- Assign static IP addresses to each PC (e.g., 192.168.1.2, 192.168.1.3, etc.).
- Ensure each PC can ping the others successfully.

Step 5: Install and Configure P2P Software

- Simulate installing P2P software on each PC.
- Configure the P2P software to share specific folders on each PC.
- Simulate file sharing by transferring a file from one PC to another.

Activity 2: Monitoring and Troubleshooting in Cisco Packet Tracer

Step 1: Network Monitoring

- Use Packet Tracer's simulation mode to capture and analyze network traffic between peers.

Step 2: Troubleshooting Connectivity Issues

- Check cable connections and network settings in Packet Tracer.
- Use tools like ping and traceroute to diagnose connectivity issues.
- Ensure that firewall settings are not blocking P2P traffic.

Student Worksheet Task: Designing Peer-to-Peer Network

Task Overview

In this task, you will design and simulate a Peer-to-Peer (P2P) network using Cisco Packet Tracer. You will configure devices, set up network connections, and implement file sharing between peers. This exercise aims to help you understand the fundamental concepts and practical applications of P2P networks.

Part 1: Network Design

1. **Network Diagram:**
   - Draw a network diagram showing the layout of the P2P network you are creating. Include all devices, connections, and IP addresses.
2. **Device Configuration:**
   - List the devices used in your network (e.g., PC1, PC2).
   - Assign a static IP address to each device.

Device	IP Address	Subnet Mask
PC1	_____	_____
PC2	_____	_____
...	_____	_____

3. **Network Topology:**
   - Describe the topology used for your P2P network (e.g., mesh, star, etc.).

Part 2: Implementation in Cisco Packet Tracer

1. **Setting Up Devices:**
   - Add the necessary devices to the workspace in Cisco Packet Tracer.
   - Connect the devices using Ethernet cables or a switch.
2. **IP Configuration:**
   - Configure the IP addresses for each device as per the table above.
   - Ensure that each device can communicate with others by pinging the respective IP addresses.

Ping Results:

Source Device	Destination Device	Ping Success (Y/N)
PC1	PC2	_____
PC2	PC1	_____
...	...	_____

3. **Installing P2P Software:**
   - Simulate the installation of a P2P software client on each device.

4. **File Sharing:**
    - Configure the P2P software to share a folder on each device.
    - Perform a file transfer between devices and document the process.

Part 3: Analysis and Troubleshooting

1. **Network Monitoring:**
    - Use Cisco Packet Tracer's simulation mode to observe network traffic during the file transfer.
    - Describe any noticeable patterns or issues.
2. **Troubleshooting:**
    - If there were any connectivity issues, describe the steps you took to troubleshoot and resolve them.
3. **Questions:**

1. What challenges did you encounter while setting up the P2P network?
2. How does the P2P model differ from a client-server model in terms of scalability and fault tolerance?
3. In what scenarios would a P2P network be more advantageous than a client-server network?

Part 4: Reflection

1. **Key Learnings:**
    - Summarize the key learnings from this lab activity.
2. **Applications:**
    - Provide examples of real-world applications where P2P networks are commonly used.

Submission

- Submit your completed worksheet, including the network diagram, configuration details, and answers to the questions, to me by the end of the lab session.

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