Basic Computing and Programming

Lecture # 8:

Computer Networks

Today's Aim

- Wireless Communication
- Pros and cons of Wireless Communication
- Different LAN standards/Protocols
- Network Topologies
- Network OS
- Network Security
- Network Addressing

Wireless Communications

- Use Radio signals; Wi-Fi – the WLAN standard
- Need Antenna /Transceiver
- Useful for Laptops, Remote Computers, Older Building
- Two Common modes in WCom:
  - Line-of-Sight
    - Microwave
    - Optical
  - Non Line-of-Sight
    - Satellite
    - Radio
    - Cellular

Pros and Cons of Wireless LANs

- **Key Benefits:**
  - Set-up time
  - Set-up Cost
  - Maintenance Cost
- **Key Challenges:**
  - Security and Privacy
  - Quality of Service
    - Lower Susceptibility to Interference
    - Lower Speed

Protocols

- Rules that govern communication over the network
- Protocols define:
    - Access Method
    - Allowed Physical Topologies
    - Types of Cabling
    - Data Transfer Speed
- Most widely used LAN standards are:
    - Ethernet
    - Token Ring

LAN Protocols (Ethernet)

- Most Widely Used
- Access Method Used: CSMA/CD (Carrier-Sense Multiple Access/Collision Detection protocol)
- Topologies Allowed:
  - Linear Bus
  - Star
  - Tree
- Communication Media:
  - Wireless Access Points
  - Twisted Pair
  - Coaxial
  - Fibre Optic Cable
- Speed:
  - 10 Mbps-1000 Mbps

LAN Protocols (Token Ring)

- Developed by IBM in 1980s
- Access Method used: Token Passing
- Topologies Allowed: Star-Wired Ring
- Cabling Use:
  - Twisted Pair
  - Fibre Optic
- Speed:
  - 4 Mbps to 16 Mbps

LAN Protocols Summary

Protocol	Cable	Speed	Topology
Ethernet	Twisted Pair, Coaxial, Fiber	10 Mbps	Linear Bus, Star, Tree
Fast Ethernet	Twisted Pair, Fiber	100 Mbps	Star
LocalTalk	Twisted Pair	.23 Mbps	Linear Bus or Star
Token Ring	Twisted Pair	4 Mbps - 16 Mbps	Star-Wired Ring
FDDI	Fiber	100 Mbps	Dual ring
ATM	Twisted Pair, Fiber	155-2488 Mbps	Linear Bus, Star, Tree

Communication Technique

- Circuit Switched _ Telephone Lines
- Packet Switched _ Postal Correspondence
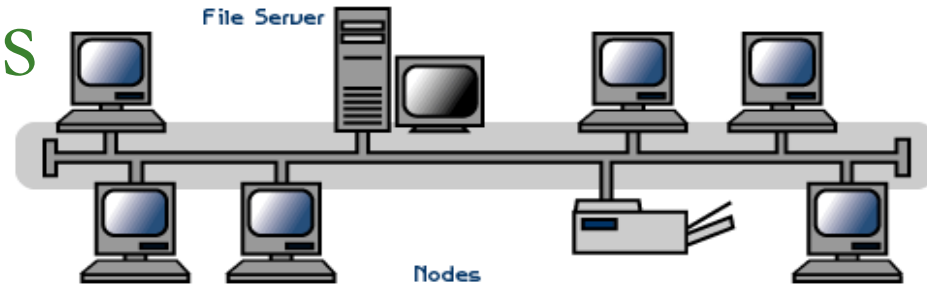- Computer Networks use Packet Switched

Packets

- A Section of Message
- Information Contained:
  - Sender's Address
  - Destination Address
  - Data
  - Error-recovery Info
- Travel Independently
- Reassembled to form Original Message at Destination

Network Topologies

- Linear Bus

- Star

- Star-Wired Ring

- Tree

Network Topologies

- **Linear Bus Topology**
  - **Uses Broadcast Technology**
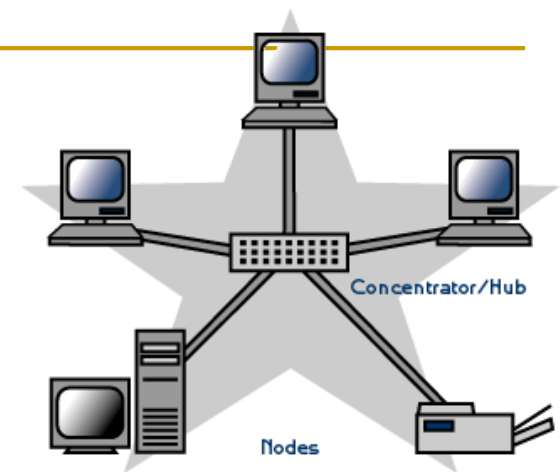 - **Advantages of a Linear Bus Topology**
    - Easy to connect new devices
    - Requires less cable length
    - Allows Direct Communication B/w Computers
  - **Disadvantages of a Linear Bus Topology**
    - One Computer Transmits data at one time
    - Effect of main cable's Failure.
    - Not meant to be used as a stand-alone solution in a large building.

Network Topologies

- Star Topology
  - All Nodes Connect to a central component (hub or switch)
  - **Advantages of a Star Topology**
    - Easy to install and wire.
    - Easy Installation of Devices
    - Easy to detect faults and to remove parts.
    - Multiple Data Transfer simultaneously
    - Effect of Node's Failure
  - **Disadvantages of a Star Topology**
    - Requires more cable length
    - Effect of Concentrator's Failure
    - More expensive

Network Topologies

- **Star-Wired Ring Topology**
  - Externally similar to Star
  - Internal Wiring forms a Circle
  - Used normally with Token Ring Protocol
  - Data Flow in one Direction
  - Multiple Data Transfer Simulatneously
  - Slow Data Flow
  - Difficult to add new Nodes
  - Effect of a Node's Failure

# Network Topologies

- ## Tree Topology
  - Combine Bus and Star
  - **Advantages of a Tree Topology**
    - Point-to-point wiring for individual segments.
    - Supported by several HW/SW vendors.
    - Easy to Expand
 - **Disadvantages of a Tree Topology**
    - Overall length of each segment is limited by the type of cabling used.
    - If the backbone line breaks, the entire segment goes down.
    - More difficult to configure and wire than other topologies.
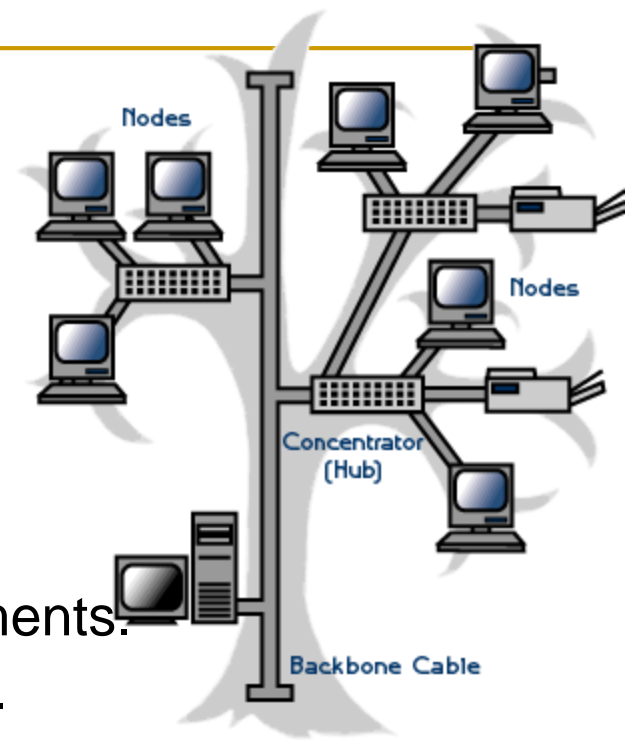
Network OS

- Used to Manage the working of Computers on the N/W
- Types:
    - Peer-to-Peer
    - Client/Server

Network OS

Resources are shared among equals in a peer-to-peer network.
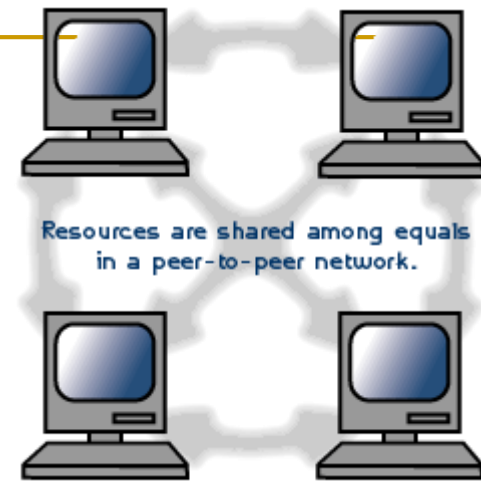
- Peer-to-Peer
  - All Computers Considered Equal
  - **Advantages of a peer-to-peer network:**
    - Less initial expense - No need for a dedicated server.
    - Setup - An operating system (such as Windows XP) already in place may only need to be reconfigured for peer-to-peer operations.
  - **Disadvantages of a peer-to-peer network:**
    - Decentralized - No central repository for files and applications.
    - Security - Does not provide the security available on a client/server network.

Network OS

File Server

Resources are controlled by the file server in a client/server network.

Clients   Clients

- **Client/Server**
  - Works with Centralized File Server
  - Multiple Workstations (Clients) use Resources on the Server Simultaneously
  - **Advantages of a client/server network:**
    - Centralized
    - Scalability
    - Flexibility
    - Accessibility
  - **Disadvantages of a client/server network:**
    - Expense
    - Maintenance
    - Dependence
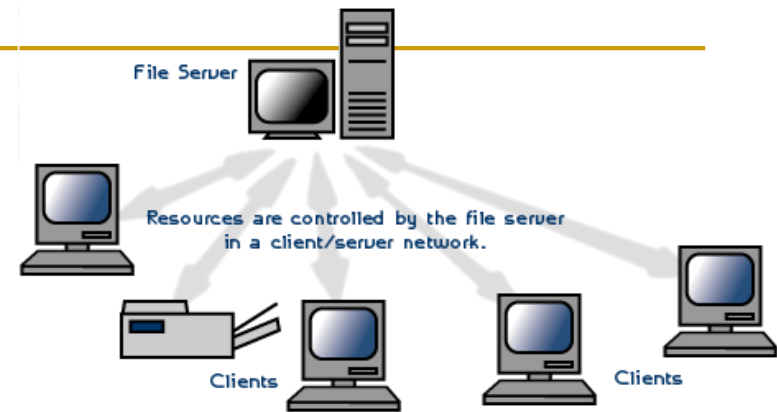
Network Security

- Private, Sensitive data Protection
- Easier Management for LANs
- Difficult for LAN-Internet Connection
- Solution – A Gateway called "Firewall"

Network Security

- **Firewall**
  - Works on Access/Deny Policy
  - Configurable according to Needs
  - Example:
    - System Firewall can be configured to Allow only certain Emails from Internet

Addressing

- Every device needs to be identified on the network

- Two types of addresses are used
  - Physical Addresses
    - 48-bit, burnt onto the NIC
    - Example; 00-15-C5-CE-2C-9C

Addressing

- IP addresses
  - Can be configured in software, usually the OS
  - 4-byte address, written in 'Dotted Decimal Notation'
  - Examples;
    - 192.168.0.1
- Two types of IP addresses
  - Global IP addresses
    - Needs to be unique world-wide
  - Local IP addresses
    - Needs to be unique only inside the network (LAN), can be reused outside, e.g., in another LAN

Port Addressing

- Use to identify an application on a particular machine.