DATA COMMUNICATION AND NETWORKS

TEC – 802

ECE 8TH SEM

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SYLLABUS

- Introduction
- The Physical Layer
- The Data Link Layer
- The Network Layer
- The Transport Layer
- Internet Issues

UNIT-1

- INTRODUCTION: Network structure, network architectures. The OSI reference model, services, standardization, Other architectures, Connection oriented and connection less services, example networks.
- The Physical Layer: Transmission media, EIA RS-232C, EIA RS-449. Pulse code modulation. FDM & TDM.
- Circuit switching. Packet switching. Hybrid switching. Polling. CCITT X.21. Ethernet.

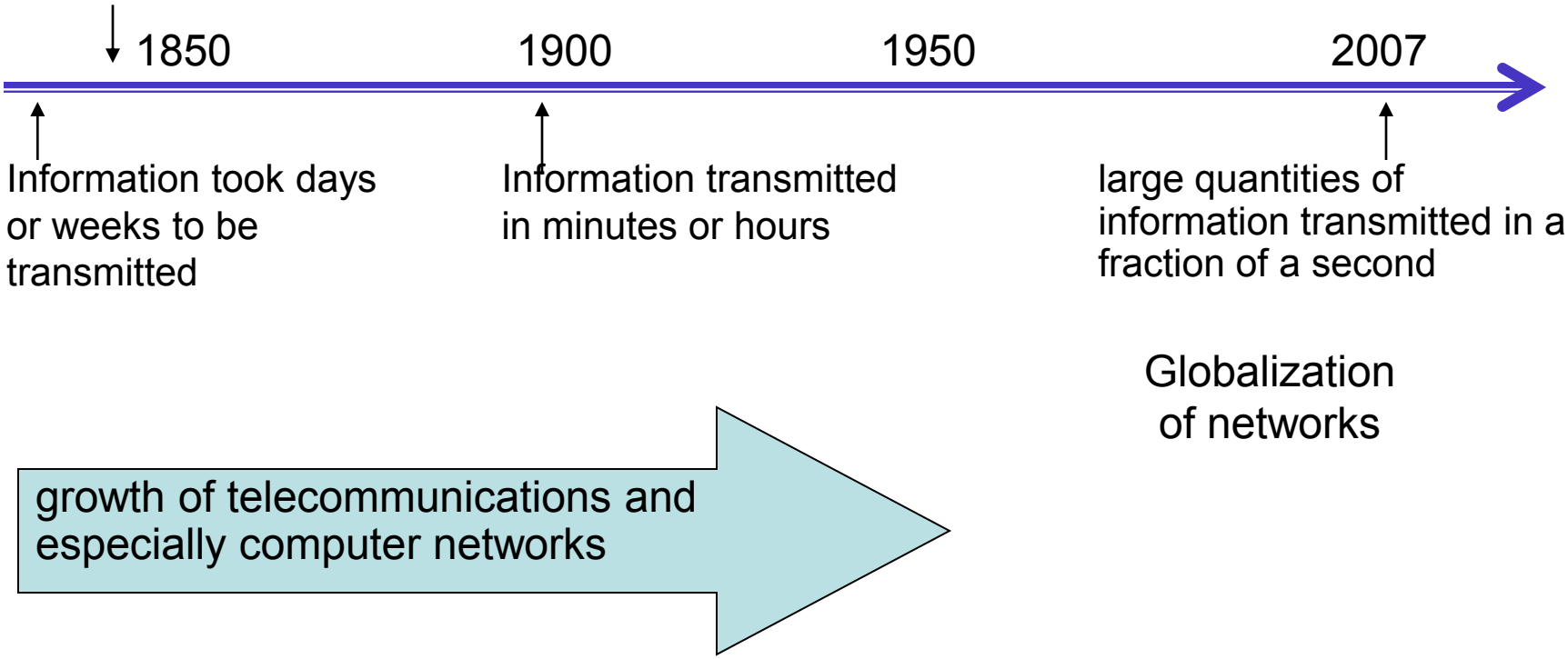
INTRODUCTION TO DATA COMMUNICATION AND NETWORKS

Information Age

- First Industrial Revolution
  - Introduction of machinery
  - New organizational methods
  - Changed the way people worked

- Second Industrial Revolution – Information Age
  - Introduction of computers
  - Introduction of networking and data communication
  - Changed the way people worked again
    - Faster communication → Collapsing Information lag
    - Brought people together → Globalization

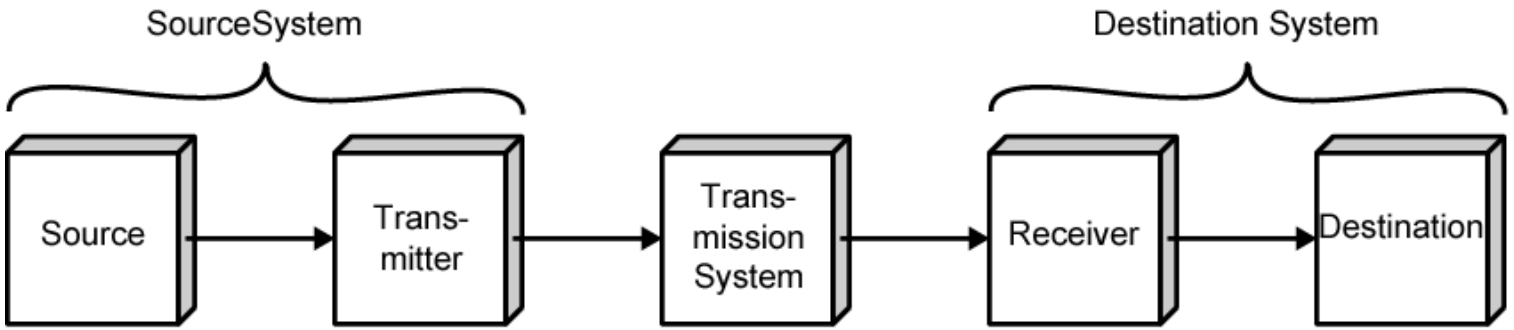
The Collapsing Information Lag



A Communications Model

- Source
  - generates data to be transmitted
- Transmitter
  - Converts data into transmittable signals
- Transmission System
  - Carries data
- Receiver
  - Converts received signal into data
- Destination
  - Takes incoming data

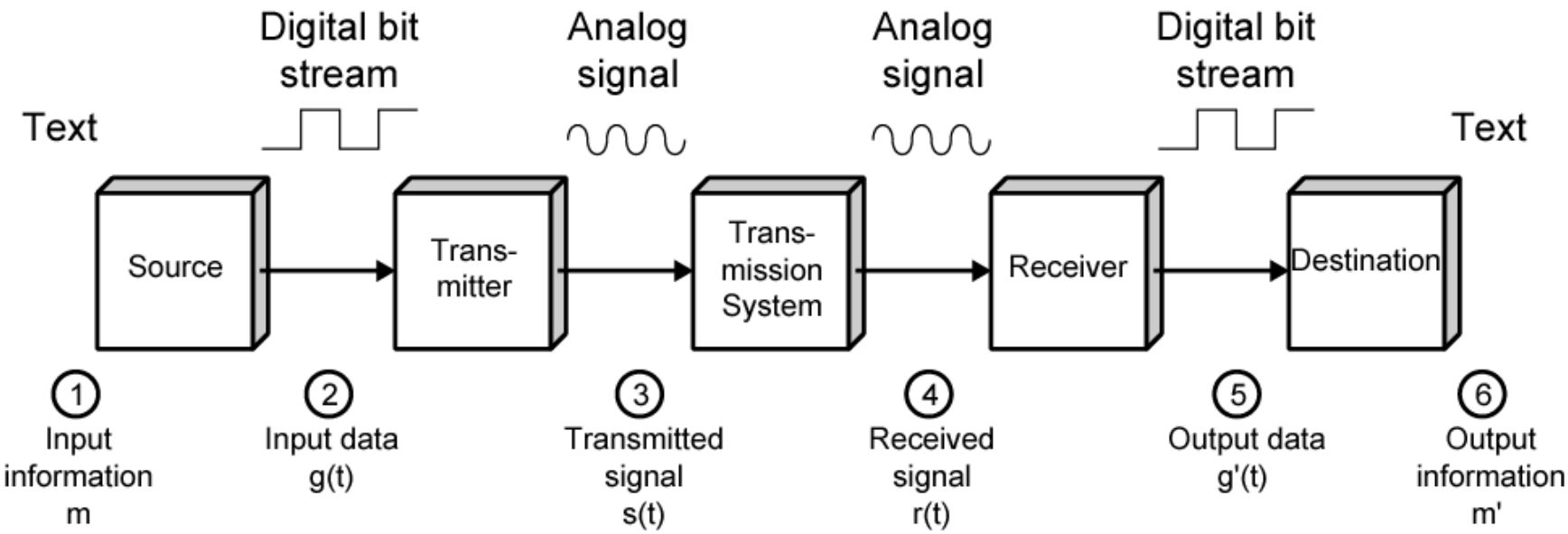
Simplified Communications Model - Diagram



(a) General block diagram

(b) Example

Simplified Data Communications Model



Datacom Basics

Telecommunications =

Transmission of voice, video, and/or data

- Implies longer distances
- Broad term

Data Communications =

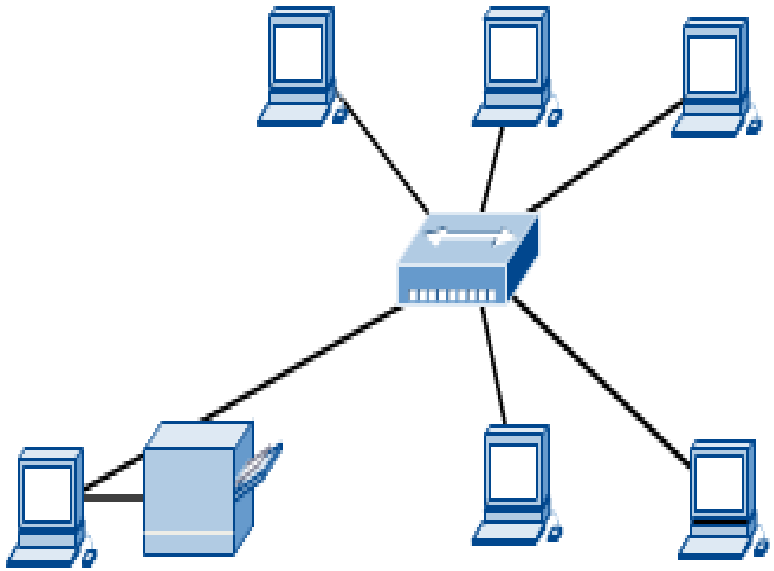
Movement of computer information by means of electrical or optical transmission systems

convergence

Broadband Communications

Computer Networks

- Computer network connects two or more autonomous computers.
- The computers can be geographically located anywhere.
- Why networking: sharing information i.e. data communication.



How many kinds of Networks?

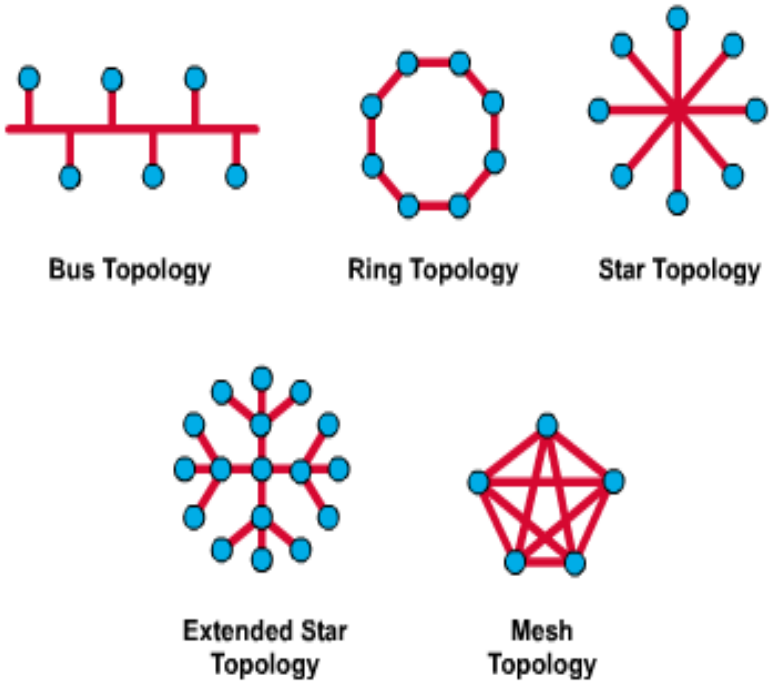
- Depending on one's perspective, we can classify networks in different ways
  - **Based on transmission media: Wired (UTP, coaxial cables, fiber-optic cables) and Wireless**
  - **Based on network size: LAN and WAN (and MAN)**
  - **Based on management method: Peer-to-peer and Client/Server**
  - **Based on topology (connectivity): Bus, Star, Ring …**

Applications of Networks

- **Resource Sharing**
  - Hardware (computing resources, disks, printers)
  - Software (application software)
- **Information Sharing**
  - Easy accessibility from anywhere (files, databases)
  - Search Capability (WWW)
- **Communication**
  - Email
  - Message broadcast
- **Remote computing**
- **Distributed processing (GRID Computing)**

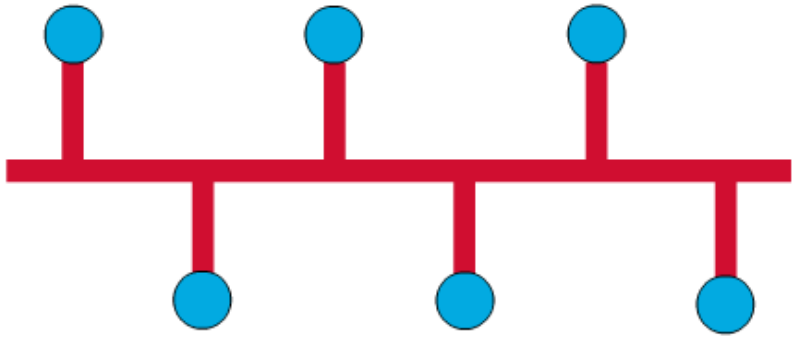
Network Topology

- The network topology defines the way in which computers, printers, and other devices are connected. A network topology describes the layout of the wire and devices as well as the paths used by data transmissions.



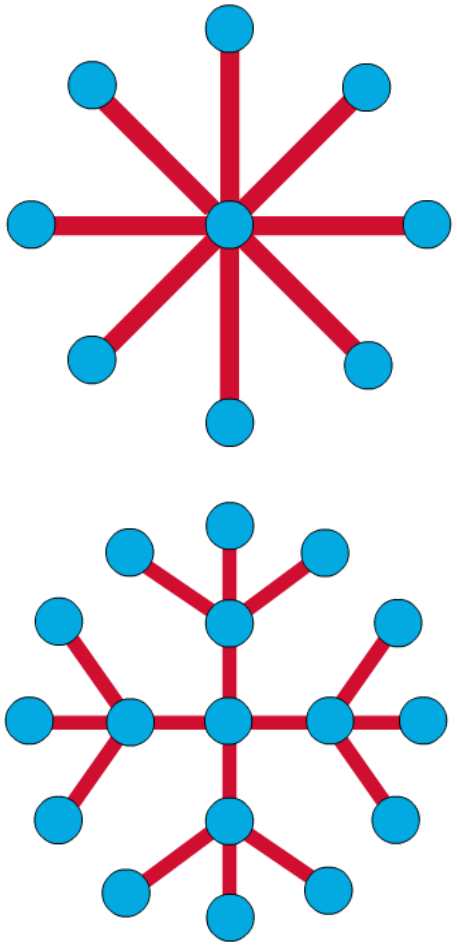
Bus Topology

- Commonly referred to as a linear bus, all the devices on a bus topology are connected by one single cable.



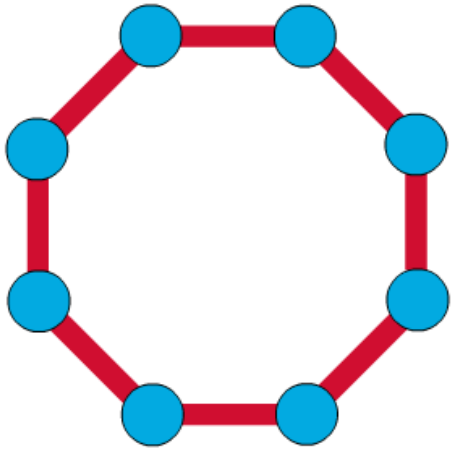
Star & Tree Topology

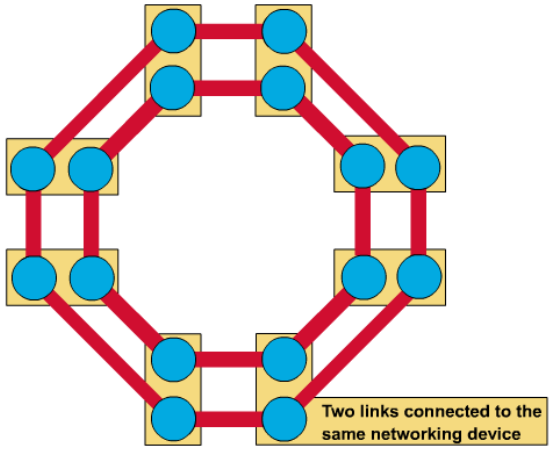
- The star topology is the most commonly used architecture in Ethernet LANs.
- When installed, the star topology resembles spokes in a bicycle wheel.
- Larger networks use the extended star topology also called tree topology. When used with network devices that filter frames or packets, like bridges, switches, and routers, this topology significantly reduces the traffic on the wires by sending packets only to the wires of the destination host.



Ring Topology

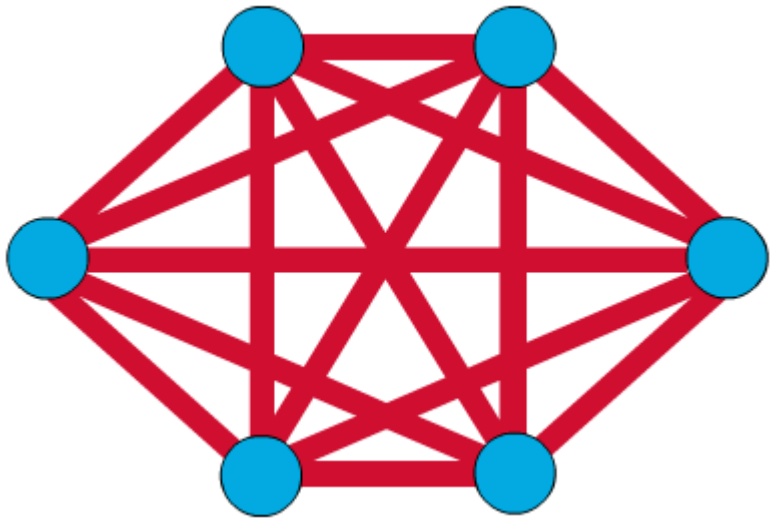
- **A frame travels around the ring, stopping at each node. If a node wants to transmit data, it adds the data as well as the destination address to the frame.**
- **The frame then continues around the ring until it finds the destination node, which takes the data out of the frame.**
  - Single ring – All the devices on the network share a single cable
  - Dual ring – The dual ring topology allows data to be sent in both directions.





Mesh Topology

- The mesh topology connects all devices (nodes) to each other for redundancy and fault tolerance.
- It is used in WANs to interconnect LANs and for mission critical networks like those used by banks and financial institutions.
- Implementing the mesh topology is expensive and difficult.

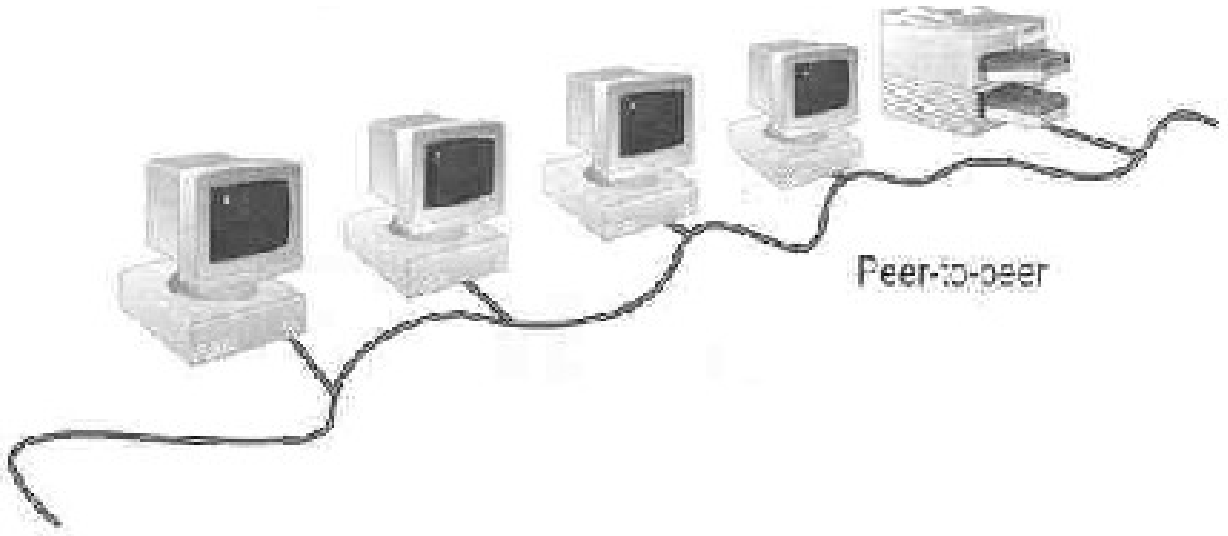


LAN, MAN & WAN

- Network in small geographical Area (Room, Building or a Campus) is called LAN (Local Area Network)
- Network in a City is call MAN (Metropolitan Area Network)
- Network spread geographically (Country or across Globe) is called WAN (Wide Area Network)

Peer-to-Peer Networks

- Peer-to-peer network is also called workgroup
- No hierarchy among computers ⇒ all are equal
- No administrator responsible for the network



Peer-to-Peer Networks

- **Advantages of peer-to-peer networks:**
  - **Low cost**
  - **Simple to configure**
  - **User has full accessibility of the computer**
- **Disadvantages of peer-to-peer networks:**
  - **May have duplication in resources**
  - **Difficult to uphold security policy**
  - **Difficult to handle uneven loading**
- **Where peer-to-peer network is appropriate:**
  - **10 or less users**
  - **No specialized services required**
  - **Security is not an issue**
  - **Only limited growth in the foreseeable future**

Clients and Servers

- Network Clients (Workstation)
  - Computers that request network resources or services
- Network Servers
  - Computers that manage and provide network resources and services to clients
    - Usually have more processing power, memory and hard disk space than clients
    - Run Network Operating System that can manage not only data, but also users, groups, security, and applications on the network
    - Servers often have a more stringent requirement on its performance and reliability

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Clients and Servers

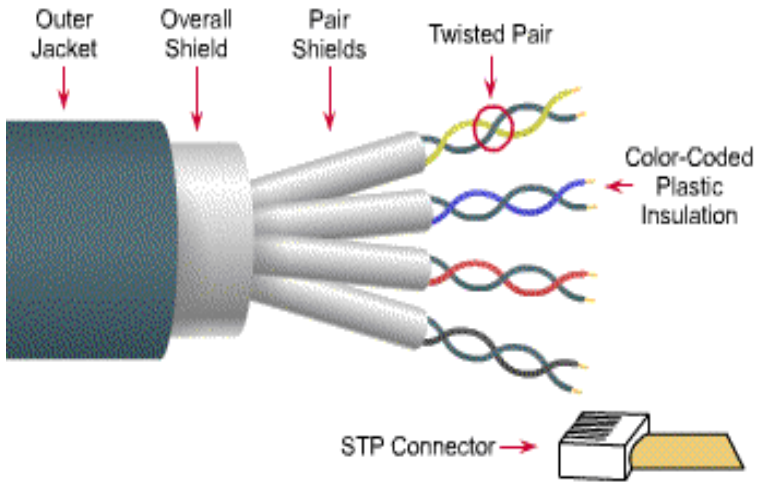
- Advantages of client/server networks
  - Facilitate resource sharing – centrally administrate and control
  - Facilitate system backup and improve fault tolerance
  - Enhance security – only administrator can have access to Server
  - Support more users – difficult to achieve with peer-to-peer networks
- Disadvantages of client/server networks
  - High cost for Servers
  - Need expert to configure the network
  - Introduce a single point of failure to the system

Network Components

- Physical Media
- Interconnecting Devices
- Computers
- Networking Software
- Applications

Networking Media

- **Networking media can be defined simply as the means by which signals (data) are sent from one computer to another (either by cable or wireless means).**



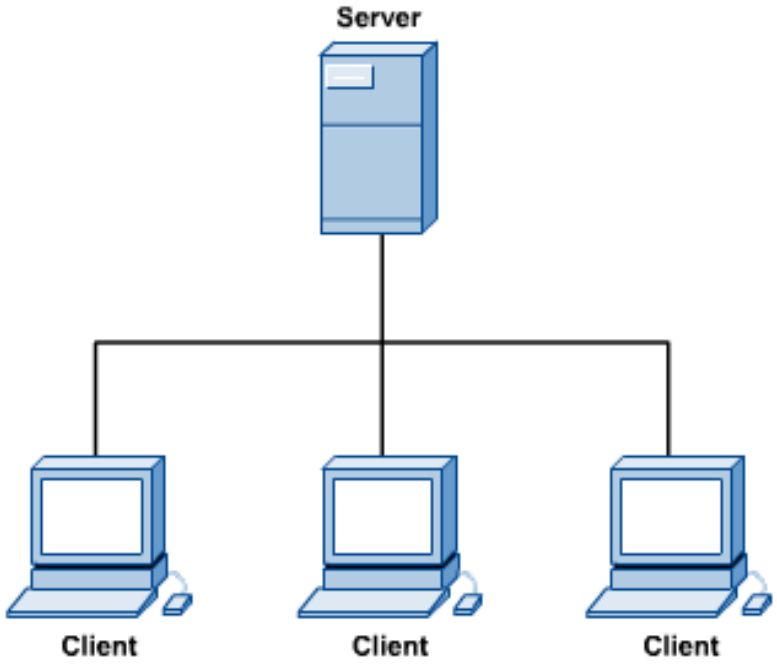
Networking Devices

- HUB, Switches, Routers, Wireless Access Points, Modems etc.

Computers: Clients and Servers

- In a client/server network arrangement, network services are located in a dedicated computer whose only function is to respond to the requests of clients.

- The server contains the file, print, application, security, and other services in a central computer that is continuously available to respond to client requests.



Applications

- E-mail
- Searchable Data (Web Sites)
- E-Commerce
- News Groups
- Internet Telephony (VoIP)
- Video Conferencing
- Chat Groups
- Instant Messengers
- Internet Radio

Standards

- Importance
  - Provide a “fixed” way for hardware and/or software systems (different companies) to communicate
  - Help promote competition and decrease the price
- Types of Standards
  - Formal standards
    - Developed by an industry or government standards-making body
  - De-facto standards
    - Emerge in the marketplace and widely used
    - Lack official backing by a standards-making body

Standardization Processes

- Specification
  - Developing the nomenclature and identifying the problems to be addressed
- Identification of choices
  - Identifying solutions to the problems and choose the “optimum” solution
- Acceptance
  - Defining the solution, getting it recognized by industry so that a uniform solution is accepted

Major Standards Bodies

- ISO (International Organization for Standardization)
  - Technical recommendations for data communication interfaces
  - Composed of each country's national standards orgs.
  - Based in Geneva, Switzerland (www.iso.ch)
- ITU-T (International Telecommunications Union – Telecom Group
  - Technical recommendations about telephone, telegraph and data communications interfaces
  - Composed of representatives from each country in UN
  - Based in Geneva, Switzerland (www.itu.int)

Major Standards Bodies (Cont.)

- ANSI (American National Standards Institute)
  - Coordinating organization for US (not a standards- making body)
  - www.ansi.org
- IEEE (Institute of Electrical and Electronic Engineers)
  - Professional society; also develops mostly LAN standards
  - standards.ieee.org
- IETF (Internet Engineering Task Force)
  - Develops Internet standards
  - No official membership (anyone welcome)
  - www.ietf.org

Some Data Comm. Standards

Layer	Common Standards
5. Application layer	HTTP, HTML (Web) MPEG, H.323 (audio/video) IMAP, POP (e-mail)
4. Transport layer	TCP (Internet) SPX (Novell LANs)
3. Network layer	IP (Internet) IPX (Novell LANs)
2. Data link layer	Ethernet (LAN) Frame Relay (WAN) PPP (dial-up via modem for MAN)
1. Physical layer	RS-232c cable (LAN) Category 5 twisted pair (LAN) V.92 (56 kbps modem)