CN1047 INTRODUCTION TO COMPUTER NETWORKING

CHAPTER 1
BASIC CONCEPTS OF NETWORK

DEFINTION & APPLICATIONS

- **DEFINTION:**

  A computer network is defined as the interconnection of two or more computers. It is done to enable the computers to communicate and share available resources.

- **APPLICATIONS:**

  i. **Sharing of resources such as printers**

  ii. **Sharing of expensive software's and database**

  iii. **Communication from one computer to another computer**

  iv. **Exchange of data and information among users via network**

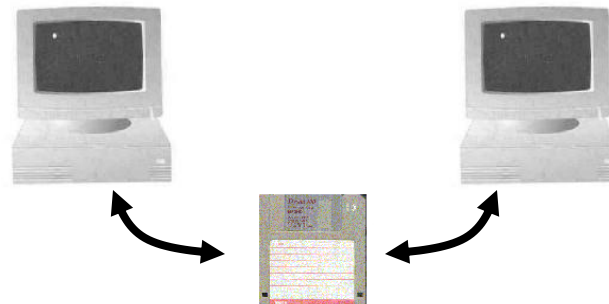 v. **Sharing of information over geographically wide areas.**

THE USE OF COMPUTER NETWORK

- **Business Applications**
  - **online buying**
- **Home Applications**
  - **mail, chat**
- **Mobile Users**
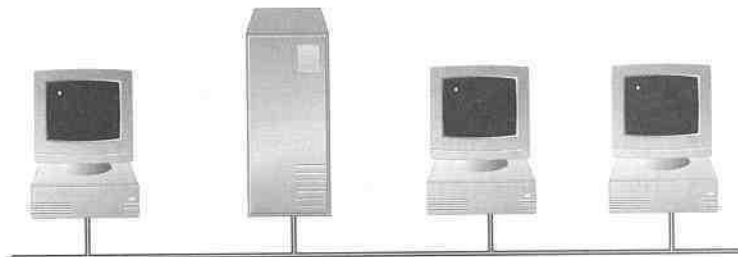 - **wireless: laptops, PDA, mobile, in plane**
- **Social Issues**

THE USE OF COMPUTER NETWORK

●**Sharing information — i.e. data communication**
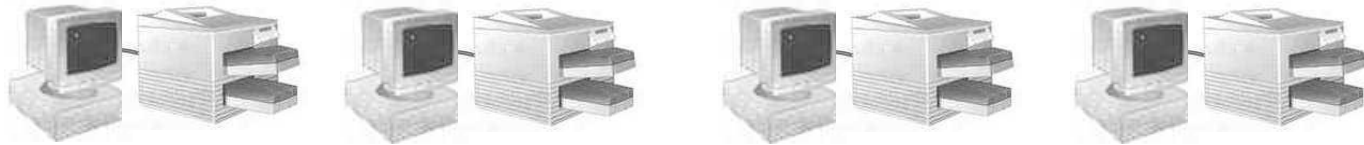
- **Do you prefer these?**

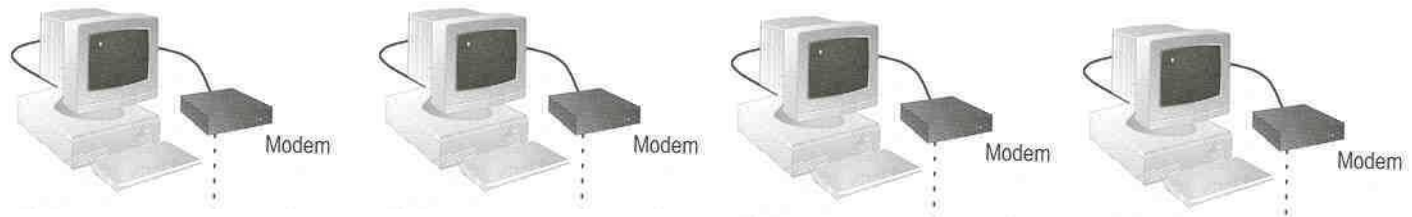- **Or this?**

THE USE OF COMPUTER NETWORK

● **Sharing hardware or software**

- **E.g. print document**

● **Centralize administration and support**

- **E.g. Internet-based, so everyone can access the same administrative or support application from their PCs**

COMPONENTS OF COMPUTER NETWORK

- Two or more computers
- Cables as links between the computers
- A network interfacing card(NIC) on each computer
- Switches
- Software called operating system(OS)

NETWORK BENEFITS

- The network provided to the users can be divided into two categories:
  - i.   Sharing
  - ii.   Connectivity

SHARING RESOURCES

- **Types of resources are:**
    1. Hardware: A network allows users to share many hardware devices such as printers , modems, fax machines, CD ROM, players, etc.
    2. Software: sharing software resources reduces the cost of software installation, saves space on hard disk.
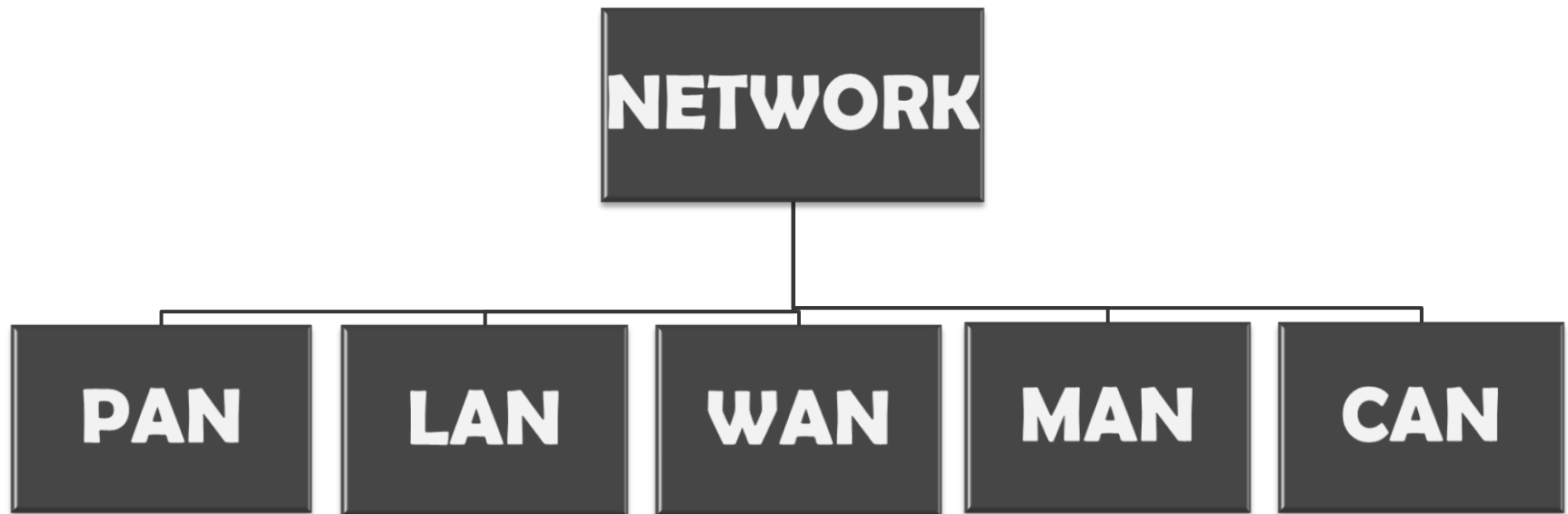
OTHER BENEFITS OF COMPUTER NETWORK

- Increased speed
- Reduced cost
- Improved security
- Centralized software managements
- Electronic mail
- Flexible access

DISDAVATAGES OF NETWORKS

o **High cost of installation**

o **Requires time for administration**

o **Failure of server**

o **Cable faults**

CLASSIFICATION OF AREA BY THEIR GEOGRAPHY

LOCAL AREA NETWORK(LAN)

- LAN is a network which is designed to operate over a small physical area such as an office, factory or a group of buildings.
- LAN's are easy to design and troubleshoot
- Exchange of information and sharing of resources becomes easy because of LAN.
- In LAN all machines are connected to a single cable.
- Different types of topologies such as star, tree, bus, ring, etc Can be used
- It is usually a privately owned network.

WIDE AREA NETWORK(WAN)

- When network spans over a large distance or when the computers to be connected to each other are at widely separated locations a local area network cannot be used. A wide area network(WAN) is installed.

- The communication between different users of WAN is established using leased telephone lines, satellite links and similar channels.

- It is cheaper and more efficient to use the phone network for the link.

- Most WAN networks are used to transfer large blocks of data between its users.
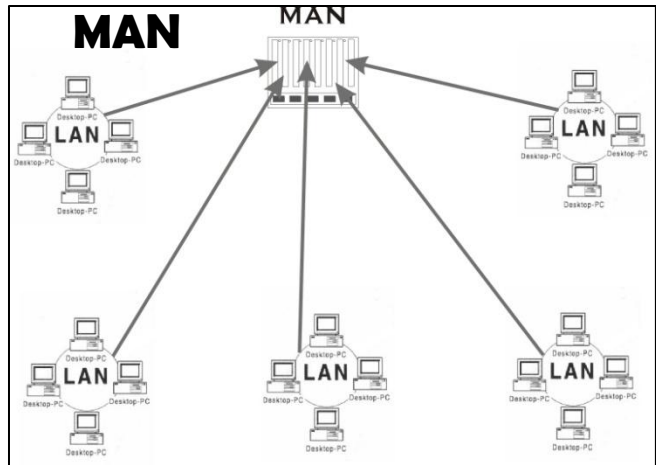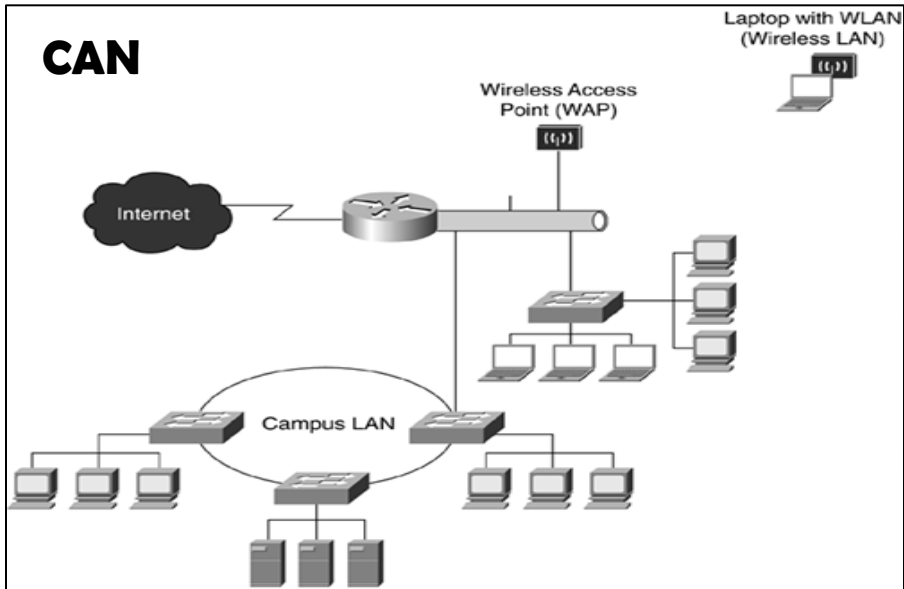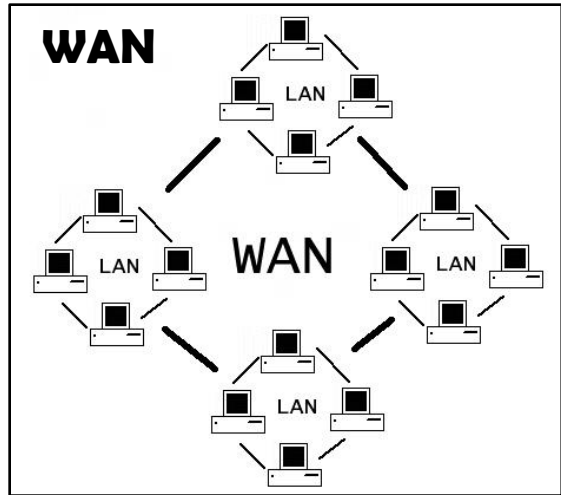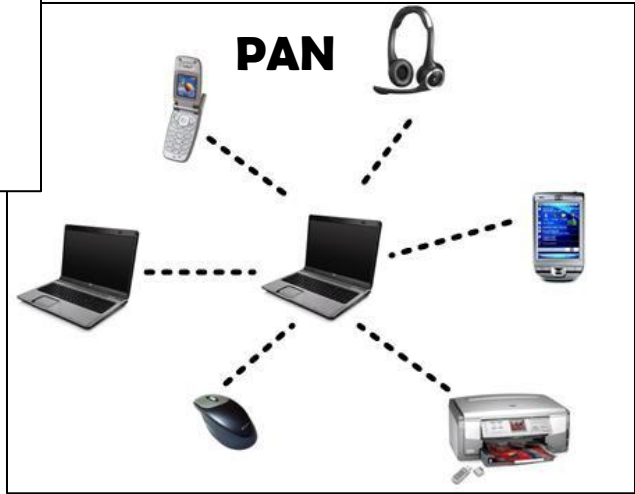
PERSONAL AREA NETWORK(PAN)

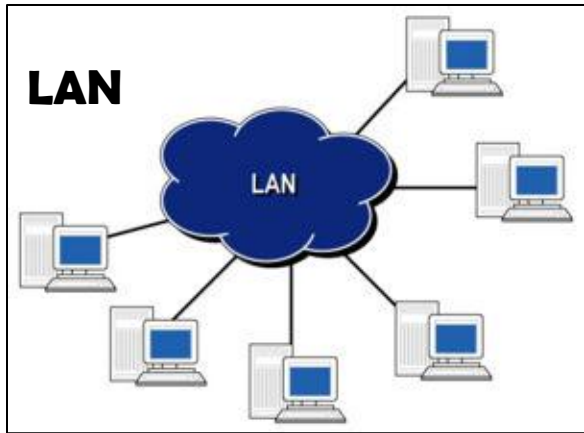- A personal area network is a computer network organized around an individual person.

- It generally consists of a mobile computer, a cell phone or personal digital assistant. PAN enables the communication among these devices.

- It can also be used for communication among personal devices themselves for connecting to a digital level network and internet.

- The PANs can be constructed using wireless or cables.

CAMPUS AREA NETWORK(CAN)

- The campus area network is made up of an interconnection of LAN with limited geographical area.

- Network equipments such as switches, routers and the transmission media i.e. optical fibre etc are almost entirely owned by the campus owner.

METROPOLITAN AREA NETWORK(MAN)

- It is in between LAN & WAN technology that covers the entire city.

- It uses similar technology as LAN.

- It can be a single network such as cable TV network, or a measure of connecting a number of LAN's o a large network so that resources can be shared LAN to LAN as well as device to device.

LAN

PAN

WAN

CAN

Laptop with WLAN (Wireless LAN)

Wireless Access Point (WAP)

Internet

Campus LAN

MAN

DISTINGUISH BETWEEN LAN,WAN,MAN

PARAMETERS	LAN	WAN	MAN
Ownership of network	Private	Private or public	Private or public
Geographical area covered	Small	Very large	Moderate
Design and maintenance	Easy	Not easy	Not easy
Communication medium	Coaxial cable	PSTN or satellite links	Coaxial cables, PSTN, optical fibre, cables, wireless
Bandwidth	Low	High	moderate
Data rates(speed)	High	Low	moderate

NETWORK CLASSIFICATION BY THEIR COMPONENT ROLE

LOCAL AREA NETWORK

PEER TO PEER NETWORK

CLIENT SERVER NETWORK
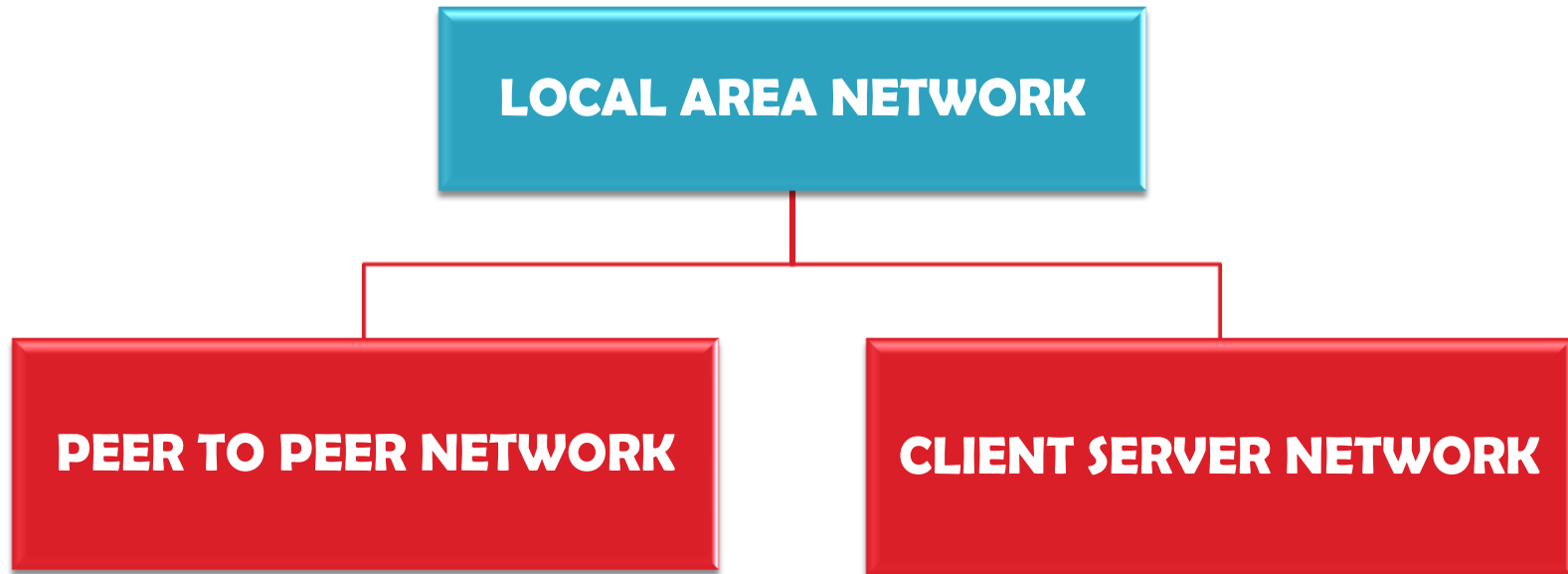
PEER TO PEER NETWORK

- In peer to peer network each computer is responsible for making its own resources available to other computers on the network.
- Each computer is responsible for setting up and maintaining its own security for these resources.
- Also each computer is responsible for accessing the required network resources from peer to peer relationships.
- Peer to peer network is useful for a small network containing less than 10 computers on a single LAN .
- In peer to peer network each computer can function as both client and server.
- Peer to peer networks do not have a central control system. There are no servers in peer networks.
- Peer networks are amplified into home group.

# ADVANTAGES & DISADVANTAGES OF PEER TO PEER NETWORK

Advantages:

- **Use less expensive computer hardware**
- **Easy to administer**
- **No NOS required**
- **More built in redundancy**
- **Easy setup & low cost**

Disadvantages:

- **Not very secure**
- **No central point of storage or file archiving**
- **Additional load on computer because of resource sharing**
- **Hard to maintain version control**
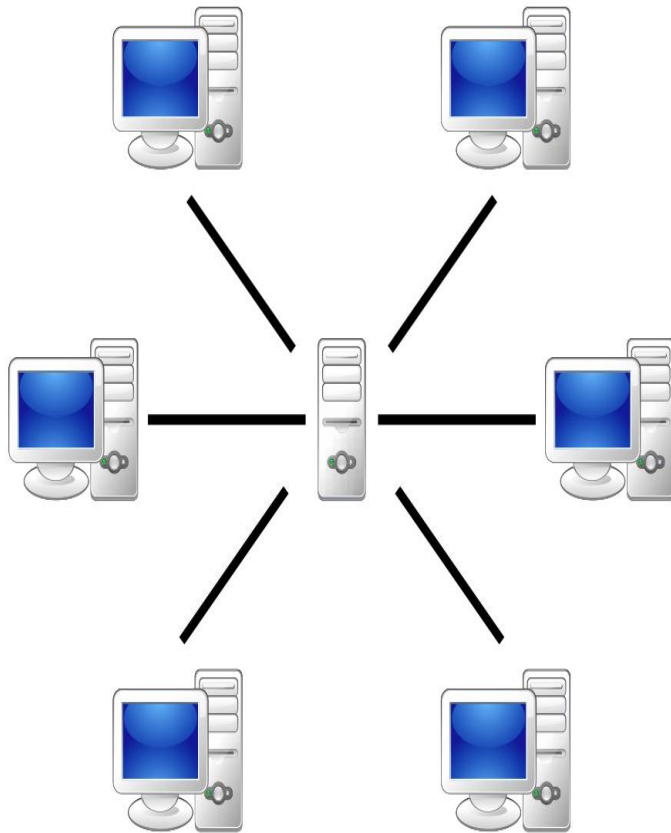
Server-based
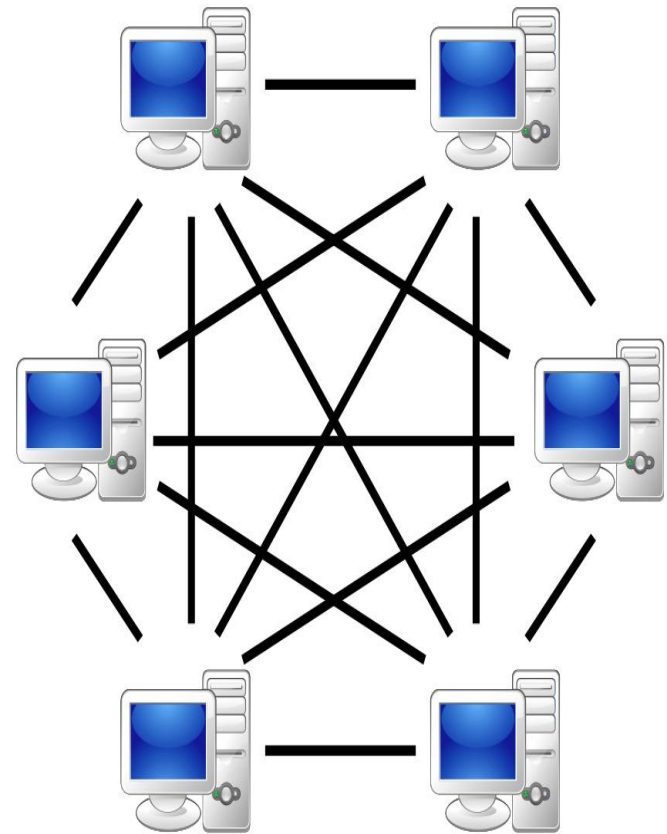
P2P-network

CLIENT/SERVER NETWORK

- In client-server network relationships, certain computers act as server and other act as clients. A <u>server</u> is simply a computer, that available the network resources and provides service to other computers when they request it. A <u>client</u> is the computer running a program that requests the service from a server.

- Local area network(LAN) is based on client server network relationship.

- A client-server network is one n which all available network resources such as files, directories, applications and shared devices, are centrally managed and hosted and then are accessed by client.

- Client serve network are defined by the presence of servers on a network that provide security and administration of the network.

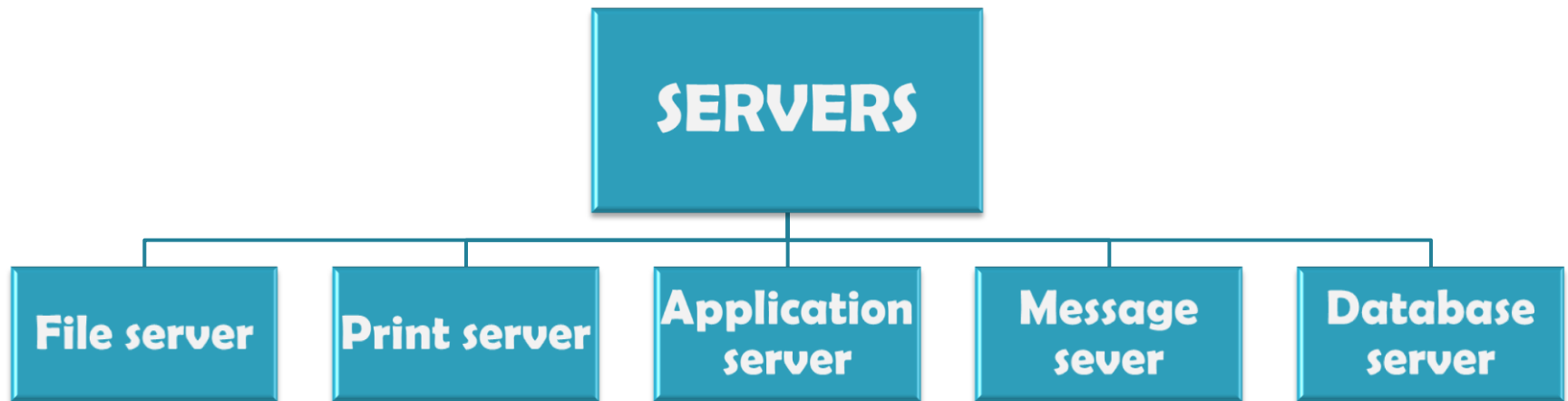# ADVANTAGES AND DISADVANTAGES OF CLIENT-SERVER NETWORK

Advantages:

- **Very secure**
- **Better performance**
- **Centralized backup**
- **very reliable**

Disadvantages:

- **requires professional administration**
- **More hardware-intensive**
- **More software intensive**
- **Expensive dedicated software**

TYPES OF SERVERS

TYPES OF SERVERS

- File server: These servers provide the services for storing, retrieving and moving the data. A user can read, write, exchange and manage the files with the help of file servers.
- Printer server: The printer server is used for controlling and managing printing on the network. It also offers the fax service to the network users.
- Application server: The expensive software and additional computing power can be shared by the computers in a network with he help of application servers.
- Message server: It is used to co-ordinate the interaction between users, documents and applications. The data can be used in the for of audio, video, binary, text or graphics.
- Database server: It is a type of application server. It allows the uses to access the centralised strong database.
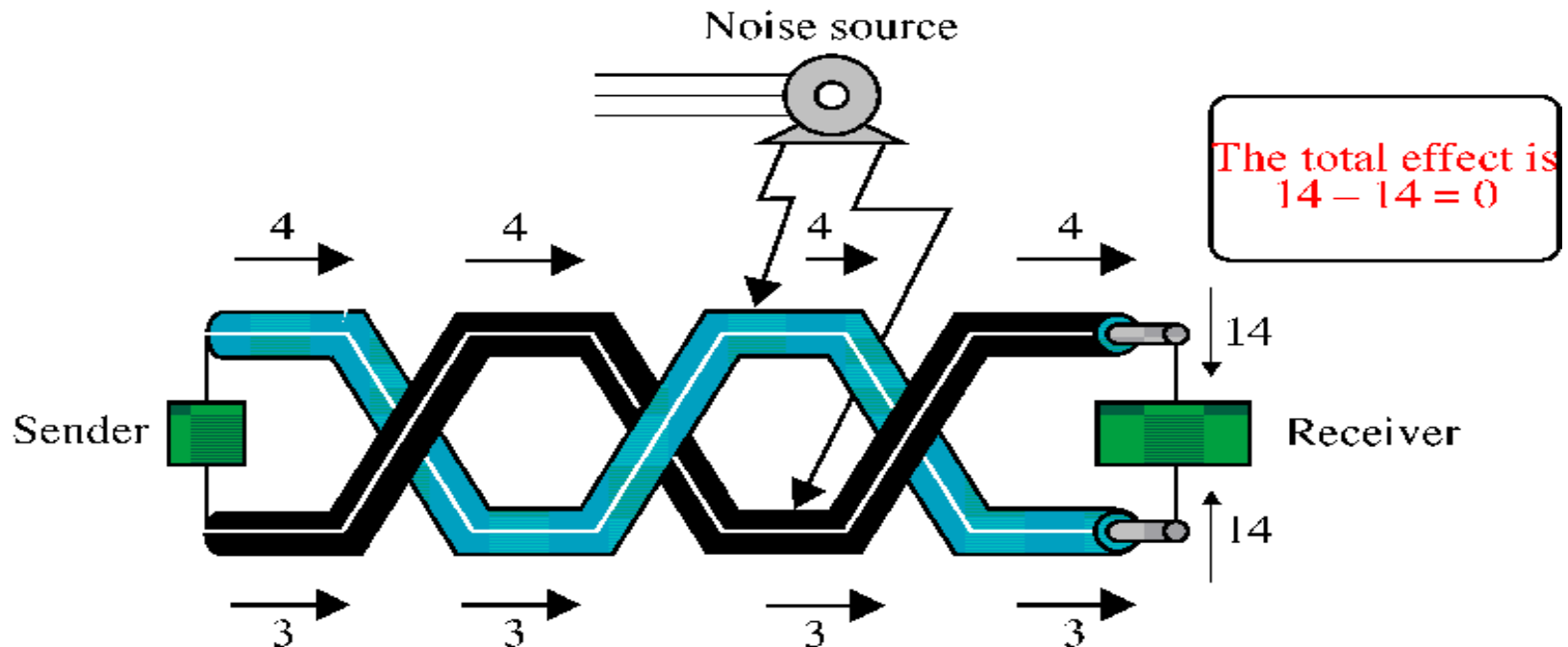
TRANMISSION MEDIA

- **Two main categories:**
  - **Guided** — wires, cables
  - **Unguided** — wireless transmission, e.g. radio, microwave, infrared, sound, sonar
- **We will concentrate on guided media here:**
  - **Twisted-Pair cables:**
    - Unshielded Twisted-Pair (UTP) cables
    - Shielded Twisted-Pair (STP) cables
  - **Coaxial cables**
  - **Fiber-optic cables**

TRANMISSION MEDIA

Twisted-Pair Cables

- **If the pair of wires are not twisted, electromagnetic noises from, e.g., motors, will affect the closer wire more than the further one, thereby causing errors**
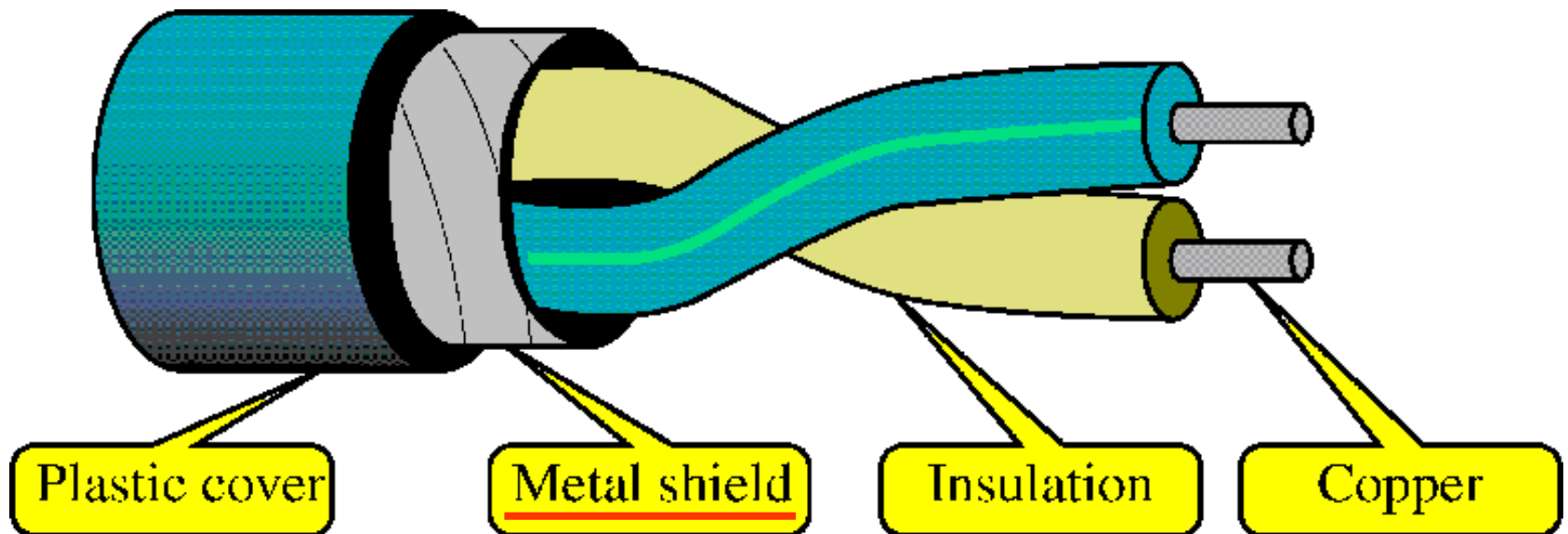
TRANMISSION MEDIA

Unshielded Twisted-Pair (UTP)

- **Typically wrapped inside a plastic cover (for mechanical protection)**
- **A sample UTP cable with 5 unshielded twisted pairs of wires**

Plastic cover

Twisted pairs (5 pairs)
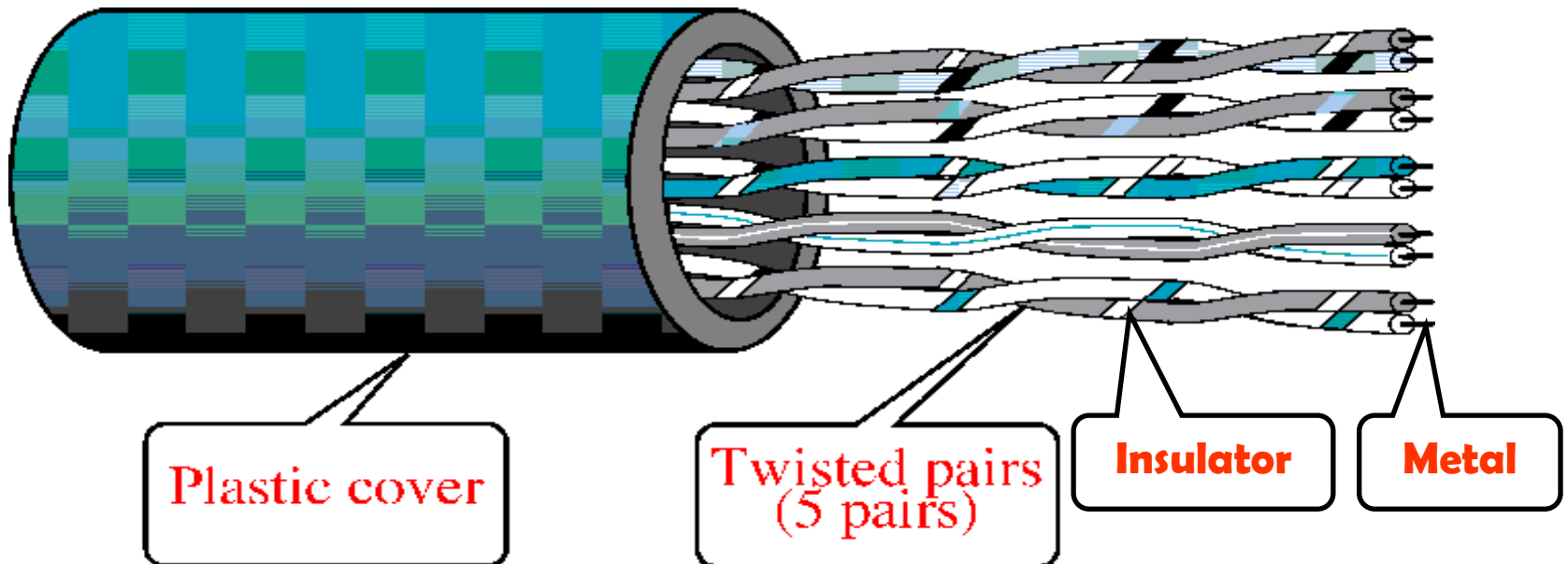
Insulator

Metal
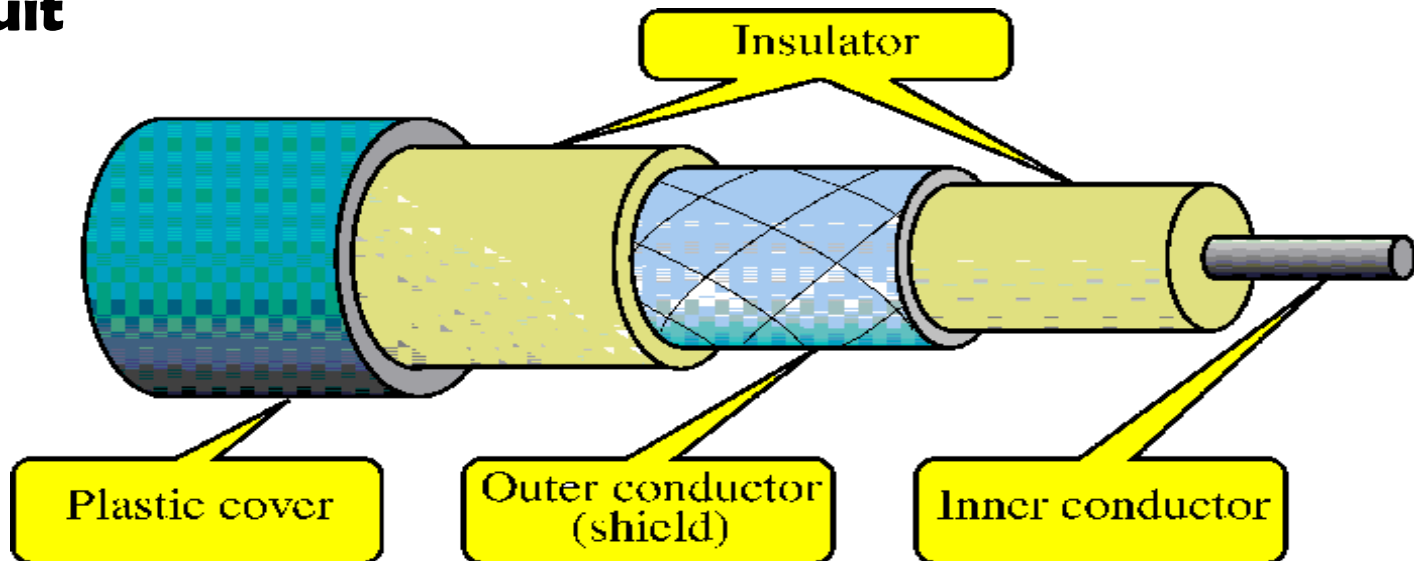
TRANMISSION MEDIA

Shielded Twisted-Pair (STP)

- **STP cables are similar to UTP cables, except there is a metal foil or braided-metal-mesh cover that encases each pair of insulated wires**

Plastic cover | Metal shield | Insulation | Copper
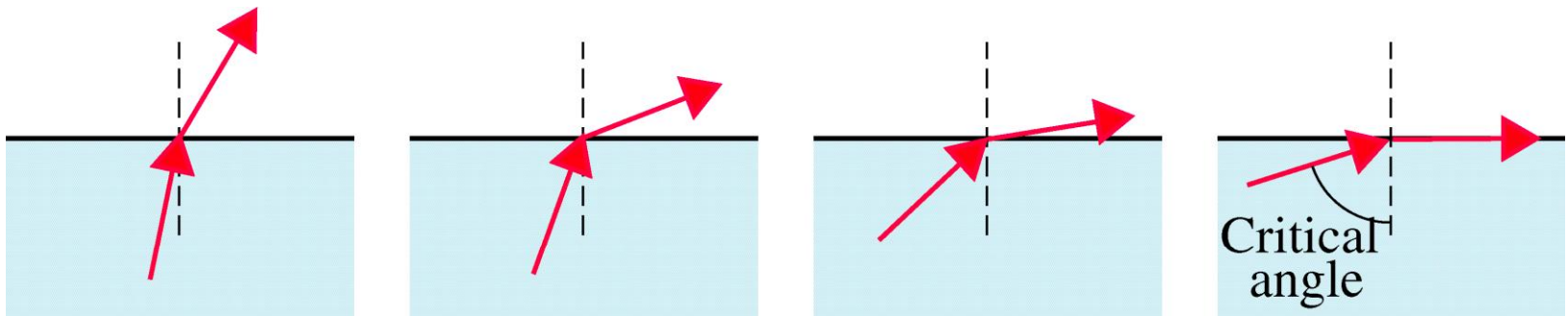
TRANMISSION MEDIA

Coaxial Cables

- In general, **coaxial cables**, or **coax**, carry signals of higher freq (100KHz–500MHz) than UTP cables

- Outer metallic wrapping serves both as a shield against noise and as the second conductor that completes the circuit

Insulator

Plastic cover

Outer conductor (shield)

Inner conductor

TRANMISSION MEDIA

Fiber-Optic Cables

- **Light travels at $\underline{3\times10^8 \text{ ms}^{-1}}$ in free space and is the fastest possible speed in the Universe**

- **Light slows down in denser media, e.g. glass**

- **<u>Refraction</u> occurs at interface, with light bending away from the normal when it enters a less dense medium**

- **Beyond the *critical angle* $\Rightarrow$ total internal reflection**

TRANMISSION MEDIA

## Fiber-Optic Cables

- An optical fiber consists of a core (denser material) and a cladding (less dense material)
- Simplest one is a multimode step-index optical fiber
- Multimode = multiple paths, whereas step-index = refractive index follows a step-function profile (i.e. an abrupt change of refractive index between the core and the cladding)
- Light bounces back and forth along the core
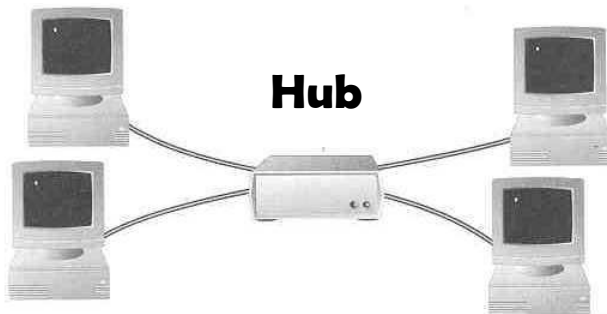- Common light sources: LEDs and lasers

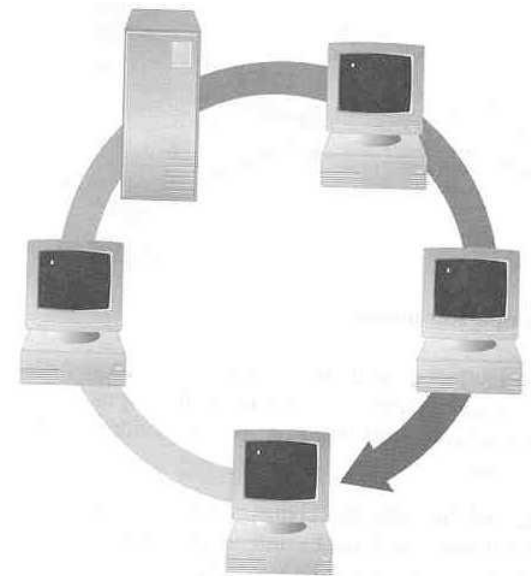# TOPOLOGY

●**How so many computers are connected together?**

Bus Topology

Ring Topology

Star Topology

Hub
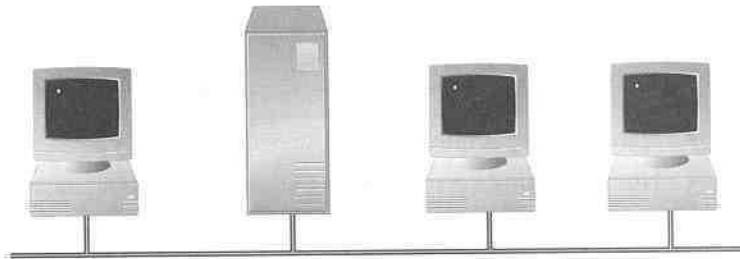
TOPOLOGY

- ## Bus Topology
    - **Simple and low-cost**
    - **A single cable called a trunk (backbone, segment)**
    - **Only one computer can send messages at a time**
    - **Passive topology - computer only listen for, not regenerate data**

- ## Star Topology
    - **Each computer has a cable connected to a single point**
    - **More cabling, hence higher cost**
    - **All signals transmission through the hub; if down, entire network down**
    - **Depending on the intelligence of hub, two or more computers may send message at the same time**

TOPOLOGY

- Ring Topology
    - Every computer serves as a repeater to boost signals
    - Typical way to send data:
        - Token passing
            - only the computer who gets the token can send data

    - Disadvantages
        - Difficult to add computers
        - More expensive
        - If one computer fails, whole network fails