Computer Network and Internet

Sisira Kumar Kapat

Department of Computer Science & Engineering,
UCP Engineering School,
Berhampur, Orissa

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Networking concept

- A computer network is a collection of two or more computers, which are connected together to share information and resources.

- Computer networks allow the user to access remote programs and remote databases either of the same organization or from other enterprises or public sources.

- Computer networks provide communication possibilities faster than other facilities.

- Types:
  - Peer to peer
  - Client/Server

Standalone vs Networked Environment

Computers

Sharing File via a Floppy

Cable

(a) Stand-alone

Sharing Data and Resources in a Network
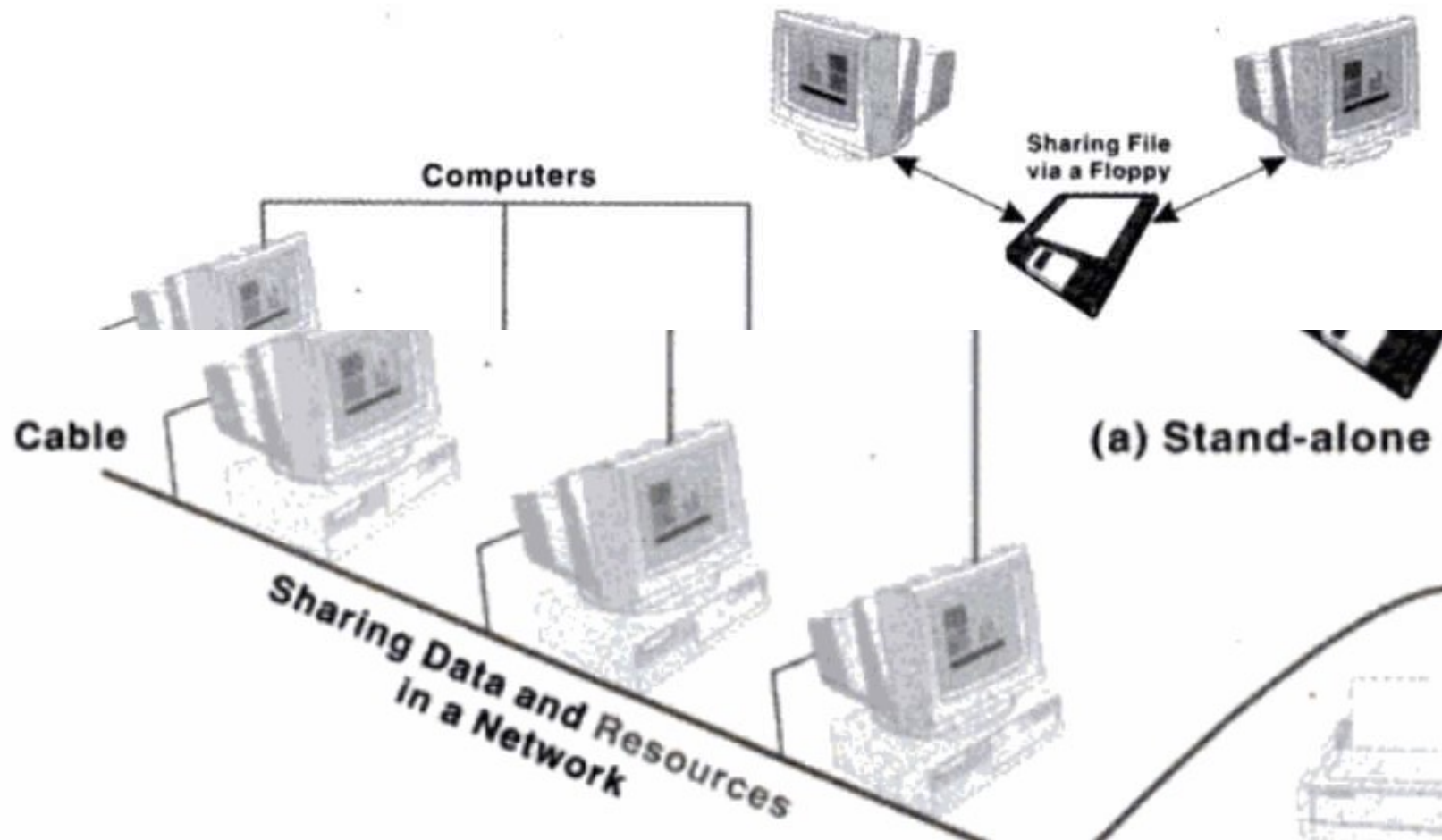
Client Server

- Each computer is either a client or a server.

- To complete a particular task, there exist a centralized host computer known as server.

- Each client is connected to the server.

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

Peer to peer Network (P2P network)

- Directly connected between peers.

- Files can be shared directly between systems on the **network** without the need of a central server

- Each system acts both as client and server.

Resources are shared among equals in a peer-to-peer network

Figure 12.30 *Peer-to-peer Networks*

Protocol

- A protocol is a set of rules that govern data communication.
- A protocol defines what is communicated, how it is communicated, and when it is communicated.
- The key elements of protocols are syntax, semantics and timing.
- Syntax: The structure or format of the data, or the order in which they presented.
- Semantics: It refers to the meaning of each section of bits.
  - How is a particular pattern to be interpreted.
  - What action is to be taken based on that interpretation.
- Timing:
  - When data should be sent.
  - How fast they can be sent.
- Examples: FTP, HTTP, UDP, TCP, IP, SMTP

Connecting Media

- Media
  - Guided: The signal is guided along a solid medium ,such as twisted pair cable, coaxial cable or optical fiber.
  - Unguided: It transports electro-magnetic waves without using a physical conductor (or through free space).
- Guided media
  - Coaxial cable
  - Twisted pair cable
  - Fibre Optic Cable
- Unguided media
 - Radio wave
  - Microwave
  - Infrared

Transmission media

Guided (wired)
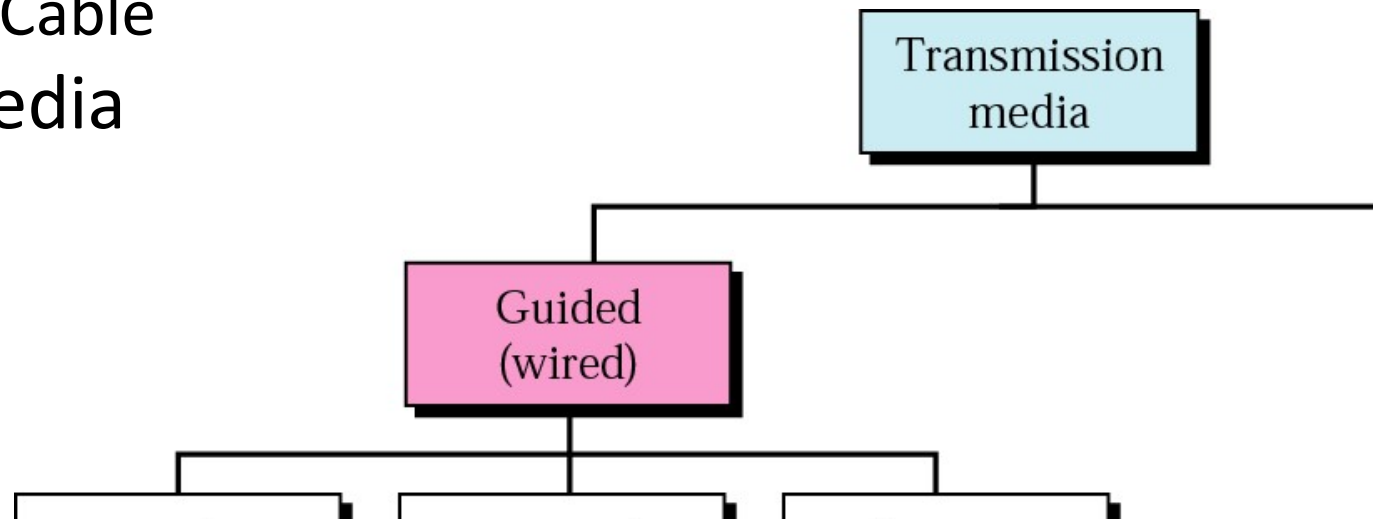
Twisted pair cable

- Two insulated cupper wire arranged in regular spiral pattern.
- Typically a number of pair of wire are bundled together into a cable by wrapping it in tough protective covering.
- Twisting decrease the crosstalk performance between adjacent pair in the cable.
- Tighter twisting provides much better performance ,but also increases the cost.
- Two types
  - UTP (Unshielded twisted pair cable)
  - STP (Shielded twisted pair cable)

Insulator

UTP and STP

- UTP (Unshielded twisted pair cable)
  - Commonly used
  - Used as telephone wire
- STP (Shielded twisted pair cable)
  - Metal shield prevents the penetration of the signals
 - Cable wires

Metal shield
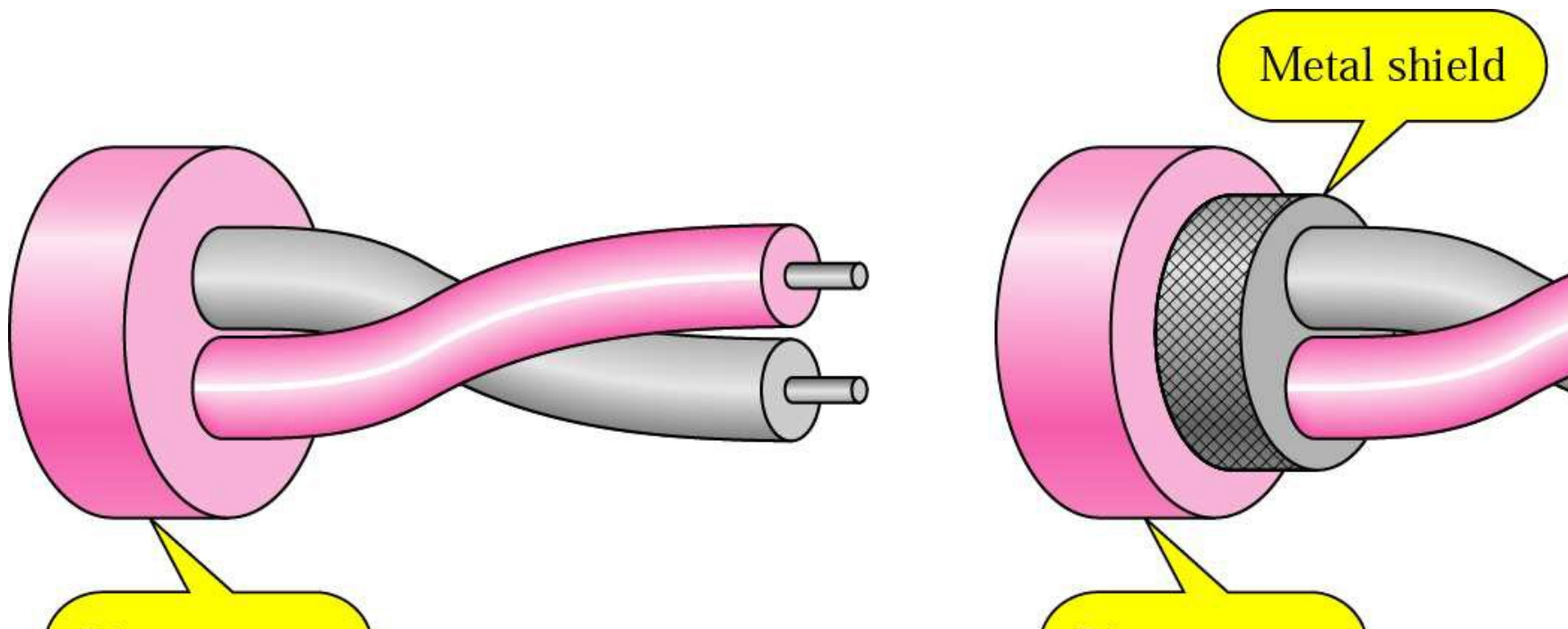
Coaxial Cable

- Consist of a hollow outer cylinder conductor that surrounds a single inner wire conductor

- The inner conductor is held in place by either regularly spaced insulting ring or a solid dielectric material .

- The outer conductor is covered with a jacket or shield .

Insulator

Plastic cover

Outer conductor (shield)

In
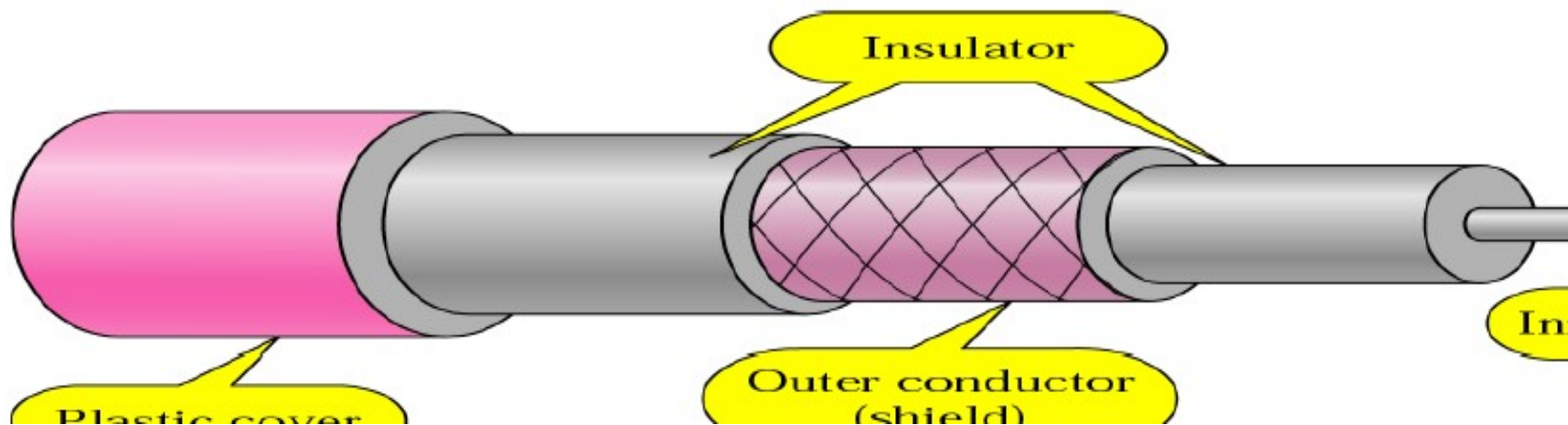
BNC (Bayone neill concelman) connectors

Cable

BNC T

BNC connector
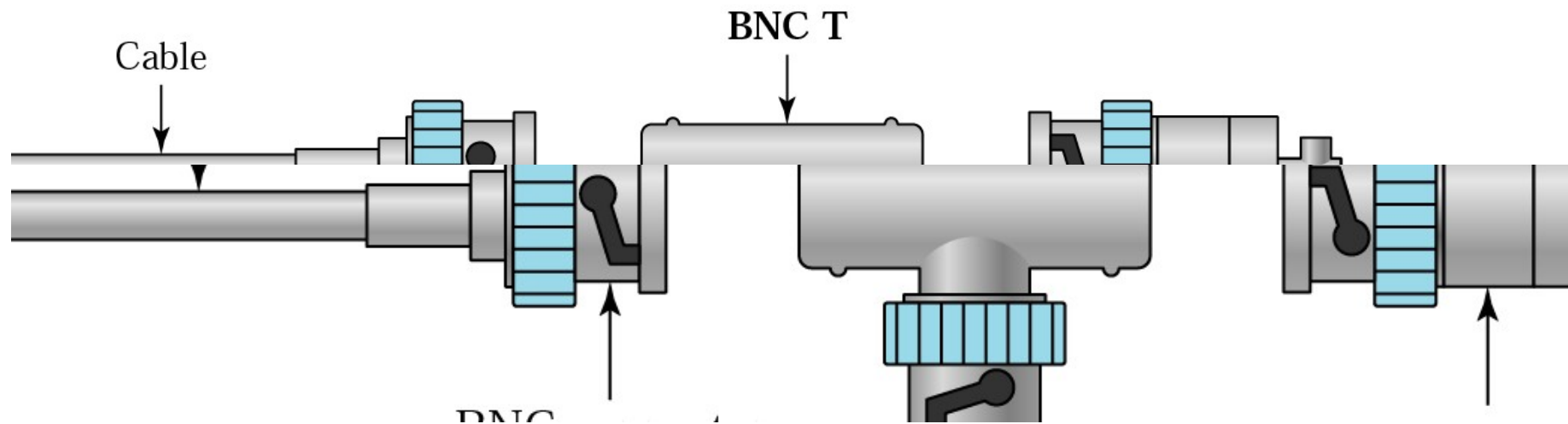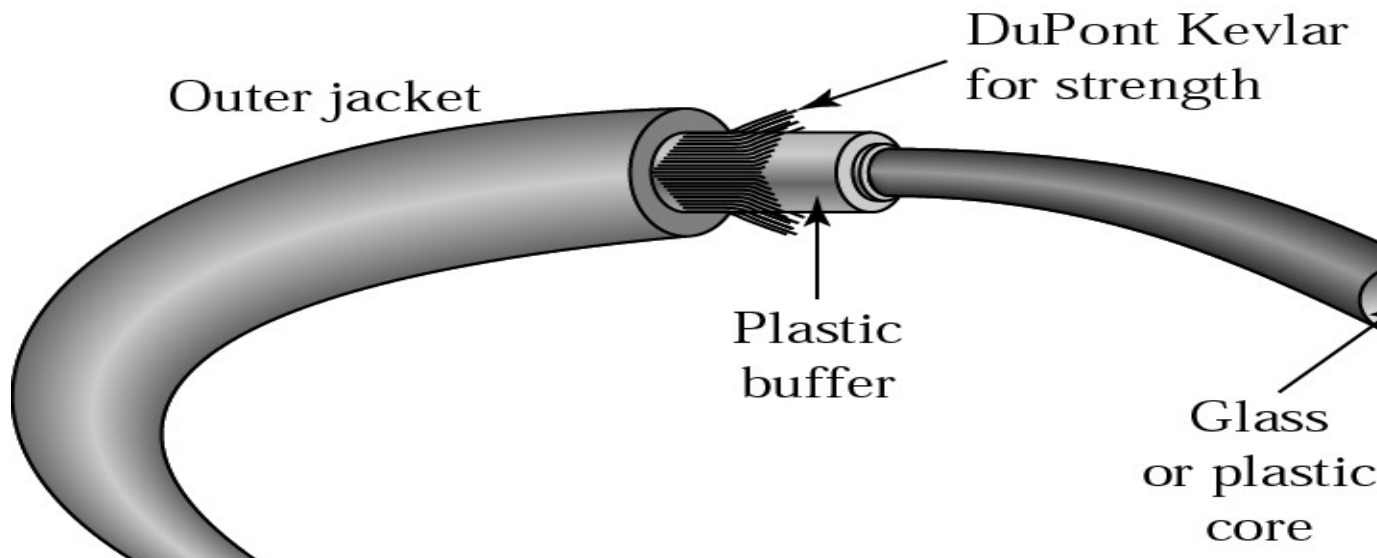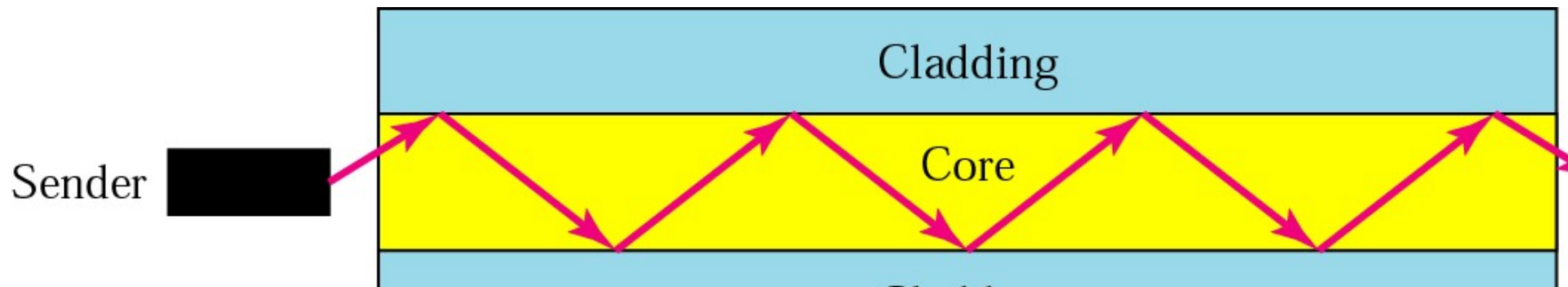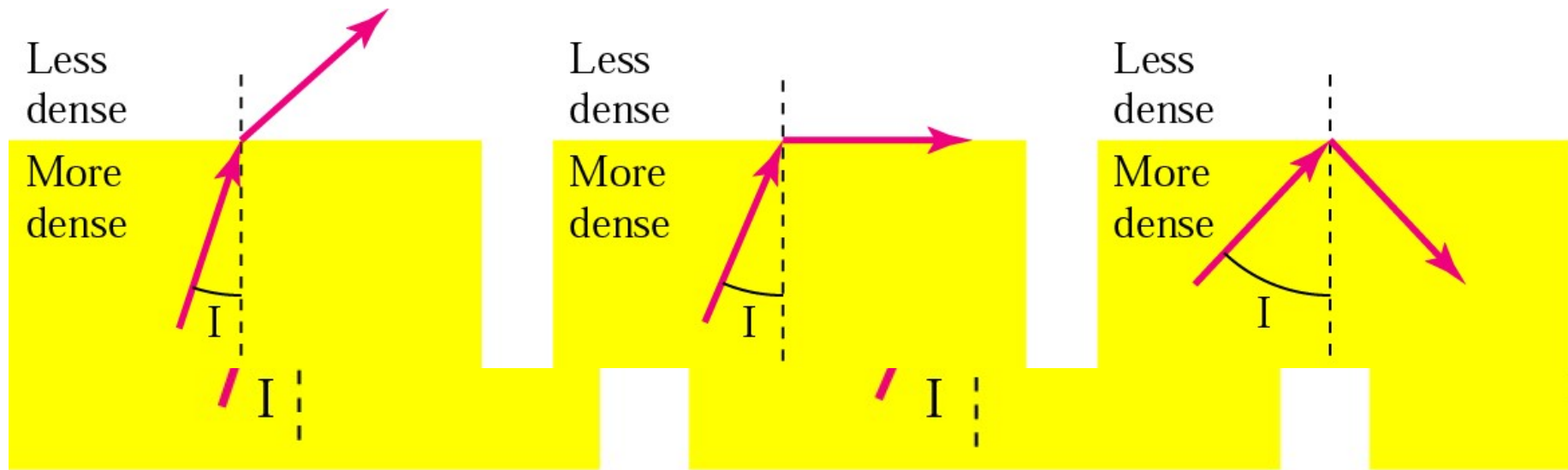
Optical Fiber

- An optical fiber is a thin ,Flexible medium capable of conducting an optical ray

- Made up of ultra pure fused silica ,glass fiber or even plastic

- It has a cylindrical shape and consist of three concentric sections : the core , the cladding and the Jacket

- Can transmit light source

Optical Fiber (cont...)

- The core consist of one very thin strands of fibers made of glass or plastic

- The Cladding is a glass or plastic coating that has optical properties different from that of the core

- The jacket surrounds one or a bundle of cladded fibers

Outer jacket

DuPont Kevlar for strength

Plastic buffer

Glass or plastic core

How Optical fiber Works

Less dense

More dense

I

I

Less dense

More dense
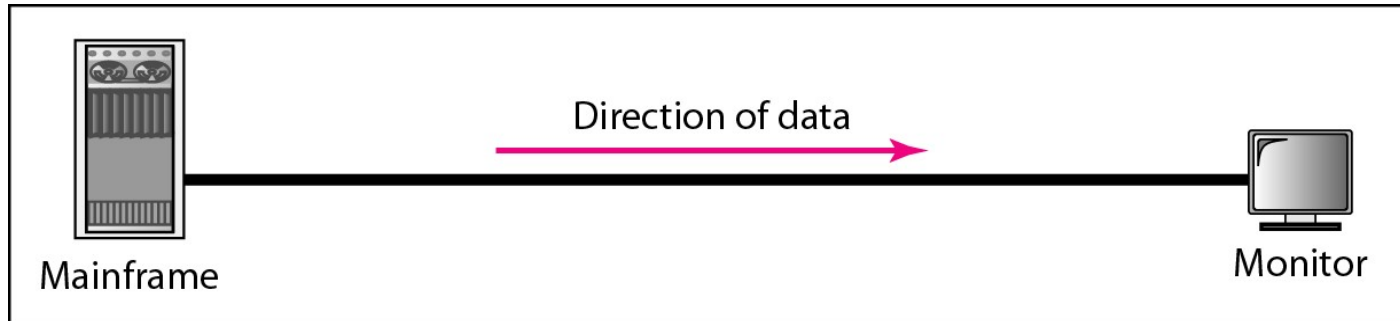
I

I

Less dense

More dense

I

Cladding

Core
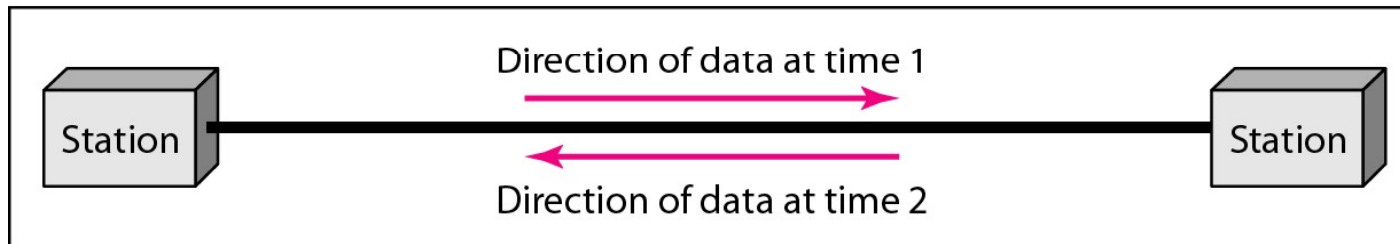
Sender

Data Transmission mode

- Simplex
  - Unidirectional communication
  - Only one of the two devices on a link can transmit, the other can only receive.
  - Example: keyboard
- Half-Duplex
  - Each station can both transmit and receive, but not at the same time.
  - When one device is sending, the other has to wait, and vice versa.
  - Example: Walkie-talkies
- Full-Duplex (or called duplex)
  - Both stations can transmit and receive simultaneously.
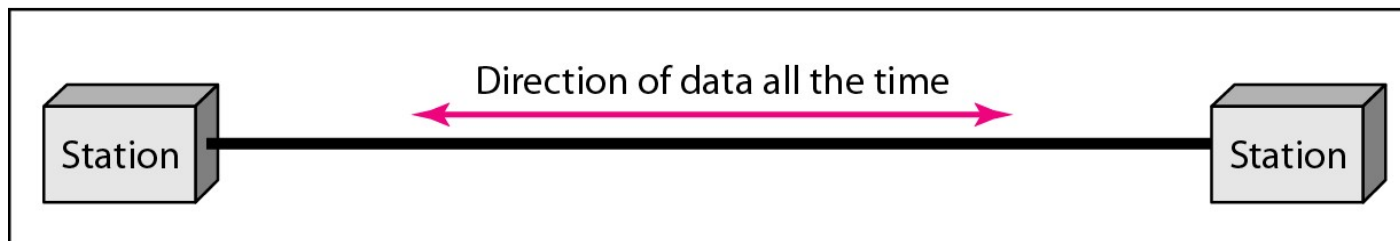 - Full Duplex

Data Transmission mode (cont…)

Direction of data

Mainframe   Monitor

a. Simplex

Direction of data at time 1

Station   Station

Direction of data at time 2

b. Half-duplex

Direction of data all the time

Station   Station

c. Full-duplex

Types of Network

- LAN
  - **used to connect networking devices that are in a very close** geographic area, such as a floor of a building, a building itself, or a campus environment.
- MAN
  - A **metropolitan area network (MAN) is a hybrid between a LAN and a WAN.**
- WAN
  - **used to connect LANs together. Typically, WANs are** used when the LANs that must be connected are separated by a large distance

Local Area Network (LAN)

- It covers a small geographical area such as an office, home or building.

- Usually privately owned.

- Depending on the needs of an organization and the type of technology used, it can be as simple as two-three end devices; or it can extend throughout a company.

- Limited to few kilometres.

Local Area Network (LAN) (cont...)

- LAN's are designed to allow resources to be shared between the participating nodes.
  - Resources may be hardware, software or data.
- One of the computer may act as a server, and others can act as clients.
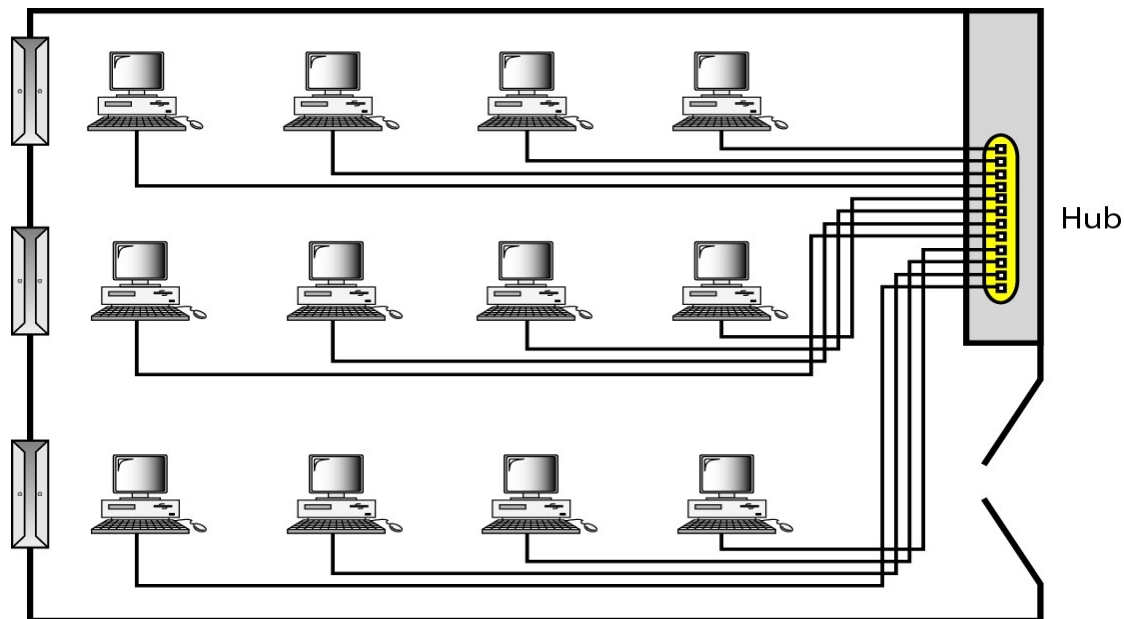
Metropolitan Area Network (MAN)

- It normally covers the area inside a town or city.

- The city bridges its LANs with a series of backbones, making a large network for the entire city.

- It is designed for customers who nee a high speed connectivity, normally to the Internet, and have endpoints spread over a city or part of city.

- Example:
  - part of telephone company network that can provide a high speed DSL line.
  - Cable TV network, now provides high speed internet.

- MAN may be operated by one organisation, or be shared resources used by several organisations in the same city.

Metropolitan Area Network (MAN)
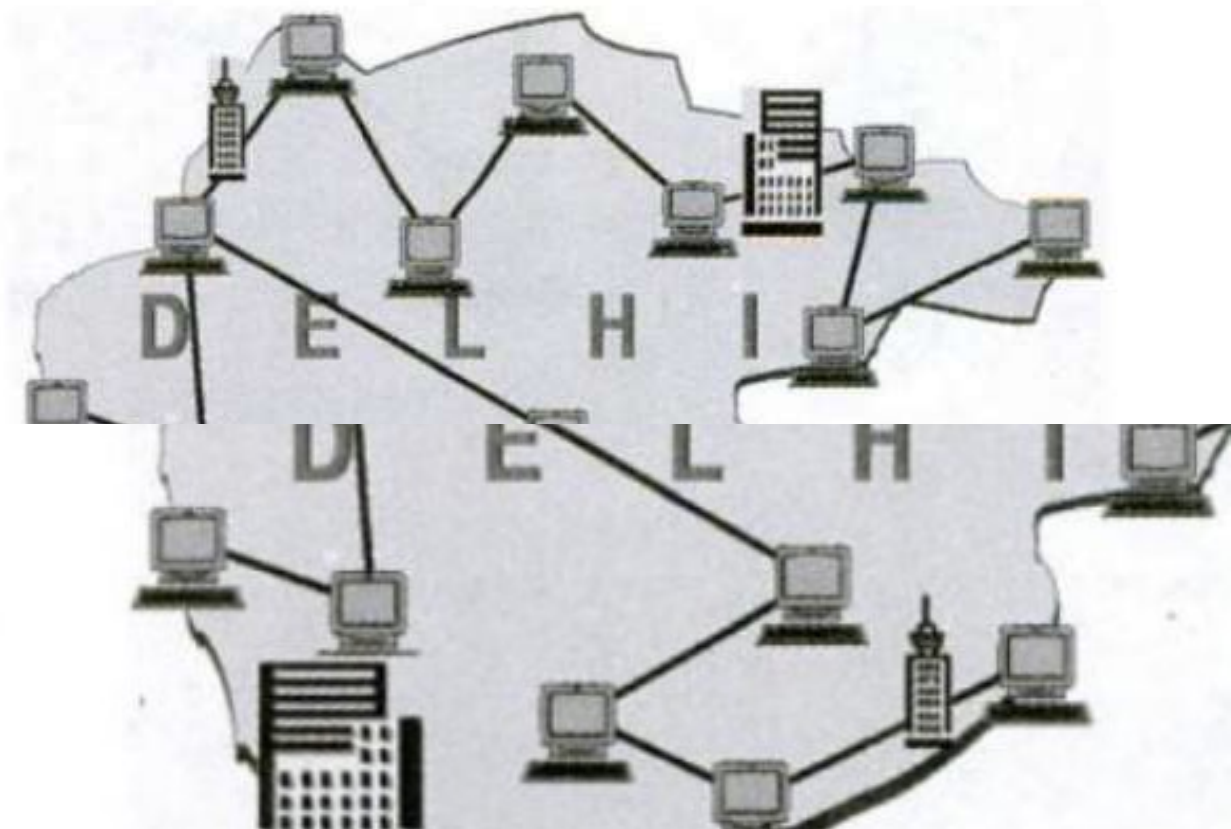
Wide Area Network (WAN)

- WAN provides long-distance transmission of data, image, audio and video information over large geographic areas that may comprise a country, a continent or even the whole world.

- WAN may be owned or rented by private business, it is usually a public network designed to connect small and intermediate sized networks together.

- The largest WAN in existence is the internet.

Wide Area Network (WAN)

- WAN offers many advantages to business organisations. Some of them are as follows,
  - It offers flexibility of location because not all the people using the same data have to work at the same site.
  - Communication between branch offices can be improved using e-mail and file sharing.
  - It facilitates a centralised company wide data backup system.
  - Companies located in a number of small, interrelated offices can store files centrally and access each other's information.

Network Topologies

- The geometric representation of a computer network is called topology. There are two types of topology,
  - Physical topology : Physical arrangement of a network.
  - Logical topology : Actual arrangement of a network.
- The connected devices are called nodes.
- There are four basic topologies possible,
  - Bus
  - Ring
  - Star
  - Mesh
- Some other topologies are,
  - Hybrid
  - Tree
  - Daisy Chain

Bus Topology

- Multipoint connection.
- One long cable act as a backbone to link all the devices in a network.
- Nodes are connected to the bus cable by drop lines or taps.
  - A drop line is a connection running between the device and the main cable.
  - A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core.
- Terminators are required for both ends of the main cable.
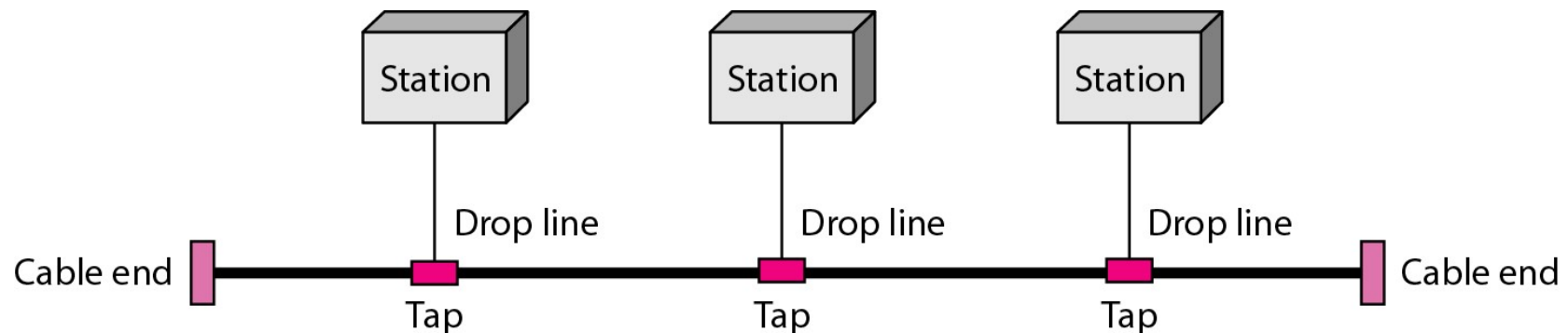
Advantages and Disadvantages of Bus topology

- Advantages
  - Ease of installation for small network.
  - Less cabling.
  - No duplicate (redundant) connection.
  - Cost effective.
- Disadvantages
  - Difficult reconnection and fault isolation.
  - Adding new devices may require modification or replacement of the backbone.
  - A fault or break in the bus cable stops all transmission.
  - There is a chance that a single node monopolise the network, for this reason token bus concept came into existence.

Ring Topology

- Each device has a dedicated P2P connection with only the two devices on either side.

- Signal is passed along he ring n one direction, from device to device until it reaches the destination.

- Each device in the ring incorporates a repeater.

- When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.
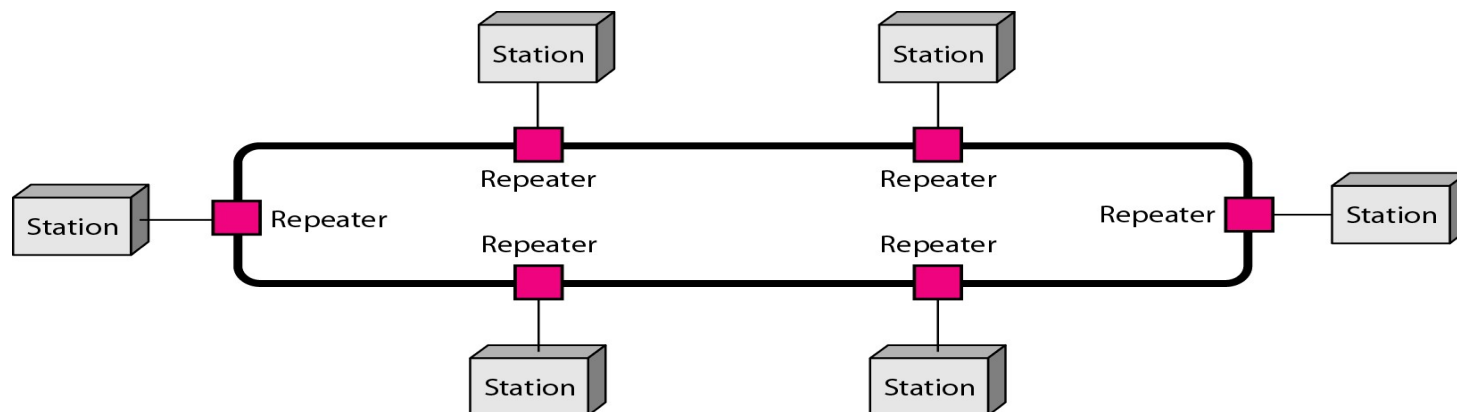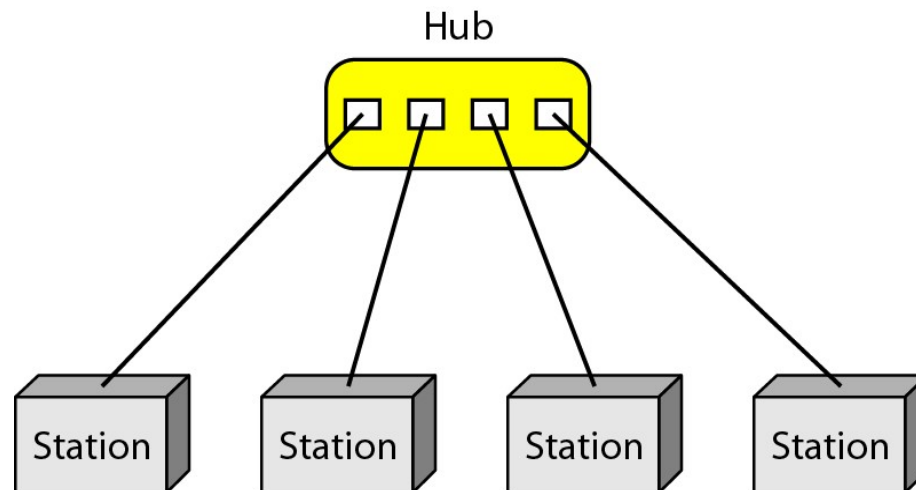
Advantages and disadvantages of Ring Topology

- Advantages
  - Easy to install and reconfigure.
  - Unidirectional traffic reduces the chance of packet collision.
  - Cost effective.
- Disadvantages
  - Unidirectional traffic may cause delay in communication.
  - A break in the ring can disable the entire network, due to which dual-ring concept came into existence.
  - A single node can monopolise the network, for this reason token ring concept (by IBM) came into existence.
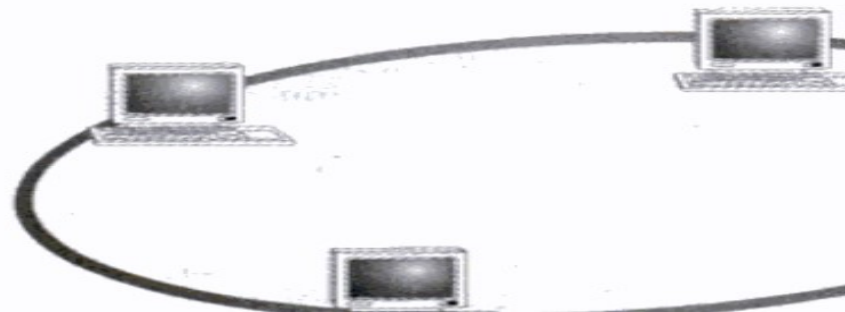
Star Topology

- Each device has a P2P link only to a central controller called hub or concentrator.

- If a node wants to send data to another node, it sends the data to the controller, which then relays the data to the intended node.

- Often used in LAN.

Advantages and disadvantages of Star Topology

- Advantages
  - Easy to install and reconfigure.
  - Robust. Network is not disrupted even if a node fails or is removed from the network.
  - Easy fault detection and fault isolation.
- Disadvantages
  - Whole network is dependent on the hub. If the hub goes down, the whole network is dead.

Mesh Topology

- Every device in the network has a dedicated P2P link to every other devices.

- The number of links (ℓ) in a fully connected mesh network with 'n' nodes is, $\ell = n(n-1)/2$
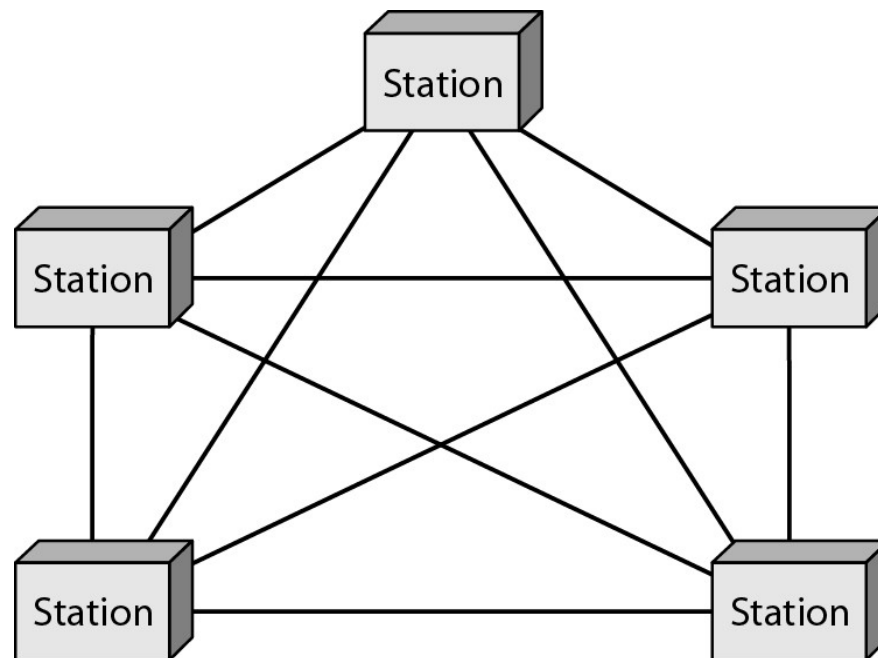
Advantages and disadvantages of Mesh Topology

- Advantages
  - Dedicated link to each node guarantees no traffic problem.
  - Robust. If one link fails, it does not incapacitate the whole network.
  - Privacy and security is maintained.
  - Easy fault identification and fault isolation.
- Disadvantages
  - More cabling is required.
  - More number of I/O port is required in each node.
  - Complexity increases with increase in nodes.

Hybrid Topology

- The network can be inhibited by using two or more number of basic topologies.

- One of the example is given below.
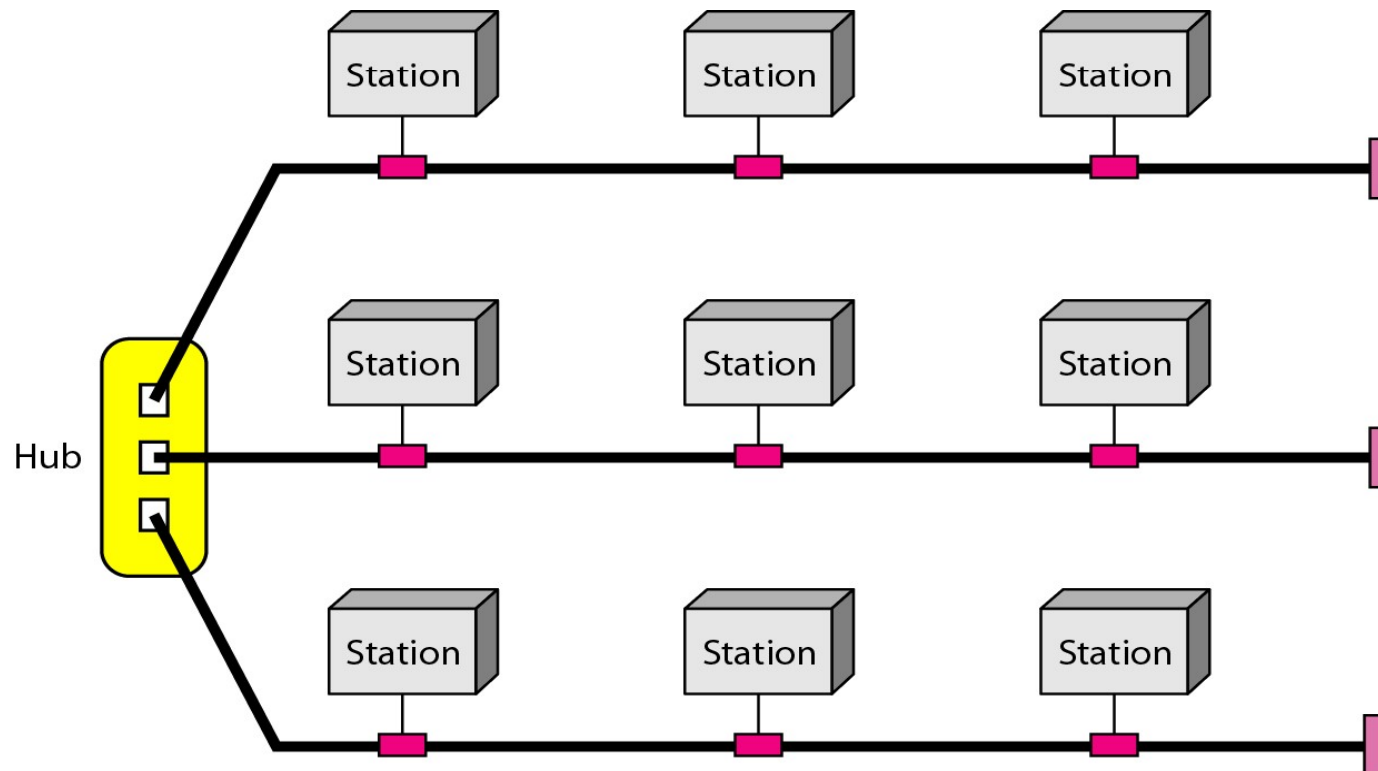
Networking Devices

- Hub
  - A hub works in the physical layer of the OSI model.
  - It is basically a non-intelligent device, and has no decision making capability.
  - It take the input data from one of the ports and broadcast the information to all the other ports connected to the network.
- Switch
  - It is an intelligent device that works in the data link layer.
  - The term intelligent refers to the decision making capacity of the Switch.
  - Since it works in the Data link layer, it has knowledge of the MAC addresses of the ports in the network.
- Router
 - Routers are used to route a packet among all available lines.

Networking Devices (cont…)

- Repeater: These are analog devices that are connected to two cable segments. It regenerate the signal appearing one of them is amplified and put as out on the other.

- Gateway

- Bridge

- NIC (Network Interface Card)

Networking Devices (cont...)-Bridge

- It is a networking device that creates a single aggregate network from multiple communication networks or network segments. The most recent ones perform similar operation as the switches.

- A bridge is also a device which works in the Data Link Layer, but is more primitive when compared to a switch.

- It also works on the principle of transfer of information using the MAC addresses of the ports.
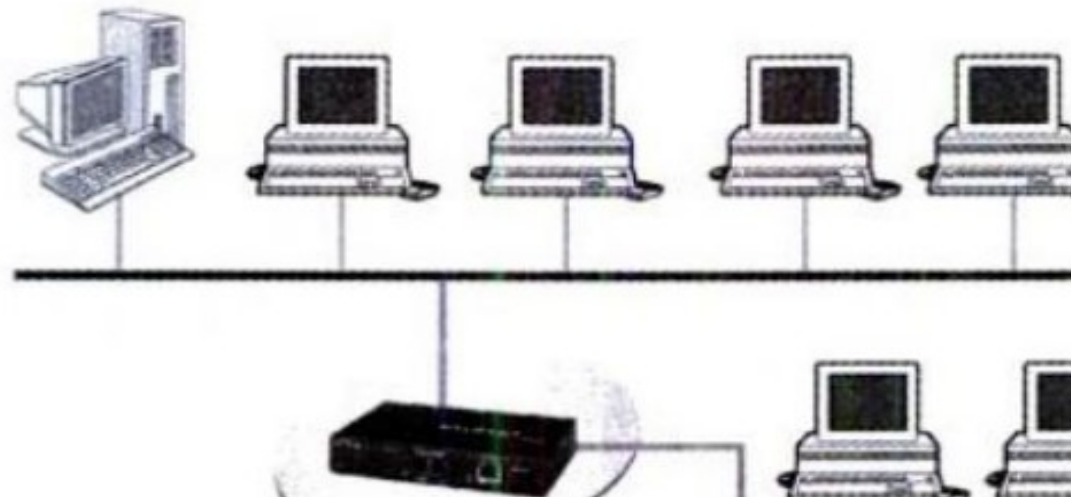
Networking Devices (cont…)-Gateway

- These connect two network that uses different connection oriented protocols.

Netware (Novell) Server

Gateway

Windows
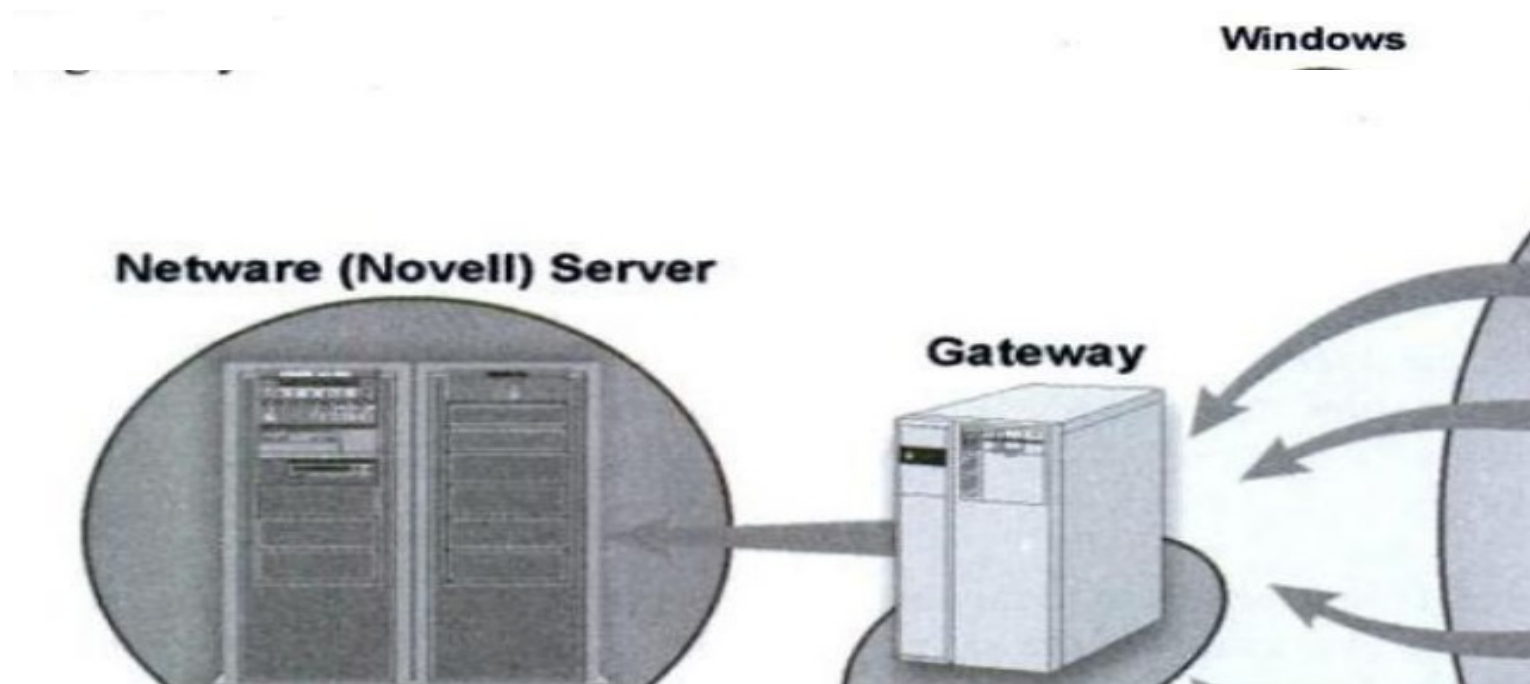
Internet

- Internet
- www
- Web page
- Website
- Home page
- Protocol
- Web server
- Browser
- Download/ upload
- Search Engine
- Cookie
- Address bar
- URL (Uniform Resource Locator)

Internet Services

- Internet Services
    - E-Mail
    - WWW
    - FTP
    - Chatting
    - Internet Conferencing

Cont…

- Electronic Newspaper
- Online Shopping

Different types of Internet connectivity and ISP

- ISP (Internet Service Provider):
  - It is an Organisation, that provides internet to individuals and other companies.
  - There are three levels of ISP, such as Tier-1 ISP, Tier-2 ISP and Tier-3 ISP.
  - Examples: AT&T WorldNet, Vodafone etc.

Types of connection

- Dial-up
- ISDN
- Cable Modem
- Leased Line
- DSL
- Broadband