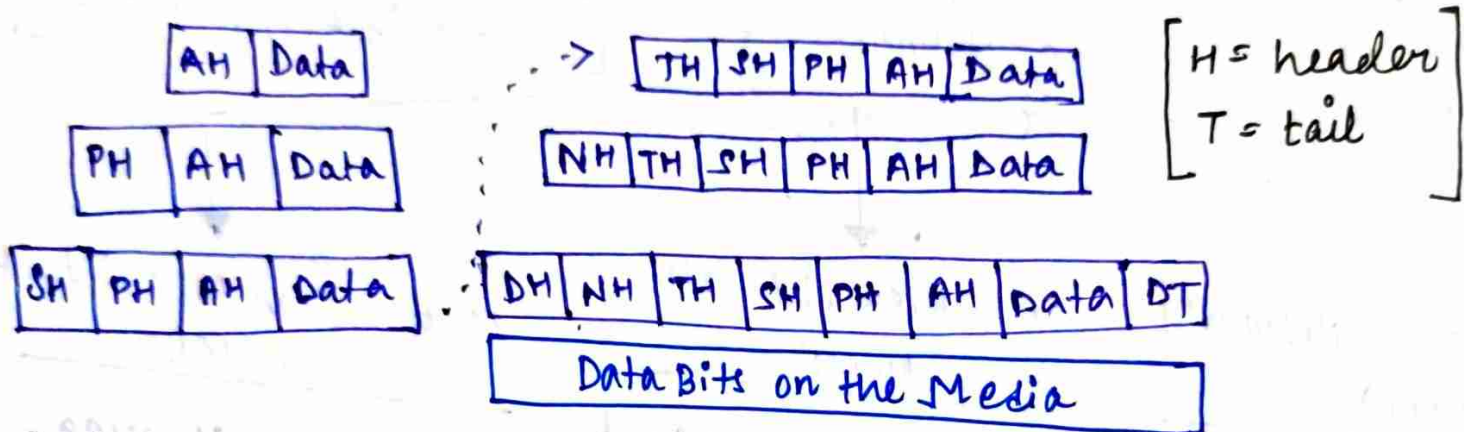


a. Physical layer

- defines the characteristics of interface b/w devices and transmission medium.



1. Representation of Bits:

- sequence of 0's and 1's with no interpretation. Bits must be encoded into signals - electrical or optical.

2. Data Rate:

- number of bits sent each second is called data rate.
- ex: Twisted pair, Co-axial cable, RJ45, fibre-optic.

3. Line Configuration:

- concerned with connection of media. (Point to point, multipoint).

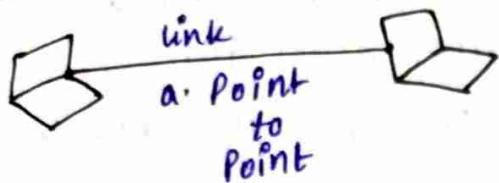
4. Physical Topology:

- defines how devices are connected to make a network.

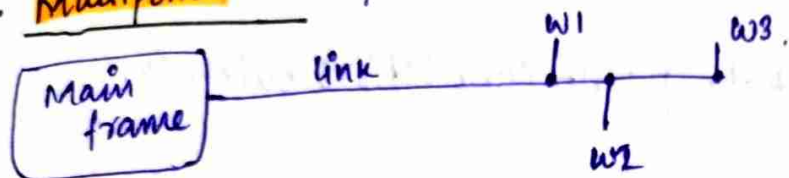
Transmission mode: Simplex, Half Duplex, Full Duplex.

- Types of connection

1. **Point to Point** :- provides a dedicated link between two devices.
- use an actual length of wire or cable to connect two ends,



2. **Multipoint** :- provides 1 two devices share a single link.



- Physical Topology

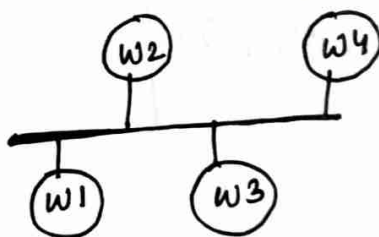
(network is laid out physically).

- Geometric representation of relationship of all links and linking device to one another.



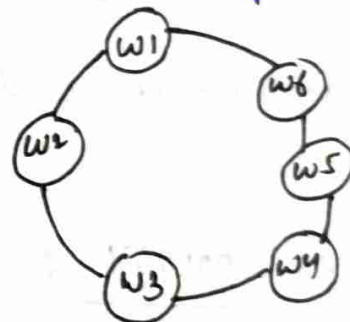
Point to Point

(a)



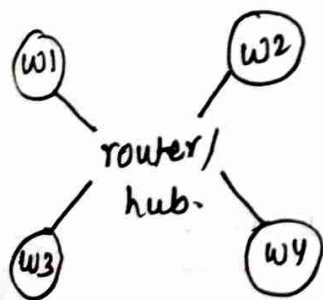
Bus topology.

(b)



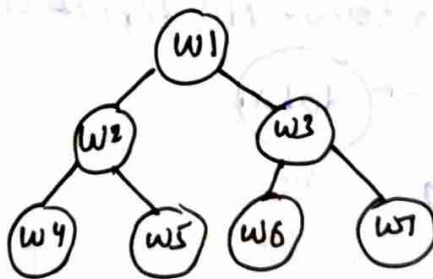
Ring topology

(c)



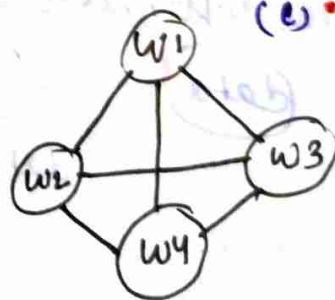
Star topology

(d)



Tree topology

(e)



Mesh topology

(f)

0. MESH TECHNOLOGY

- Every computeration is connected to every other workstation (point to point link) to every device.

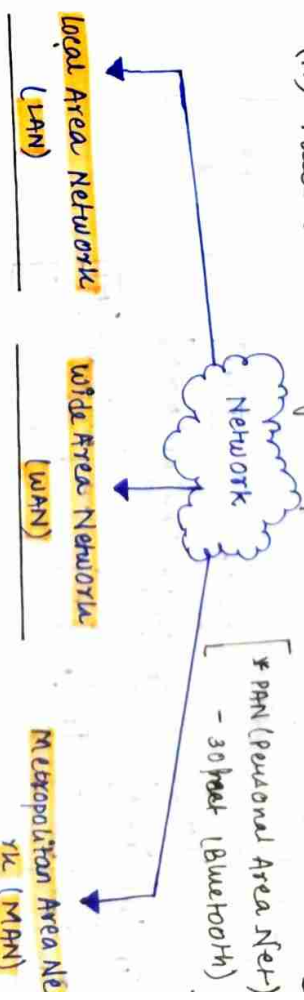
$$\left[n \left(\frac{n-1}{2} \right) \text{ duplex mode links } (n = \text{number of nodes}) \right]$$

Advantages:

- (i) No traffic problems.
- (ii) Robust
- (iii) Privacy & security.
- (iv) Fault isolation easy.

Disadvantages:

1. Bulk wiring
2. Expensive
3. Installation and Reconnection are difficult.



Range: few kilometres area

may be privately owned and could be a network inside a building.

Range: geographical large area.

made up of all networks

Range: city size

larger than LAN and WAN.

- NETWORK MODELS

• International Standards Organization (ISO) proposed Open Syst Interconnection to allow communication b/w two systems regardless of their architecture. (OSI)

ISO/OSI Models

- Purpose of the model is to facilitate communication between different systems without requiring changes to the logic of underlying hardware and software.

- OSI is model not a protocol (Flexible, Robust and Interoperable)

- One long cable acts as a backbone to link all devices in a network.

- Nodes are connected to main line using drop line and tap.

Advantages:-

- (i) Easy installation.
- (ii) uses less cable than mesh and star.

Disadvantages:-

- (i) Fault in bus cable stops all transmission.
- (ii) Difficult to add devices.

c. Ring Topology:

- Each device has dedicated point to point connection with the only devices either side.

- signal is uni directional. Each device incorporates a repeater.

Advantages:-

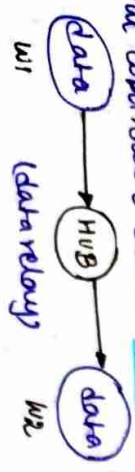
- (i) ease of installation and reconfigure.
- (ii) Fault isolation is simplified.

Disadvantages:-

- (i) Any breakage in ring leads to fault in entire network.

STAR Topology:

each device has a dedicated point to point link only to a central controller called a hub. No direct link.



Advantages:

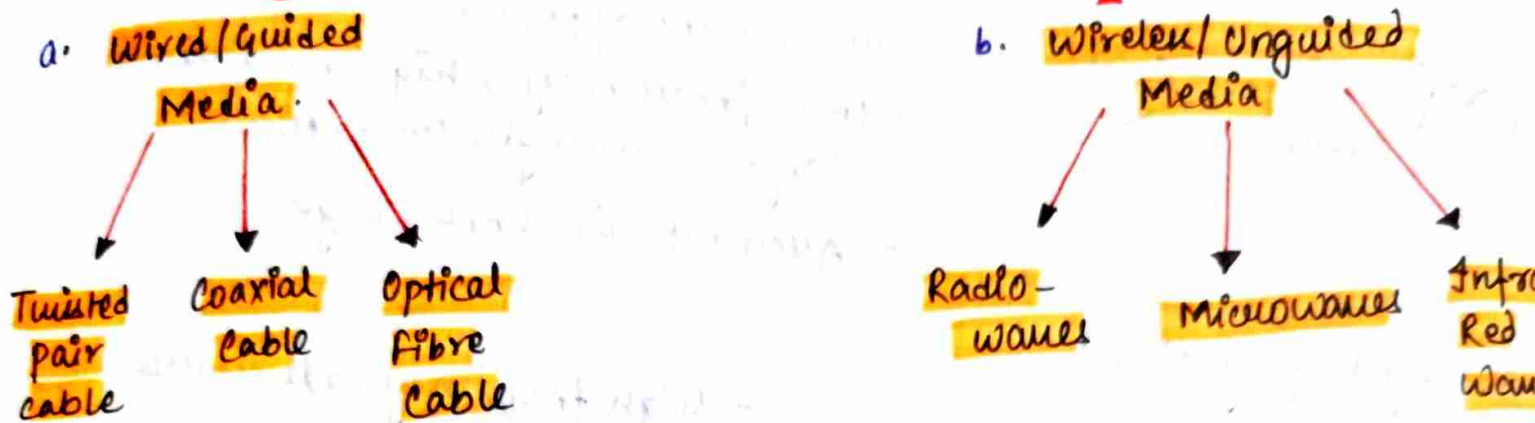
robust (one link fails, only that link is affected).

expensive and easy to install.

Disadvantages:

- (i) Hub fails, network fails.
- (ii) More cabling.

TRANSMISSION MEDIA



a. Guided Media

- Provides connection from one device to another.

1. Twisted Pair Cable

- Consisted of **two conductors (copper)**, each with its **plastic insulation**, **twisted together**.
- **shielded and unshielded twisted pair of cables**.
- **telephone lines**.

an insulating sheath, encase the conductor / foil, braid or a combination of two.

- cable tv.

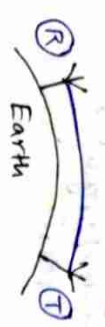


3. fibre optic

- transmit signal in the form of light (made of glass, plastic) using **total internal reflection**
- network cost effective can go up to **1600 Gbps**
- **light weight**, **low attenuation**, **no corrosion**, **light weight**

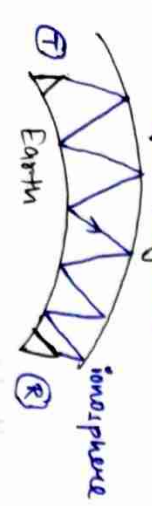
(b) Unguided Media: Wireless

1. Ground Propagation:



- omnidirectional, distance depends on amount of power.
- low frequency, high **bandwidth** large wavelength (kmz - Hz)
- Attenuate in short range.

2. Sky Propagation:



- high frequency radio waves
- greater distance with low p.
- 3 Mhz - 32 Mhz
- 5000 km.

3. Line of Sight Propagation:



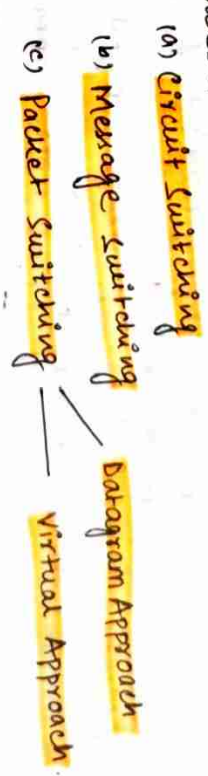
- very high frequency transmitted in straight line directly antenna to antenna.

(line of sight)

- 3 kHz to 16 GHz
- Omnidirectional
- penetrate through wall
- long distance
- managed by government.
- 14 THz to 300 GHz
- Unidirectional
- cannot penetrate wall
- wide band so high rates are possible.
- managed by government.
- 300 GHz to 400 THz
- short range comm.
- home appliances

switching

- switching is the technique by which nodes control or switch data to transmit it between specific points on a network.
- Methods are:-



(a) Circuit Switching:

A **dedicated path** is established between sender and receiver. Before transfer, connection will be established first.

Ex: **Telephone Network**.

- 3 phases in circuit switching:-

- connection establishment
- Data Transfer
- connection disconnection

(b) Message Switching:

- Message is transferred as a **complete unit** and forwarded using **and forward and mechanism** at intermediary node.
- Store and Forward Mechanism

(c) Packet Switching:

- Message is broken into **individual chunks** called **packets**. Each packet is **sent individually**.

- Each packet will have source and destination **IP address** with **sequence number**.

(helps to reorder packets and detect missing packet and switch acknowledgements.)

- Packet switching

(a) **Datagram Approach**

(b) **Virtual Circuit Approach** (path is virtually

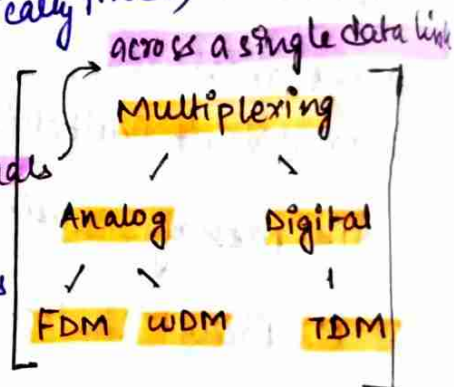
logically fixed)

Note:

→ where **set of techniques** which allow **simultaneous transmission of multiple signals**

(a) **Time Division Multiplexing (TDM)**

- Divides time domain into fixed lengths
- Sequential transmission.
- Telephone, computer networks.



(b) **Frequency Division Multiplexing (FDM)**

- analog technique.
- Bandwidth of single transmission is subdivided.
- Crosstalks, short range.
- TV networks, Radio (FM)

(c) **Wavelength Division Multiplexing (WDM)**

- analog technique
- combines multiple signals transmitted at different wavelengths of light onto single fibre optic strand.
- optical communication system (optical networks).

• Integrated Services Digital Network (ISDN) (1980-1990's).

- A set of protocols for establishing and breaking circuit switched connections, and advanced call features for the user.
- used digital signals for transmission.
- Channels :-
 - (a) B-channels (for data)
 - (b) D-Channels (for control and signaling)
- data rates are **128 kbps** in the case of BRI and up to 1.544 Mbps for PRI.
- Before broadband availability, it was popular for internet services.