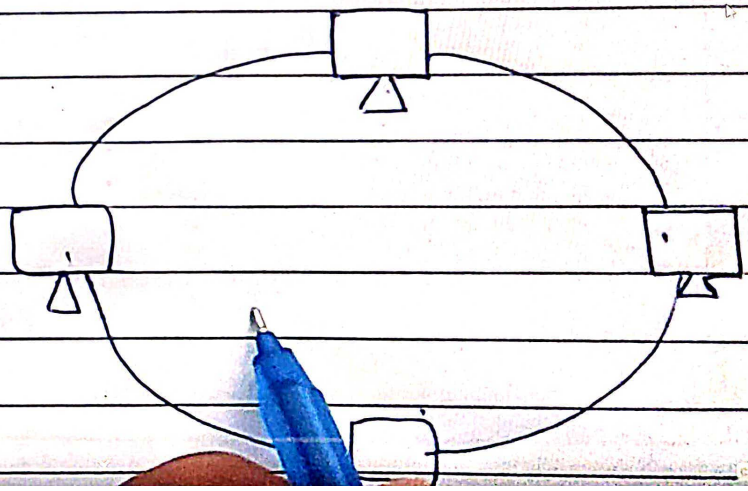
Q. What is Computer Network ? Full Form.

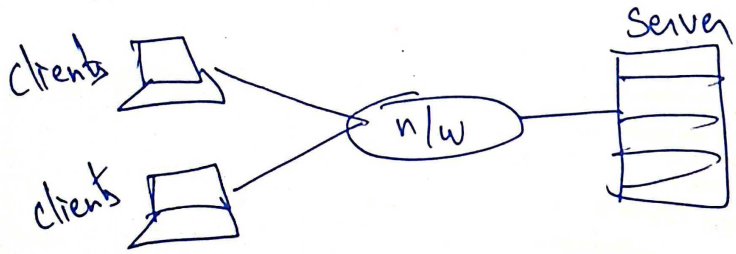
Ans → A group of computers which are connected to each-other for the purpose of sharing their resources is called Computer Network.



Uses of Computer Networks

- Business Applications.
- Home Applications
- Mobile users.
- Social Issues.

⇒ Business Applications:-



(a) Resource Sharing
h/w, s/w, inf.

(b) Providing communication media
e-mail, Video Conferencing.

(c) Doing business electronically
B2B, B2C, e-Commerce.

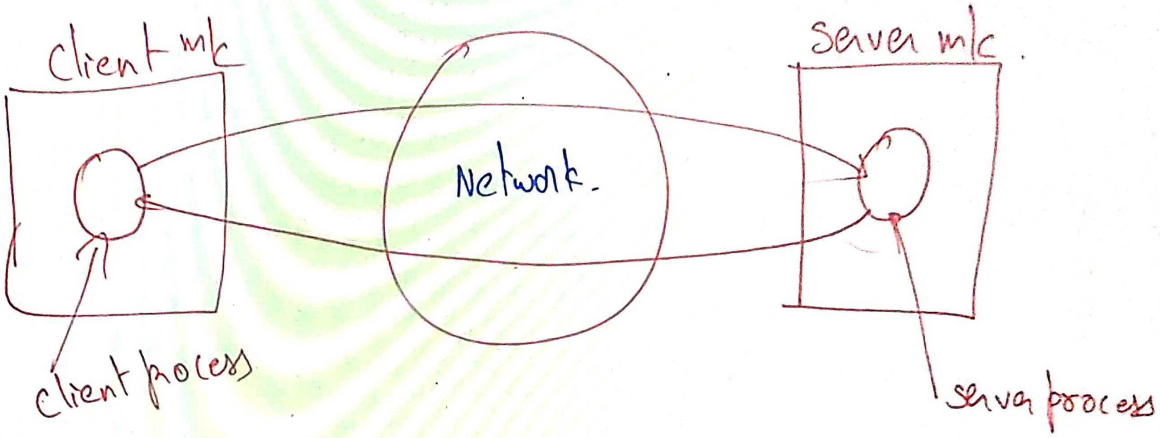
als of n/w in companies :-

* resource sharing :- Equipment, program, data.
* high reliability :- replicated data, h/w
* Saving money :- Main frame :- 10 times faster. but 1000times more Expensive. ✗

Client-server Model ✓

* scalibility :- Main frame : replace a large one
client-server :- add more Server

Client-Server Model



Home Network Applications

(i) Access to Remote information

(ii) Person-to-Person communication

(iii) Interactive entertainment

(iv) Electronic commerce.

(i) Access to Remote information → Eg:- financial, shopping, customized Newspaper, online digital libraries, WWW

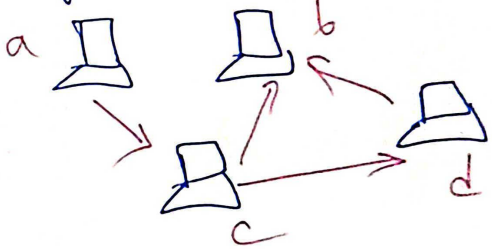
(ii) Person-to-Person Communication

(iii) Interactive Entertainment → Eg:- TV's, game playing

(iv) electronic commerce.

E-mail, Video Conference, News group

In peer to peer sys there are no fixed client & serva.



About Network Hardware

- ✓ **Broadcast** links and **point-to-point** links .
- ✓ **Broadcast:** Simultaneous transmission of the same message to multiple recipients.
- ✓ **Point-to-point:** Connect individual pairs of machines.
- ✓ **Unicasting:** Transmission with exactly one sender and exactly one receiver
- ✓ **Multicasting:** single sender and multiple receivers on a network

Data Communication and Networking

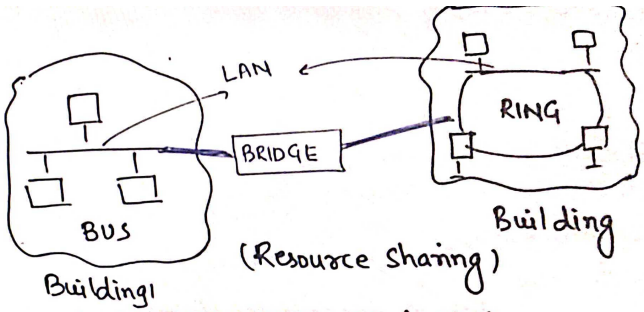
TYPES OF NETWORKS

LOCAL AREA NETWORKS (LAN):-

↳ operate over small physical area such as office / society etc.

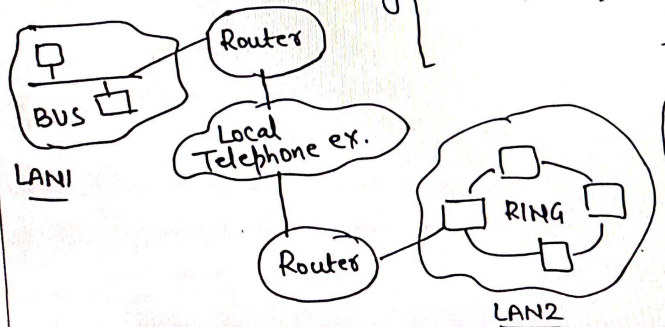
→ Easy to design and troubleshoot

→ BUS, RING Topology are generally used.



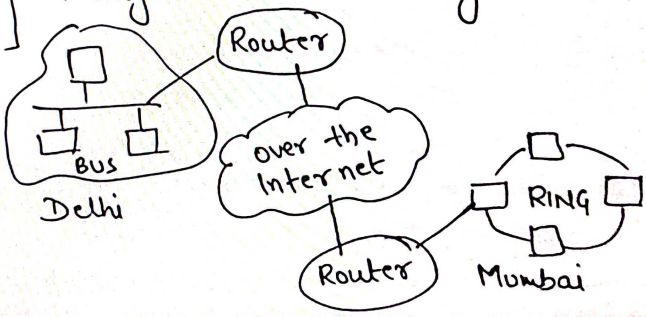
METROPOLITAN AREA NETWORK (MAN):-

↳ Extend over entire city. [50Km, optical fibres.]



WIDE AREA NETWORK (WAN):-

↳ Large distance such country / states.

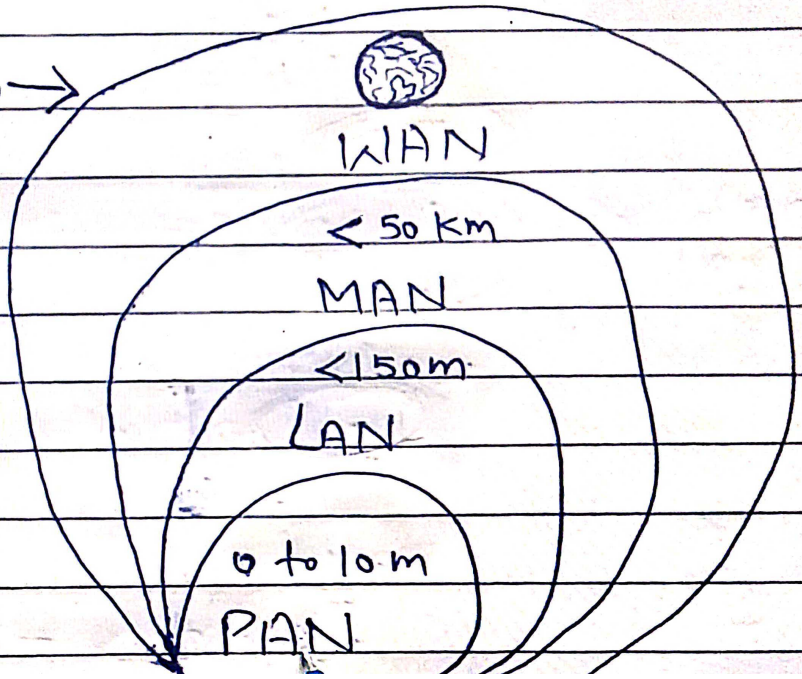


Data Communication and Networking

Comparison b/w LAN and WAN (IMP)

LAN (Local Area N/W)	WAN (Wide Area N/W)
owned by a Person = Privately owned.	Can be Private or Public.] Ownership
operate over small area	Large distance, across Countries
Easy to design and maintain	Not Easy.
Co-axial Cables	Satellite links.
Minimum Propagation delay	Excessive
High Data Rate	Low data rate
Broadcasting	Switching

Summary →



Difference between LAN MAN and WAN

Basis	LAN	MAN	WAN
Expands to	Local Area Network	Metropolitan Area Network	Wide Area Network
Range	A communication network linking a number of stations in same local area. Range is 1 to 10 km	This network shares the characteristics of packet broadcasting networks. Range is100 km	A communication network distinguished from LAN. Range is beyond 100 km
Media Used	Uses guided media	Uses guided as well as unguided media	Uses unguided media
Speed	A high speed i.e. 100kbps to 100mbps	Optimized for a large geographical area than LAN.	Long distance communications.
Cost	cheaper	costly	expensive
Equipment needed	NIC, switch and hub	Modem and router	Microwave, radio, infrared laser

Data Communication and Networking

Open System Interconnection (OSI) Model

It is a layered framework for the design of NIW systems that allows Comm^n between all types of Computer Systems.

↳ '7' Seven Separate layers.

IMP.. → Each Layer calls upon the services of the Layer just below it. (All people seems to Near Dominos Pizza)

Layers in OSI Model

Layer 7 - Application Layer

Layer 6 - Presentation Layer

Layer 5 - Session Layer

Layer 4 - Transport Layer

Layer 3 - Network Layer

Layer 2 - Data Link Layer

Layer 1 - Physical Layer

(i) Physical Layer:- It is responsible for moving individual bits from one (node) to the next.

Functions:-

(i) Transmission Media

(ii) Types of Encoding

(iii) Data Rate [no. of bits sent each sec.]

(iv) Synchronization of bits

(v) Line Configuration → Point-to-Point, Multipoint

(vi) Topology → Mesh, Star, Bus, Ring

(vii) Transmission Mode → Simplex, Half-duplex, Full-duplex.

OSI MODEL

(ii) Data Link Layer:- It transforms the physical layer into a reliable link.

Functions:- (i) Framing :- Conversion of bits → Frames.

(ii) Physical Addressing → Header is added to frame

IMP.. (iii) Flow Control ✓

(iv) Error Control ✓

(v) Access Control

(iii) Network Layer:- Responsible for source-to destination delivery of Packet.

Functions:- (i) Logical Addressing → Header to the Packet Coming from Upper.

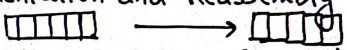
IMP. (ii) Routing → Routing algorithms. ✓

(iv) Transport Layer:- Responsible for Process-to-Process delivery.

Functions:-

(i) Service-point Addressing (Port Address)

(ii) Segmentation and Reassembly → Sending → Receiving.



(iii) Connection Control → Connectionless. → Connection Oriented.

(iv) Flow and Error Control ✓

(v) Session Layer:- Functions:-

(i) Dialog Control → Half Duplex (One Way at a time)
→ Full Duplex (two ways at a time)

(ii) Synchronization :- Adding checkpoints

OSI MODEL

(vi) Presentation Layer:- It deals with the Syntax and Semantics of the Info^n exchanged b/w two systems.

Functions:- (i) Translation :- Converting a message to Compatible bit stream.

(ii) Encryption :- Converting Plaintext to Ciphertext. → Decryption (receiving side).

(iii) Compression :- Reducing no. of bits contained in the info^n.

(vii) Application Layer:- It enables the users (Human/SW) to access the N/w.

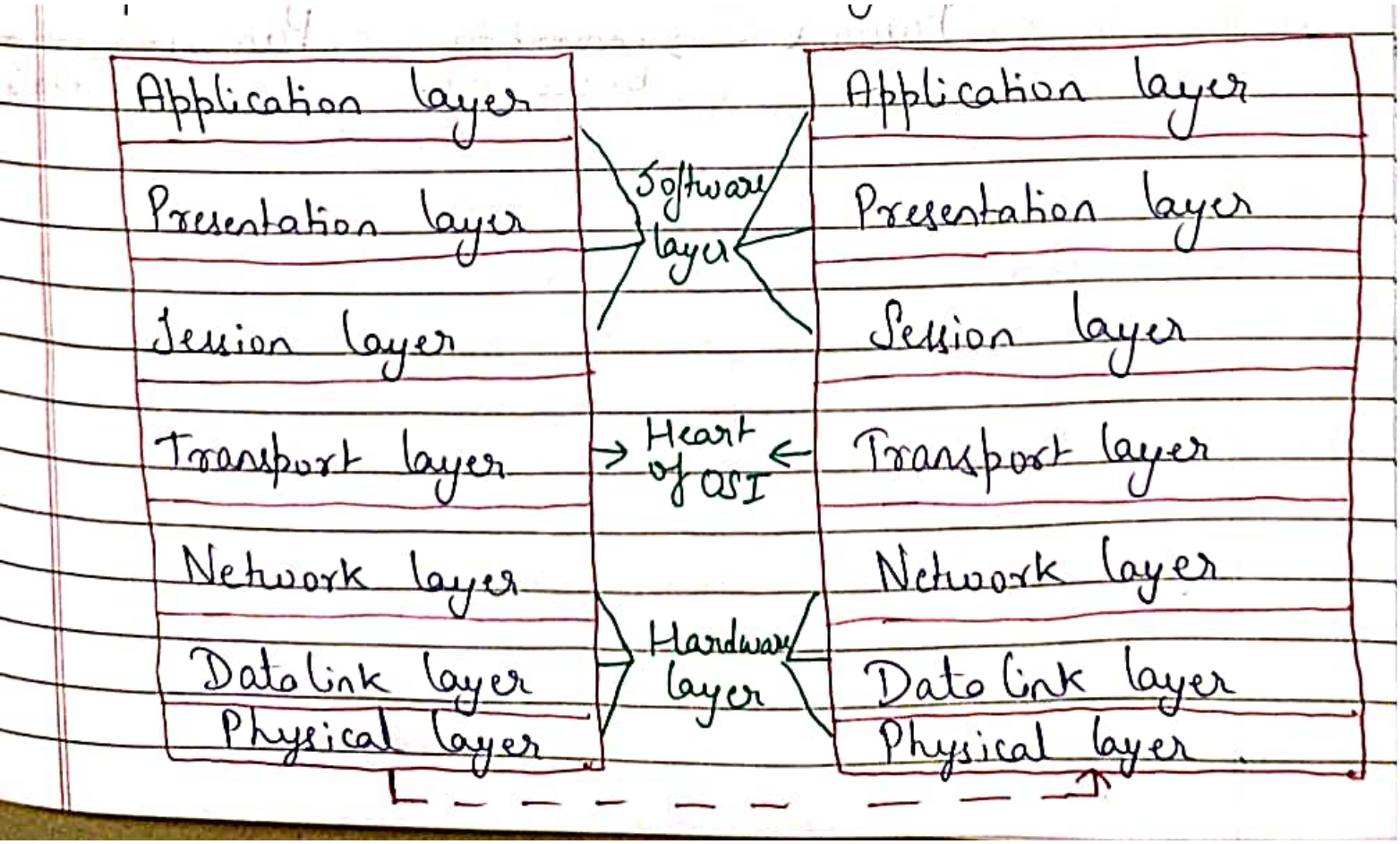
Functions:-

(i) N/w Virtual Terminal :- S/w version of Physical terminal. (Remote Host Login is facilitated)

(ii) File Transfer, access and Management

(iii) E-mail Services

(iv) Directory Services


Application layer
Presentation layer
Session layer
Transport layer
Network layer
Data link layer
Physical layer
Software layer
Heart of OSI
Hardware layer
Application layer
Presentation layer
Session layer
Transport layer
Network layer
Data link layer
Physical layer

V.V.IMP

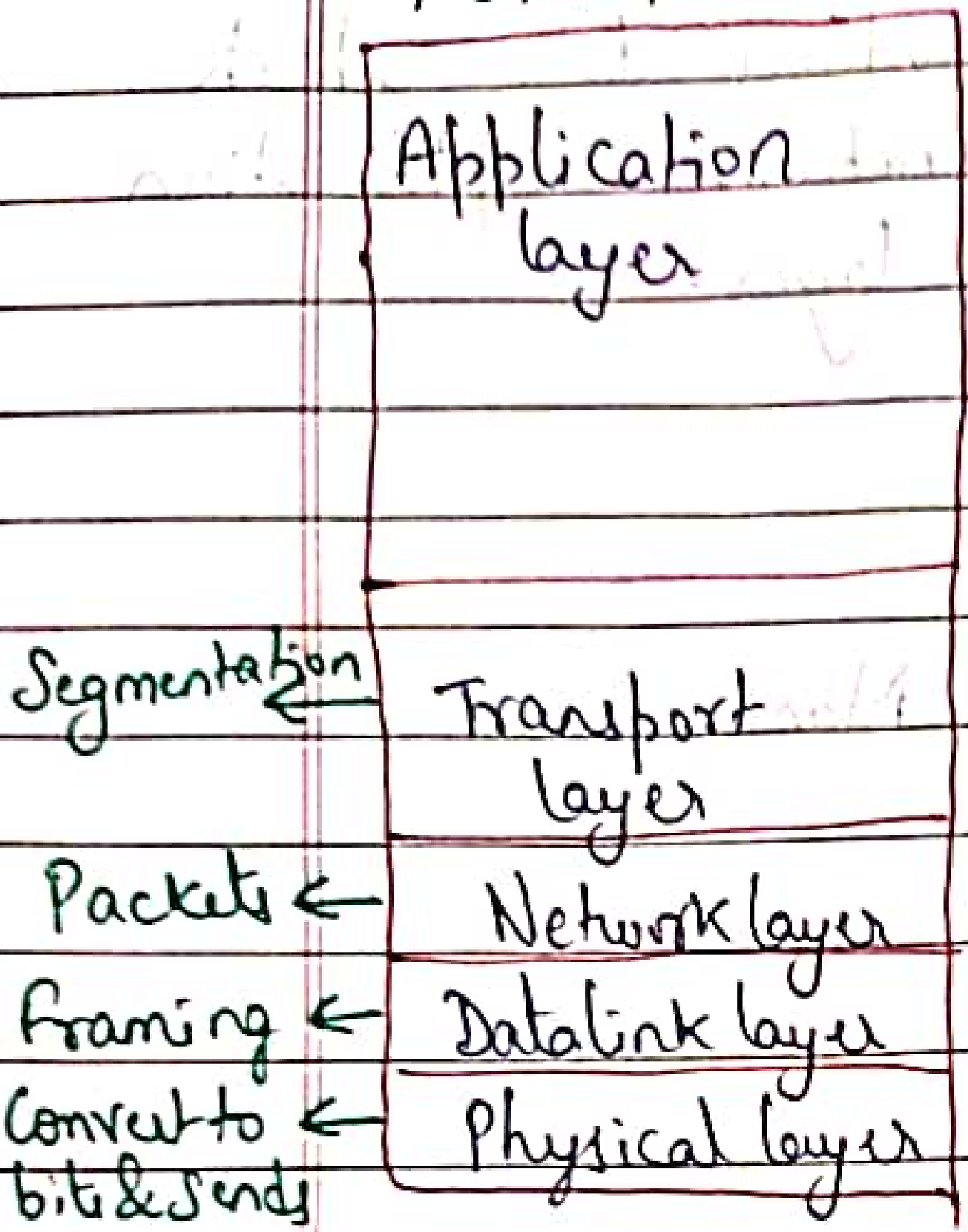
TCP/IP Model

The TCP/IP protocol suite was developed prior to the OSI Model. Therefore layers in TCP/IP do not match exactly with those in OSI Model. The original TCP/IP protocol suite was defined as four software layer built upon hardware. Today, however, TCP/IP is thought of as a 5 layer model with layer named similarly to ones in OSI Model.

TCP/IP is normally considered to be 5-layer system. The 5 layers are as follows :-

1) Application layer
2) Transport layer
3) Network layer
4) Data link layer.
5) Physical layer.

TCP/IP-5


Application layer
Segmentation
Transport layer
Packets
Network layer
Framing
Datalink layer
Convert to bits & Send
Physical layer

1) Application layer :- This layer includes application or processes that use transport layer protocol to deliver the data to destination computers. Some of popular application layer protocols are :-

HTTP, FTP, SMTP, SNMP, etc.

2) Transport layer :- This layer provides the backbone to data flow between two hosts. There are may protocol that work at this, but two most famous one are TCP & UDP.

TCP :- Speed does not matter. Secure & No data loss should be there. So, reliable connection uses this.

UDP :- In this Secure & No-data loss does not matter. Speed should be high. Used ~~when~~ for unreliable connections. Eg. Video streaming.

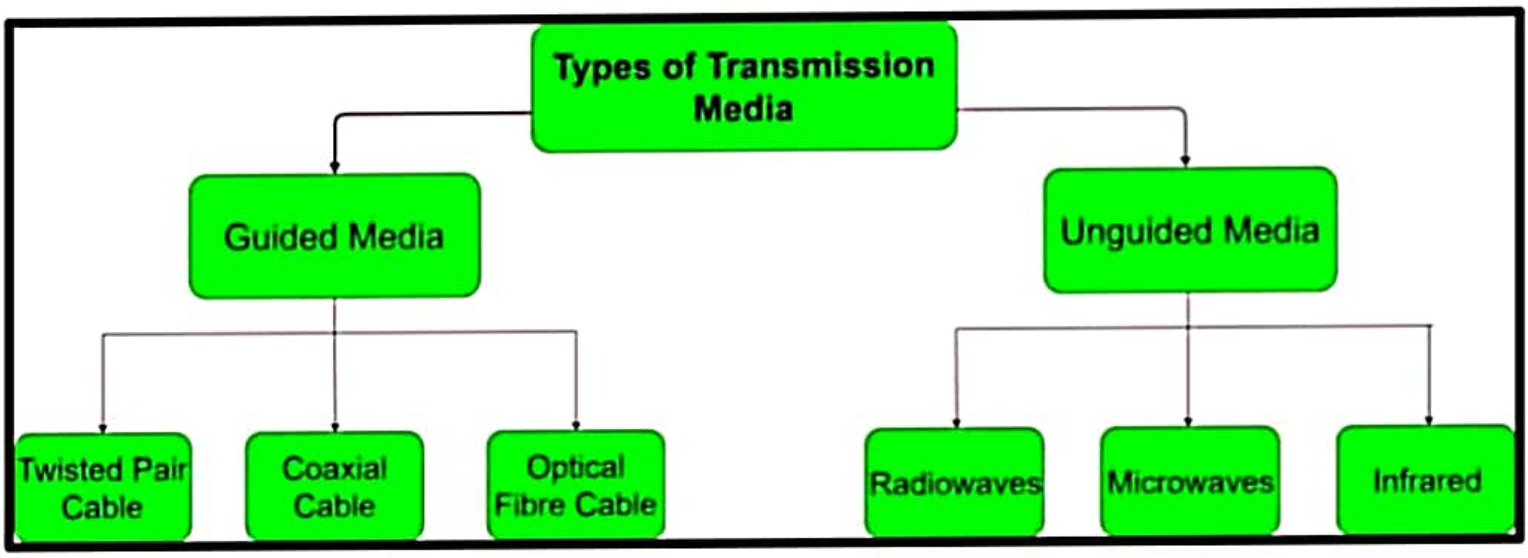
3) Network layer :- This is also known as Internet layer. The main purpose is to organize or handle the movement of data. The main protocol used at this layer is IP.

4) Data link layer :- Also known as network interface layer. It normally consist of device drives in the OS and the network interface card attached to the system. Both the device driver & network interface card take care of communication details with media being used to transfer the data over the network. Protocols used in this layer include ARP (Address resolution Protocol), PPP (Point to Point protocol), etc.

Guided Media and Unguided media:-

Types of Transmission Media

In data communication terminology, a transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one place to another. Transmission Media is broadly classified into the following types:



1. Guided Media:-

It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

- High Speed
- Secure
- Used for comparatively shorter distances

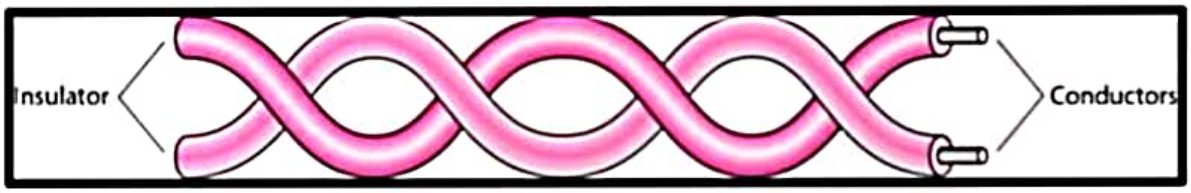
There are 3 major types of Guided Media:

(i) Twisted Pair Cable –

It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media.

One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference. The receiver uses the difference between the two.

In addition to the signal sent by the sender on one of the wires, interference (noise) and crosstalk may affect both wires and create unwanted signals.



Twisted Pair is of two types:

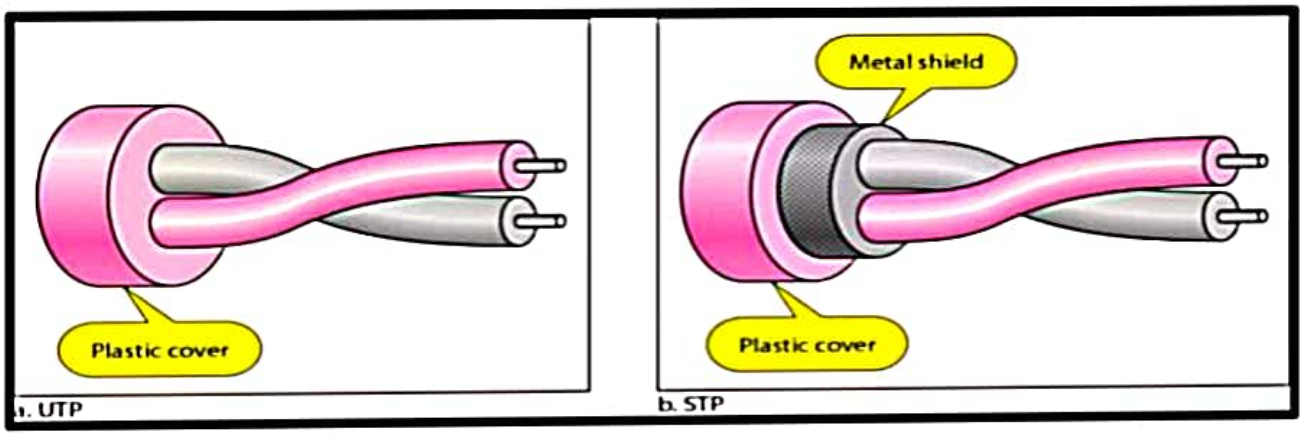
1. **Unshielded Twisted Pair (UTP):**
   This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.
   Advantages:

- Least expensive
- Easy to install
- High speed capacity

Disadvantages:

- Susceptible to external interference
- Lower capacity and performance in comparison to STP
- Short distance transmission due to attenuation

2. **Shielded Twisted Pair (STP):**
This type of cable consists of a special jacket to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.



Advantages:

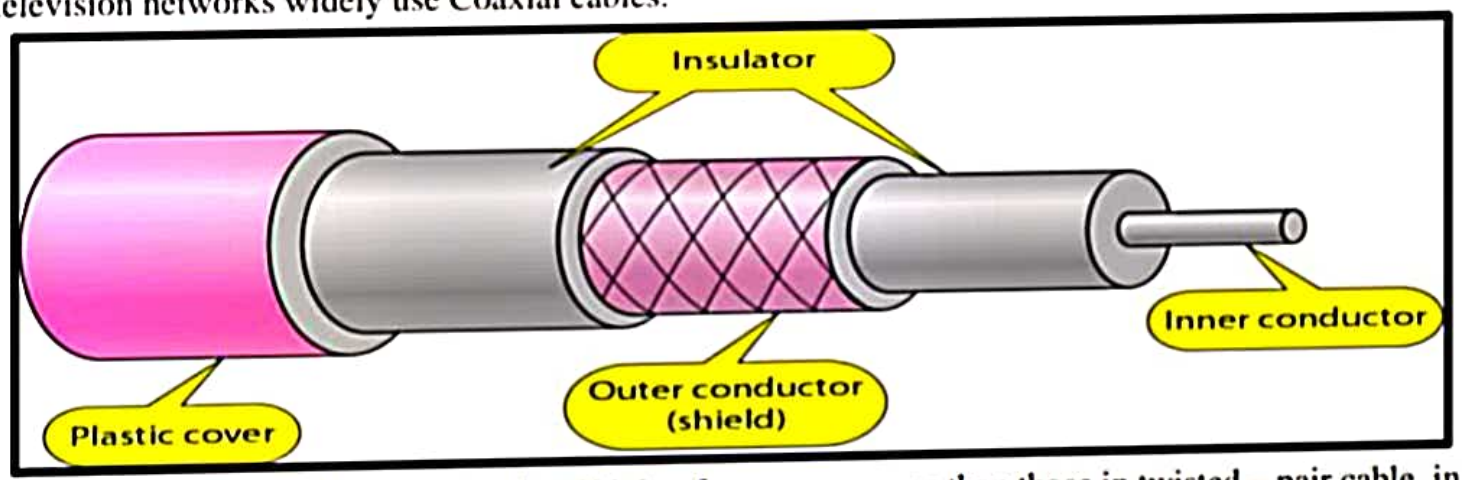
- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster

Disadvantages:

- Comparatively difficult to install and manufacture
- More expensive
- Bulky

(ii) Coaxial Cable –

It has an outer plastic covering containing 2 parallel conductors each having a separate insulated protection cover. Coaxial cable transmits information in two modes: Baseband mode (dedicated cable bandwidth) and Broadband mode (cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.



Coaxial cable (or coax) carries signals of higher frequency ranges than those in twisted – pair cable, in part because the two media are constructed quite differently. Instead of having two wires, coax has a

central core conductor of solid or stranded wire (usually copper) enclosed in an insulating sheath, which is, in turn, encased in an outer conductor of metal foil, braid, or a combination of the two. The outer metallic wrapping serves both as a shield against noise and as the second conductor, which completes the circuit. This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.

Advantages:

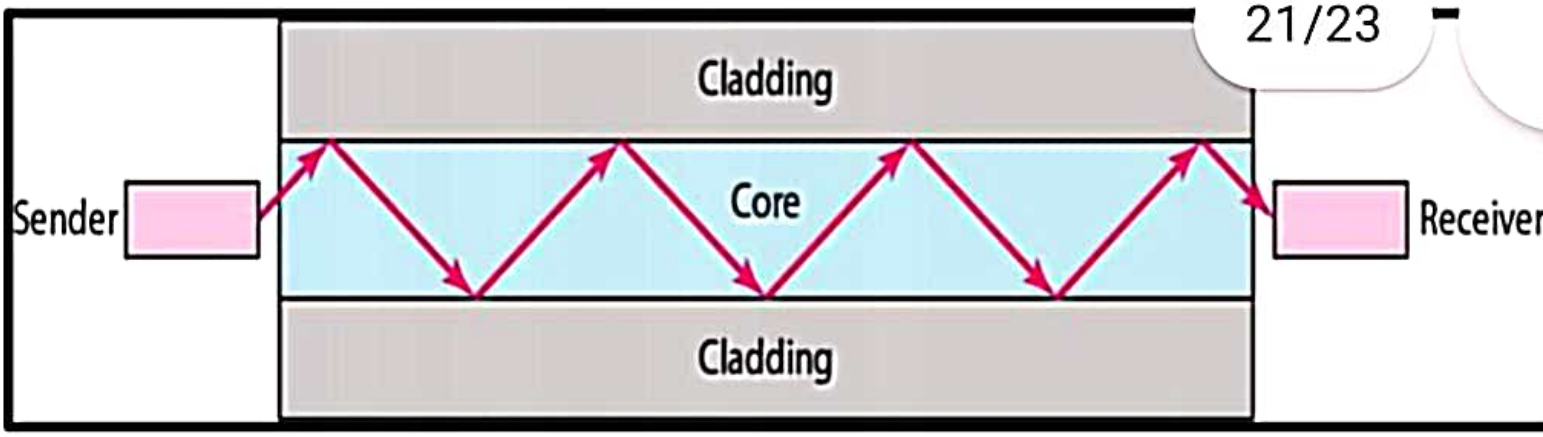
- High Bandwidth
- Better noise Immunity
- Easy to install and expand
- Inexpensive

Disadvantages:

- Single cable failure can disrupt the entire network

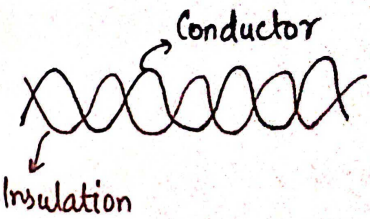
(iii) Optical Fiber Cable –

It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for transmission of large volumes of data. The difference in density of the two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refracted into it.



Types of WIRED MEDIA

(i) TWISTED PAIR CABLE:- It Consists of two identical wire's wrapped together in double helix.



Twisting of wires reduces Crosstalk. (Bleeding of Signal from one wire to another ↔ NOISE)

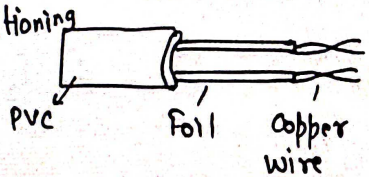
↳ also prevents from external form of signal interference.

Advantages:-
i) Simple
ii) Flexible
iii) Connected
iv) Easy to Install/main.
v) Low Weight
vi) Cheaper

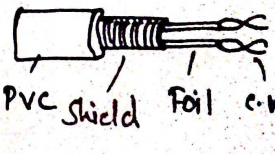
Disadvantages:-
i) ↑ attenuation (Loss of Signal) Carrying a signal for large dis. w/o repeater is problem
ii) Low bandwidth
iii) → 1 Mbps W/o Conditioning
→ 10 Mbps

Types of Twisted Pair Cables

UTP Cable — Unshielded Twisted Pair



STP Cable — Shielded T.P

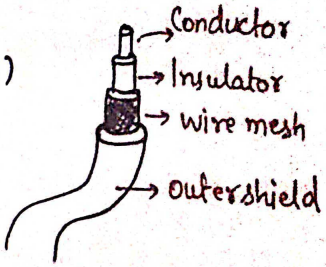


Types of WIRED MEDIA

Data Communication and Networking

(ii) CO-AXIAL CABLE:- Consists of Solid wire Core (Concentric Conductors) Surrounded by one or more foil/wire shields, each Separated by plastic insulator.

↳ Suitable for high-speed Comm^n and widely used in television Signals.



Advantages:-

i) Tr. ch. are better than twistedpair.

ii) Shared Cable N/w.

iii) Broadband tr^n.

iv) High B/W → 400 Mbps.

Disadvantages:-

i) Expensive Compare -to twisted pair.

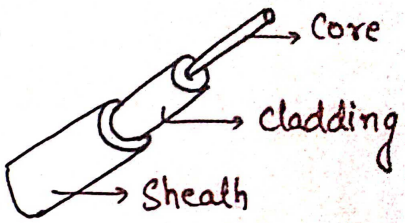
ii) Not Compatible with twisted pair.
- → thicker than thinnet
- → 500 metres long.

Types of Co-axial Cables.

Thicknet	Thinnet
thicker than thinnet	Much thinner
500 metres long.	185 m.

Types of WIRED MEDIA

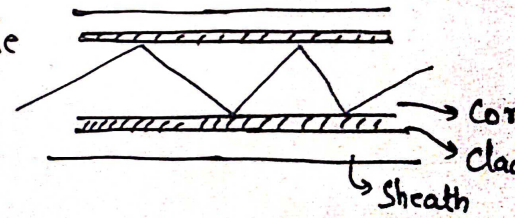
(iii) OPTICAL FIBERS:- It Consists of an inner glass core surrounded by a glass like material which has lower refractive index.



Parts of Fiber Cable:- (i) CORE :- Glass/Plastic through which light travels.

(ii) CLADDING :- Reflect light back to the core.

(iii) PROTECTIVE COATING :- Prevent the cable from hostile env.



It works on the Concept of Total Internal Reflection.

(i) $R.I_{core} > R.I_{cladding}$ IMP..

(ii) Angle of Incidence > Critical angle ϕ_c. IMP..

Type of fiber optic Cable:-

- Single Node:- 2 kms, 100 Mbps
- Multinode:- 100km, 2Gbps

Advantages:-

(i) Immune to elec./mech Interf.
(ii) Suitable for Harsh env.
(iii) Secure transmission.
(iv) Broadband tr.

Disadvantages:-

(i) Installation Prob.
(ii) Connecting two fibres
(iii) Light out of phase
(iv) Conn^n loss
(v) Most expensive.

Circuit Switching & Packet Switching :-

Circuit Switching :- Circuit Switching establish a physical path between the sender and receiver before a message is delivered. When a connection is established between a sender and a receiver, the entire message travel through the established path from sender to the receiver. Once message is delivered, the source informs the network about the completion of transmission and all the switches released. Then the link and other connecting device are used for setting of another connection.

Circuit Switching is always implemented at Physical layer.

Packet Switching :- It is connectionless as it does not establish any physical connection before transmission starts. In packet switching before the message is transmitted, it is divided into some manageable parts called packets. These packets are routed one by one from source to destination. In packet switching, each packet may follow a different route to reach destination. Packets arrived at the destination are out of order but, they are assembled in order before the destination forward it to the upper layer.

Packet Switching is always implemented at the Network layer.

Difference between Circuit Switching & Packet Switching:

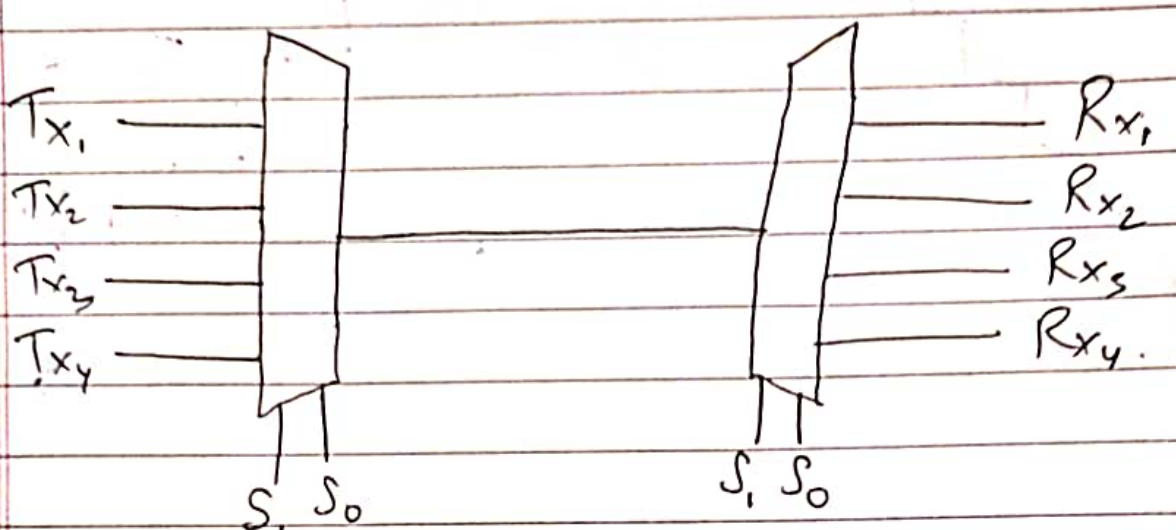
Circuit Switching	Packet Switching
1. Connection is established first then the data flows.	1. Message breaks into packets first, then stores and then travels.
2. No need of storage.	2. Storage is Needed.
3. Fast travel.	3. Less speed
4. It is implemented at physical layer.	4. It is implemented at Network Layer.
5. Message is received in the order, sent from the source.	5. Packet of a message are received out of order and assembled at the destination.

Multiplexing

Multiplexing is used in the cases where the signal of lower bandwith and transmitting media is having higher bandwidth.

Multiplexing is process of combining multiple signal into one signal. Device which does multiplexing is called MUX. It reverse process i.e. extracting the

channel from one channel is called demultiplexing. Device which does it is called DEMUX.



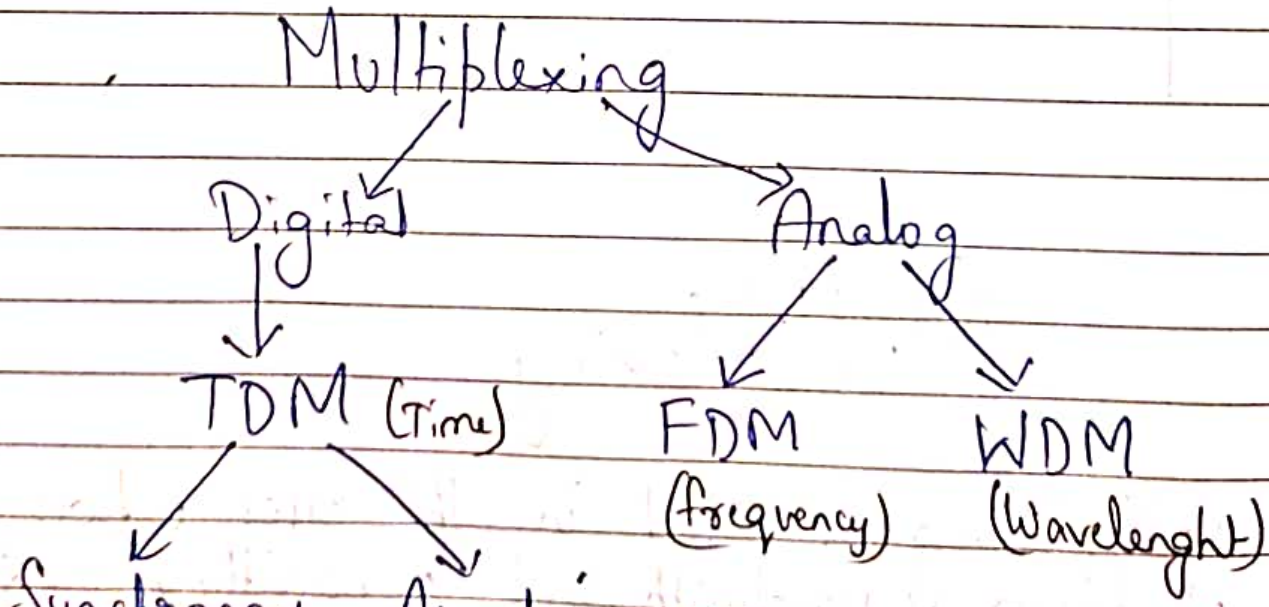
4x1 MUX

0	0
0	1
1	0
1	1

1x4 DEMUX

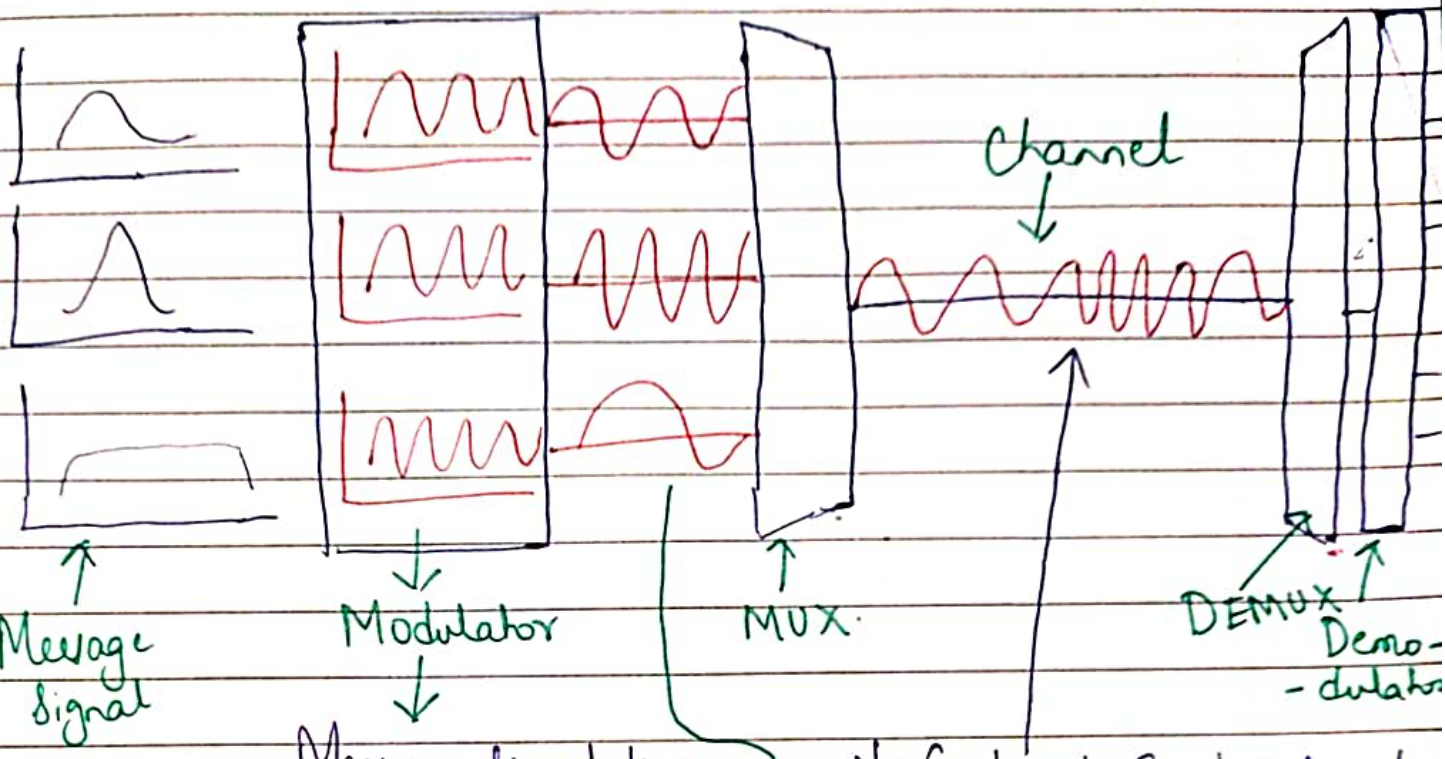
0	0
0	1
1	0
1	1

Rx_1	Rx_2	Rx_3	Rx_4
1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1



DM → Dimension Multiplexing

(a) FDM [Frequency Division Multiplexing]

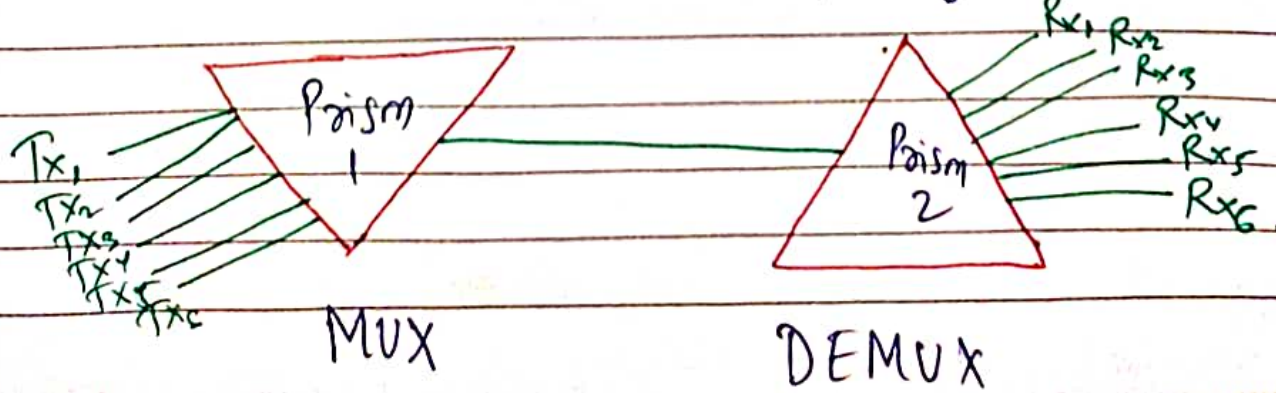


Message signal ko Carrier signal pe super impose karega.

* Combined Bandwidth of all the carrier signal should be less than the Channel Bandwidth.

(b) WDM [Wavelength Division Multiplexing] :-

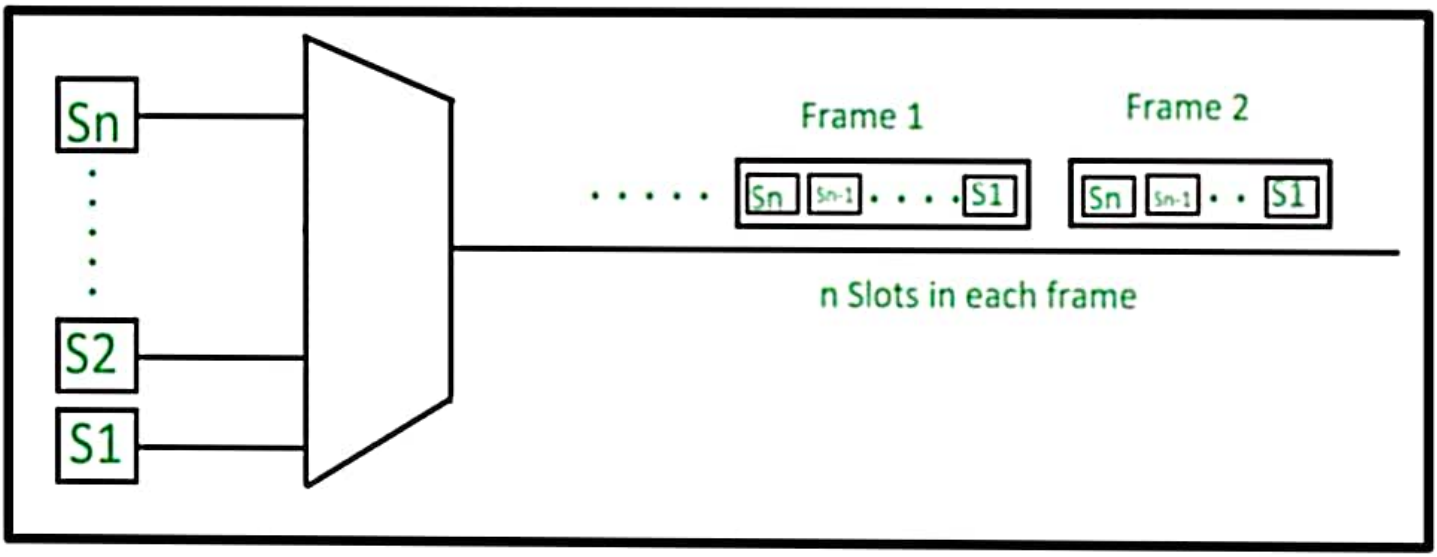
It is an analog technique in which many data stream of different wavelength are transmitted in the light spectrum. If wavelenght increases frequency decreases. A prism which can turn different wavelenght into one line can be used as output of MUX & input of DEMUX



Time Division Multiplexing (TDM):-

This happens when data transmission rate of media is greater than that of the source, and each signal is allotted a definite amount of time. These slots are so small that all transmissions appear to be parallel. In frequency division multiplexing all the signals operate at the same time with different frequencies, but in time division multiplexing all the signals operate with same frequency at different times.

In TDM, the time frame is divided into slots. This technique is used to transmit a signal over a single communication channel, by allotting one slot for each message.

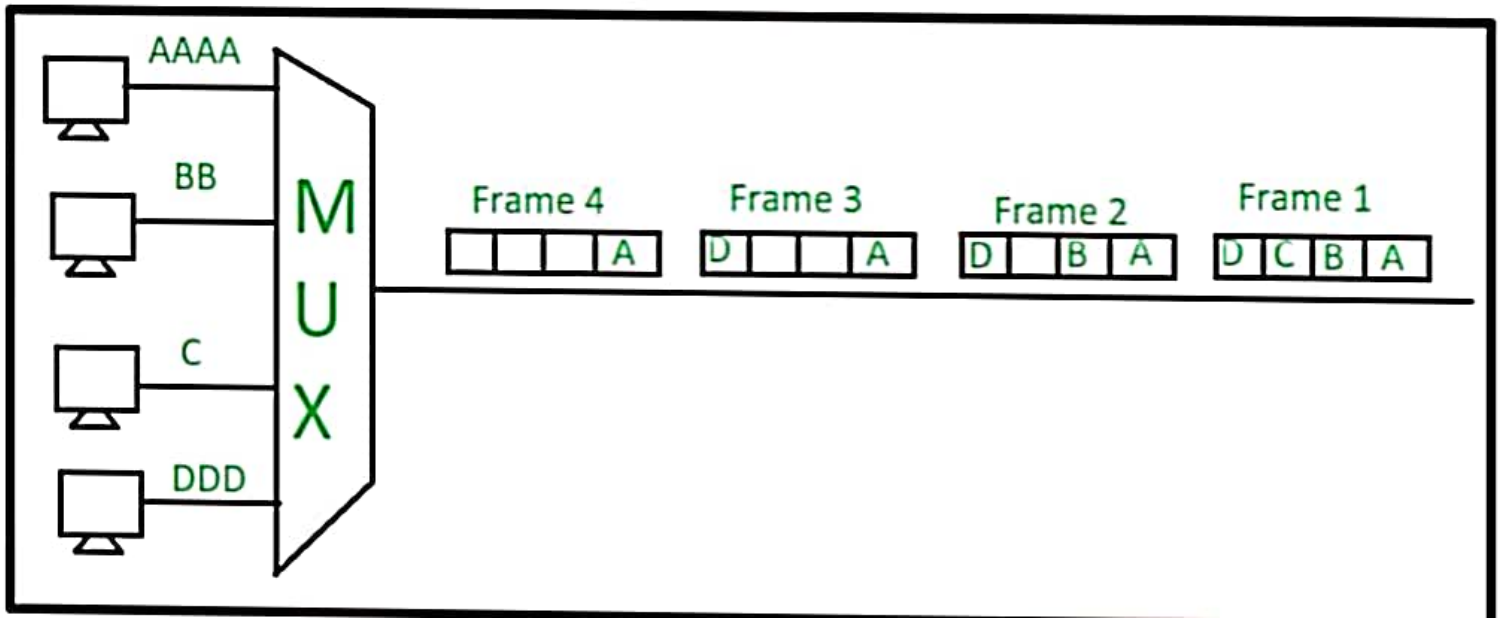


The main ones are **Synchronous and Asynchronous TDM.**

Synchronous TDM

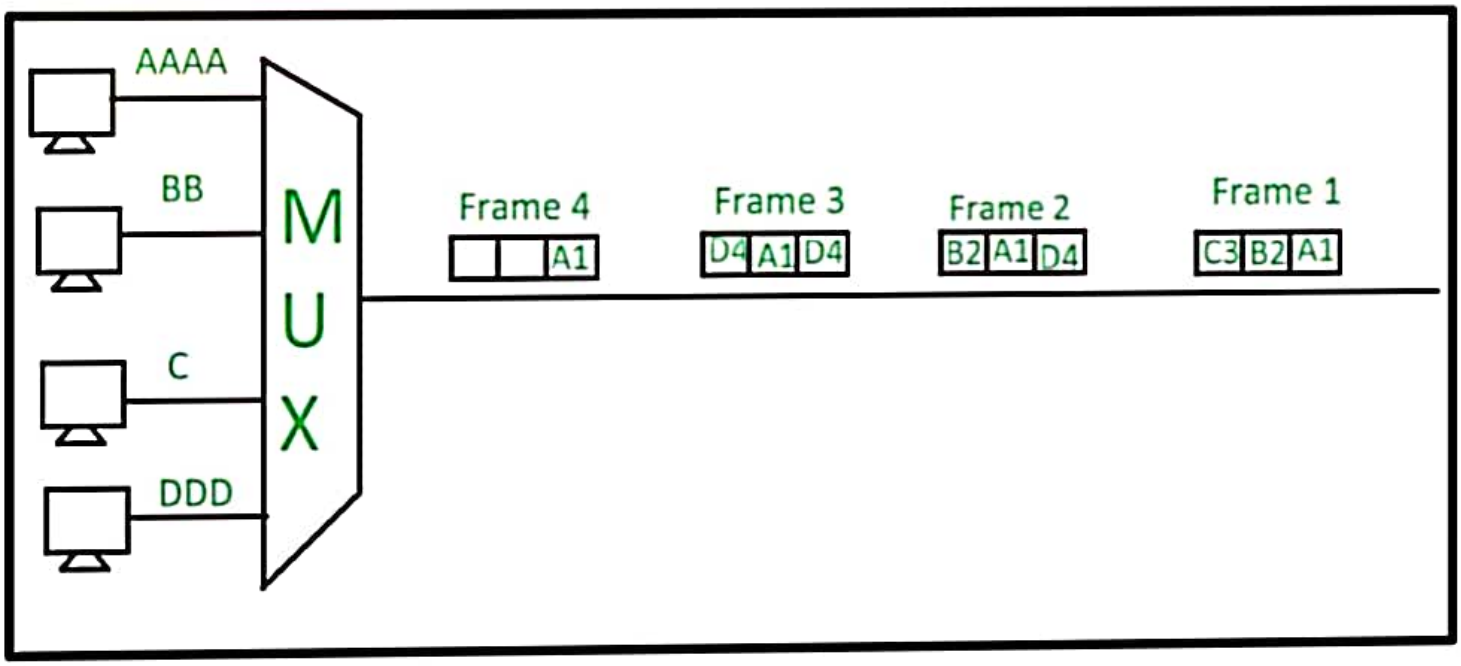
In Synchronous TDM, the input is connected to a frame. If there are 'n' number of connections, then the frame is divided into 'n' time slots. One slot is allocated for each input line.

In this technique, the sampling rate is common for all signals and hence the same clock input is given. The MUX allocates the **same slot** to each device at all times.



Asynchronous TDM

In Asynchronous TDM, the sampling rate is different for each of the signals and a common clock is not required. If the allotted device, for a time slot transmits nothing and sits idle, then that slot is **allotted to another** device, unlike synchronous. This type of TDM is used in Asynchronous transfer mode networks.



Difference between TDM and FDM:

.NO	TDM	FDM
1.	TDM stands for Time division multiplexing.	FDM stands for Frequency division multiplexing.
2.	TDM works with digital signals as well as analog signals.	While FDM works with only analog signals.
3.	TDM has low conflict.	While it has high conflict.
4.	Wiring or chip of TDM is simple.	While it's wiring or chip is complex rather than simple.
5.	TDM is efficient.	While it is inefficient.
6.	In TDM, time sharing takes place.	While in this, frequency sharing takes place.
7.	In TDM, synchronization pulse is necessary.	While in it Guard band is necessary.

Switching → Process of fwdg. Packets coming from one port to another port.

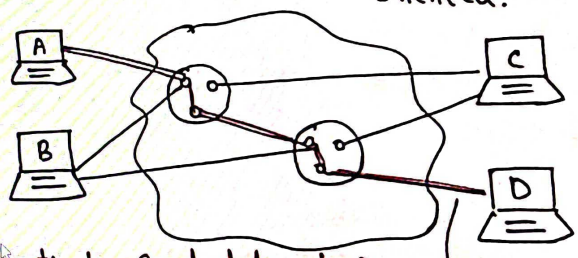
Switching Methods

Switching Sends data along different routes.

Switching → Connectionless
→ Connection-Oriented.

(i) CIRCUIT SWITCHING:- It is a transmission mode that involves setting up a dedicated end to end Connⁿ.
- ↳ Commonly used in Telephone Systems.
- ↳ Connection Oriented.
- ↳ No delay in data flow
- ↳ Link of the Connⁿ Can't be used to send any other data even when free.
- ↳ More bandwidth is required.
- ↳ Connⁿ establish time is more.

Three Phases:-
- ↳ i) Circuit establishment
- ii) Data Transfer
- iii) Circuit disconnection.



A wants to send data to D.

Circuit Switching.

→ Route for A→D.

Data Communication and Networking

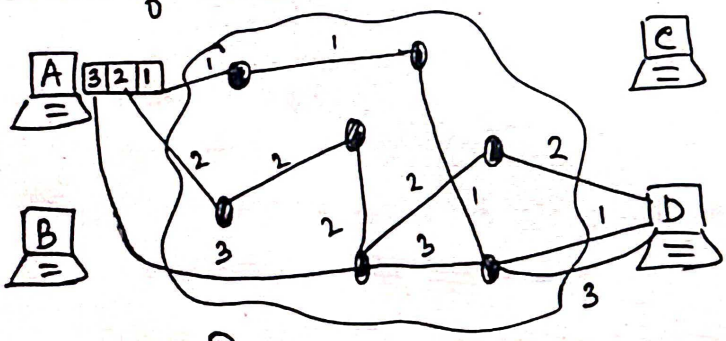
(iii) **PACKET SWITCHING**:- In this Messages are broken up into packets.

↳ Individual Packets take different routes to reach the destination.

↳ Advantages:- (i) Required Bandwidth ↓

(ii) In Link failure diff. route can be chosen for rcvng. packets.

Datagram Packet Switching:- Message is divided into Stream of Packets.



Packet Switching

Virtual Circuit Packet Switching:-

Logical connection is establish blw the sending and receiving devices.

↳ All the packets travel through the logical conn^{n} → Virtual Circuit.

- → ↑ the bandwidth
- → ↓ transmission delay
- → Large amount of RAM is required.
- → Requires ↑ Processing Power.

A wants to send msg. to D.

Reassembly of Packets 1 2 3