

Computer Communication

Unit - 1

Communication :- Communication is the exchange of information between two or more things.

Data Communication :- It is the exchange of data between two or more computing devices.

Characteristics of Computer Communication :-

- 1) Reliable
- 2) Low cost
- 3) Jitter → [Same data is received or not]
- 4) Transmissible

Categories in Computer Communication :-

- 1) Message
- 2) Sender
- 3) Receiver
- 4) Transmission Medium (Wired / Wireless).
- 5) Protocol → (Set of rules) → Eg. TCP/IP .

Advantages of Computer Communication :-

- 1) Fast and Easy
- 2) Low Cost

Evolution of Computer Network :-

1969 → Department of US Defence developed ARPANET (Advance Research Project Agency for Network). It is used for university and department of defence.

1980's → NSFNET (National Science Federation Foundation Network) was developed. It is used for more university and some public sector department.

1990's → Some businessmen established their own network.

1995 → ARPANET + NSFNET + Private Network.

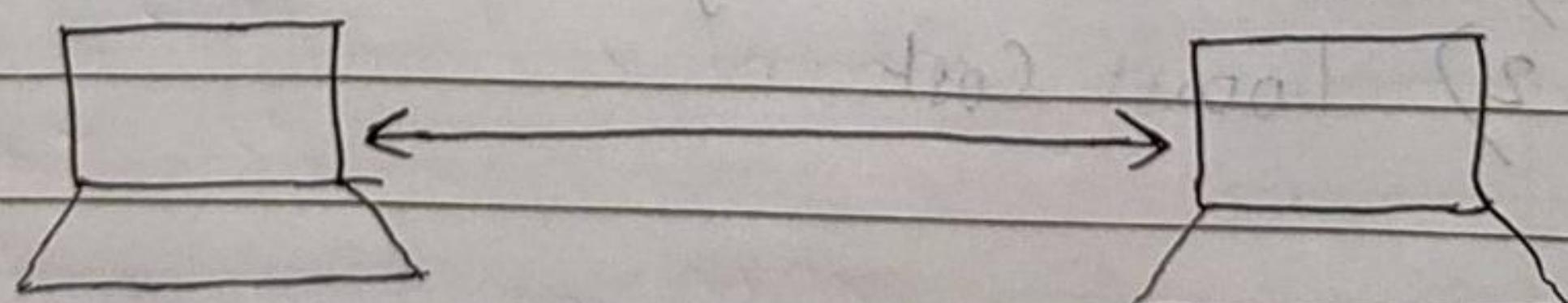
together called as Internet

* first message ever sent → "login"
What received → "Lo".

In Internet, data is transferred in form of packet.

Types of Networks / Communication :-

1) Point to Point Network :-



2) Point to Multiple Network :-

Types of Networks :-

1) LAN (Local Area Network) :- It is a group of computers connected to each other in a small area such as building, office, etc.

It is less costly as it is built with inexpensive hardware. The data is transferred at an extremely fast rate in LAN. It provides higher security.

Application of LAN :-

- * One of the computer in a network can become a server serving all the remaining computer called client.
- * Software can be stored on the server and it can be used by all remaining client.
- * Sharing common resources like printer, etc are some common application of LAN.

Advantage of LAN :-

- a) Resource Sharing :- Resource like printer, modem, CD-ROM, etc can be shared with help of LAN.
- b) Software Application Sharing :- It is cheaper to use same software over network instead of buying separate license for each client.
- c) Easy and cheap communication
- d) Centralized Data
- e) Data Security.

Disadvantage of LAN :-

- a) High Setup Cost
- b) Privacy violation
- c) Data Security Threat
- d) Lan Maintenance Job
- e) Covers Limited Area

2) PAN (Personal Area Network) :-

It is a network arranged within an individual person. It is used for connecting computer devices of personal use known as Personal Area Network. Thomas Zimmerman brings this idea.

3) MAN (Metropolitan Area Network) :-

It is a network that connects covers a larger geographical area by interconnecting a different LAN to form large network. Government agencies use MAN to connect to citizens and private industries.

Eg:- RS-232, Frame Relay, ATM, ISDN, etc.

Characteristics :-

- It covers towns and cities.
- Communication medium used are optical fibres, cables, etc.

Application :-

- Used to communicate between bank in a city.
- Used in Airline Reservation.
- It can be used for communication in military.

Advantages :-

- Extremely efficient & provide fast communication via high-speed cable.
- Dual bus used in MAN helps the transmission of data in both direction.

4) WAN (Wide Area Network) :- It is a network that covers large distance such as cover state of a country. It is not easy to design and maintain.

Example :- Mobile Broadband, Last mile, etc.

Characteristics :-

- Cover large distance (countries, continent, etc).
- Communication medium used are satellite, public telephone network which are connected by routes.

Advantage :-

- 1) Large Geographical Area
- 2) Centralized Data
- 3) Fast Exchange of Message
- 4) Global Business
- 5) High bandwidth

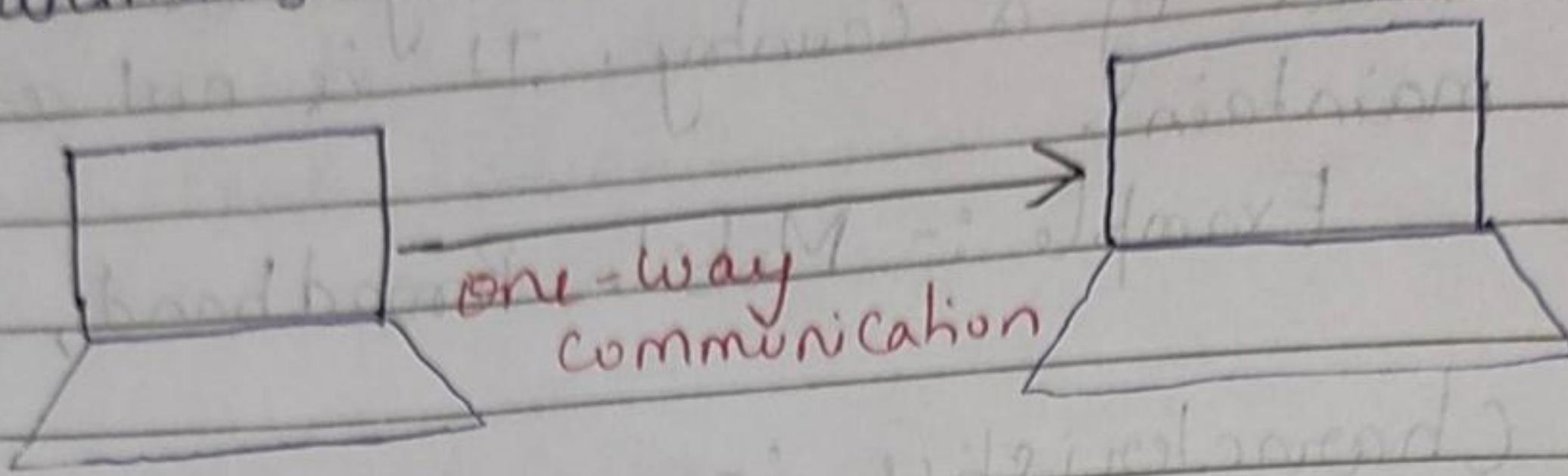
Disadvantage :-

- 1) Security Issues
- 2) Need Firewall & antivirus Software.
- 3) High Setup Cost
- 4) Troubleshooting problem.

Transmission Modes of Data :-

- 1) Simplex
- 2) Half-Duplex
- 3) Full - Duplex

1) Simplex :- In Simplex mode the data transmits in one direction only.



Eg :- T.V, Radio, Printer, Keyboard, etc.



Advantage :-

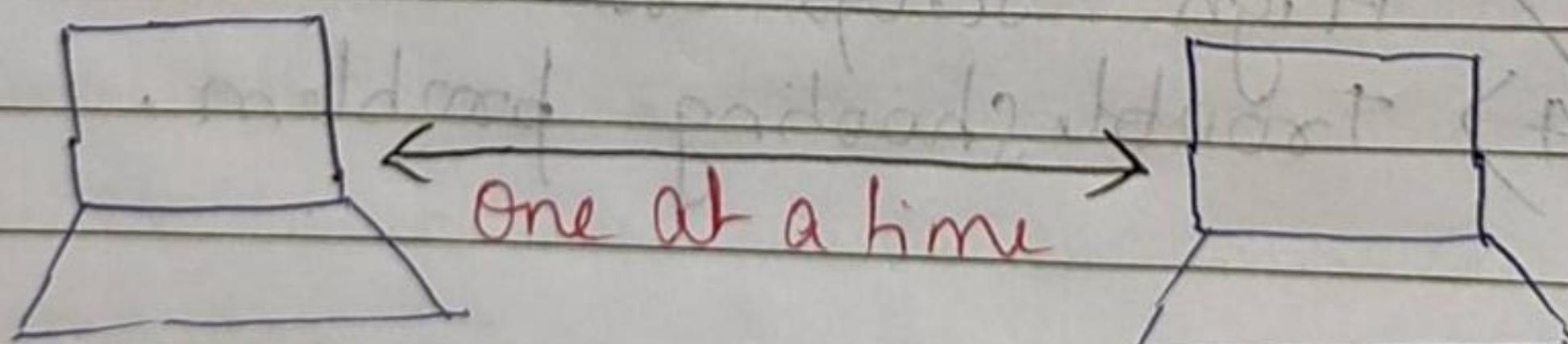
Since there is one-way communication, there is no traffic issues.

Disadvantage :-

No bidirectional communication is possible.

2) Half-Duplex :- In half-duplex mode,

transmission can be done in both ways but not at the same time. If one device is sending data, then other device cannot send data until it reaches and vice-versa.

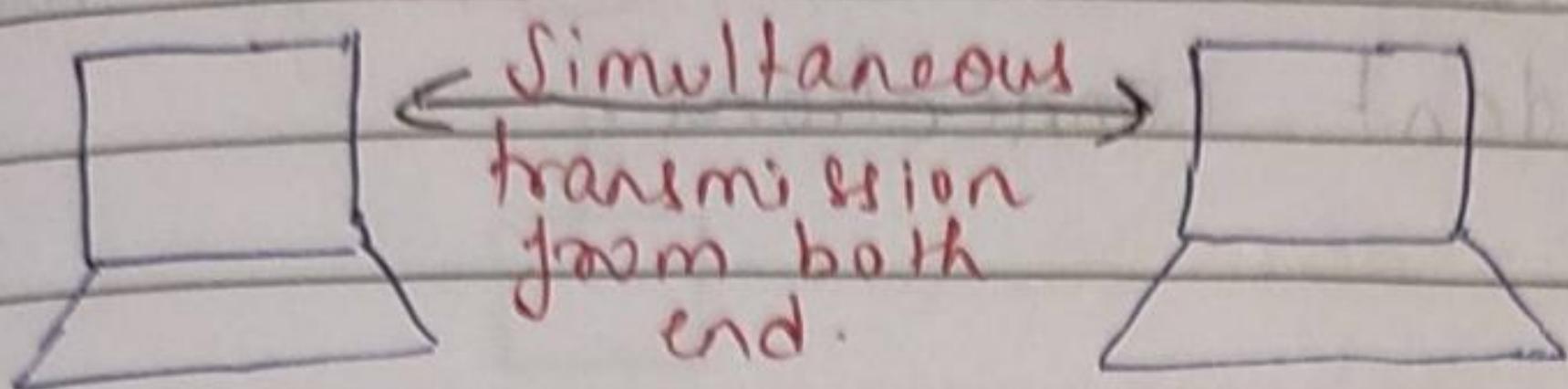


Ex → Walkie-talkie.

Advantage :- Both can send or receive data and whole bandwidth can be utilized as only one data transmit at a time.

Disadvantage :- No simultaneous transmission of data.

3) Full-Duplex :- In this, both the devices can send and receive data simultaneously.



Ex :- Mobile Phone, Telephone, etc.

Advantage :- No delay in communication as both can send or receive data simultaneously.

Disadvantage :- No proper bandwidth utilization.

Bandwidth order :-

Simplex < Half-Duplex < Full-Duplex.

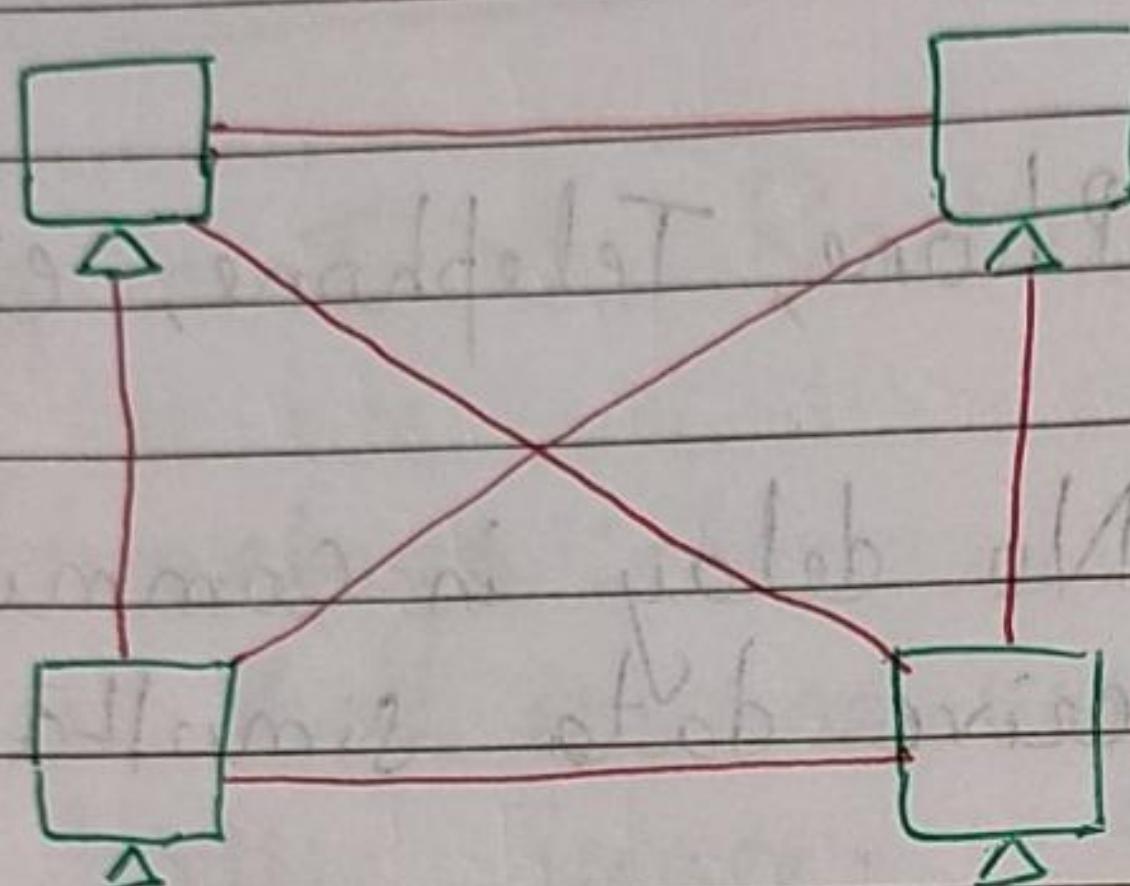
Network Topology :-

* Topology :- Physical or logical arrangement of devices.

Following are the 6 common topologies of Computer Networks :-

- (a) Mesh Topology
- (b) Bus Topology
- (c) Ring Topology
- (d) Star Topology
- (e) Tree Topology
- (f) Hybrid Topology.

1> Mesh Topology :- It is an arrangement of the network in which computer are interconnected with each other through various redundant connections.



$$\text{No. of cables} = \frac{n(n-1)}{2}$$

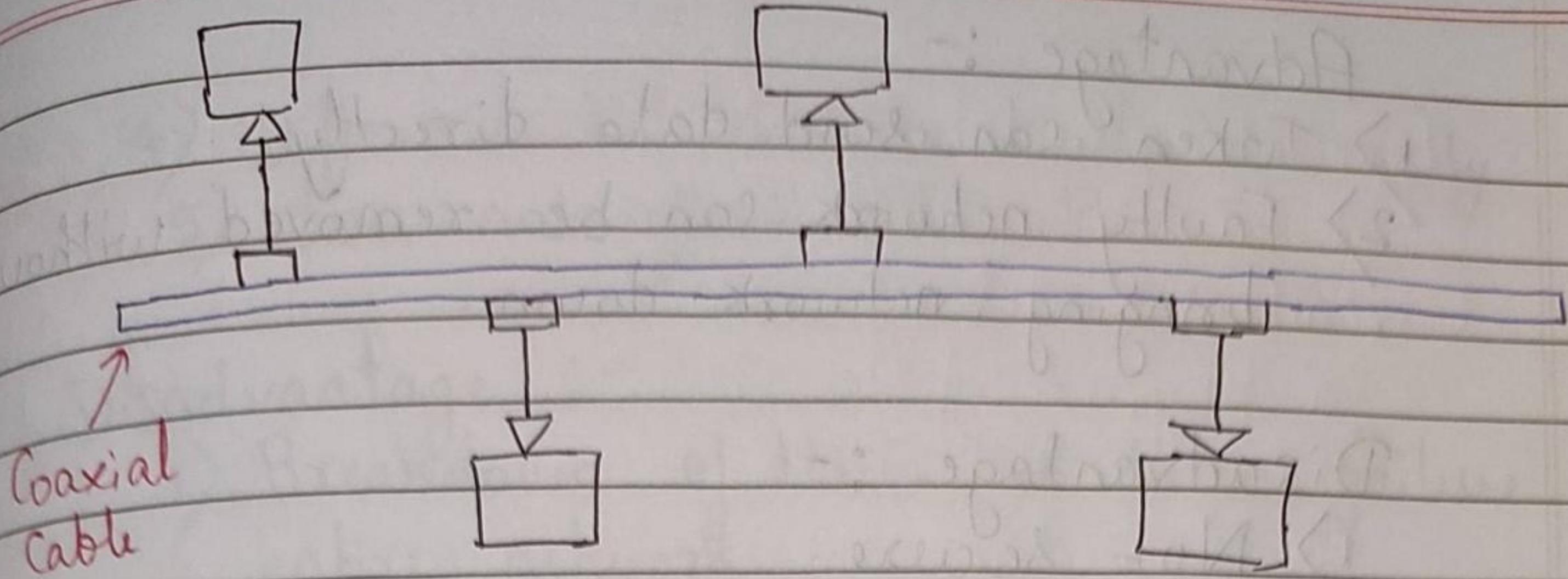
Advantage :-

- 1> Fast Communication
- 2> Secure
- 3> Reliable

Disadvantage :-

- 1> Hard to find fault
- 2> Not easy to connect new P.C.
- 3> Difficult to management
- 4> High cost and less efficient.

2> Bus - Topology :- It is designed in such a way that all stations are connected through single cable known as back-bone cable.



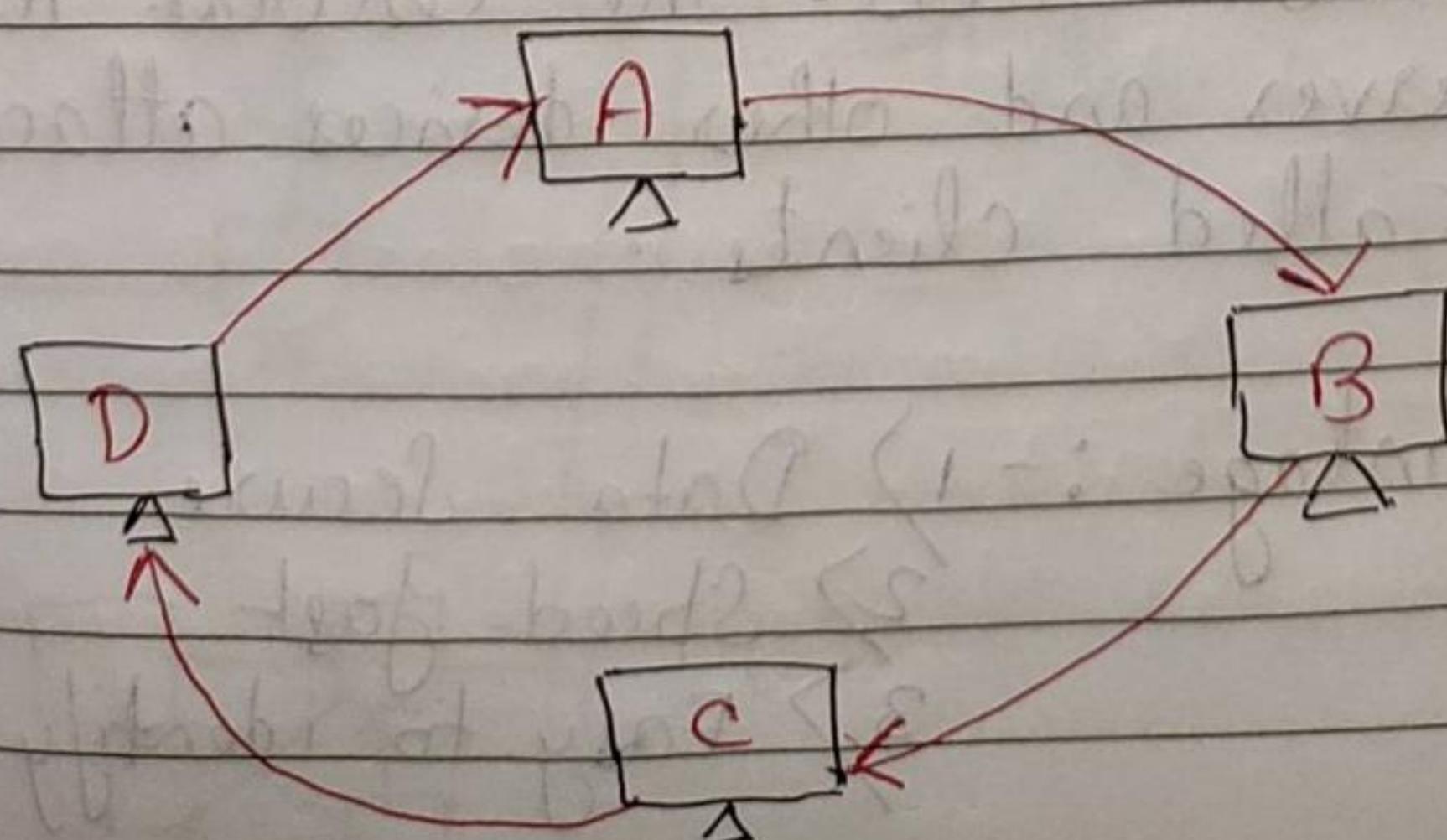
Advantage :-

- 1) Easy to find fault.
- 2) Easy to connect new P.C.
- 3) Low cost.
- 4) Failure in one node will not affect other node.

Disadvantage :-

- 1) Not secure.
- 2) Slow speed.

3) Ring Topology :- It is like a bus topology, but with connected end. It is based on token. A token moves around the network, and it passes from computer to computer until it reaches the destination.



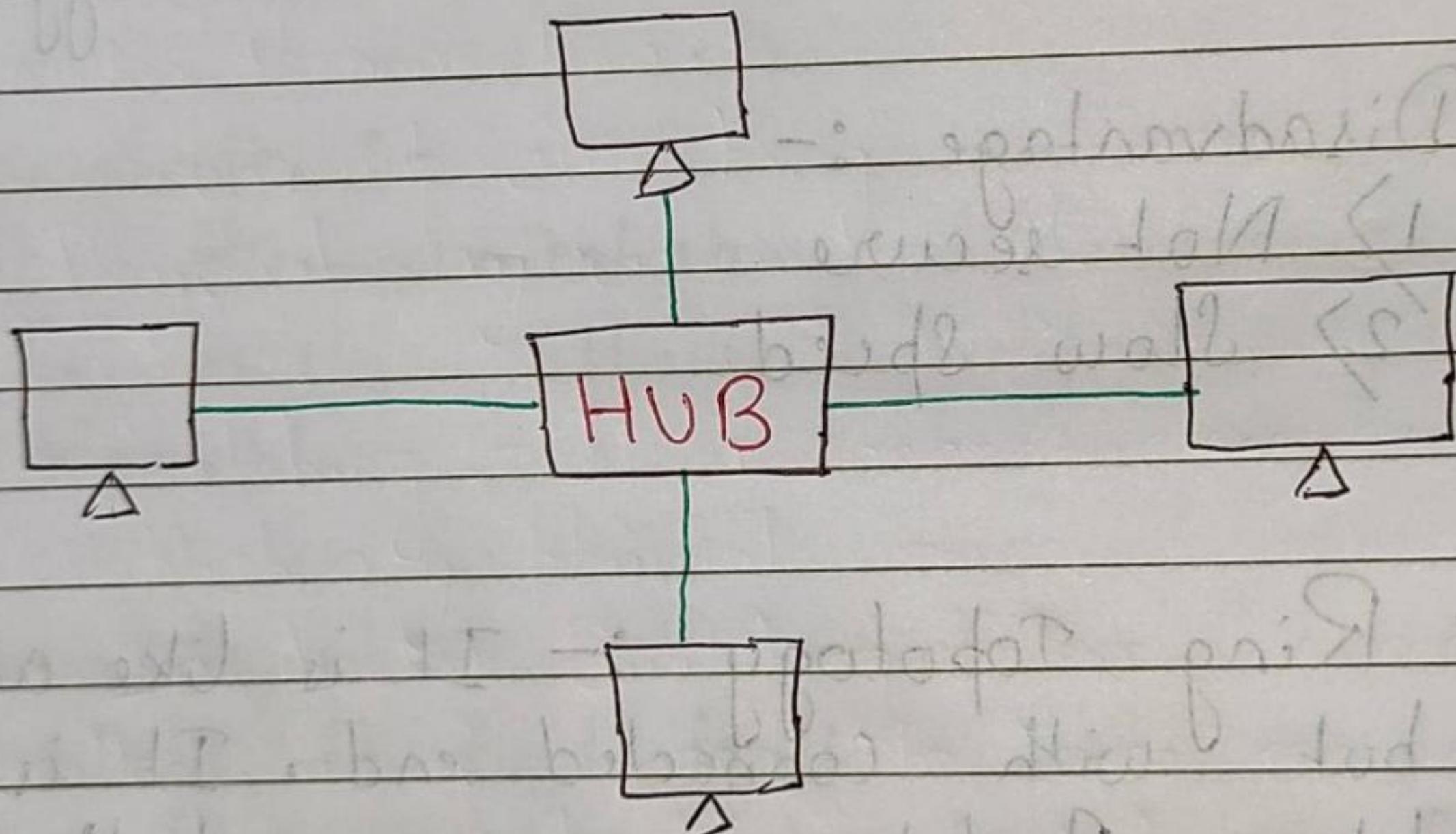
Advantage :-

- 1) Token can send data directly.
- 2) Faulty network can be removed without bringing network down.

Disadvantage :-

- 1) Not secure.
- 2) Slow Speed
- 3) Not easy to add new PC.
- 4) Breakdown of one results in failure of overall network.

4) Star Topology :-



Star topology is an arrangement of the network in which every node is connected to the central hub. The central hub is known as server and other devices attached to server is called clients.

Advantage :- 1) Data Secure

2) Speed fast

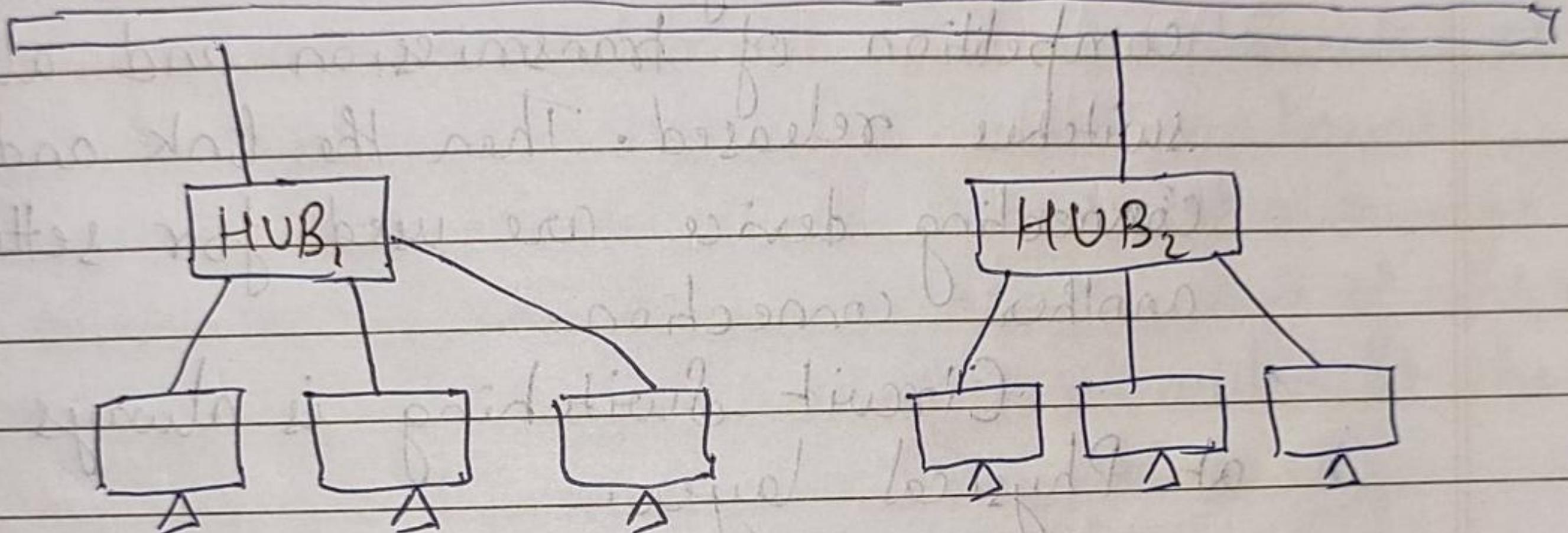
3) Easy to identify fault.

- 4) Different PC can be connected easily.
- 5) Does not affect other PC.

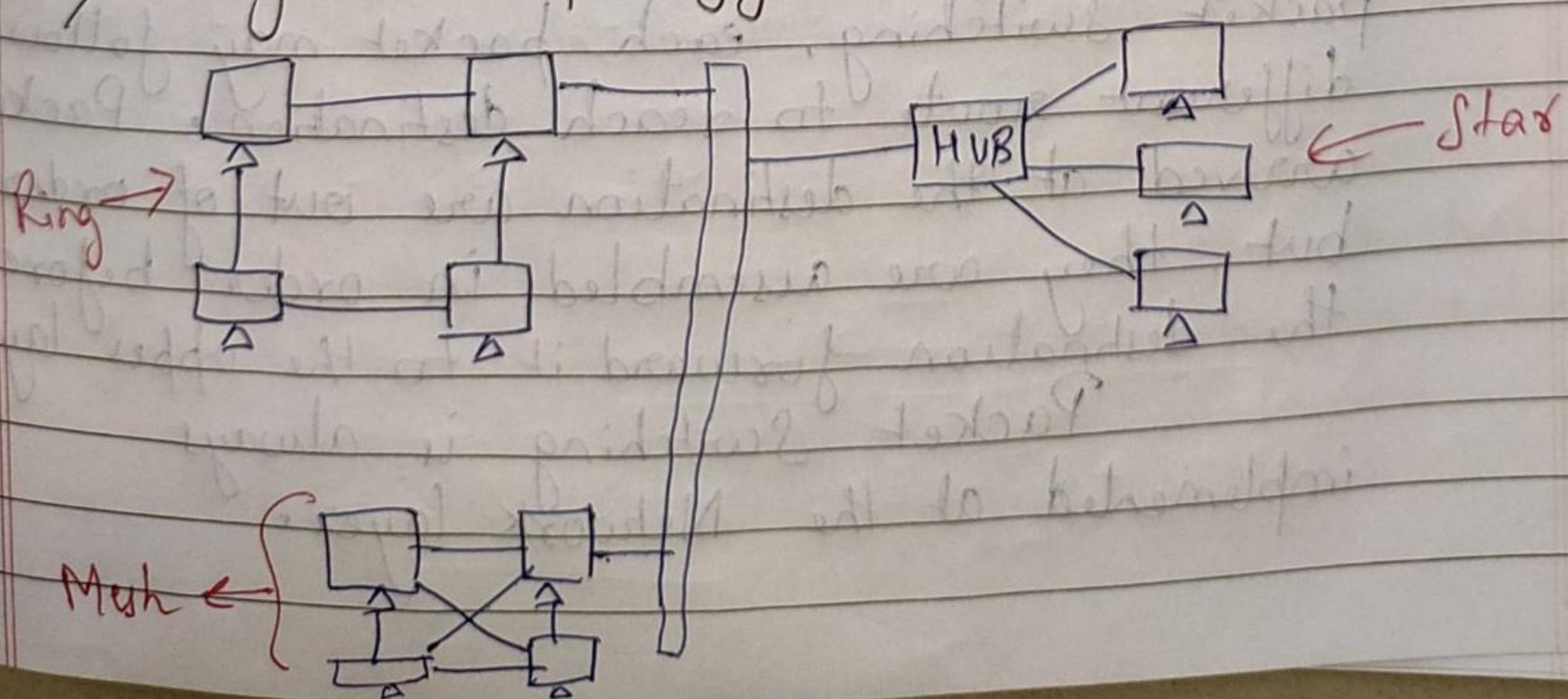
Disadvantage :-

- 1) Breakdown of HUB result in failure of entire network.

5) Tree Topology :- (Bus & Star)



6) Hybrid Topology :- (Bus, Ring, Mesh, Star)



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

1. Connection is established first then the data flows.
2. No need of storage.
3. Fast travel.
4. It is implemented at physical layer.
5. Message is received in the order sent from the source.

Packet Switching

1. Message breaks into packets first, then stores and then travels.
2. Storage is Needed.
3. Less speed.
4. It is implemented at Network Layer.
5. Packet of a message are received out of order and assembled at the destination.

Protocols and Standards :-

Protocols :- A protocol is a set of rules that govern communication.

It basically defines what is communicated, how it is communicated, and when it is communicated.

Key elements of protocols :-

① Syntax :- Syntax refers to the structure or format of the data, meaning the order in which they are presented.

⑥ Semantic :- Semantic refers to meaning of each section of bits.

⑦ Timing :- The timing refers to two characteristics when data should be sent and how fast it can be sent.

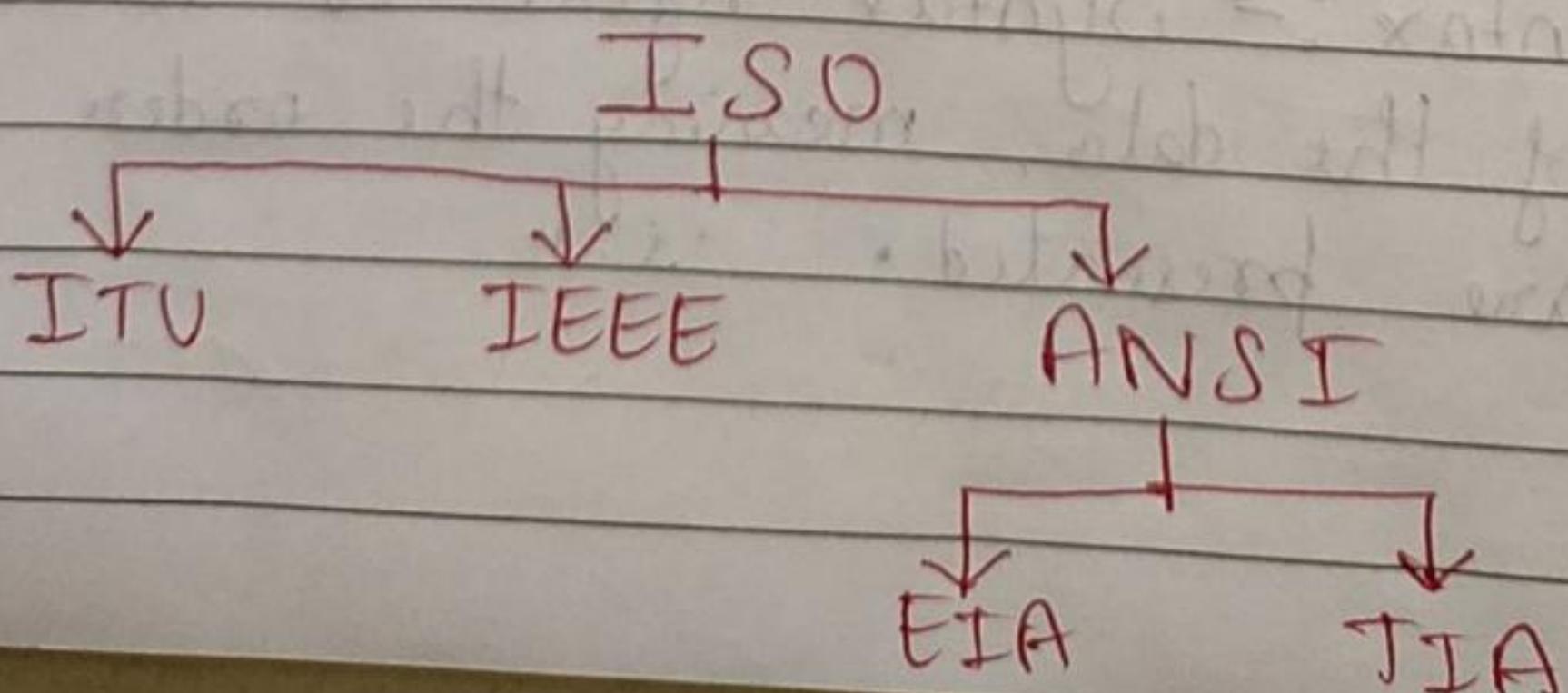
Standards :- Standard are essential in creating and maintaining an open and competitive market for equipment manufacturer and also in guaranteeing national and international interoperability of data and telecommunication process.

Data Communication Standard fall into two categories :-

① De-facto :- (It means "by fact" or "by convention")
These standards that have not been approved by an organised body but have been adopted as standard through widespread use are known as de-facto standard.

Example :- MS office and various DVD standard

② De-jure :- (meaning "by law" or "by regulation").
De-jure standard are those which have been legalised by an officially recognized body.

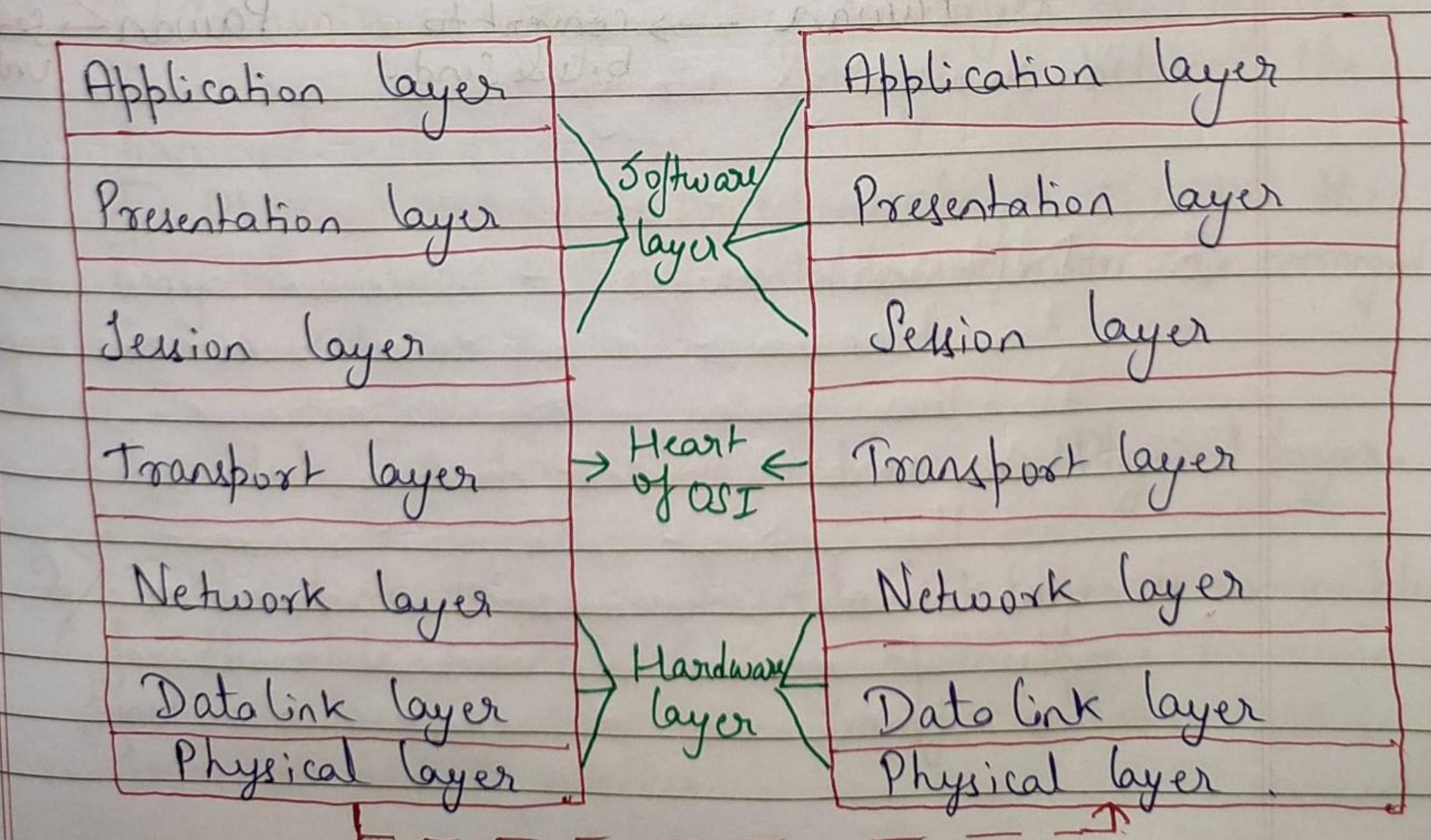


* Some abbreviation :-

1. ISO :- International Standards Organization
2. ITU :- International Telecommunication Union.
3. ANSI :- American National Standards Institute.
4. IEEE :- Institute of Electrical & Electronics Engineers.
5. EIA :- Electronic Industries Association.
6. TIA :- Telecommunication Industry Association.

V.N.Imp OSI Model

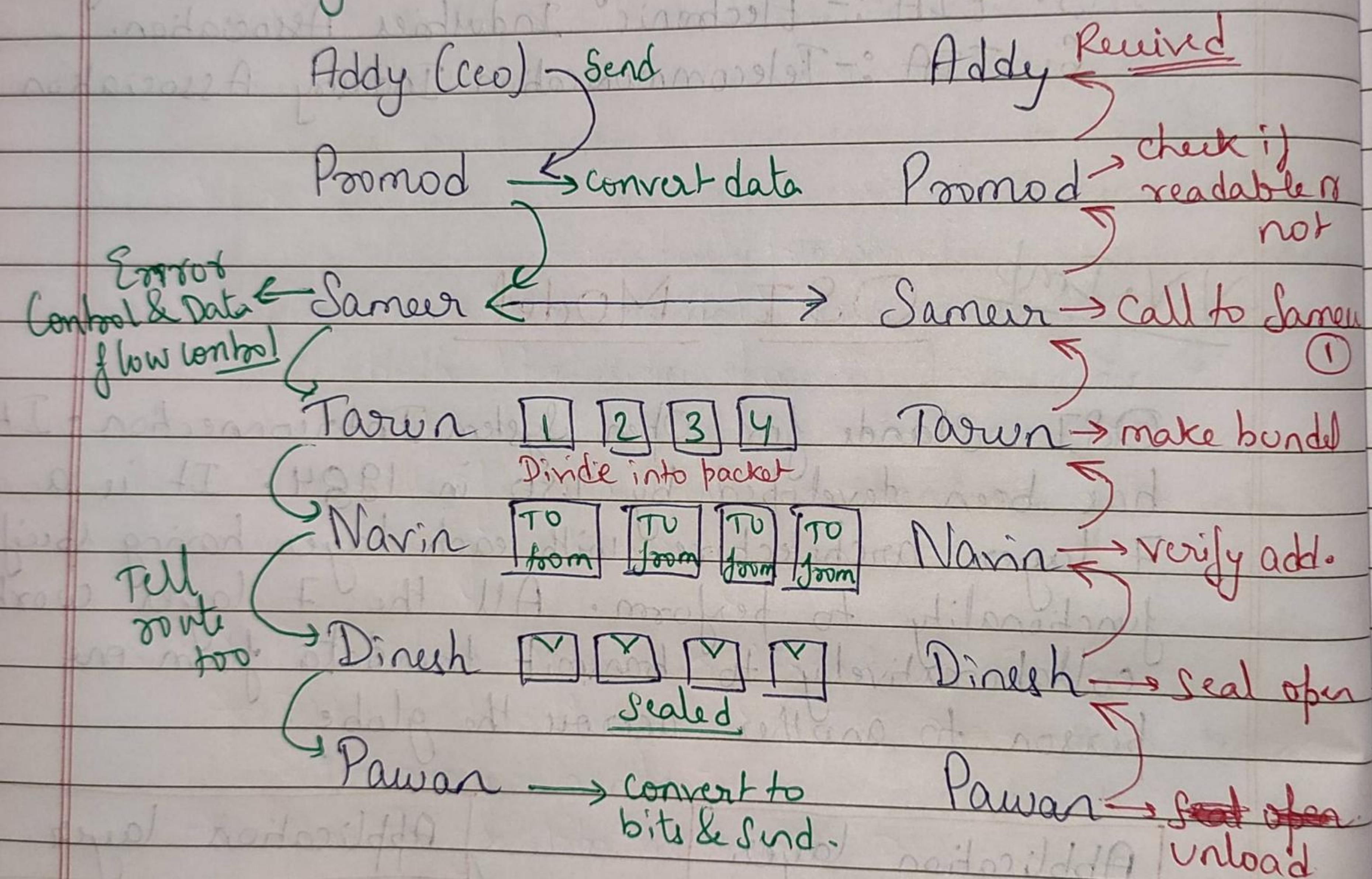
OSI stands for Open System Interconnection. It has been developed by ISO in 1984. It is a 7 layer architecture with each layer having specific functionality to perform. All the 7 layer work collaboratively to transmit the data from one place to another across the globe.



* Trick to learn :-

All People Seems To Need Data Processing.

* Story to Understand it



1) Physical layer :- The lowest layer of OSI model is the physical layer. It is responsible for actual physical connection between devices. It contains information in form of bits. When receiving data, this layer will get the signal received and convert it into 0s and 1s and send them to Data link layer which will put the frame back together.

Functions :-

- (a) Bit synchronization :- The physical layer provides the synchronization of bits by providing a clock. This clock controls both sender & receiver thus providing synchronization at bit level.
- (b) Bit rate control :- This layer also defines the transmission rate i.e. number of bits sent per sec.
- (c) Transmission mode :- Physical layer also defines the way in which the data flows between the two connected devices.
- (d) Physical topologies :- This layer specifies the way in which the different devices/nodes are arranged in a network.

Hub, Repeater, Modem, Cables are Physical layer.

2) Data link layer :- The data link layer is responsible for the node-to-node delivery of message. The main function is to make sure data transfer is error free from one node to another.

Function :-

- (i) Framing :- Framing is a function of data link which provide a way for a sender to transmit a set of bits that are meaningful to receiver.
- (ii) Physical addressing :- After creating frames, Data link layer adds physical addresses of sender and/or receiver in header of each frame.
- (iii) Error Control :- It detects & retransmit damaged or lost frame.
- (iv) Flow control :- The data rate must be constant on both the side else the data may get corrupted. Thus, flow control coordinate that amount of data that can be sent before receiving acknowledgement.

* Packet in DLL is referred as frame.

* DLL is handled by NIC (National Network Interface Card)

* Switch & Bridge are DLL device.

3) Network layer :- Network layer works for transmission of data from one host to other located in another network. It also take care of packet routing i.e. Selection of the shortest path to transmit the packet. The sender & receiver IP address are placed in the header by network layer.

Function :-

1. Routing :- Network layer determine which route is a suitable from source to source destination.
2. Local Addressing :- In order to identify each device on internetwork uniquely, network layer defines an addressing scheme.

- * Segment in Network layer is referred as Packet.
- * Network layer is implemented by networking devices such as routers.

4) Transport layer :- It provides service to the application layer and take services from network layer. The data in transport layer is referred to as segments. It is responsible for end-to-end delivery of complete message.

Function :-

1) Segmentation & Reassembly :- This layer accept the message from session layer and break the message into smaller parts. Each of segment produced has a header associated with it.

The transport layer at receiver end ~~will~~ reassemble the data.

2) Service Point Addressing :- In order to deliver the message to correct process, transport layer header include a type of address called service point addresses or port address.

* Transport layer is called as Heart of OSI Model.

5) Session Layer :- If it is responsible for establishment of connection, maintenance of sessions, authentication & ensure security.

Function :-

- 1) Session Establishment, maintenance & termination :- This layer allows two process to establish, use & terminate a connection.
- 2) Synchronization :- This layer allows a process to add checkpoint which are considered as synchronization point into the data. These point help to identify error.
- 3) Dialog Controller :- The session layer allows two system to start communication with each other.

6) Presentation Layer :- Also called as Translation layer. The data from application layer is extracted here and manipulated as per the required format to transmit over the network.

Function :-

- 1) Translation
- 2) Encryption / Decryption
- 3) Compression

7) Application Layer :- At the top of the OSI Model, we find application layer which is implemented by network application.

These network applications produce data which has to be transferred over the network. Application layer is also called as Desktop layer.

functions :-

- 1) Network Virtual Terminal
- 2) FTAM - File Transfer Access & Management
- 3) Mail Services
- 4) Directory Services.

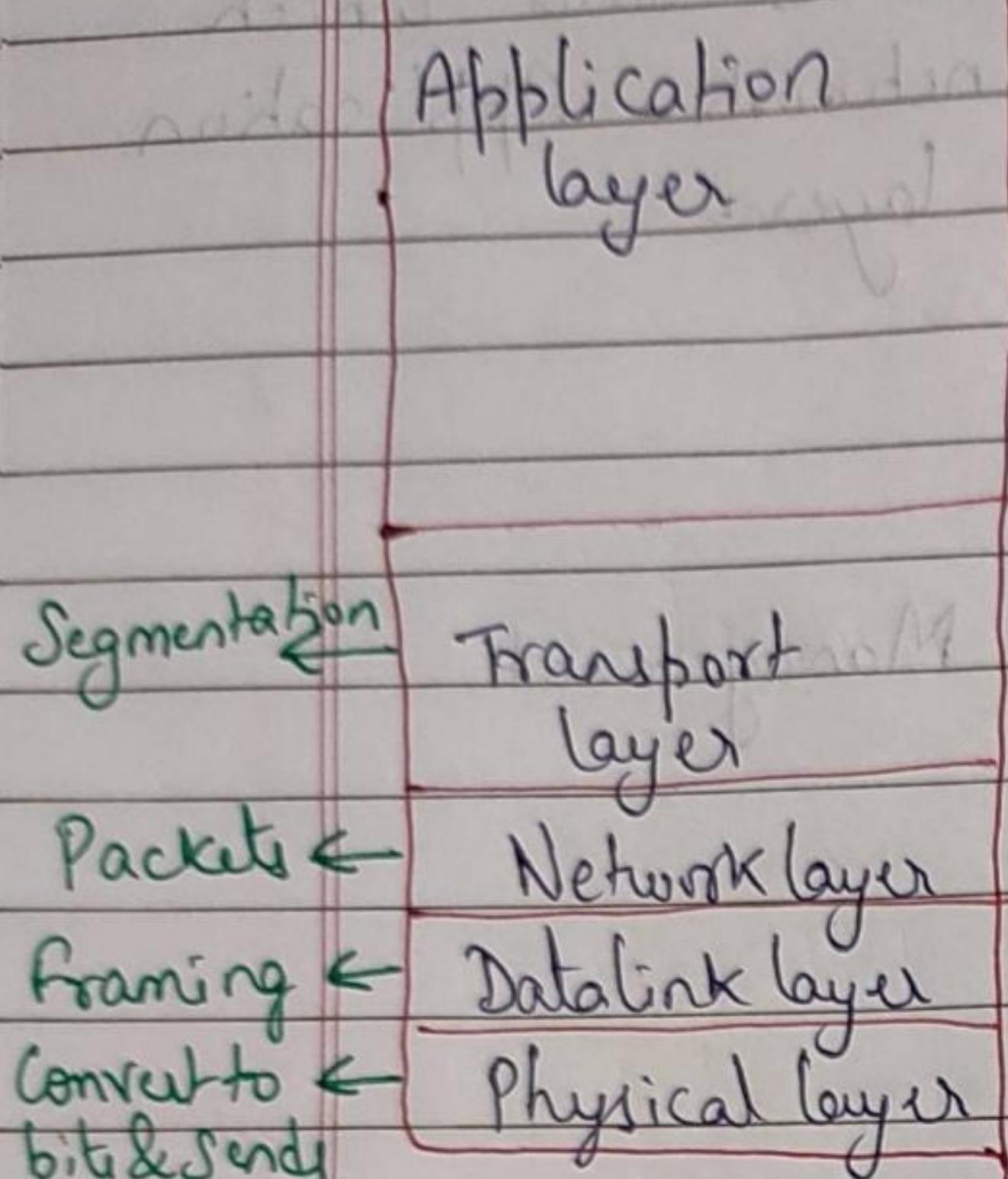
V.V.I.M.P. TCP/IP Model

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 layers built upon hardware. Today, however, TCP/IP is thought of as a 5 layer model with layer named similarly to ones in OSI Model.

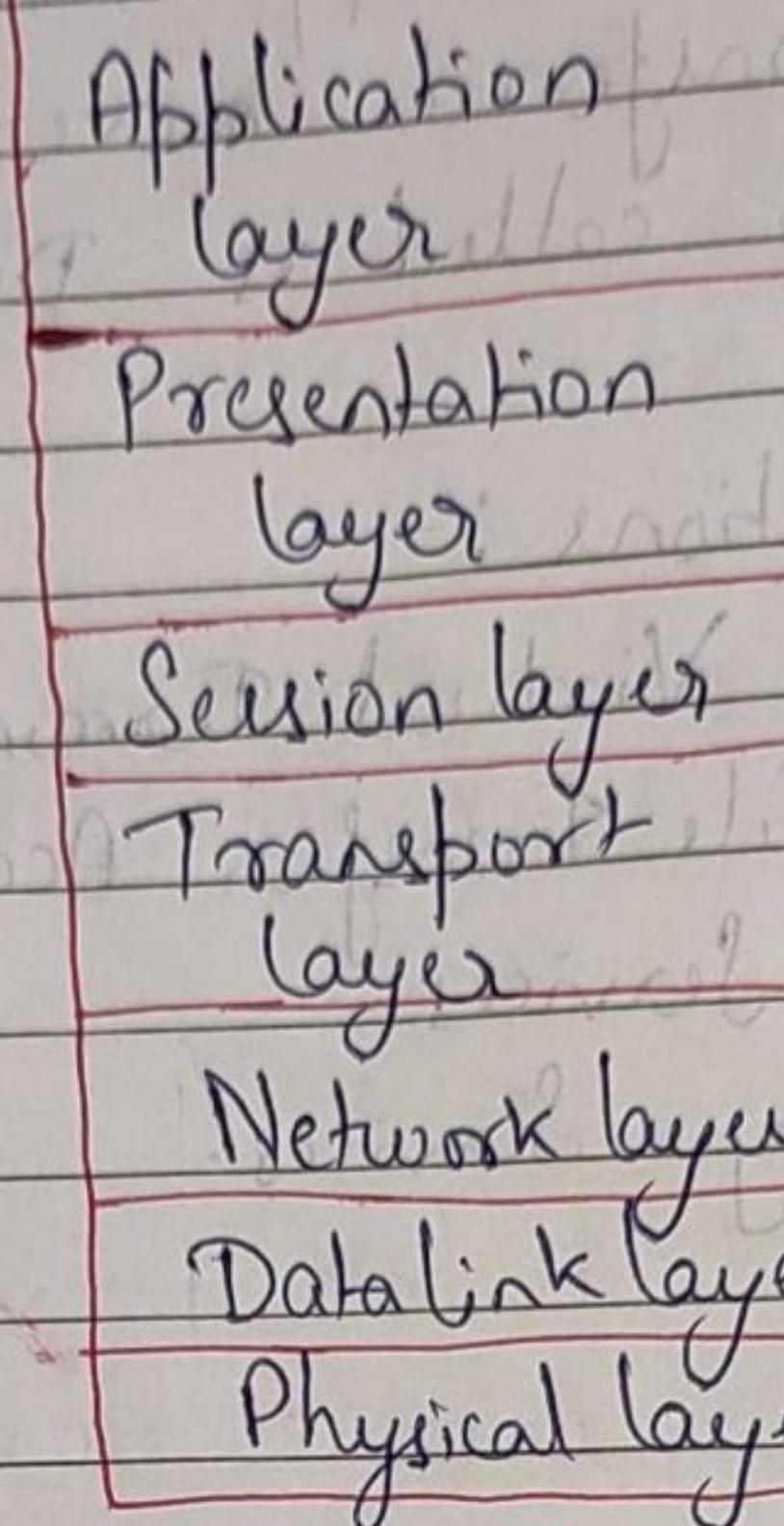
TCP/IP is normally considered to be 5-layer system. The 5 layers are as follows :-

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

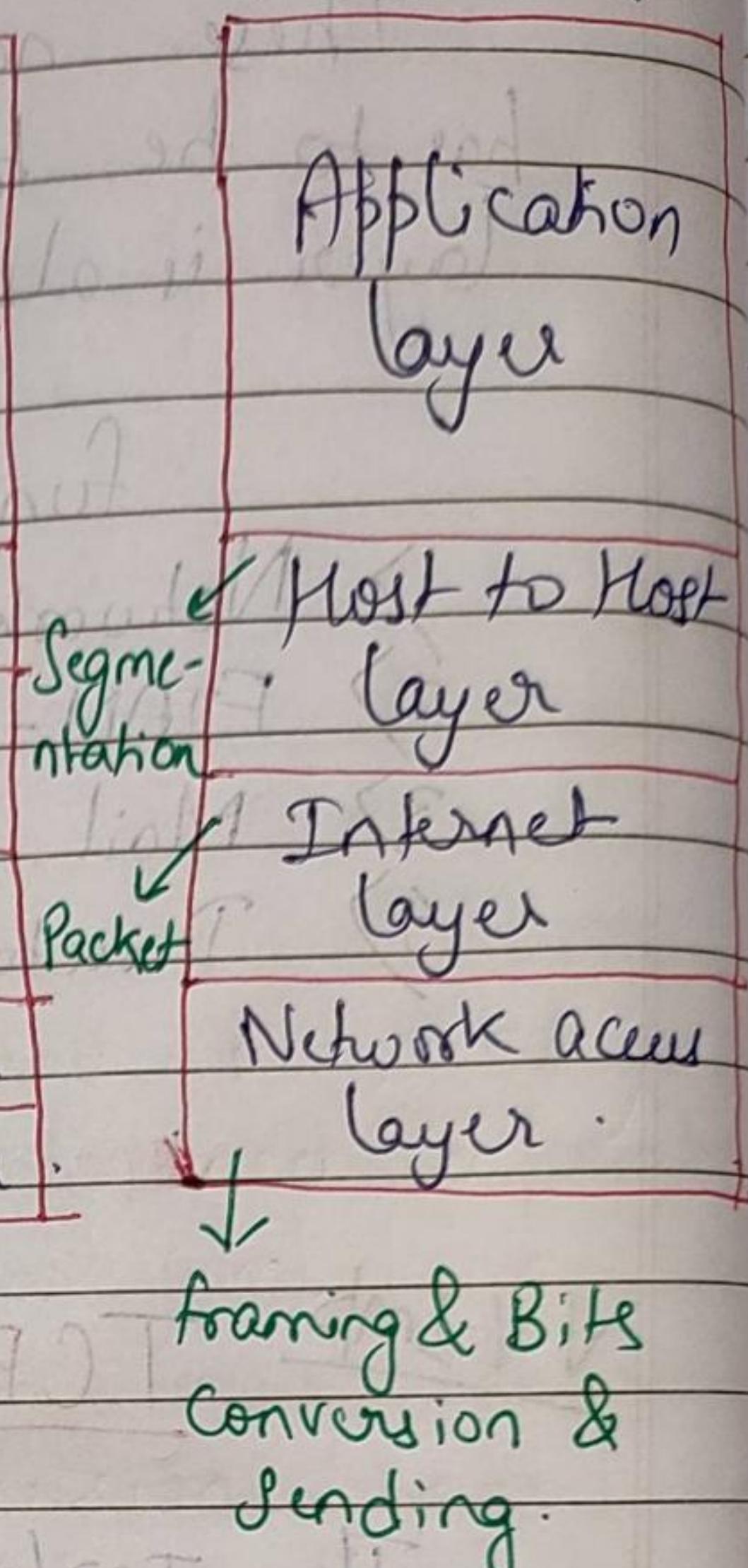
TCP/IP - 5



OSI



TCP/IP - 4



1) **Application layer** :- This layer includes application or processes that we 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 many 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 drivers 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.

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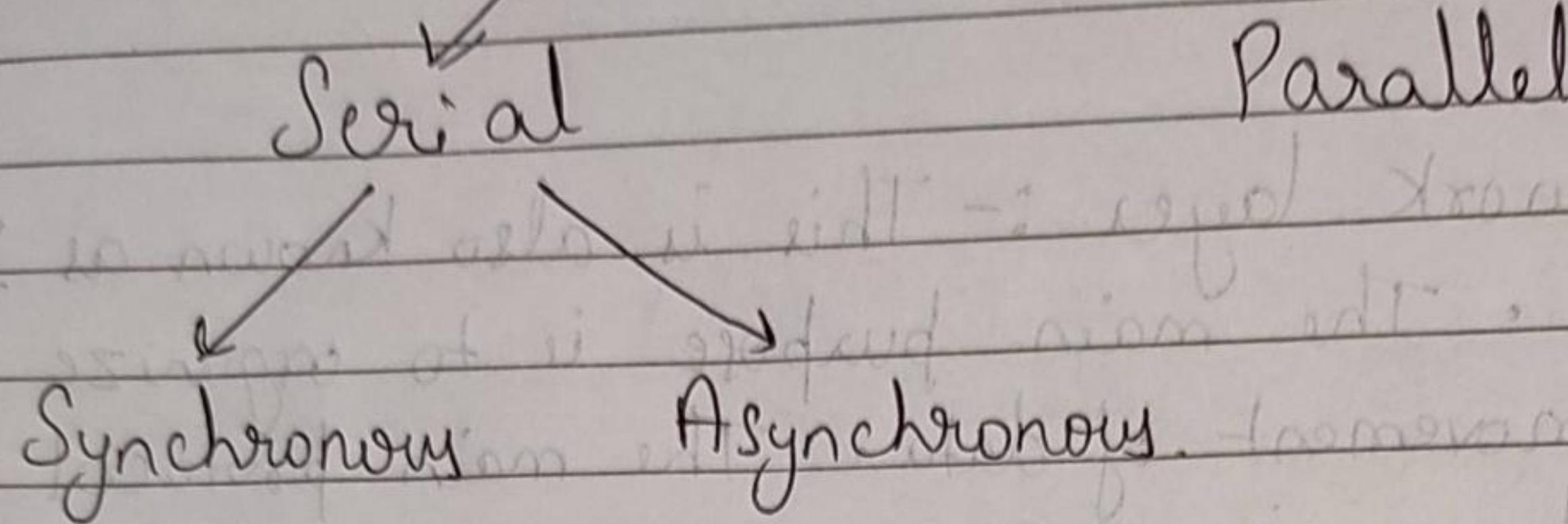
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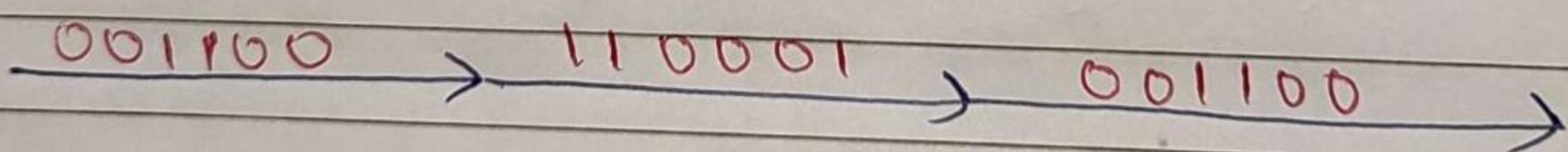
Data Transmission



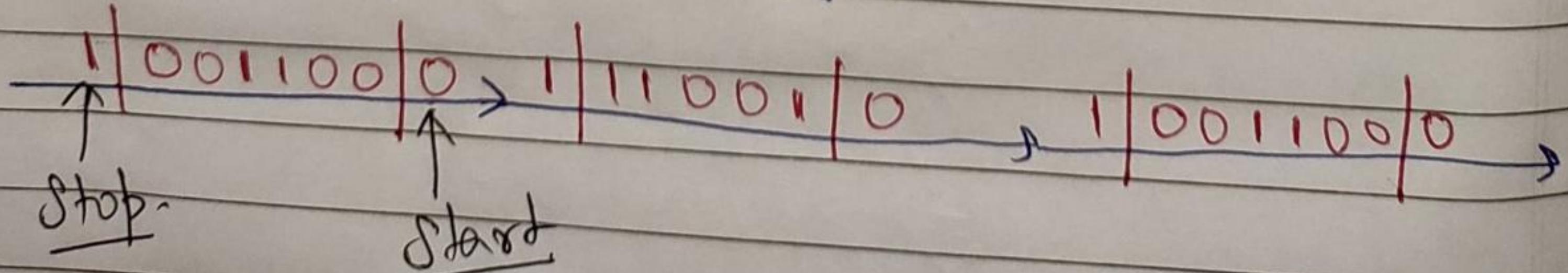
1) Parallel :- In parallel transmission, many bits are flowing together simultaneously from one computer to another computer.

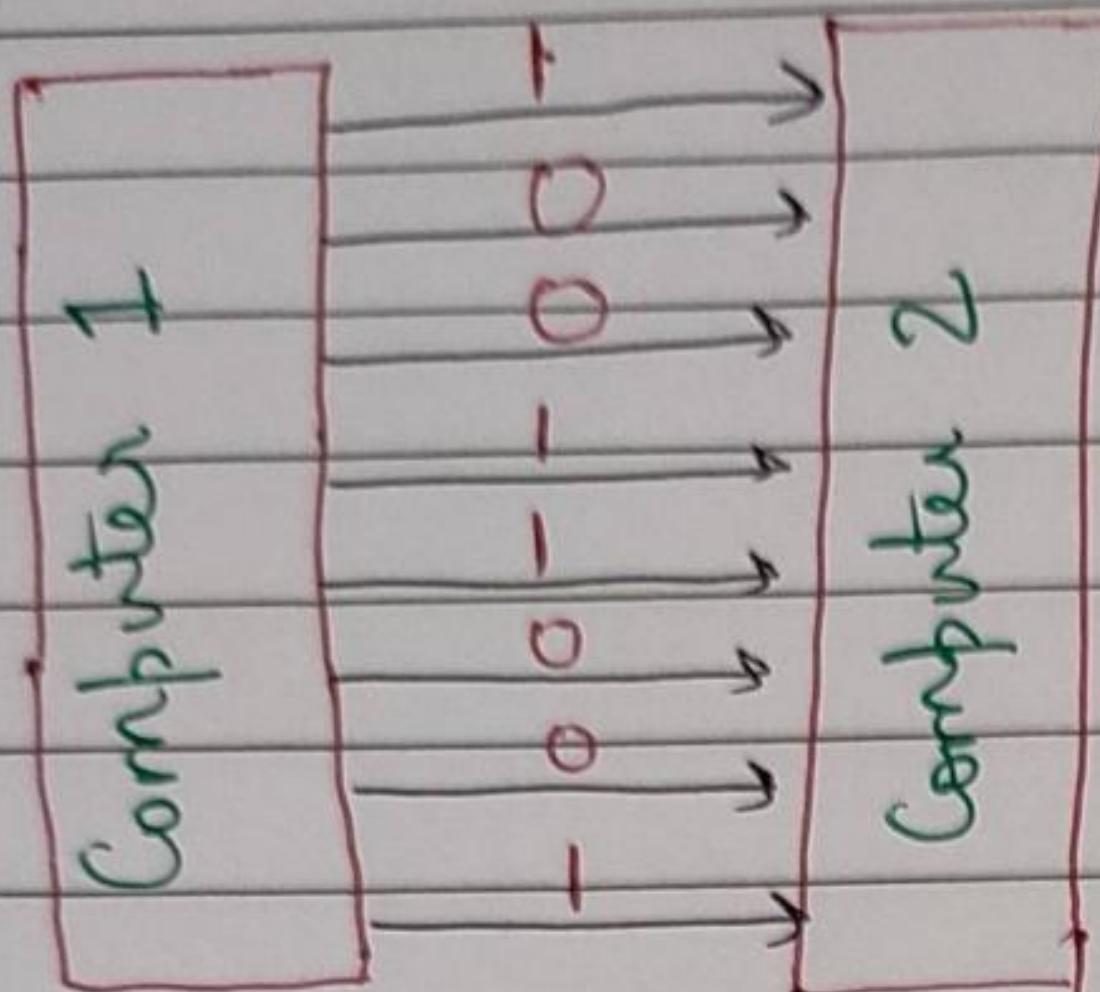
2) Serial :- In serial transmission, data-bit flows from one computer to another computer in bi-direction.

(a) Synchronous :- Will travel in synchronous form and data move after clock pulse.

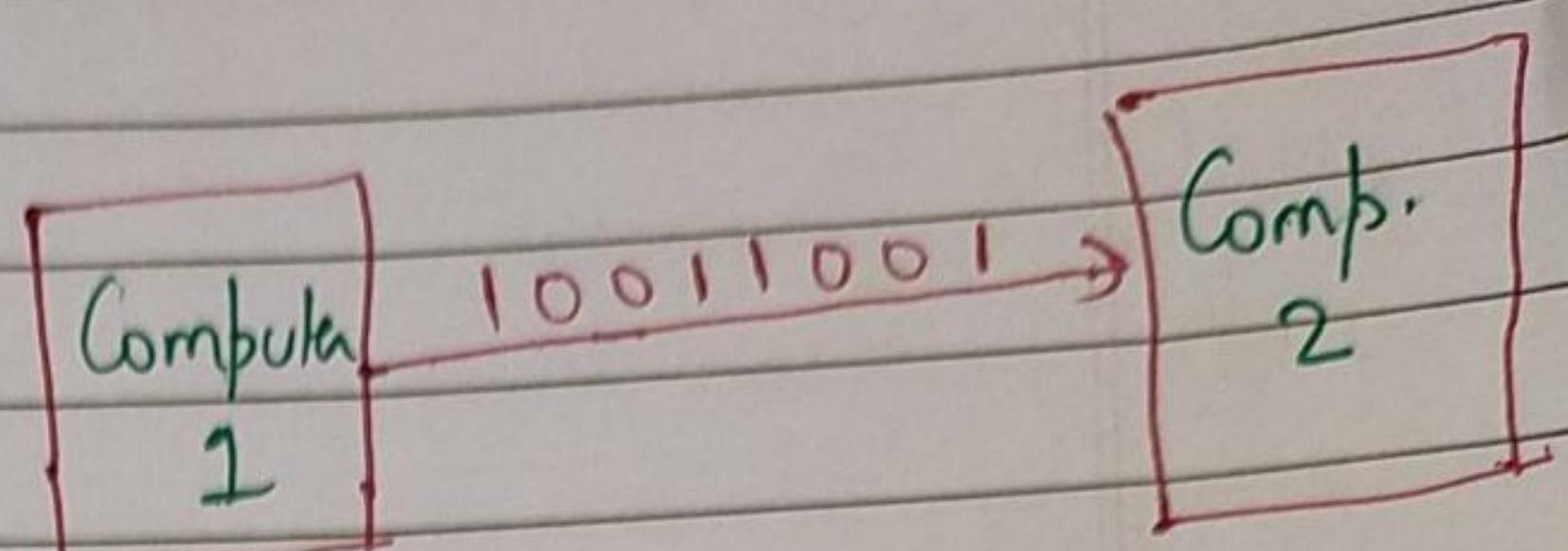


(b) Asynchronous :- In this data move in serial manner but there is NO clock pulse in this.





1) Parallel



2) Serial

Serial

- 1. Data flows in bi-directional.
- 2. It is cost efficient
- 3. One-bit is transferred at one clock pulse.
- 4. Slow
- 5. long distance
- 6. More reliable

Parallel

- 1. Data flows in multiple lines.
- 2. It is not cost efficient
- 3. Eight-bit is transferred at one clock pulse.
- 4. Fast
- 5. Short distance
- 6. Less reliable