12.5.2028

Unit - I
Introduction

* Data Communication:

* Data Communications are the exchange of data (information) between 2 devices via some form of transmission medium such as a wire cable.
* In term telecommunication, "tele" refers to far
* 4 fundamental characteristics :-

1) Delivery
   * System must deliver data to the correct destination.
   * Data must be received by intended device or user and only by that device or user.
2) Accuracy
   * System must deliver data accurately.
   * Data altered in transmission and left uncorrected are unusable.
3) Timeliness
   * System must deliver data in a timely manner.
   * Data delivered late are useless.
   * In case of video and audio, timely delivery means delivering data as they are produced and in same order without significant delay. This is called real-time transmission.
4) Jitter
   * It refers to variation in packet arrival time.
   * It is the uneven delay in the delivery of audio or video packets.

* 5 Components of data communications: -

1. Message - Information to be communicated. Popular forms: text, numbers, pictures, audio and video
2. Sender - Device that sends data message. It can be computer, workstation, telephone handset, video camera and so on.
3. Receiver - Device that receives data message. Can be similar to sender devices. [television]
4. Transmission medium - Physical path by which a message travels from sender to receiver.
   Eg: twisted-pair wire, coaxial cable, fiber-optic cable, radio waves.
5. Protocol - A set of rules that govern data communication. Represents an argument between communicating devices. Without this, 2 devices may be connected but not communicating.

22.5.2023

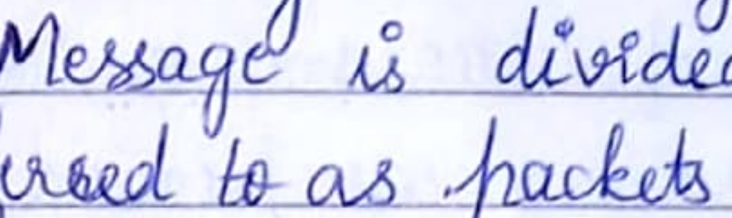
* Packet

It is created by adding boundary to actual msg being communicated. Message is divided into small chunks which are refered to as packets. This is created with the purpose of accurately delivering message.

* Size of packet depends on
  ① Receiving Capacity
  ② Transmission Meduim (TM) Capacity

* It contains 3 sections:-
  1) Header
  2) Payload
  3) Trailer

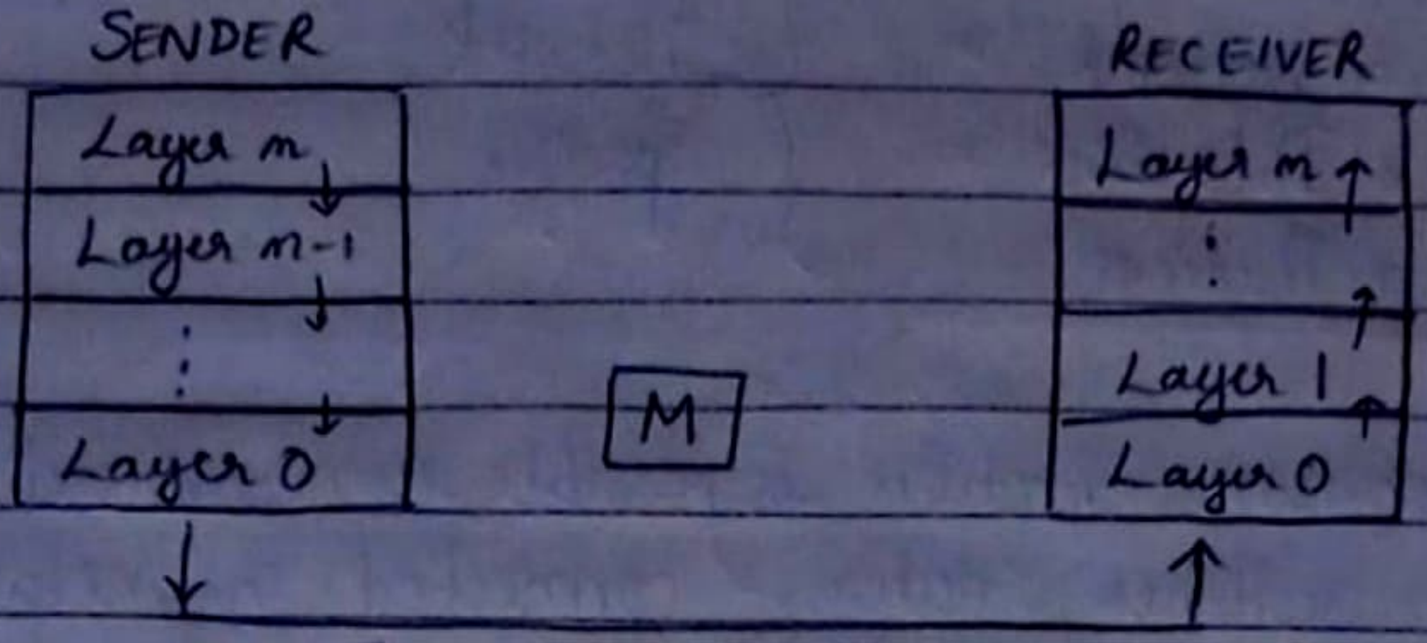
1 Packet



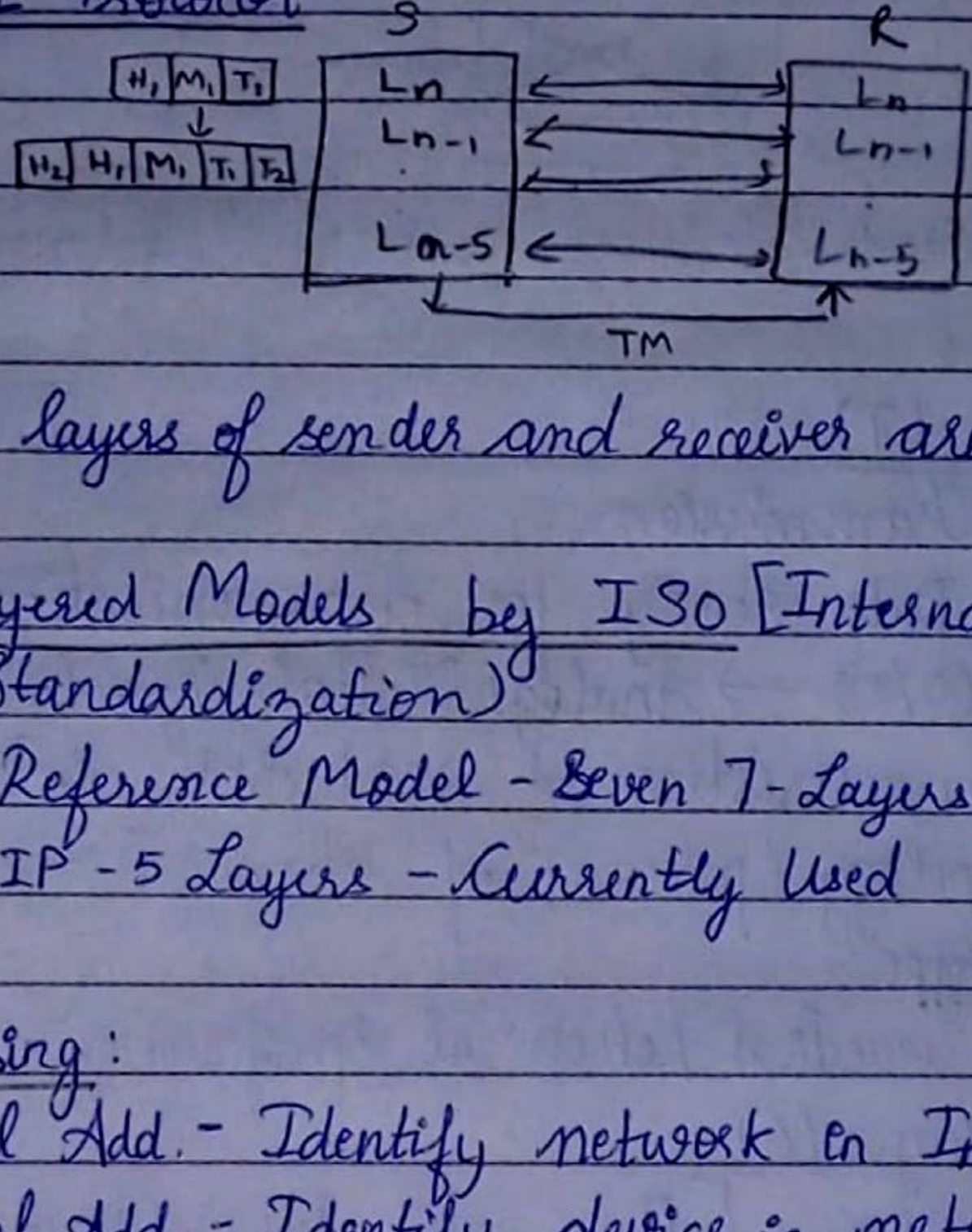
* To deal with → speed we use packets
* Errors can be avoided which is due to noise - unwanted signals

* Layered Model :

Transmission of data takes place in multiple layers
* Every layer adds their own service to original message.



* Interfaces - are used to exchange data b/n layers
* PL to PL Protocol



* No. of layers of sender and receiver are equal.

* 2 Layered Models by ISO [International Organisation for Standardization)

① OSI Reference Model - Seven 7-Layers
② TCP/IP - 5 Layers - Currently Used

* Addressing :

1) Logical Add. - Identify network in Internet World.
2) Physical Add. - Identify device in network by locally unique address. [Mac / Board Addressing]
3) Port No. - It reaches application in a device
* IP address (Internet Protocol) - Version 6 - references Log. Add.
(IEV)

① OSI Reference Model

* It is a 7-layered model

→ Layering Model - defines functionality of layers
+ Design protocol for layers
Exchange through Interfaces

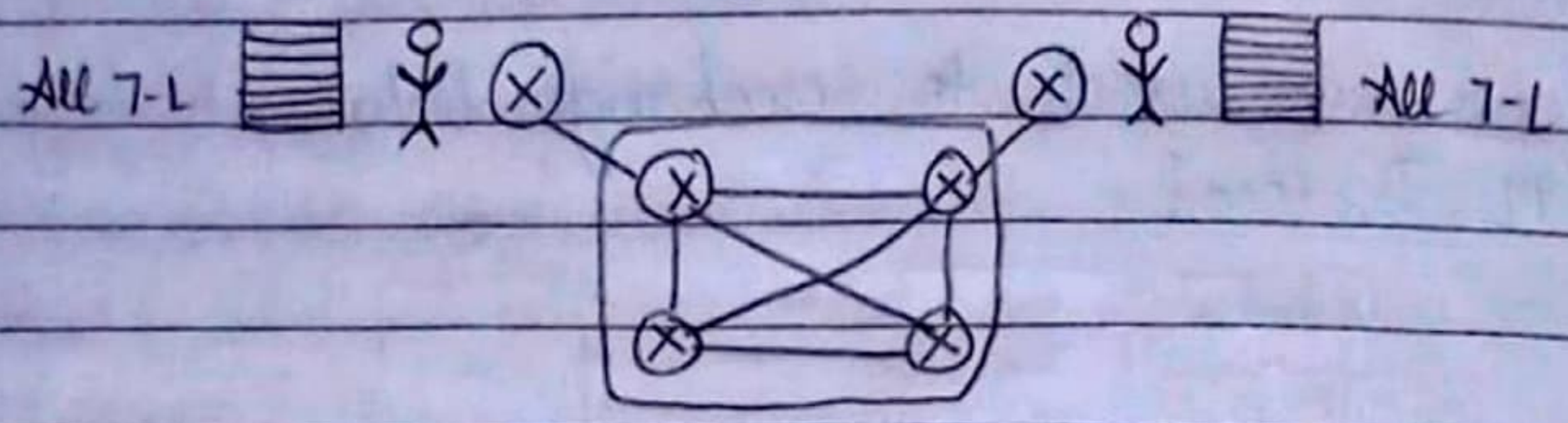
← OSI Ref. Model

Latency is high ↓

1. Application Layer } → User Specific (UI) - Helps end user to generate or represent data
2. Presentation "
3. Session "
4. Transport " → Binds user & network specific
5. Network " } → Network Specific
6. Data link "
7. Physical "

* Data communication is possible even without top 3 layers
* Nodes - switches, routers, - connected in network.
computer, bridges, server

Eg:



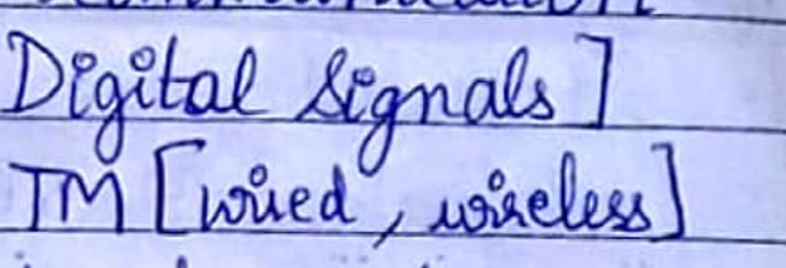
Intermediate Nodes - No need of 1st 3 layers

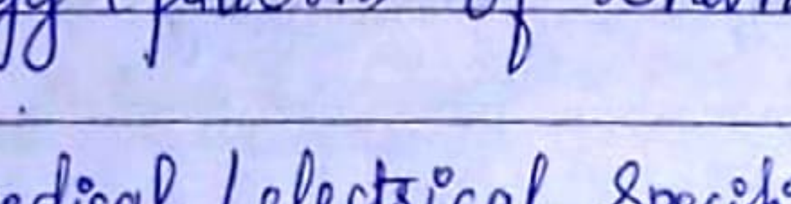
* Physical Layer (1)

* Raw data Transmission
* Raw data → Data ready for communication
[Bits (0/1) → Analog/Digital Signals]
* Defines phy. Characteristics of TM [wired, wireless]
* Defines topology (pattern) of channel - cabling - bus, ring, star type.
* Deals with medical/electrical Specifications of TM

23.5.2023 ## Data Link Layer (2)

* Hop - Hop Delivery [Req. only phy. addressing] * Movement of frames
* Framing
* Delivery :-
1) Process to Process
2) Source to Destination
3) Hop - Hop





DLL of R_1 takes resp. of delivery from R_1 to R_2
DLL of R_2 takes resp. of delivery from R_2 to R_3

(Layer - Layer)

* Framing - Process of adding boundaries to the (message) original data communicating - among the layers - within same network
* Packet - has headers & trailers ends] → ready to go outside our network (N/W → N/W)

Senders Add. → Receiving Add.

[Actions performed] push data to one of the ports

* N/W Layer (5) [Decision] which port - decided
  * Source to Destination delivery
  * Movement of packets
  * Req. only logi(& phy) addressing.
  * Decides optimal route to reach the destination based on various metrics
* Transport Layer (4)
  * Process to Process delivery.
  * Req. Port No. addressing
  * Movement of msg
* Session Layer (3)
  * Deals with session management [helps user - access N/W functionality]
  * Session - sharing the channel based on frequencies, bandwidth
  * Multiple senders & receivers → have common transmission layer → session layer.
* Presentation Layer (2)
  * Helps for Data Representation.
  * Files (Img, Audio, Video) → converted to standard pattern using encryption & decryption.
* Application Layer (1)
  * Provides UI - User Interface
  * Layman - access the functionality of N/W
  * User sits at app. layer - gets msg. [data generated]
  * Entry of data

* Bandwidth - Amt of data being transferred.
* Buffer - stores data at sender & receiver's end.

* Communication:

1) Unicast (1S-1R) - Only 1 R gets msg
2) Multicast (1S - few R) - Multiple R gets msg but not all
3) Boardcast (1S - many R) - Everyone in the network

26.5.2023

* Simulation Exercises:

1) Open OPNET Modeler 14.5
2) File → New → Project
* Common Objects
1) App. Configuration
2) Profile Configuration
   ↳ Bandwidth, Queue size, etc - N/W
* Run simulation → longer time - accurate results
* 10 Base T - Link Model
10 Mbps Base band transmissions; T - Twisted pair
10 Base 5 - Thick } coaxial 500 m
10 Base 2 - Thin } cable 200 m

Eg: 3 Node point-point network - duplex links. Set Queue size & vary bandwidth & find no. of packets dropped.
* Open Object Palette

30.5.2023

* TCP/IP Model :- 5-Layers [AL, PL merge SL, TL, NL, DL merge PL]

textbook - 3 merged

AL
PL
SL
} → SMTP, FTP, TELNET, DNS_SNMP

TL → TCP, UDP, SCTP
NL → IP, ICMP, IGMD, ARP, RARP
DL
PL
} → Protocols defined by below N/W's } merged to one Host N/W Layer

* Subnetting - Every sub-network - uniq NId
  providing → Host → uniq HId
  uniq IP address to every machine - local IP address

* Based on functionality of protocol, it is fit to the layers.
* More User-friendly.
* Processing time is less compared to OSI so, its faster
* Define protocols in every layer

NL 1) * IP - Internet Protocol [Logical Addressing] ≡ IP address

Version 4 (IPV4) | Version 6 (IPV6) | (ip config - command to display)

Notation:	Dotted Decimal X.Y.Z.a	Hexadecimal colon X:Y:Z..
Size:	32 bits 4 → 8-bit groups 0.0.0.0 255.255.255.255	128 bits 8 → 16 bit groups

* IPV 4 — (b) Classless
  ↓
  Entire IP address is divided into 5 classes

(a) Classfull → 2^8 subnetworks - 2^{24} Hosts

1) Class A - Networkid . Hostid . Hostid . Hostid (less dept more machines in every dept)
2) Class B - Networkid . Networkid . H . H
3) Class C - N . N . N . H
4) Class D - Multicasting
5) Class E - Experimentation (No IP address)

(b) Classless

Notation: X.Y.Z.a/n

Size : $32_{b}^{\wedge n}$

* Global IP address → gateway

* NAT - Network Address Translator
  System that translates local / global to global / local IP address

2) * ICMP - Internet Control Message Protocal
   * Constant monitoring of operations of N/W under FCAPS

   * IGMP - N/W mngt - manages 5 areas - FCAPS

   * SNMP - Simple N/W Management Protocol

   → * Management : [ICMP]
   F - Fault mgnt - link, node failure
   C - Configuration mgnt
   A - Access mgnt
   P - Performance mgnt [Bandwidth, packets dropped]
   S - Security mgnt

3) * IGMP - Internet Group Management Protocol
   * Create & manage groups
   * Knows log. add but not phy. add

4) * ARP - Address Resolution Protocol
   * Find phy. add using log. add [Maps log. add to phy. add]

5) * RARP - Reverse Address Resolution Protocol
   * Find log. add using phy. add [Maps Phy. add to log. add]

2.6.2023

* Services (in D.C) offered by a N/W :
1) Connection Oriented Service
2) Connectionless Service

1) Connection Oriented Service
* Connection Establishment - 1st phase
  Negotiate metrics
* Reliability - major advantage - in data transfer
* Data Exchange
* Connection Disconnection

2) Connectionless Service
* No latency issue
* Faster
* Not Reliable
* Only phase - data exchange

* TL - Transfer Layer
* TCP - Transmission Control Protocol - Connection oriented service
UDP - Connectionless Service

* SCTP - Stream Control Transmission Protocol
* Req. streaming of multimedia info

* IP - engine of packet - helps in movement

* AL - App. Layer
* SMTP - Simple Mail Transfer Protocol
* Provides structure of email
* POP3 - Post Office Protocol
IMAP - Internet Mail Access Protocol } Movement of email

* HTTP - Hyper Text Transfer Protocol
* Transfer of HTML pages or links
* SNMP - Simple N/w Mngt Protocol
* Manages operations of applications

* FTP - File Transfer Protocol

* TELNET -

* Remote login

* Addressing:
1) Logical 2) Physical 3) Port [4) Specific]*

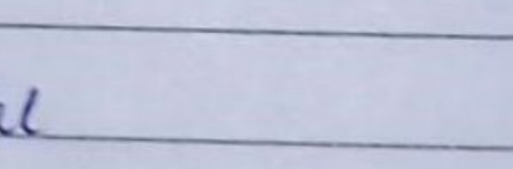
* DNS - Domain Name Service
  * Maps IP address to naming convention
  * They ~~use~~ specific addressing

* Network Topology:

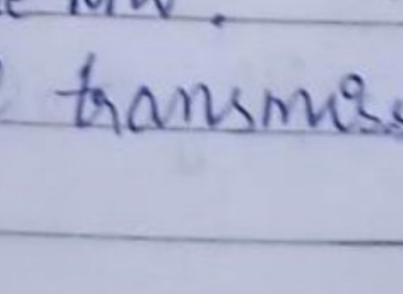
1) Point - Point link (P-P)
   * Dedicated channel b/n S & R
   * Data security
   * Costlier

2) Multi - Point link
   * Single channel shared by multiple ppl.
   * Speed is less [of communication]
   * Insecure [Need of hashing technique - encryption before sending]

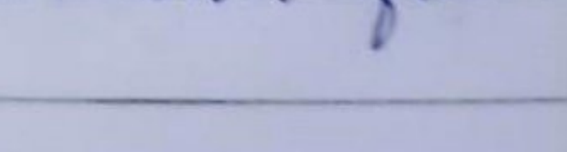
* Bus Topology
  * Cost effective
  * Less devices & links
  * Managing N/W is easy
  * Disadv:- 1) Single point failure
    2) Insecure



* Star Topology
  * Data security
  * Dedicated link to each device
  * Cost effective
  * Disadv:- 1) Single point failure



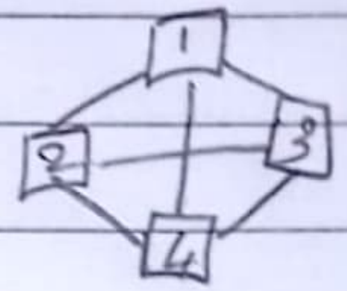
* Ring Topology
  * A token revolves around the N/W.
  * Device with token gets full transmission of data
  * Cost effective



* No single point failure
* FDDI - Fiber Data Distribution Interface
* Cabling is less
* Superior to Bus & Star.

* Mesh Topology

* Point-Point Link
* Every device



* Secure, full access capacity
* Disadv:- 1) More complex bcoz of more cabling
  2) Expensive
* For n nodes, links req. $n(n-1)$ for ½ duplex
  $\frac{n(n-1)}{2}$ for duplex