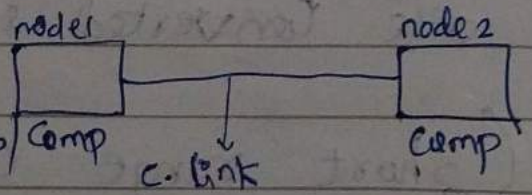
Module - I

CN

Network : A set of nodes connected to a commun. links.

* node → device capable of sending & receiving data.
* comman links → carries the info, can be wired / wireless.
* A comp (N) can be defined as a inter connected collection of autonomous computing devices / nodes.
* A comp (N) allows nodes to share digital resources using data links like wires, optic cables & wireless media like wifi.
* Nodes are (N) devices that originates, route & terminate the data & generally identified by (N) addresses & can include personal comp, phones & srvrs as well as networking hardware like routers & switches.



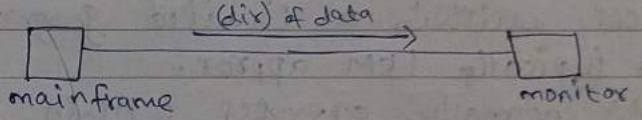
→ Components of Comp (N):

1) Nodes – To Snd & receive data.
2 types –
1) end nodes – comp | mob.
2) Intermediatoly nodes – Switches, hub, routors, Security devices, bridges, repeators, cell towers.

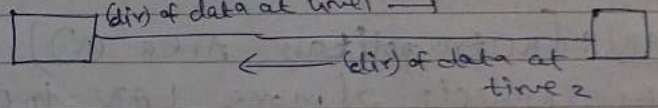
2) Media (links):
a) wired media (guided): (5 types)
* Ethrnet Straight through Caldes (Connect diff devices)
* Ethernt cross ovr calde (Connect 2 comp)
* Fiber optic Caldes (light and faistst mode)
* Coxcial calde (Audio, video, electric Signal)
* USB calde (connect comp, Phn).

b) wireless media (ungaided):
here data's are converted into waves)
* Infrared waves (short range Commu~)
* Radio waves (bluetooth, wifi)
* micro waves (Cellular System).
* Satellite waves (long range Commu~)

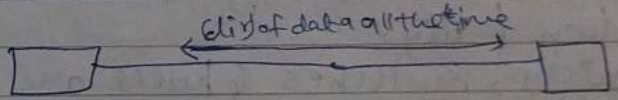
3) Transmission media:
During Commu~, data flow b/t 2 devices ovr a transmission media can be
a) Simplex [unidirectional]:



b) Half-duplex: each Stations can both transmit & receive bt not Sane time.



c) Full-duplex:



→ Types of (N):

1) LAN: → limited range, high Security, Lack of privacy, eg → office, sch.
2) MAN: → conn^n of diffrnt LAN, less Security, requires more cable, eg → within a city
3) WAN: → Conn^n among diff cities/States.

4) PAN (personal AN) → for commu - among comp devices close to one person.
5) CAN (campus AN) → intrconn" of LANs within a limited geographical area.
6) MAN (Global AN) → model for supporting mob commu across wireless LANs.

Transmission media is Satellite, less security, collection of MAN, uses routers

1) LAN:
* Local area (N) (LAN) is a digital communi" system capable of intrconnecting a large no of comp. terminals & othr ~~per~~ peripheral devices within a limited geographical area typically 1KM approx.
* LANS normally operates within a compact area like office building / campus, etc.

2) MAN: (Metropolitan Area (N))
* They connects 2/more LAN togthr bt does not extends beyond the boundaries of town / city.
* Routers, Switches & hubs are connected to create a MAN.

3) WAN:
* WAN is a comp ntwrk that covrs a broad area often intrconnects comp's that are distributed all ovr the country / continent.
* WAN is a geographical collection of LAN.

→ (N) Devices:

1) Repeater:
* regenerates signal to main signal strength.
* used inside LAN.
* whn signal is lost, it will regenerate.
* WAN contains many repeaters.

2) HUB:
* msg snt / receive is broadcast
* used in LAN.
* operated on physical layer
* Have 4/12 ports
* It is half duplex T-mode.
* Cannot be used a repeater

3) Switch:
can snd & receive data to an exact recepient.
used in LAN.
operated on data link layr
Have 24 to 48 ports
It is full duplx T-mode
used as Repeatr.

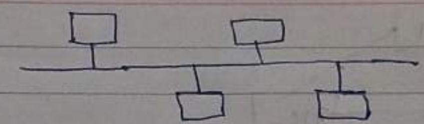
4) Routers:
* Can connect widely & uses ip add
* ntwrking device that forwards data packets b/o diff comp ntwrks.
* perform 'traffic directing' fns on the intrnt.
* 2 types → wired & wireless.
* used in WANS & sometimes in LANS.

5) **Bridge**:
* used in ~~MAN~~ LANs
* Interconnects 2 ntwrk using same technology.
* It is more sophisticated than a repeater.
* Are easy to intall & provide an easy way to perform ntwrk managmnt Os.

=> **Network Topologies**:

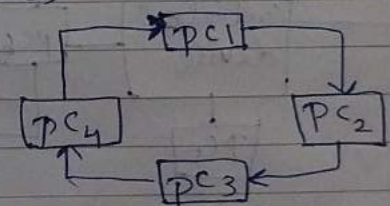
* It is the arrangmnt of comp in (N).
* placemnt of various nodes → physical } 2 types of
* Data flow in the (N) → Logical } topologies
* A comp ntwrk is an intrconnⁿ of various comp systm located at the same / diff places.
when comp at same / diff locations are to be intrconnected I may do it in no- of ways.
* The term 'topology' refers to the way in which individual comp called nodes of a ntwrk are linked togethr.
* 5 types —

1) **Bus (T)**:
* All nodes will snd & receive data.
*



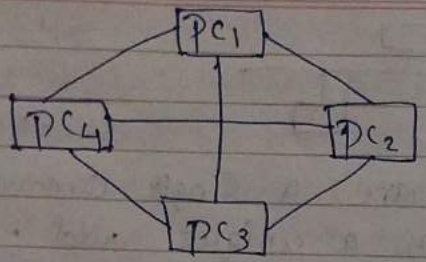
* Here, nodes share a single commun channel.
* Each node has a unique add. All nodes will receive a msg bt only the add node will respond.
* AdV → only 1 wire & less expensive, Node failure does not affect
* DisadV → limited cable length & no security

2) **Ring (T)**:
* Have simple commun- capabilities.
* Unidirectional & it uses token([illegible])
* All nodes are connected to 2 nodes.
*



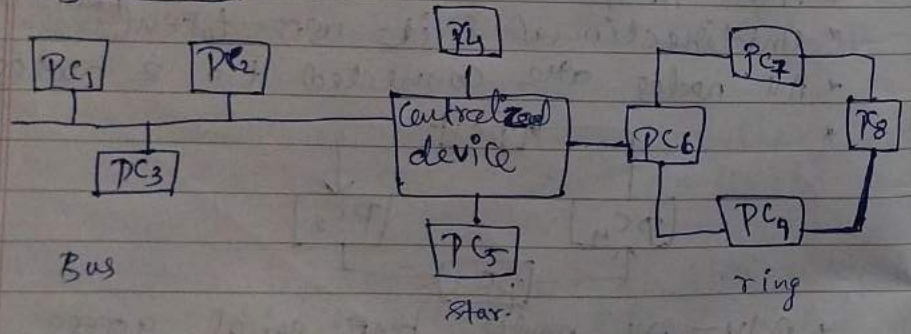
* AdV – All nodes hve equal access.
* DisadV – If single node failure, data flow stops.

3) **Mesh (T)**:
* Bidirectional & fault tolernce (If 1 node in the (N) goes dwn, the rst of nodes can still communicate with each othr).



* Here, each node is connected more than 1 node to provide alternative routes ~~in case the~~
* Have dedicated Conn^{n} to every other node in the (N).
* It is expensive to implemnt.
* Can be complex to configure & manage.

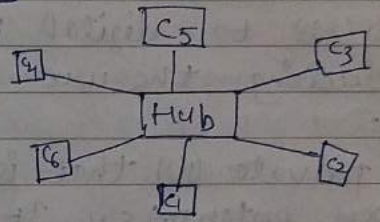
4) Hybrid (T) :



* It is an intr Conn^{n} of 2/more basic (N) (T).
* Each of which contains its own nodes.
* A variety of technologies are needed for its physical implemntation & offers a complex str.

* ~~Basic topology~~ Uses flexibility, fault tolerance
* Has the ability to transfer data easily in b/w the diffrnt kinds of (N).

5) Star (T) :



* It is a (N) (T) in: which each device is connected to a central hub.
* All devices linked to a central (N) devices are displayed as a star.
* Cannot provide commun^{n} directly b/w the devices in a star (T).
* eg → Airport (N), hosp (N), Bank (N).

⇒ Inter (N) =

* It is combination of words inter (b/w) & networking.
* It is the concept of interconnecting diff types of (N) using (N) routers to build a large, global (N).

* It is enforced in Layer 3 of OSI. - ISO model

* **Internet :**

It is the global system of interconnected comp (N) that use the IP to link devices worldwide.

Sprt access to digital info by many applin including the www.

* **Intranet :**

It is private (N) that is contained within an enterprise. It may consist of many interlinked LAN & use any WAN technologies for (N) connectivity.

main purpose is to share company info & computing resources among employees.

* **Extranet :**

It is a controlled private (N) that allows access to partners, vendors & suppliers / an authorized set of ~~cus~~ customers, etc.

It can be viewed as part of a company's intranet that is extended to users outside the company.

⇒ **(N) Models :**

* users to communicate & transmit data through efficient & ordered path.

It is implemented using models & comp (N) → (N) models.

* Also referred to as (N) stacks / protocol suits

* There are a num of diff (N) models - Based on the fn of networking 2 types -

a) **protocol models :**

It is closely matches the str of a particular protocol suit.

eg → 4-layer TCP/IP model.

b) **Reference model :**

provides a common reference for maintaining consistency within all types of (N) protocols & services.

eg → 7-layer open System Interconn (OSI) model.

I **Layered Model :**

* Here, the (N) are organized as a series of layers / levels, each layer is built upon the one below it.

* The no. of layer, name of each layer, contents of each layer, (-) of each layer differ from ~~each~~ (N) to (N).
* The purpose of each layer is to offer certain services to the higher layers.
* Main aim of the layered design is to ÷ the design into small pieces.
* Basic elements of this model are –
a) interface : way through which the msg is transferred from 1 layr to anthr layr.
b) protocol : set of rules governing the format & meaning of the packets / msgs.
c) service : set of opr that a layer provides to the layer above it.

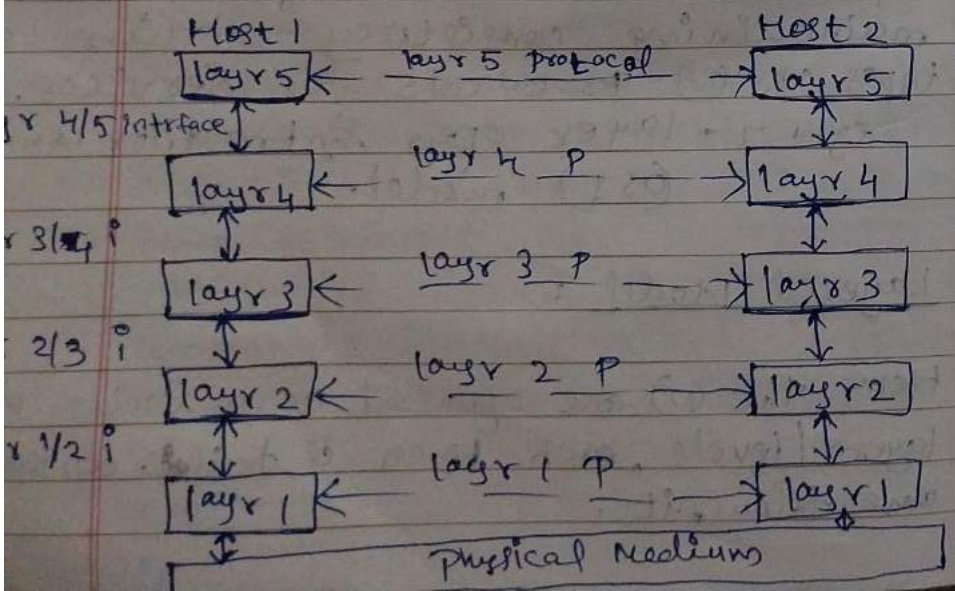
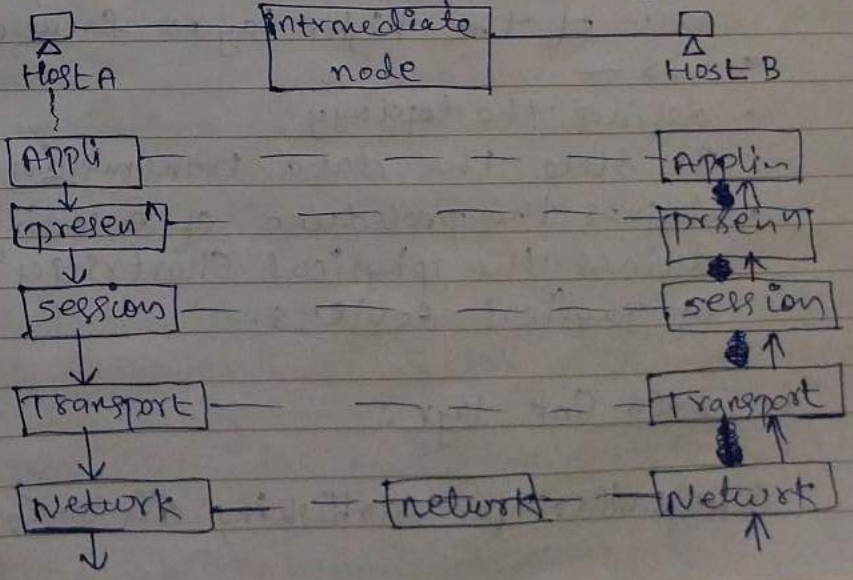


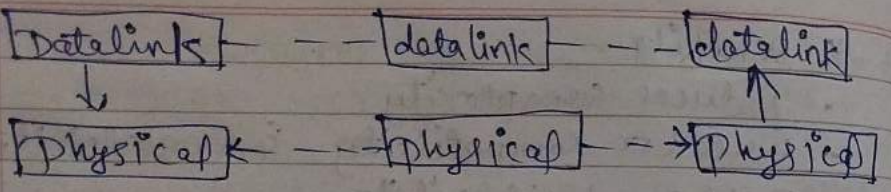
Fig: Layered (7) model

* Benefits –
- Reduces complexity
- Greater compatibility & scalability.
- Better flexibility
- Easier to port from 1 system to anthr.
- cost effective quality.

II • ISO – OSI Model :

* The initial comp(N) had their own set of standards & conventions that were quit hardware oriented.
* Each manufacturer used to develop his own common protocol for his (N).



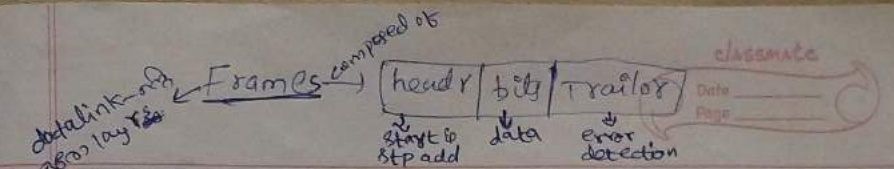


I Physical layer:

* It is the 1st & lowest layr in the 7-layr OSI model of comp Networking.
* defines the electrical & mechanical aspects of interfacing to a physical medium for transmitting data.
* It is the only layer which is concerned with the hardware whereas the rest of the highr layrs focus on s/w.
* CNs —
  - defins the topology
  - It state the data transmission rate
  - defines the procedure of encoding of bits
  - defines the physical chartrstics & CNs of physical devices.

II Data link layr:

* Responsible for establishing an error-free



commn ~~with~~ path b/w comp ovr the physical channel.

* Splits msg packets into data frames which are transmitted sequentially by the sendr & the receivr transmit the acknowledgmnt.
* 2 Sublayrs —

a) Logical link control (LLC): provides the logic for the data link. It controls synchroniza^n, flow control & error checking (N) of data link layr.

b) Media access control (MAC): provides control for accessing the (trans) medium. It is responsible for moving data packets frm 1 ~~pack~~ NIC to anthr.

* Does many tasks on behalf of upper layer —
  - Framing
  - Flow control & error control
  - Access control.
  - Synchronization. & Physical addressing.

III Network layer:

* It is layer 3 of 7-layer OSI model of comp (N)-ing.
* Responsible for end to end (Sr to destn) packet delivery including routing through intermediate hosts.

* The msg to be transmitted is fragmented into smaller segments at this layer. Then it performs sequencing & error-control of these packets.
* eg → IP.
* Specific () are —
  - fragmntation & reassembly
  - connection model
  - Routing
  - Local host addressing.

IV Transport layer :

* It is the layr of 4 of network model.
* Responsible for end-to-end delivery ovr a network. Note that the network layr is concerned with the end-to-end delivery of individual packets & does not recognize any relationship b/w those packets.
* Once the logical path is established b/w sending & receiving stations, transport layr (provided) controls & standards for commun~ sessions for enabling (p)s to exchange data reliably.
* The best known transport protocol of TCP/IP are the trans~ control protocol (TCP) which is used for connection-oriented trans~ & the connectionless user datagram (p) (UDP)

V Session layer :

* It is a layr 5 of 7-layr OSI model of comp (N)-ing. Responsible for managing & structuring all sessions.
* provides the mechanism for opening, closing & managing a session b/w end-user appli~ (p).
* (f)s →
  - Synchronization — It allows a (p) to add checkpoints which are considered as synchroniza" point into the data.
* responsible for managing & structuring all sessions.
* (f)-s →
  Authentica", permissions, Dialog controller, Synchroniza". Commonly used in appli~ envrnmt that makes use of remote procedure calls (RPCs).

VI presentation layer :

* It is the layr of 6th layr of OSI model. Responsible for delivering & formatting of info to the appli~ layr for processing & displaying.
* It is the lowest layr at which appli~ prgmrs consider data str & presenta". Instead

of Simply Sending data in the form of packets b/w hosts.

* (3s → Encryption & Decryption, Syntx translation, compression.

VII **Appli.. layr** :

* It is the top most layr of the OSI model. It is basically the user oriented layr that provides service that directly sprt the end user of the (n) & enables access to the ntwrk.
* services offered by this layr includes file transfer, DB managmnt, etc.
* Has several protocols to hlp with info interchange — (DNS Domain Name System), HTTP, SOAP (Simple obj Access protocol), POP3 (post office protocol version 3)

VIII **TCP/IP protocol/model:**

OSI		TCP/IP
Appli, Presen, Session	← FTP, HTTP, SMTP, DNS →	Appli layr
Transport	← TCP, UDP →	Transport layr
Network	← IP, ARP →	Intrnt layr
Datalink, Physical	← NIC, hub, switch →	N/w Access layr

OSI → for Sending/receiving data.
TCP/IP ~~protocol~~ → wht protocol we want to use.

(last R)

I **TCP/IP** : It is the conceptual model & set of commun protocols used in Intrnet ~~Appli layer FTP (file Transfer protocol)~~ & comp ntwrks.

* IP protocol provides end-to-end commun specifying how data should be addressed, transmitted, packetized, routed & received.
* Consist of 4 layers, from lowest to highst these are the layers —

a) **N/w Access layr / Link layr:**

- 1st layr of TCP/IP stack & ∴ it is the closest layr to n/w hardware.
- offers the ability to access the physical n/w to transmit data.
- Has n/w-ing scope of local n/w conn to which a host is attached. This scope → link.
- NIC, hub, switch operate at this level.

(P) → protocol:

↳ main (P)s → routing, checking data format

b) Intrnt layr:
- ↳ responsible for finding packets through diffr n/ws.
- ↳ 2 (P)s → ↳ Host addrssing & identificaⁿ
  - ↳ packet routing.
- ↳ protocols —

1) IP: provide a mechanism to use s/w to addrss & manage data packets being sent to comp.
2) ARP (Address Resolvⁿ protocol): Enables the ~~packetr~~ packaging of IP data into diffrnt packets. It is the systm & messaging protocol that is used to find the ethrnt addrss frm a specific IP no.
3) ICMP (intrnt control msg (P)).

c) Transport layr:
- ↳ estaldishes basic data channels that applin use for task-specific data exchange
- ↳ This layr provide end-to-end msg transfr
- ↳ transm & reception of data are handled by T. layr.
- ↳ (P) are —

NIC → Are circuit board/chips that allows a comp to connect to a n/w. (hardware component)

1) TCP: divide the incoming byte stream into discrete msg & passes each 1 onto intrnt layr.
Deals with flow control to make sure a fast sendr cannot flood a slow receivr with more msg than it can handle.
2) UDP (user datagram (P)): It is an unreliable, connecⁿ less (P) for appli- that do not want TCP's sequencing on flow control.
used for client-srvr type reqst-reply queries & appli-.

d) Application layr:
- ↳ top most layr in TCP/IP model
- ↳ provides the devices to access n/w & appli-. like emails.
- ↳ while comunicating frm 1 applin layr (P) to antr applin layr, the info is forwarded to transport layr.

1) HTTP:
used for exchanging the hyper txt on diffrnt systms. It is a reqst response (P) with the hlp of URL's HTTP resources are identifiable on the Nw. It is considered as a base of www.

~~switching Techniques~~ HTTP is used for transferring the web pgs.

2) FTP :

- In ordr to perform file opr FTP allows the users to log into remote host.
- whn a successful connn is being established b/w FTP client & srvr FTP makes an reqst for usrname & password for accessing the srvr host.

3) SMTP : used for transferring the emails.

- It works on store & forward model. within the working of a ntwork this mail being used twice.
- whn any client sends a mail to srvr it keeps a cpy of mail until the mail is successfully received by the srvr client.

4) DNS : It is a decentralised naming system used by the comp system & othr devices ovr the intrnt.

- It translates the domain name into IP add & IP add into domain name.

layers of tcp/IP { Applin layr ↕ Transport layr ↕ Internet layr ↕ N/w access layr }

- Adv- user need not be remember the IP add, It domain name is sufficient.
- (P) sprted by DNS are TCP & UDP.

OSI Model	TCP/IP Model.
Stands for opn systms intr connn.	Stands for - - - -
Has 7 layrs	Has 4 layrs.
It is low in usage	mostly used
" vertically approached	horizontally approached
Delivery of packge is guaranteed in OSI model	- - not guarenteed - -
less reliable	more reliable.

⇒ Physical Layr :

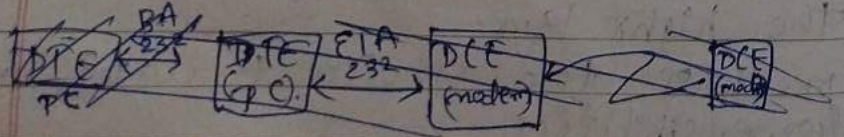
* lowest layr of the OSI model.
* Describes the electrical/optical, mechanical, & ()-al interfaces to the Physical ~~layr~~ medium & carries the signals for all of the highr layr.
* provides the services to data link layr.
* Responsibilities —

- Encoding & Signalling
- Data transm & reception.
- Topology & physical N/w design.

* most used command p. layr standards - ISO, CCITT & Telegraphy.
* 2 very popular standards for connecting DTEs & DCEs are analogue standard RS-232 & digital standard X.21.

I DCE, DTE interface:

* DCE (data circuit-terminating equipmnt) is any device that transmit/receives data in the form of an analogue/digital signal through N/w.
* most common DCE is modem.
* A DEE usually sits b/w DTE (data Terminal Equipmnt) & a data transm circuit.
* DCE works at the physical layr of OSI model



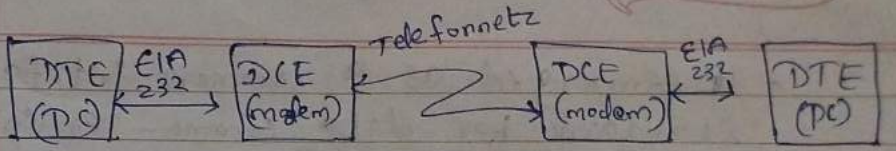


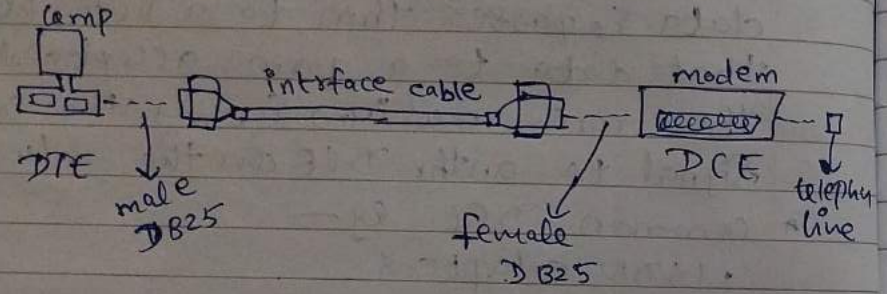
fig: DCE & DTE n/w.

* In any N/w, a DTE generates digital data & passes thm to a DCE, DCE converts that data to a form acceptable to the transm medium & sends the converted signal to anthr DCE on the n/w.
* common DCE eg —
  - ISDN adapters
  - Satellites
  - NIC
* DTE includes any unit that (s either as a source of / as a destina" for binary digital data.
* A DTE device communicates with the data circuit-terminating equipmnt.
* DTE/DCE classifica" was introduced by IBM.

II EIA RS-232 DCE/DTE interface:

* Recommended standard (RS) 232 refrs to a standard introduced in 1960 for serial comma- transm of data.
(EIA → electronic Industries Alliance)

* It emerged as a common interface standard for data commun equipmnt.
* Defines the conn^{n} b/w data terminal equipmnt (DTE) & DCE.

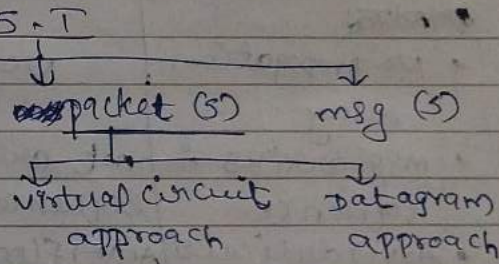


III CCITT X.21 interface:

* It is a standard that was designed to replace the aging EIA-232 standard
* It is a widely-accepted standard for interfacing a DTE to a DCE of a digital n/w.
* Can be used for conn^{n} of upto 1km in length & data rates upto 10 mbps.

⇒ Switching Techniques:

* Commun is typically achieved by transmitting data frm source to destin^{n} through a n/w of intermediate nodes → switches.
* In large n/w, there can be multiple paths frm sndr to receivr. It will decide the bst route for data trans-
* used to connect the systems for making 1-to-1 commun

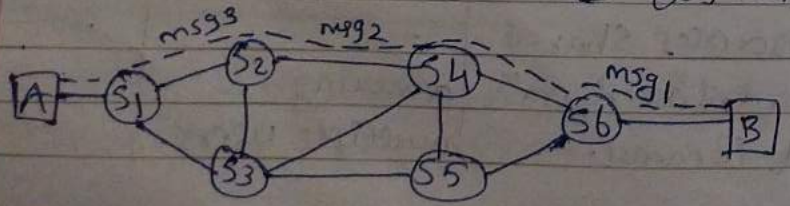


circuit (S)	packet (S)	msg (S)
* commun is performed through a dedicated path	No dedicated path exists	No dedicated path. exists.
* No data storing is required	packets are not stored, they are queue for delivry	msgs are stored for latr retrival.
* resources shared for entire dura^{n} of commun	– – amoung multiple users.	– – – – – –

* Efficient for continous data streams	Efficient for bursty & intermittnt data	less efficient
* limited flexcibility	flexcibele	less flexcibelity.
* eg → traditional telephn n/w	eg → TCP/IP	eg → older comp n/w
* No propogation delay	No	yes
* msg arrivs in sequence	not arrive in sequence	msg arrive in sequnce
* Adv → dedicated path, fixed bandwidth ...	Adv → Flexibility, scalability	Adv → Simplicity msg priority can be used to manage the n/w

I circuit (S) :

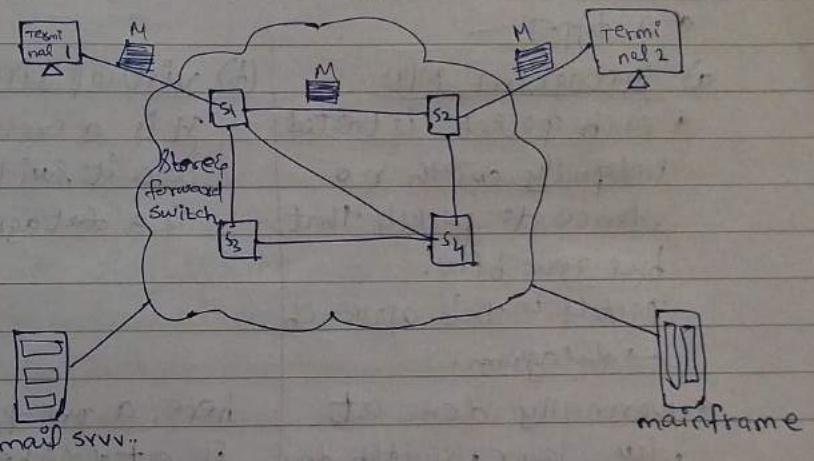
↳ has 3 phases → circuit establishment
→ data transfr
→ circuit disconnect.



II msg (S) :

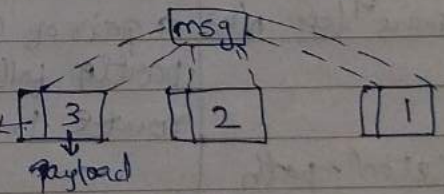
↳ each msg is treated as a separate entity. Each msg contains addressing infor.

↳ each msg is stored bfre being transmitted to the nxt switch.



III packet (S) :

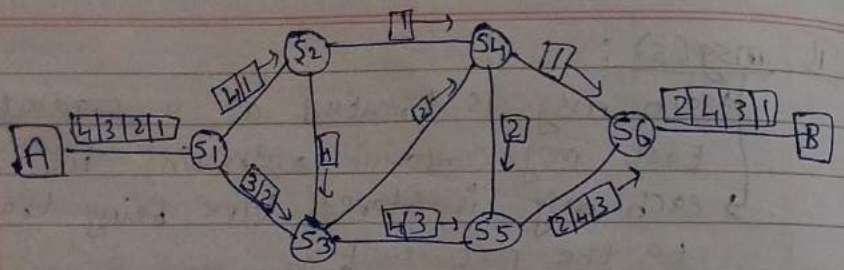
↳ packets are made of headr & payload.



if a source has a longr msg to snd, the msg is broken up into a series of packets.

Header → contains control info essential for proper routing & delivery of the packet.

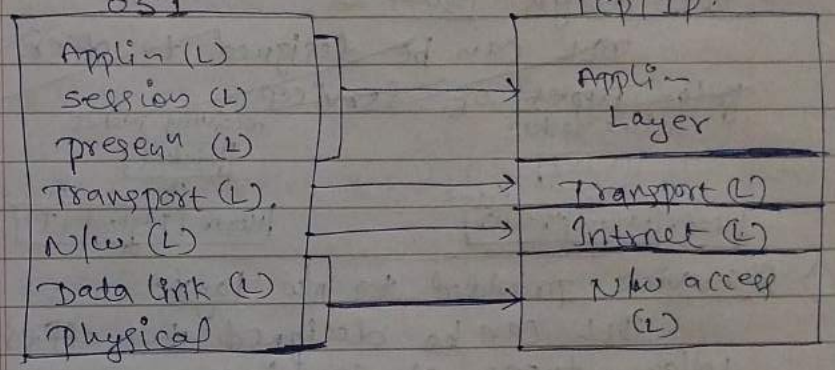
Payload → containing actual data being transmitted.



* 2 types —

a) Datagram N/w	(b). virtual circuit n/w
* each packet is treated indepndly with no refrnce to packets that hve gone bfre. Packets in this approach → datagram.	: It is a cross b/t a circuit switched n/w & a datagram N/w.
* Normally done at N/w layr. switch does not keep info about the conn^n state. That's why it is referred to as Connectionless n/w	here, a pre-planned route is established bfre any packets are snt. once the route is established, all the packets b/t a pair of communicating parties follow this same route through the n/w
* No dedicated path	— — —
* Dynamic use of bandwidth	— — —
* overload rises	— — — overload may block.

* TCP/IP Model =



* Circuit Switching 3 phases —

a) C.E = a dedicated commun path & → a circuit is established b/w the sndr & receivr befre any data transm begins.

b) D.t = once the c. established, the actual data transfr takes place

c) c.d = After the commun is complete, the dedicated circuit is released & resources are freed up for othr commun —