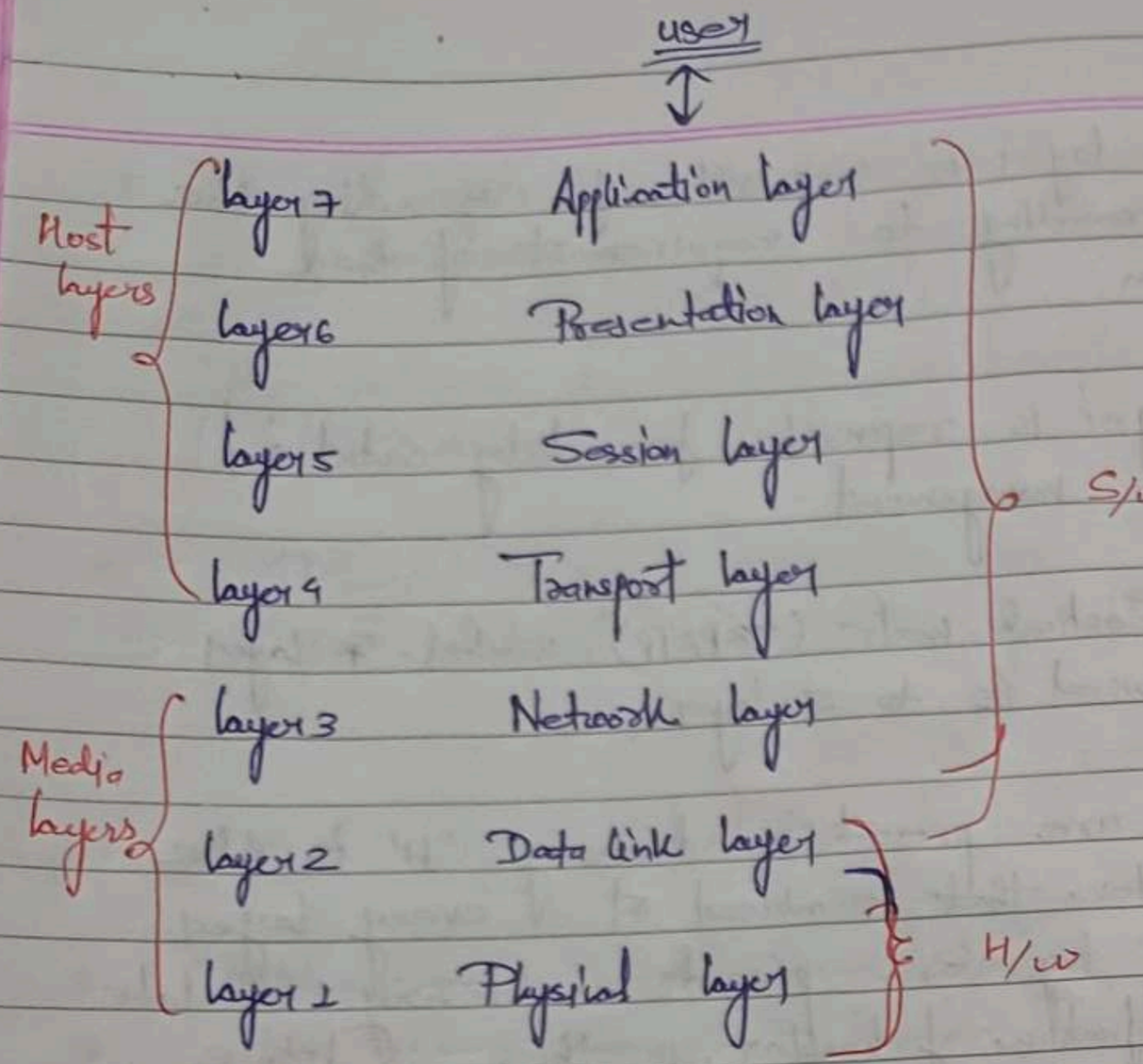


TCP/IP Model

layer 5 → Application layer

layer 4 → Transport layer → TCP & UDP

layer 3 → Network layer Internet

layer 2 → Data link layer } Network Access

layer 1 → Physical layer }

CMD → "netstat"

* Application layer :—
Network application program (network process)
Eg:- Browser

→ Process : Program in execution

Port Number :— (16-bit) : Identifier → 16 bit unsigned int Range 0 to $(2^{16}-1)$
→ Used to identify a network process in a machine
[process involved in Network Communication]

→ Port Number managed by OS
[different with process id (pid)]

Port Number :—

1> System (Well-known) Ports : 0 to 1023
[assigned and controlled]

2> Registered Ports : 1024 to 49151
[Not assigned or controlled, but can be registered to prevent duplication].

3> Dynamic (Private) Ports : 49152 to 65535
[Not assigned, controlled or registered]

Server

client

* Two Process Communication :—

1> Same Host :— Communicate using IPC (Inter-Process Communication) of OS.

=> Different Host :—

→ Communicate over network.

Protocol :—

→ Set of Rules
→ Define, how data is exchange between network process

* Application layer protocol :—

client server Model.

DNS :— Domain Name System
HTTP :— Hyper text transfer Protocol.
FTP :— file transfer Protocol.
SMTP ⇒ Simple Mail transfer Protocol.

* Protocol Data unit :—

→ Basic unit of exchange
→ Between same protocol of different Machine
→ Between 'layer-n protocol' of one machine and 'layer-n same protocol' of other machine.

Application layer PDU ⇒ Message

Q The Protocol data unit (PDU) for the application layer in the Internet stack is. [Gate- 2012]

A> Segment
B> Datagram
C> Message
D> Frame

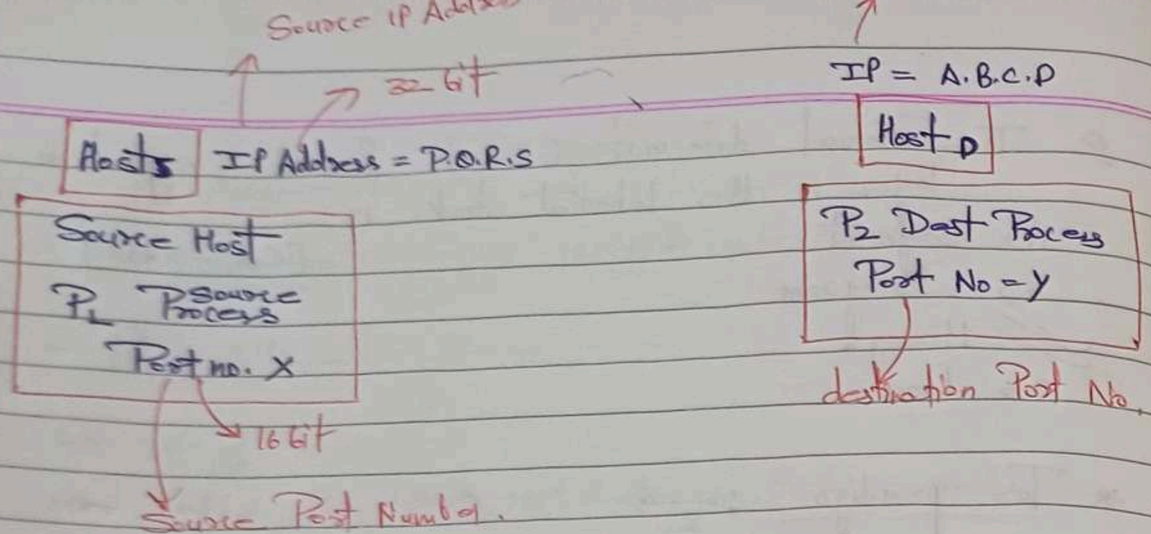
* Two paradigm :—

1> Client - Server (Web browsing, Gmail)

2> peer to peer (Bit torrent, VoIP)

Q which one of the following is not a client Server Application [Gate- 2010]

A> Internet chat
B> Web browsing
C> E-mail
D> Ping.



* Presentation layer :—
  1> Code Conversion
  2> Encryption and Decryption } optional
  3> Compression and Decompression }

Input Data Format$_1$ ⟶ Presentation layer ⟶ Output data format$_2$

* Code Conversion :—
  Convert data into network standard code, before transmission [Network presentable form]

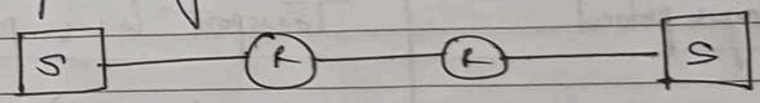
ASCII :
EBCDIC
UNICODE

* Session layer :—
  1> Session Establishment
  2> Dialog Management
  3> Authentication
  4> Authorization.

Q. Assume that source and destination hosts are connected through one intermediate router. Determine how many times each packet has to visit the data link layer during the a transmission from source to destination.

Ans = 4

Q. Assume that source S and Destination D are connected through two intermediate routers labeled R. Determine how many times each Packet has to visit the network layer and the data link layer during a transmission from S to D?



Ans :— Network layer → 1+1+1+1 = 4
Data link layer → 6

* Transport layer :—

→ Provide logical communication between application processes (Processes running on different machine)

→ Responsible for Process to process (end to end) Communication.

→ Multiplexing & DeMultiplexing

[DeMultiplexing on the basis of Destination Port Number]

* Two Transport layer protocol :—

1> UDP ⇒ User Datagram Protocol (Basic Protocol)
2> TCP ⇒ Transmission Control Protocol
↳ UDP + (Extra services)

[UDP is faster than TCP]

Application layer protocol	Transport layer protocol
DNS	UDP (Default) TCP (Conditional)
HTTP/1 HTTP/2	TCP
HTTP/3	UDP
FTP	TCP
SMTP	TCP

Q Which one of the following uses UDP as the transport layer? 2007

0> HTTP
b> Telnet
✓ DNS
D> SMTP.

Q Which of the following transport layer protocols is used to support Electronic mail.

A> SMTP
B> IP
✓ TCP
D> UDP

Service Data unit :—
→ Upper layer 'Protocol Data unit'
→ layer n PDU is SDU for layer (n-1)

Transport layer PDU : "Segment"

→ Sender :- Divide application message into segments, segments passes to network layer.

→ Receiver :- Resembles segments into message, Message passes to application layer.

*
Application layer PDU — Message

Transport layer SDU

Transport layer PDO "Segment" — Header | Payload. (segment.)

if the message is large

T_H | Payload$_1$ | T_H | Payload$_2$ | T_H | Payload$_3$

* Network layer :—

→ Provide host-host communication services
→ Forwarding and Routing
→ Internet and protocol (IP) :- IPV4, IPV6
  ↳ IP Header
  ↳ IP Addressing

inter-networks :— Source & Destination host belongs to different network.

forwarding (Data plane) :—

→ Determine how datagram is forwarded [forwarding table]

→ Move Packet from a router's input link to appropriate router's output link.

Routing (Control plane) :—

→ Determine how datagram routed during among routers [Router table]

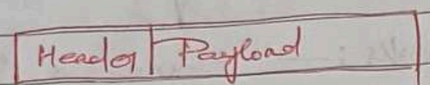
→ Determine route taken by packet from Source to destination [Routing table]

Network layer Pdu : "Datagram"

Sender :— Divide a segment into datagrams, Datagram passes to data link layer

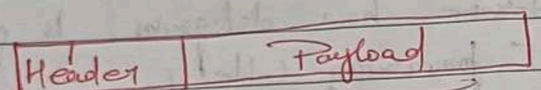
Receiver :— Resemble datagram into segments passes to transport layer.

Transport layer PDU "Segment"

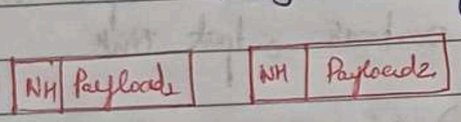


Network layer SDU

Network layer PDU "Datagram"



if size is large.



Router → Store and forward device
[store, Process and forward]

* Data link layer :— Responsible for node to node communication.

Data link layer services

1> framing
2> Error Control
3> flow Control
4> Access Control

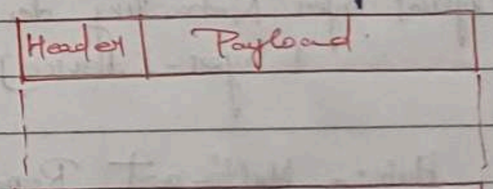
Data link layer PDU :—

Data link PDU : "frame"

Sender :— Encapsulate datagram into frame frame passes to Physical layer for transmission

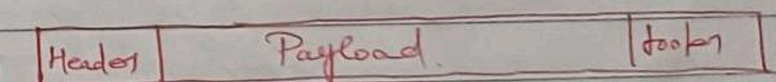
Reciever :— extract datagram from frame. then datagram passes to network layer

Network layer PDU "Datagram"



Data link layer SDU

Data link layer PDU "frame"



* Data link layer Networking Devices : "Switch"
[layer-2 device, Old name : "Bridge"]

→ Store and forward Device
→ forwarding based on MAC Address.

* Physical layer :—

Responsible for transmission of "bit"

→ Copper Cable
→ Fiber Cable
→ Wireless

⇒ Encoding / Signaling

→ Physical layer Networking device : "Repeater and Hub"
[layer-1 device]

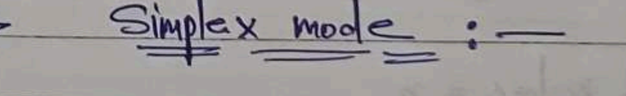
→ Hub :- Multi-port Repeater.

* Line Configuration :—

Attachment of Communication devices to a link.

1> point to point :—

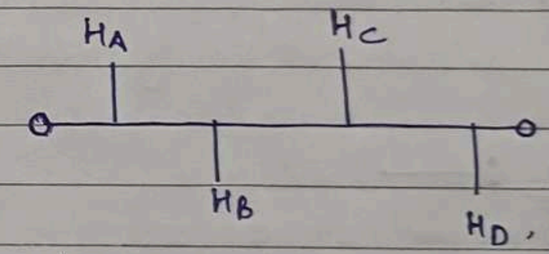
Dedicated link between two devices
[One sender and one reciever]



2> Multipoint (Multidrop) :—

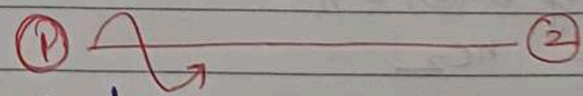
→ More than two devices share a single link
→ Broadcast medium
[one sender and all are receiver]

eg:- Bus topology



* Transmission Mode :—

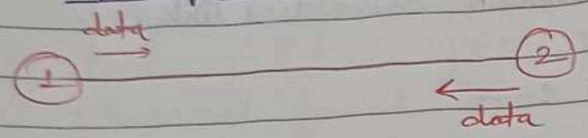
1> Simplex mode :—



2> Half-duplex transmission :—

Ex → walkie-talkie

3> full duplex transmission :—



Example :— Mobile Comp Communication.

2> Network Topology :—

→ Arrangement of host inside a network

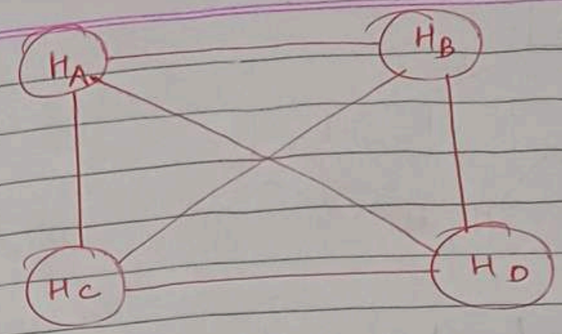
→ Different type of topology are :—

1> Mesh
2> Star
3> Bus
4> Ring.

* Mesh Topology :—

Every device has dedicated point to point link to every other device.

total number of nodes = n
total link = nC_2



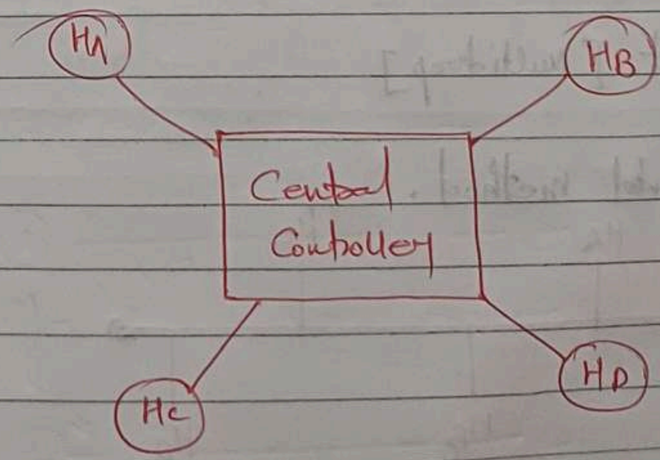
* Faster Communication
* Installation cost is very high
* No MAC Address required.
* Inefficient utilization of links.
* (n-1) input-output (I/O) port per device.

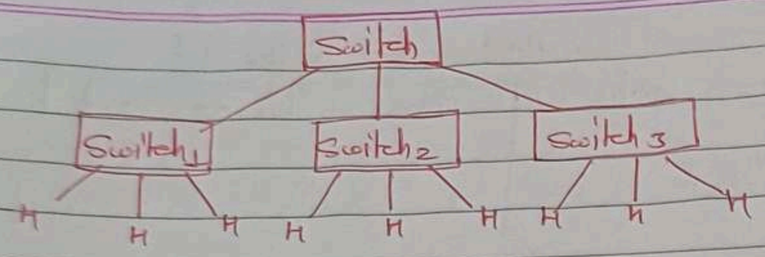
Star topology :—

Every device has dedicated point to pointer link only to central controller.

total number of nodes = n
total number of link = n

Central Controller :— Hub, Switch or Router.





* Insertion / removal of devices are easy
* Easy to extend the topology
* If Central Controller fails then all communication fail stop.

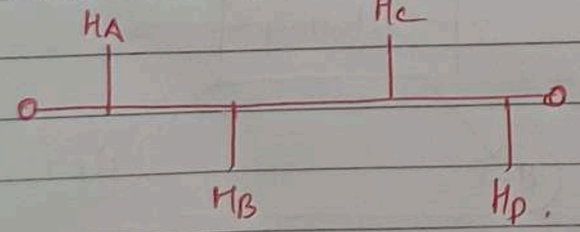
Q Consider that 11 machines need to be connected in a LAN using 6-port Ethernet switches The minimum number of switches needed is 3.

* Bus topology :— Every host Connected to centralized backbone media (Coaxial Cable)

total number of nodes = n
total number of link = 1

→ Multipoint [Multidrop]

→ Access Control method.



* Installation cost is very low.
* If backbone media fails then all communication stop.

* Ring Topology :—

Every host connected to two adjacent host using point to point link

number of nodes = n
total number of links = n.

→ Simplex Communication
→ Access Control Method.