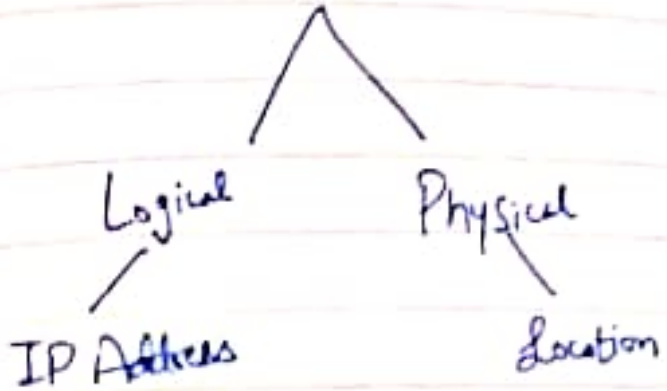
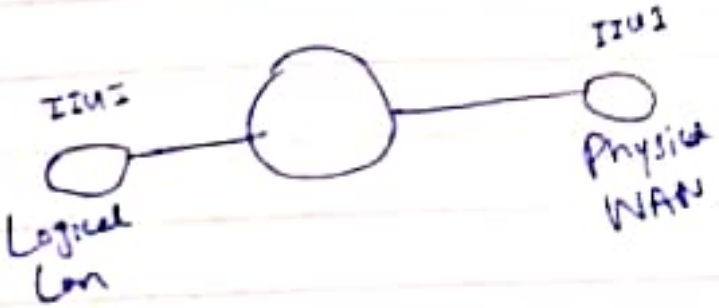
Email: qaisarjavidmct@hotmail.com

Computer Networks:-

Combination of two or more PC's but shared the resources.





⇒ Combination of public networks are called internet
⇒ Combination of private networks are called intranet
⇒ Combination/ b/w two remote side via internet and intranet Communication with the least and dedicated / fixed path are called extranet / vpn.

⇒ Layout of Network is Topology.
⇒ Mesh → Wastage of cable.
If one will down, other will work.

To find No. of meshes :-

$$K = \frac{K(K-1)}{2}$$

K = No. of nodes

$$\frac{4(4-1)}{2} = \frac{12^{6}}{2} = 6$$

Mesh:- (Point-to-Point)

Advantages:-

⇒ Use of dedicated links guarantees each connection can carry its own data load.

⇒ Eliminate traffic problems that can occurs when link must be shared by multiple devices.

⇒ If one link become unusable, it does not incapcitate whole system (robust).

⇒ If every message travels along dedicated line, only intended recipient sees it. (privacy, security)

⇒ Easy fault identification due to point to point connection

Dis-Advantages:-

⇒ The amount of cabling and no. of I/O ports requir

⇒ Because every device is connected to every other device, installation and reconnection is difficult.

⇒ Sheer bulk of wiring can be greater than available space can accomodate.

⇒ Hardware requirement to connect each link (I/O, cable) can be expensive.

Example:-
Connection of telephone regional offices in which every office is connected with other office.

Star:- (Point - to - Point)

Advantages:-
⇒ Less expensive than mesh - topology.
⇒ Each device needs only one link and one I/O port to connect it to any number of others.
⇒ Easy to install and reconfigure.
⇒ Less cabling is required.
⇒ Robustness
⇒ Easy fault identification due to point to point connection.
⇒ As long as hub is working, it can be used to monitor link problems.

Dis- Advantage:-
⇒ Dependency of whole topology on one single point. (hub).
⇒ If hub goes down, whole system will dead.

Example:-
Used in LAN's

Bus:- (Multi Point)

Dropline → Connection b/w devices and main cable.

Tap → Connector that either splices into main cable

⇒ As signal travel along backbone, some of its energy transformed into heat. Therefore it becomes weaker and weaker as it travel farther. For this reason there is a limit on no. of taps a bus can support and distance b/w taps.

Advantages:-

⇒ Ease of Installation.

⇒ Less cabling then mesh and star. (b/c backbone cable can be laid along most effecient paths, then connected to nodes by droplines of various lengths).

⇒ Only backbone cable stretches through whole facility.

Dis-Advantages:-

⇒ Difficult reconnection and fault isolation.

⇒ Difficult to add new device.

⇒ Signal reflection at taps can cause degradation in quality.

⇒ Fault in bus cable stops all transmission, even b/w devices on same side of problem.

Example:-
⇒ Used in design of early LAN's.
⇒ Ethernet LAN's.

Ring:- (Point-to-Point)
⇒ Signal reaches from one device to device until its destination. Direct signal from one to last can't be send.
⇒ Each device has repeater, when device receives a signal intended for other device, its repeater regenerates the bits and passes them along.

Advantages:-
Easy to install and reconfigure.
⇒ To add or delete, devices requires changing only two connections.
⇒ Fault isolation is simplified.
⇒ If one device doesnot receive a signal within specified period, it can issue an alarm.

Dis-Advantage:-
⇒ Uni-Directional traffic is a problem.

Example:-
Ring Topology was prevalant when IBM introduced its LAN Token ring, the need for higher speed LAN's made this less Popular.

OSI Model:-

All People seems to need Data Processing

① Application (User Interface) (Not familiar with Backend)
② Presentation
③ Session
④ Transport (Acknowledgement that data is received)
⑤ Network (Path Selection)
⑥ Data Layer
⑦ Physical - Link

⇒ SMTP (connection oriented) → Email

Logical → 32 bit Physical → 48 bit (IP_Address)

SAP

=

MAC → 48 bit

⇒ Collision of Domain Hub = 1

⇒ IP Address parts → Node / Network

OSI Model (Open Systems Interconnection):-

Layering:- It means decomposing of problem of building a network into more manageable components (layers).

Benefits:- ① More Modular design
② Easy to Trouble shoot

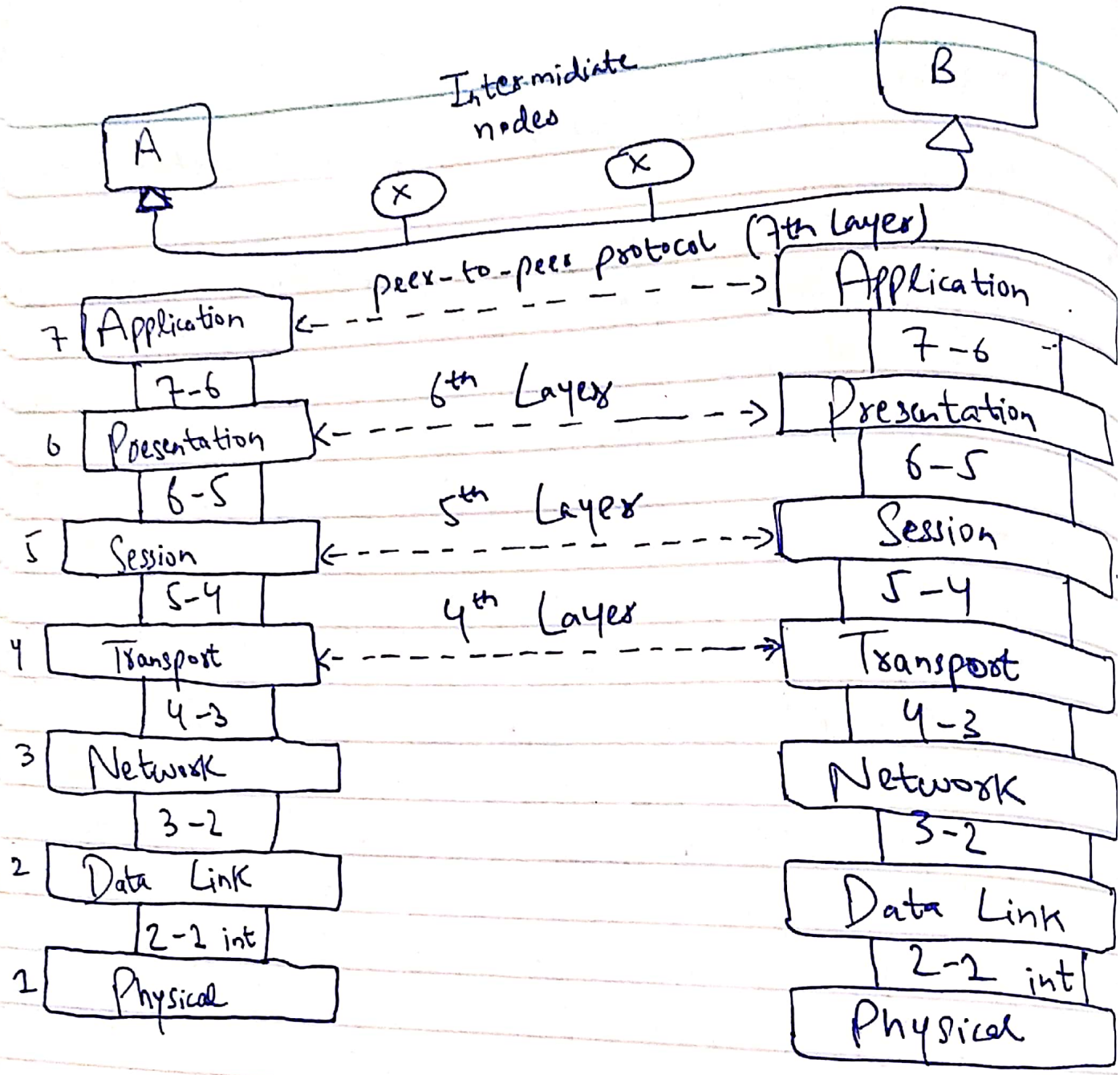
Purpose:-

The purpose of OSI model is to facilitate communication b/w different systems without requiring changes to logic of the underlying hardware and software.

⇒ As message travels from A to B, it may pass through many intermidiate nodes. These nodes usually involve only first 3 layers of OSI model i.e: Physical, Data Link, Network. If someone want to access application da to be accessed by the routers, he is an attacker or a bad guy.

⇒ The data generated by device or source computer will be from layer seven to layer one. Upon reception of data, the data will be processed from layer one to layer seven.

⇒ There will be interaction b/w adjacent layers i.e presentation layer is going to interact with application layer



⇒ If two systems want to communicate with each other, the user at system A is going to generate the data. Data is going to be generated through application layer by open a application. Data data generated by application layer of system A must reach destination computer's application layer. (pass through all seven layers of system A and then pass through layer of system B from bottom to top).

Application Layer:-

It enables users to access network resources.

Services:- ① File Transfer and Access Management (FTAM)
② Mail Services
③ Directory Services.
↓
access of data globally

Presentation Layer:-

It is concerned with syntax and semantics of the information exchanged b/w two systems.
⇒ User Interface

Services:- ① Translation (format must be same) (sender or receiver)
② Encryption
③ Compression (reduced no. of 0's and 1's whe sending multimedia)

Session Layer:-

It establishes, maintains and synchronizes the interaction among communication devices.

Services:- ① Dialog control
② Synchronization

Transport Layer:-

It is responsible for process to process delivery of entire message. Acknowledgement that data is received.

* Whatever data is received from upper layers, it adds Source port no. and destination port no. is added in Transport Layer.

Services:-
① Point / Port addressing
② Segmentation and reassembly
③ Connection Control

Connection oriented → Before sending data, connection will be established.

Connection less → Connection will be established and data will be sent.

④ End-to-End flow control

⇒ If sender is fast, and receiver is slow, so receiver cannot handle that speed. So, we are in a need to speed matching mechanism. (where will be common speed matching mechanism). So whatever sender sends, receiver is able to receive without any loss.

⑤ Error Control

Network Layer:-

It is responsible for delivery of data from original source to the destination network.

Services:-
① Logical Addressing

⇒ It means IP addressing. It helps the router to take decisions, so when a packet is received by this routers, it will have source and destination IP address.

* ⇒ Source IP. address and destination IP address is added in network layer.

② Routing

⇒ Finding best route for the packet to be transmitted. Use IP address for finding best route.

Data Link Layer:-

It is responsible for moving data (frames) from one node to another.

Services:-

① Framing

⇒ The data link layer of system A groups the bits of zeros and ones and we call this grouping as a frame.

② Physical Addressing

Every computer is identified with IP, MAC address, and process is identified with help of port numbers. IP address related services are handled by network layer. Port no. → Transport Layer, MAC/physical addressing are done by data link layers.

③ Flow Control } → also in Transport Layer
④ Error Control }
⑤ Access control

→ If two or more devices are connected, it determines which device has control over link at any given time.

* ⇒ Source MAC address and destination MAC address are added in Data link layer. Frames are also made in Data link layer.

⇒ Adds header and trailer for MAC address and error.

Physical Layer:-

It is responsible for transmitting bits over a medium. It also provides electrical and mechonical specifications.

⇒ After creation of frames, it is responsibili of this layer to place that frames on channel or medium.

Services:-

① Physical characteristics of medium

⇒ which type of media is used i.e wireless/wir

② Representation of bits

⇒ How zeros and ones converted into signals.

③ Data Rate.

⇒ No. of bits sent each second.

④ Synchronization of bits.

⇒ The clock b/w sender and reciever must synchron

⑤ Line configuration

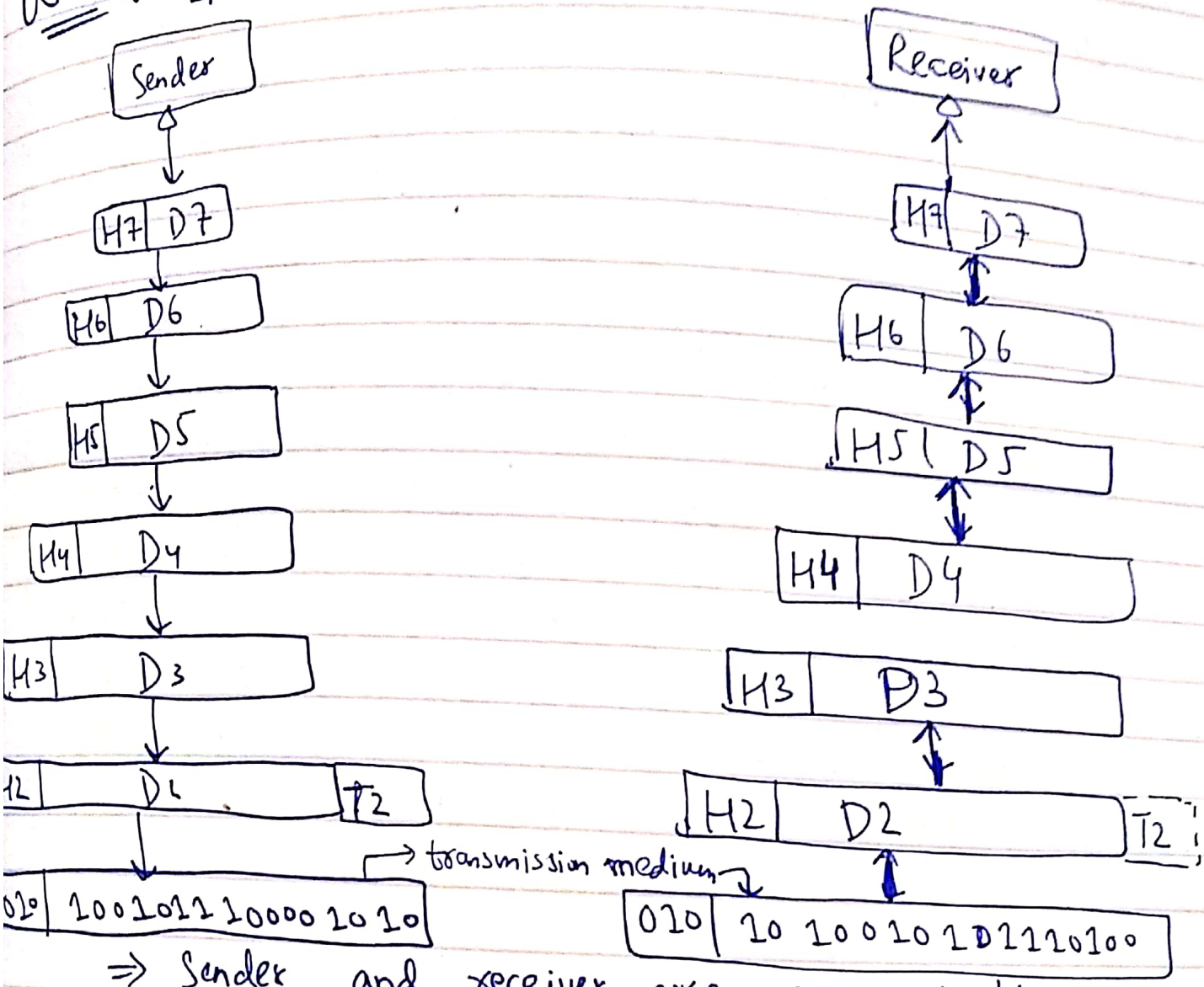
⇒ Determins whether point-to-point or multipoint communication.

⑥ Physical Topology

⇒ How devices are connected to make a network.

⇒ Place the fromes on a medium.

Working of OSI:-



⇒ Sender and receiver are connected through a network (Transmission Medium). Data Generated by Application Layer is D7. Some activity is carried out in Application Layer that is H7. Then data is given to ~~&~~ presentation Layer, where data is encrypted, compressed or translated and header is added in presentation Layer. → Session Layer (where it establish, synchronizes interaction b/w sender and receiver (Dialog Control)) → Transport Layer (where source port no.

and destination port no. is added) in H4 → network layer (whose Source IP address and destination IP address is added) in H3 → Data Link layer (where Source MAC address and destination MAC address is added) in H2 and error control is are added in trailer part(T2, Then all data is converted into 0's and 1's in physical layer. It is responsibility of physical layer to take frames which are generated by data link layer and place frames on the transmission medium. And upon the reception, all the data received in form of bits only in receiver side. So physical layer of receiver side receives the data and handed it over to application layer through all various layers.

TCP/IP Model Protocol Suite:-

The original TCP/IP protocol suite was defined as having four layers:- ① host to network ② Internet ③ Transport ④ Application. However, when TCP/IP is compared to OSI, the functionalities of physical layer and data link layer are combined into a single layer called network / host to network layer. The network layer's is equivalent

* in TCP/IP model is Internet Layer. The transport layer is the same as OSI model. The functionalities of Session Layer, Presentation layer, and Application Layer are merged into a single layer called Application Layer. So, it is made up of four layers.

Network Access Layer → Point to point protocol (PPP)
→ Ethernet Protocol (very popular for wired LAN technologies)
→ Interface Drivers

Internet Layer → Routing Protocols (BGP)
IP (NAT)
IP Support (ICMP) (IGMP)

Transport Layer → TCP (Transmission control Protocol)
UDP (User Datagram Protocol)
SCTP

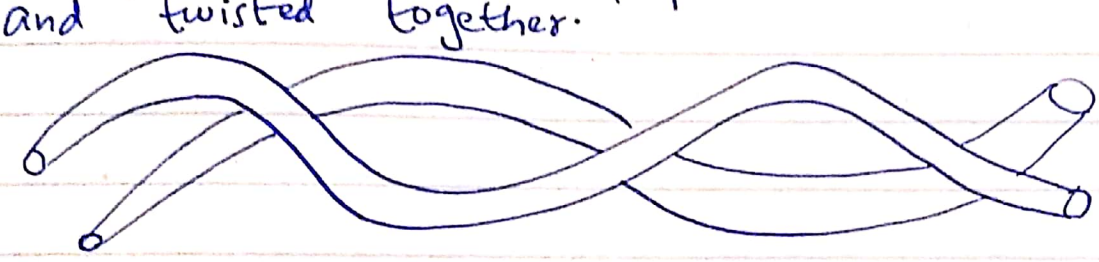
Application Layer → Web (HTTP)
Email (SMTP)
Name system (DNS)
File Transfer (FTP)

Protocol Data Unit:-
Application Layer → Data
Transport Layer → Segment
Network Layer → Packet
Data Link Layer → Frame
Physical Layer → Bits

(PDU's are named according to protocols of TCP/IP suite.)

Twisted Pair Cable:-

⇒ It consists of two insulated copper wires arranged in spiral pattern to minimize electromagnetic interference b/w adjacent pairs.
⇒ Customer facilities and over distance, data communication.
⇒ Low frequency transmission medium.
⇒ One of wire carries signal, other used as ground reference.
⇒ Used for both analog and digital.
⇒ Pair of wires is covered by plastic insulation and twisted together.



e.g:- Subs connected through a connector.

Telephone lines / LAN	Computer → printer
Digital Subscriber line	Computer → computer

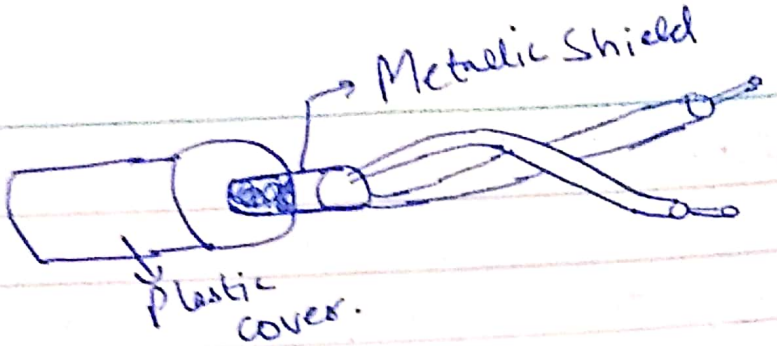
Types:-

1) Shielded Twisted Pair (STP):-

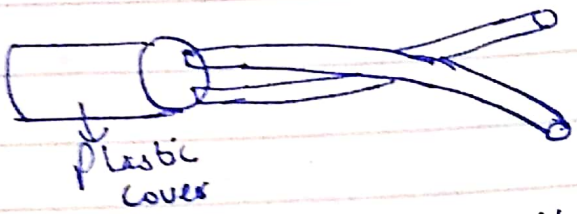
⇒ The pair is wrapped with metallic foil to insulate the pair from electromagnetic interference.

Advantage → Less prone to noise due to metal casing.

Disadvantage → costly, heavy, hard to install
→ Less flexible.



② Unshield Twisted Pair (UTP):-



(No metallic Shield)

⇒ Each wire is insulated with plastic wrap but pair is encased in outer covering.

3 UTP

→ Data rates upto 16 mbps are achieveable

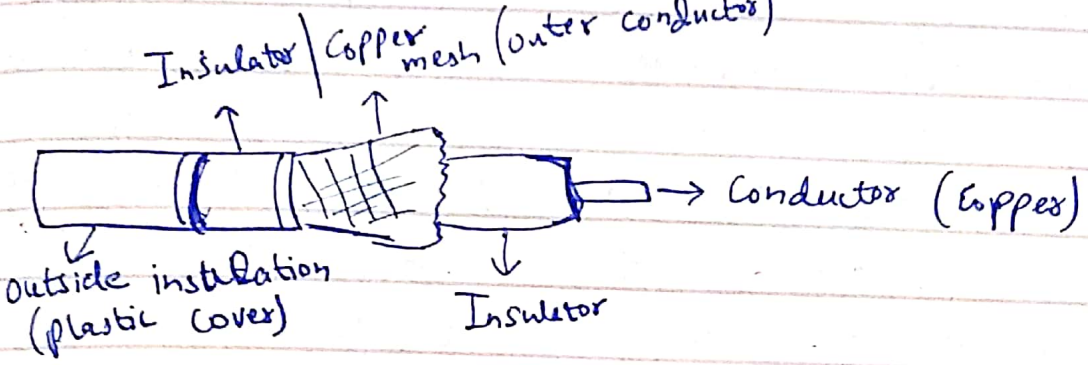
5 UTP

→ Data rates upto 10 mbps are achieveable.
→ More Expensive
→ Better performance.
→ Flexible.

⇒ Most commonly used in communications / network
⇒ IBM introduced STP for their own use.
⇒ RJ45 (UTP connector) can be insested in one way.
⇒ It is flexible.

Coaxiale Cable:-

⇒ Used for cable Television, LAN's / Telephones.



⇒ It consists of copper wire covered by insulating material.

⇒ Insulated copper wire is covered by copper mesh.

⇒ Mesh protect data signals from interference by external electromagnetic waves.

⇒ Carries signal of higher frequency than twisted pair cable.

⇒ Instead of two twisted wires → coax has central core conductor of solid (Copper) enclosed in an insulator → which is enclosed/encased in outer conductor of metal foil (shield against noise) → Outer conductor also encased by insulator and whole cable is protected by outer cover.

⇒ Standards depends on thickness of inner insulator, Construction of shield, Size and type of outer casing.

BNC (Bayone - Neill - Concel man)

- BNC connector
  - Use to connect end of cable to a device, (TV set).
- BNC T connector
  - Ethernet Networks, to Branch out to a connection to a computer or other device
- BNC Terminator
  - Used at end of Cable to prevent reflection of the signal.

⇒ High Bandwidth

Coaxial Cable

1. 10Base5 ← Thicknet Ethernet
   - RG-11
   - 10Mbps
   - 5000m
- Thin net → 10Base-2 Ethernet
  - RG-58
  - 10Mbps
  - 185m

- Broad Band
- Base Band

⇒ Base Band coaxial Cable supports quick transmission of a single signal at a time and mainly used for LAN's.

⇒ Broad Band Coaxial Cable transmits multiple signals at same time and used for longer distances.

Fiber Optic Cable:-

⇒ Expensive

⇒ Data Transmission speed are high than other

⇒ Fibre optic cable is made of glass or plastic and transmits signals in form of light.

$\Delta I < \delta c$ ⟶ the ray refracts and moves closer to surface

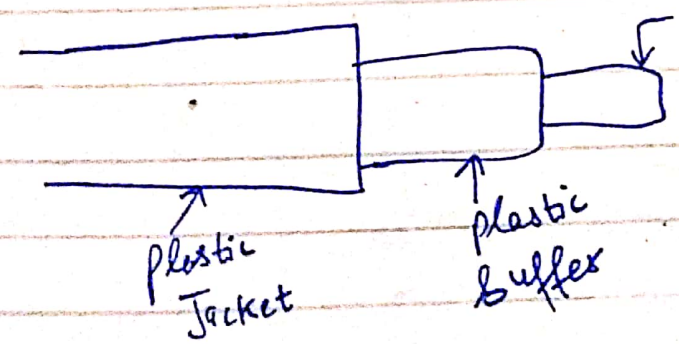
$\Delta I = \delta c$ ⟶ the light bends along the interface.

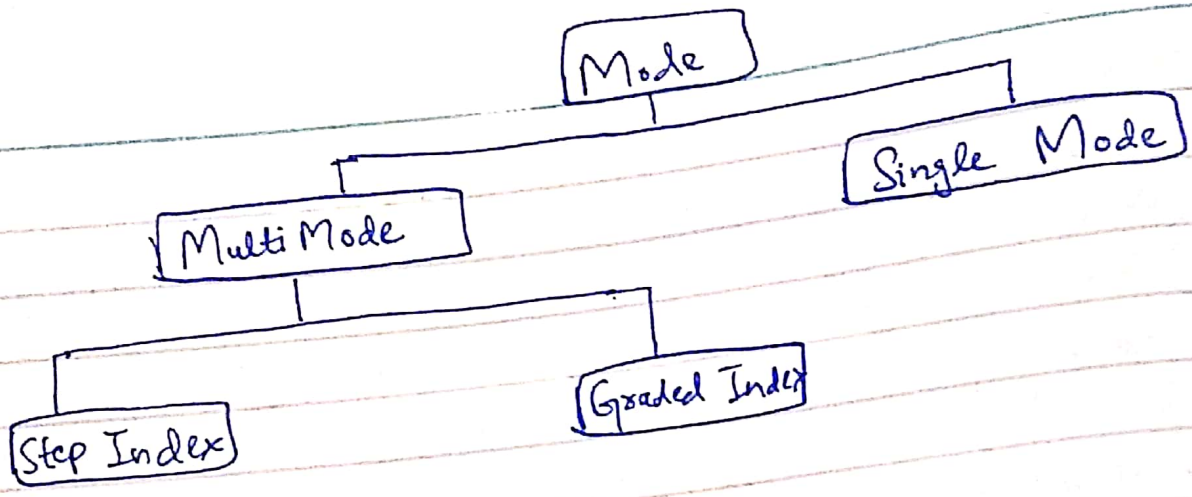
$\Delta I > \delta c$ ⟶ the ray reflects and travel again in denser substance.

⇒ A glass or plastic core is surrounded by a cladding of less dense glass or plastic.

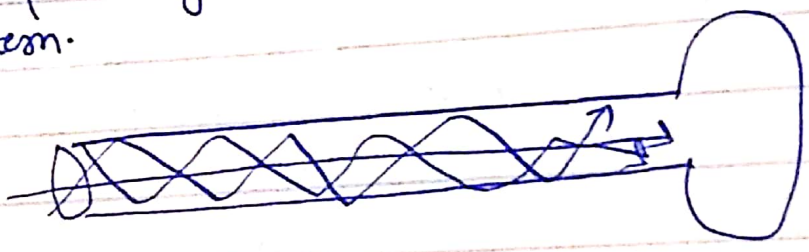
⇒ Works at very high speed / Not effected by electromagnetic waves.

⇒ New transmission medium used by telephone companies.

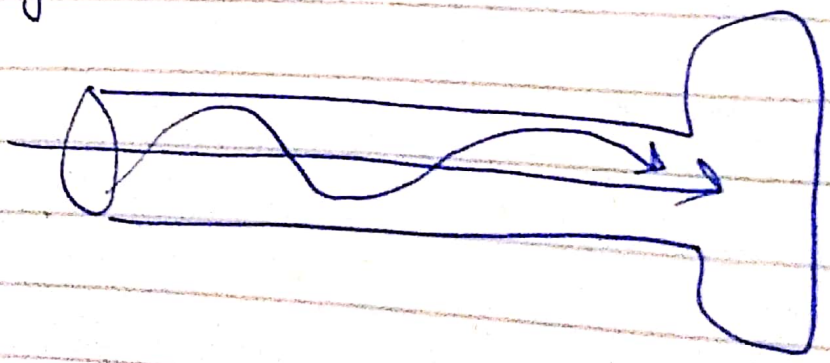




Multimode step Index fiber → The reflective walls of the fiber move light pulses to the recievers. It operates on principle of total reflection and allow travelling of light across fibre/core axis in a zigzag pattern.



Multimode graded Index fiber → It is a type of optical fibre where refractive Index is higher at the axis of core and it decrease gradually. It is one with varying densities. Density is higher at centre core and decreases gradually to its lowest at the edge.



Single Mode ⟶ Lower Density

→ It is manufactured with much smaller diameter than that of multimode.
→ It is a single glass fibre strand used to transmit a single mode or ray of light.
→ Uses only one transmission mode.
→ Higher Bandwidths.

Advantages:-

⇒ Electromagnetic waves can't affect fibre optic cable.
⇒ Resistance of corrosive materials.
⇒ Light weight
⇒ Greater Capacity / Smaller size / Light weight.

Dis-Advantages:-

⇒ Installation / Maintenence
⇒ Expensive over short Distance
⇒ Adding additional nodes is difficult.

Connectors:-

RJ-11 (4) O B G D
RJ-45 (8) O W B W G W D

Same devices, Cross cable
Diff devices, Same cable

SC connector → Subscriber Channel (SC) connector is used for cable TV.

ST connector → Straight-Tip (ST) connector is used for connecting cable to network devices.

⇒ IP addressing (Imp Chapter)

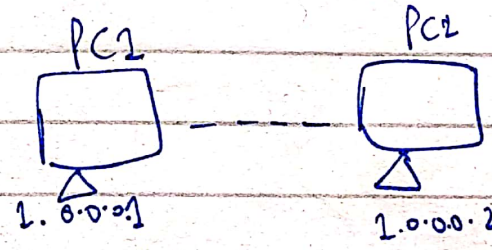
⇒ Chapter No. 19

Google.com → Domain Name (DNS)

Class A	1-126	} Practical Network
B	128-191	
C	192-223	
D	224-239	} → Multi Tasking / Casting
E	240-254	} → Future Reserve / Experimental

127: Loop Back → Network Testing

Ping ⇒ Package Internet Grouper



S1: Ping 127.0.0.0

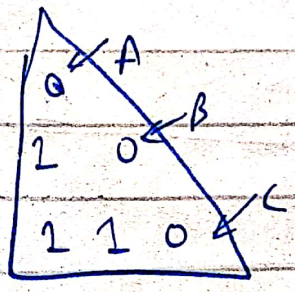
0.2.3.6 ✗

1.2.3.4 ✗

1-255 ✓

131.2.3.1 (B)

16.1.1.1 (A)



1 1 1 0

1 1 1 2

8	4	5	7	=32

8	7	6	5	4	3	2	1
128	64	32	16	8	4	2	1

IP Address → Node ID → PC/Machine/Client → Can be changed
IP Address → Network ID → fixed

IPV4 → 32 bits (unique and universally defines the connection of a device (computer or router) to the Internet.)

2^{32} = 4,294,967,296 (total no. of IP address you can assign to machine or router).

00001011

10000000 ← 128.22.3.32 → 00011111

00000011

Example:- (a)

	128	64	32	16	8	4	2	1
1st	1	0	0	0	0	0	0	1
2nd	0	0	0	0	1	0	1	1
3rd	0	0	0	0	1	0	1	1
4th	1	1	1	0	1	1	1	1

129.11.11.239

(b)

128	64	32	16	8	4	2	1
1	1	0	0	0	0	0	1
1	0	0	0	0	0	1	1
0	0	0	1	1	0	1	1
1	1	1	1	1	1	1	1

193.131.27.255

2	78
2	39 - 0
2	19 - 1
2	9 - 1
2	4 - 1
2	2 - 0
	1 - 0

(a) 111.56.45.78

01101111 00111000 00101101 01001110

Error Conditions:-

(a) There must be no leading zero (045)
(b) There can be no more than four numbers.
(c) Each no. needs to be less than or equal to 255.
(d) A mixture of binary and dotted-decimal notation is not allowed.

0 0 0 0 0 0 0 0
128 64 32 16 8 4 2 1

2	111
2	55 - 1
2	27 - 1
2	13 - 1
2	6 - 1
2	3 - 0
	1 - 1

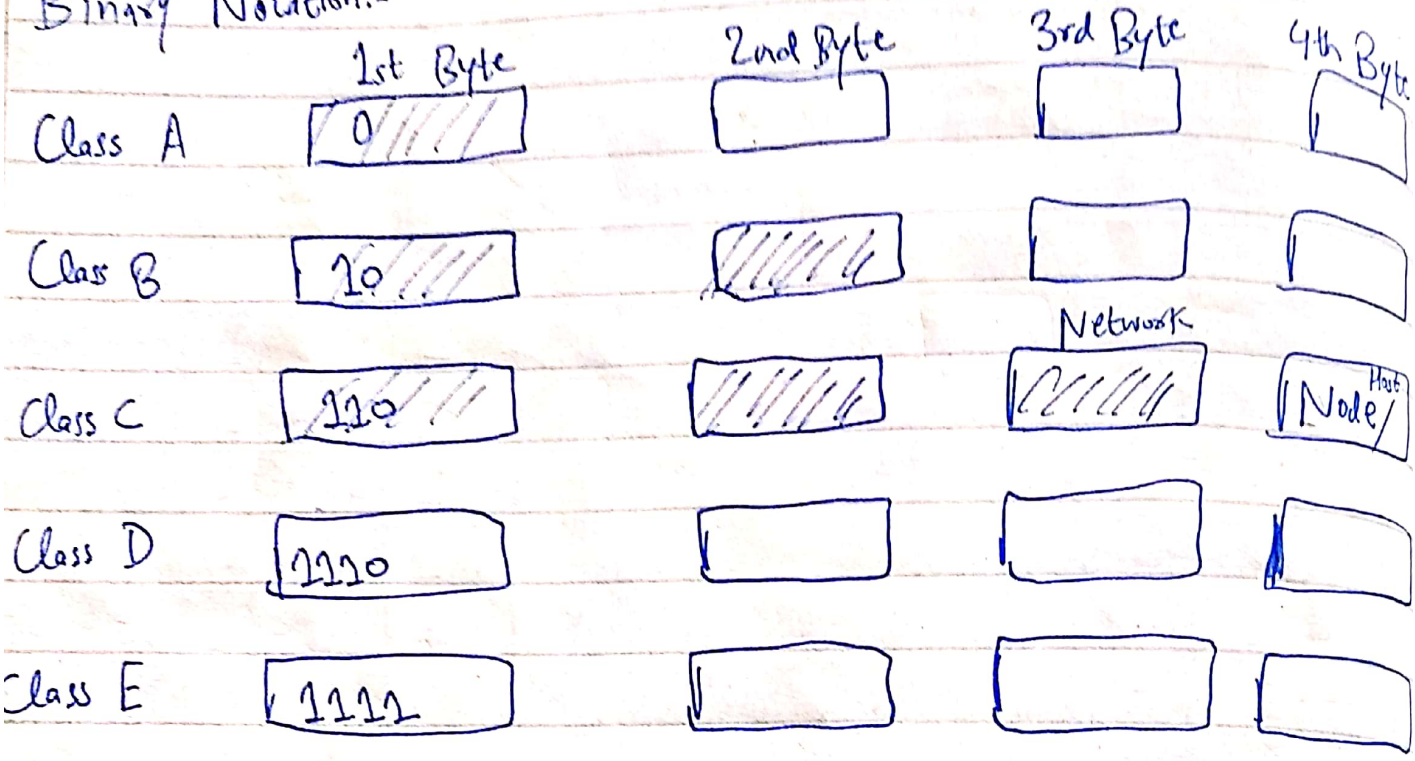
2	56
2	28 - 0
2	14 - 0
2	7 - 0
2	3 - 1
	1 - 1

2	45
2	22 - 1
2	11 - 0
2	5 - 1
2	2 - 1
	1 - 0

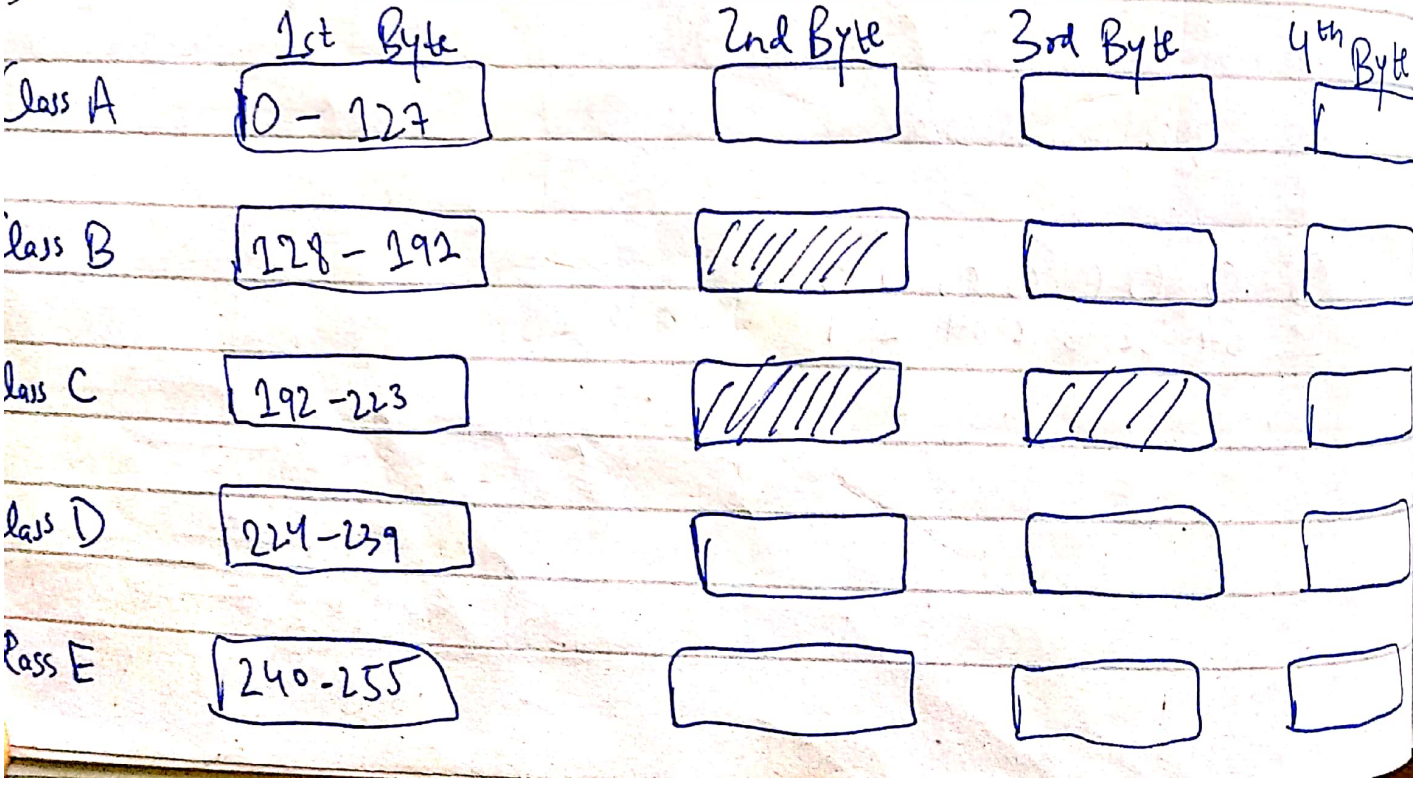
Classful Addressing:-

In classful Addressing, the address space is divided into five classes A, B, C, D, E.

Binary Notation:-



Dotted-Decimal Notation:-



Class A → 01111111 → 127

Class B → 10000000 → 128
10111111 → 191

Class C → 11000000 → 192
11011111 → 223

Class D → 11100000 → 224 (Multi Casting) → (send data to specific group)
11101111 → 239

Class E → 11110000 → 240 (Future Reserve)
11111111 → 255

⇒ In classful addressing, a large part of available addresses were wasted.

Class	Binary	Dotted Decimal	CIDR
A	11111111 00000000 00000000 00000000	255.0.0.0	/8
B	11111111 11111111 00000000 00000000	255.255.0.0	/16
C	11111111 11111111 11111111 00000000	255.255.255.0	/24

Network | Node

⇒ Classful addressing, which is almost obsolete is replaced with classless addressing.

Note:

Network IP ← [ ] ~~~~ [20] → Broadcast IP

↓

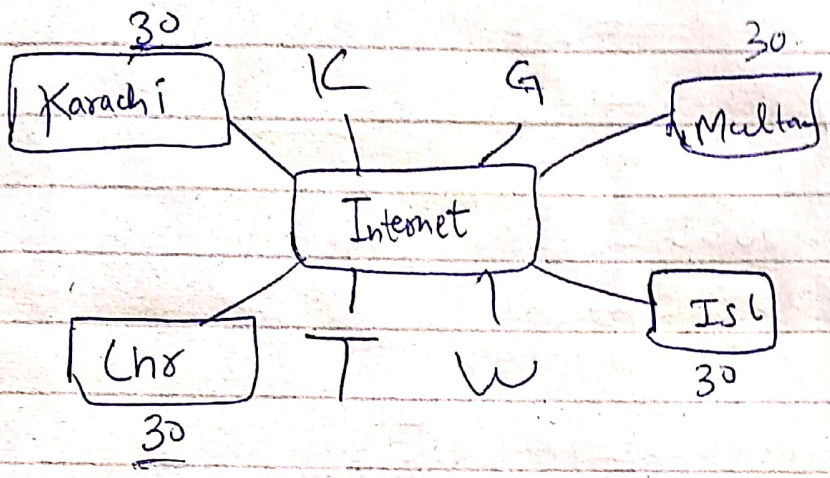
Host IP

Private → 10.0.0.0

172.16.0.0

192.168.0.0

Sub Neting:- w.r.t Networks



S1 = $2^K - 2$ ⇒ K = no. of bits

$= 2^1 - 2 = 0$

$= 2^3 - 2 = 6$ → K = 3

200.20.100.0

200.100.100.0000 0000

128 64 32 16 8 4 2 1

0010 0000 : 1/4

0100 0010

0120 0011

0000

0001

0010

0011

0100

0101

0110

0111

robustness.

200.200.100.32 N-ID

200.100.100.33 First PC

200.100.100.63 Last PC