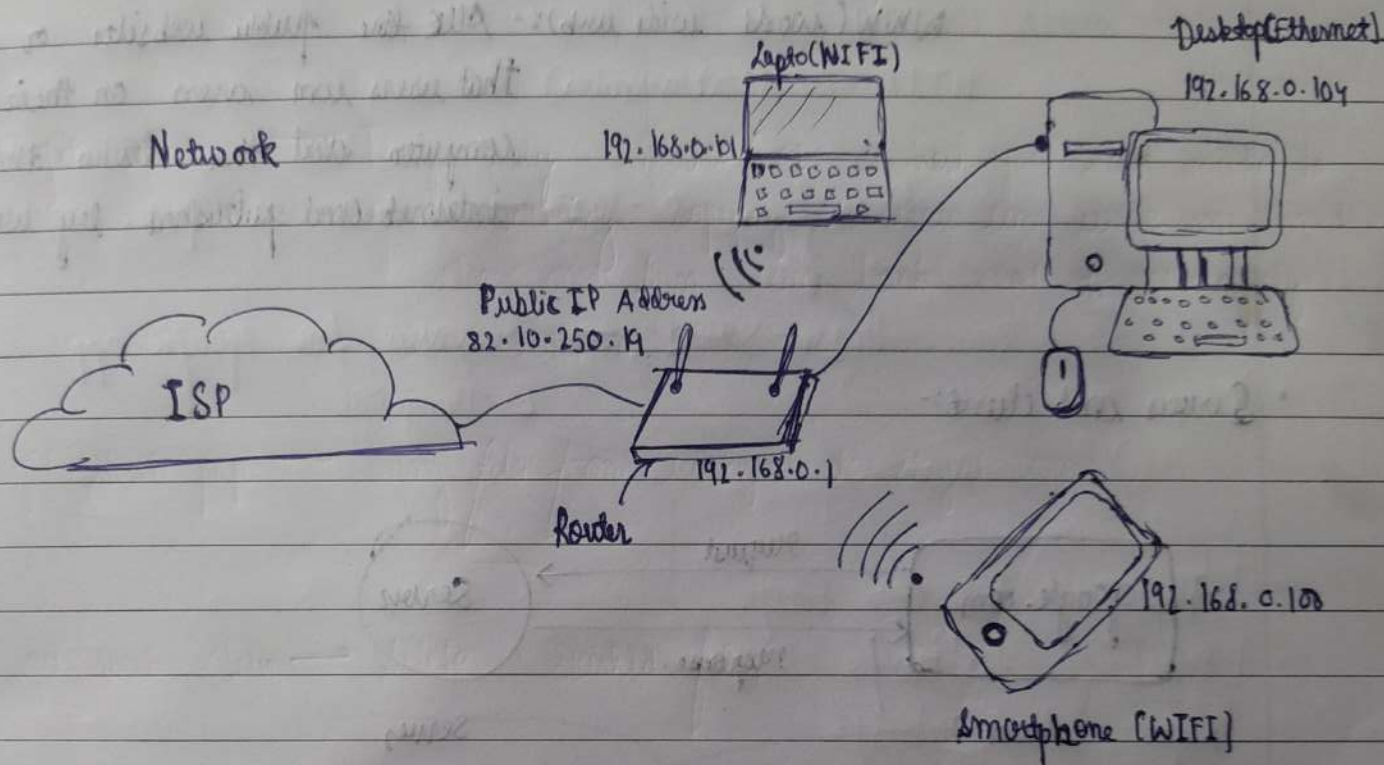-PRATYUSH BIROLE

COMPUTER NETWORKS

BRIEF NOTES

COMPUTER NETWORKS

- Computer :- Commonly oriented machine particularly used for training, education and f research

- Computer networks :- Interconnected computing devices that can exchange data and share resources with each other.

Network

Laptop (WIFI)
192.168.0.01

Desktop (Ethernet)
192.168.0.104

ISP

Public IP Address
82.10.250.19

192.168.0.1

Router

192.168.0.100

Smartphone [WIFI]

- History of computer network :-   US Vs Russia.

  (i) ARPA created by US :- Advanced Research Projects Agency Network

  (ii) ARPANET :- Created to communicate :-

        MIT ──────────────→ STANFORD
         ↑   ↓
        UCLA ←──────────── UTAH
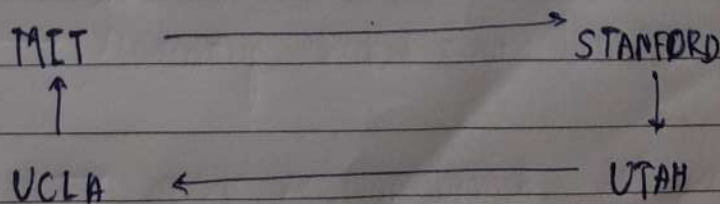
·· Yahoo was the first web engine.

(iii) They were using TCP :- Transmission Control Protocal

TCP / IP

(iv). WWW was introduced to acess differene research paper/imp. documents.

WWW (world wide web):- All the public websites or pages that users can acess on their local computer and other device through internet and published by we server

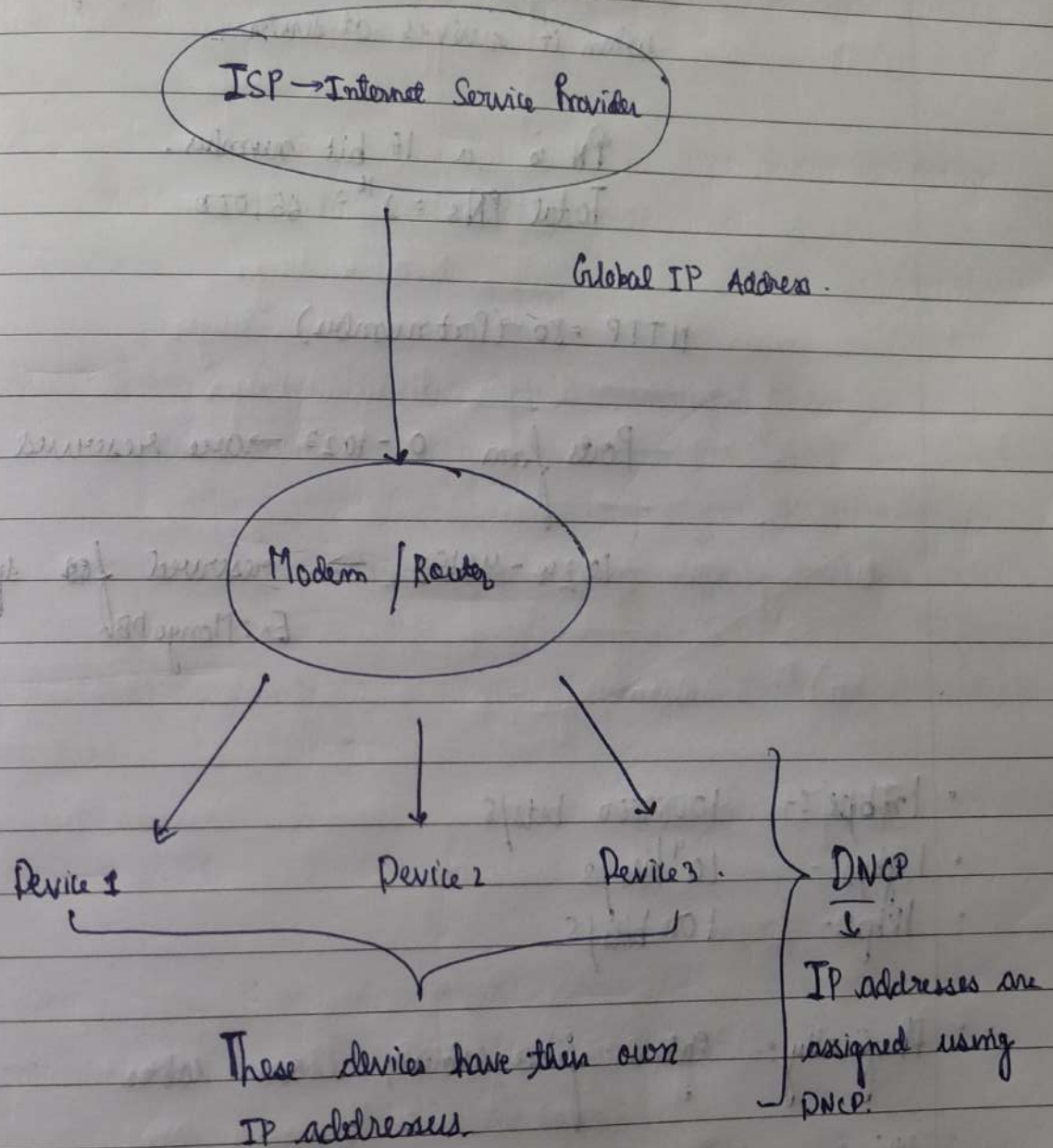· Servers and client :-

google.com

request ⟶

⟵ response.

Server

client

Server
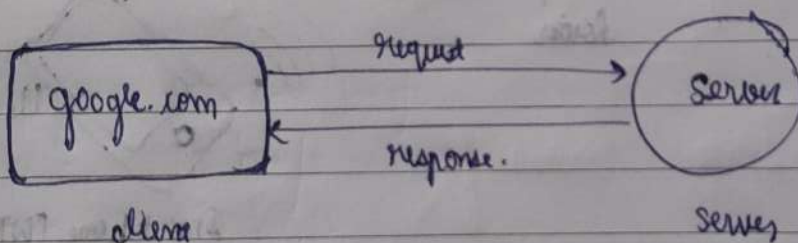
Ensures All

· TCP :- Transmission Control Protocol.   (Data must be sent to the reciever without
· UDP:- User DataGram Protocol (Some data may be lost. En :-Video call).

· HTTP:- Hypertext Transfer Protocol :- set of rules for transfering files - such as of text, images, sound, video etc.

· IP address of local machine ⇒ $ cure ifconfig. me   -s

ISP → Internet Service Provider

Global IP Address.

Modem / Router

Device 1   Device 2   Device 3.   } DNCP
                                                        ↓

                  These devices have their own   IP addresses are
                  IP addresses.   assigned using
                                                        DNCP.

corrupting
any file)

- Port numbers:- It is a way to identify a specific process to which an internet or other network message is to be forwarded when it arrives at server.

PN is a 16 bit number.
Total PNs $= 2^{16} = 65,000$.

HTTP $= 80 \rightarrow$ (Port number)

Ports from $0 - 1023 \rightarrow$ are reserved ports.

$1024 - 49152 \rightarrow$ reserved for specific applications
Ex: Mongo DB

- 1 mbps :- 1000000 bits/s
- 1 gbps :- 10^9 bits/s
- 1 kbps :- 1000 bits/s.

- Physically:- optical fibre cables, coaxial cables

- Wireless:- Bluetooth, wifi, 3g, 4g, LTE, 5g

- LAN:- Local Area Network
  Small geographic area, usuall within the same building.

- MAN:- Metropolitan Area Network
  Across a city.

- WAN:- Across countries

  → SONET :- Synchronous Optical networking
  → Frame relay &

- Modem :- Used to convert digital signal to analog signal and vice versa

- Router :- A device that connects 2 or more packet-switched networks or subnetworks.

- Topologies :-

  (i) Bus   (iv) Mesh
  (ii) Star   (V) Tree
  (iii) Ring   (vi) Point to point.

- OSI Model :- Open Systems Interconnection model.

OSI MODEL

→ Application layer
→ Presentation layer
→ Session layer
→ Transport layer
→ Network layer
→ Data link layer
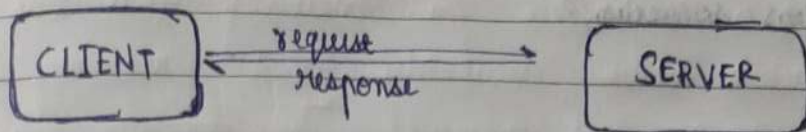→ Physical layer

(i) Application layer :- Software.

(ii) Presentation layer :-

TCP/IP model :-

(i) Application layer :- ☆ Users interact
* Messaging apps.
* where : on devices.
☆ Protocols
☆ Client server - Architecture

* Data centers :- Collections of servers at a large scale is called data center.

(I)

CLIENT ⇄ request / response → SERVER

(ii). P2P :- Different devices are connected to each other. Every single device can be a server & client itself. Ex:- Bit Torrent

(Peer to Peer).

D₁ ─── D₂

D₄ ─── P₃
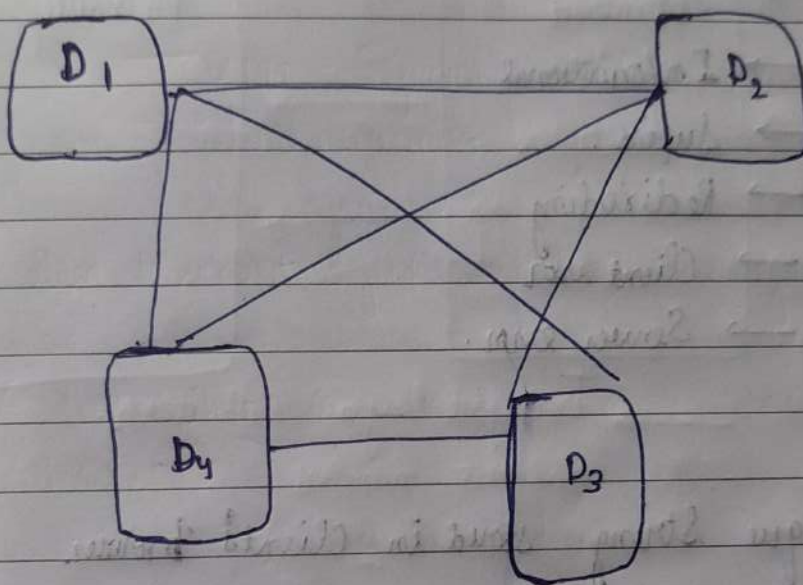
• Protocols:-

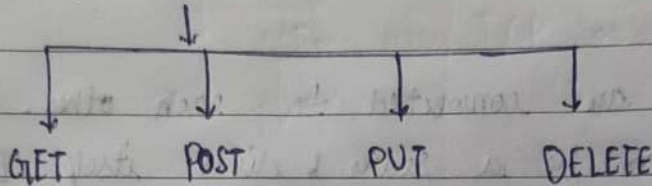Web protocols:-

(i). HTTP

(ii). DHCP

(iii). FTP

(iv). SMTP

(v). POP 3 & IMAC

(vi) SSH.

• Telnet : Port 23.

• UDP :- Standardless connection.

• HTTP methods :-

```
        ┌──────────┬──────────┬──────────┐
        │          ↓          │          │
        ↓                     ↓          ↓
      GET        POST        PUT       DELETE
```

• Status codes :

    (i) 1×× ⟶ Informational

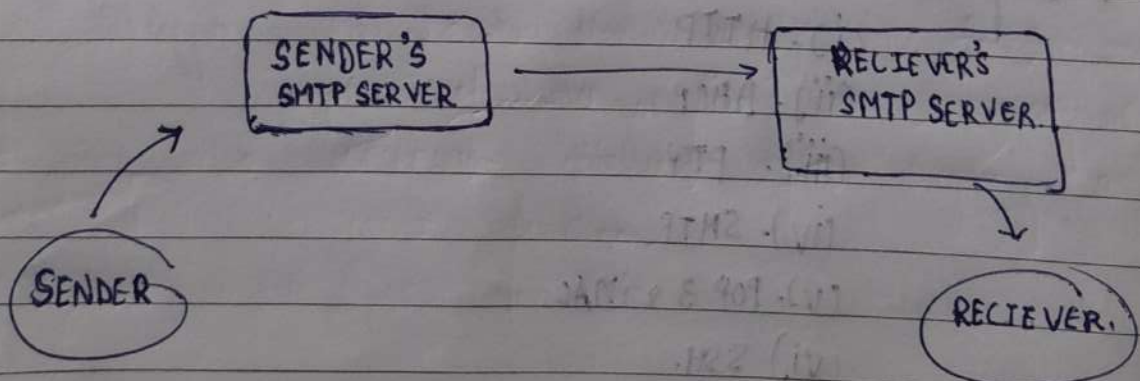   (ii). 2×× ⟶ Sufes.

    (iii). 3×× ⟶ Redirecting

    (iv). 4×× ⟶ Client error

    (v). 5×× ⟶ Server error.

• Cookies :- Unique String stored in client's browser.

• How Email works :-

```
 ┌─────────────┐                 ┌─────────────┐
 │  SENDER'S   │  ───────────→   │  RECIEVER'S │
 │ SMTP SERVER │                 │ SMTP SERVER │
 └─────────────┘                 └─────────────┘
        ↑                                │
        │                                ↓
   ( SENDER )                      ( RECIEVER )
```

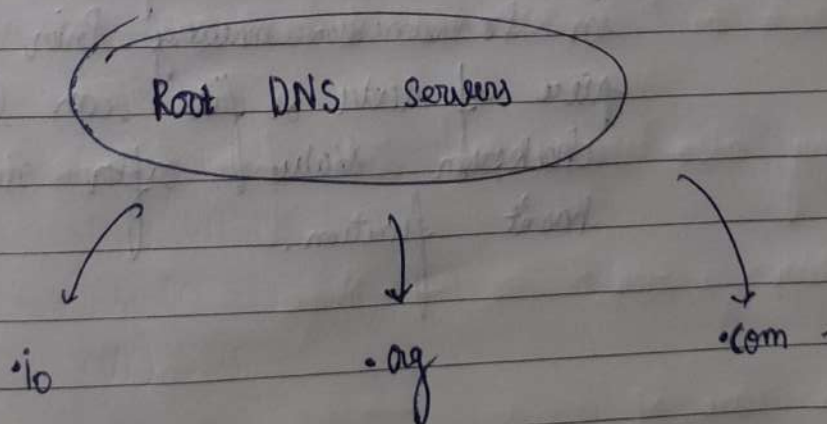- POP - Post office protocol. → Port 110.
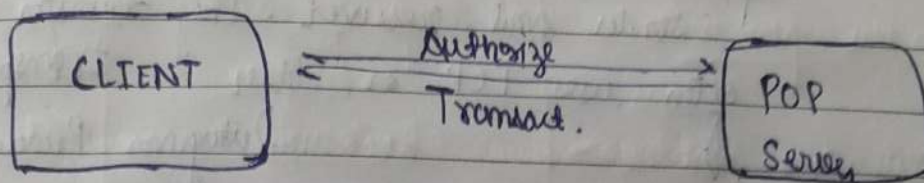
- IMAP:- Internet message across protocol.
   Used to view emails on multiple devices.

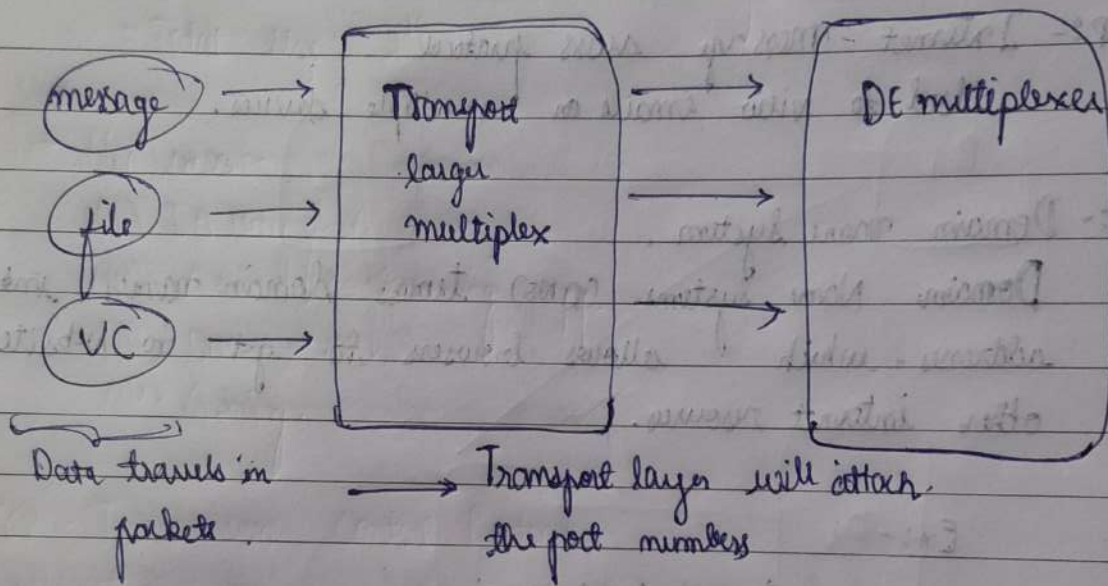- DNS:- Domain name system.
   Domain Name Systems (DNS) turns domain names into IP addresses, which allows browsers to get to websites and other internet resources.

   Ex:-

   Second level domain
   mail.google.com
   Sub-domain   Top level domain

- Transport layer:- It is responsible for ensuring that the data packets arrive accurately and reliably between sender and receiver. The transfer layer most often uses TCP or User transport Datagram Protocol.

```
message ─────→   ┌─────────┐  ─────→   ┌─────────┐
                 │Transport│  ─────→   │DE multiplexer│
file    ─────→   │ larger  │           │         │
                 │multiplex│  ─────→   │         │
VC      ─────→   │         │  ─────→   │         │
                 └─────────┘           └─────────┘
```

Data travels in   ─────→ Transport layer will attach
packets   the port numbers

Transport layer also takes place care of congestion control

   ↳ Check Sums:- It is a value that represents the number of bits in transmission message. Prior to transmission, every piece of data or file can be assigned a checksum value after running a cryptographic hash function.

Quick Summary:-

(i) Transport layer protocol :- TCP/UDP

(ii) Application layer protocol:- HTTP

(iii) Network layer protocol:- IP.

→ UDP:- User datagram protocol.

↓

Transfer data from

Network ⟶ Transport layer ⟶ Network

(i) Data may or may not be delivered.

(ii) Data may change.

(iii). Data may or may not be in order.

(iv) connectionless protocol.

(v) UDP uses Checksums.

∴ Every data packet has its own port number.

(Non-connection oriented)

• UDP packet:- → Header = 8 bytes.

2 bytes	2 bytes
S ou pork no. *	Length of datagram
2 bytes	2 bytes
Destination port no.	Checksum
	Data - 2 bytes

= Total size = 2^{16}

✦ Use cases:-

(i). Its very fast.

(ii). Video conferencing app.

(iii). DNS → UDP

(iv) Gaming.

• TCP - Transmission Control Protocol.

↳ Transport layer protocol.

• Application layer sends lots of raw data. TCP segments this data
→ divide in chunks add header.

• It may also collect the data from network layer.

• Congestion control.

• Takes care of :

(i) When data doesn't arrive.
(ii) Maintains the order of data.

Features :-

(i). Connection oriented.
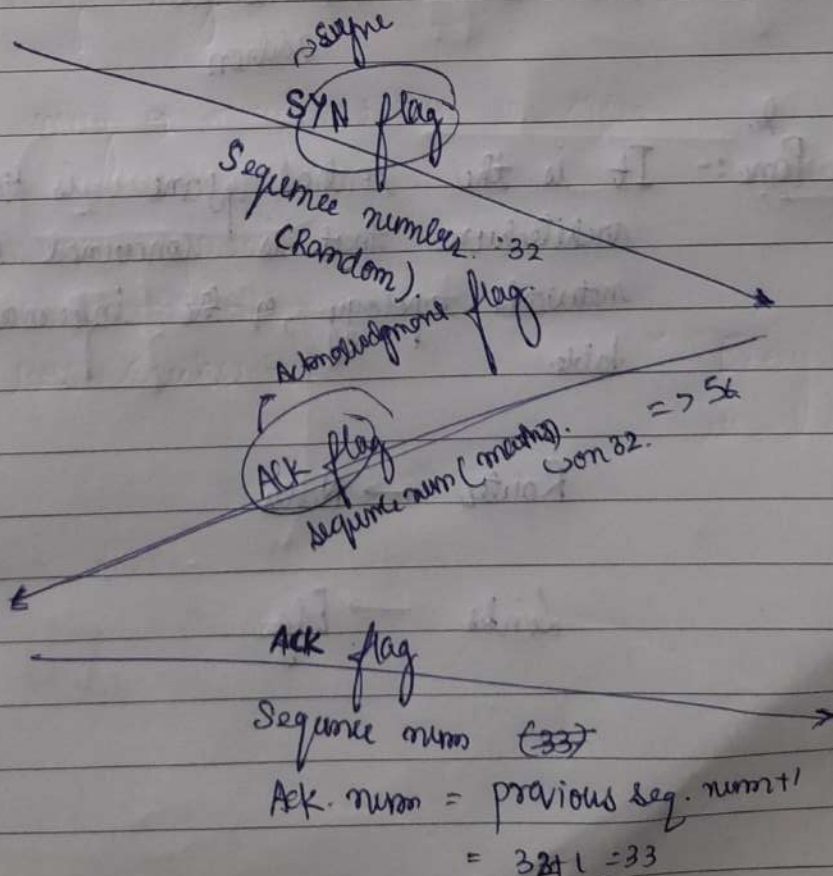(ii). Error control
(iii). Congestion control.
(iv). Full Duplex.

∴ 1 TCP connection can be only established between 2 computers.
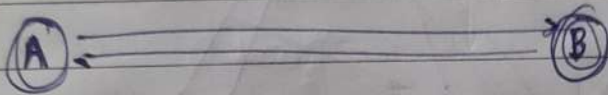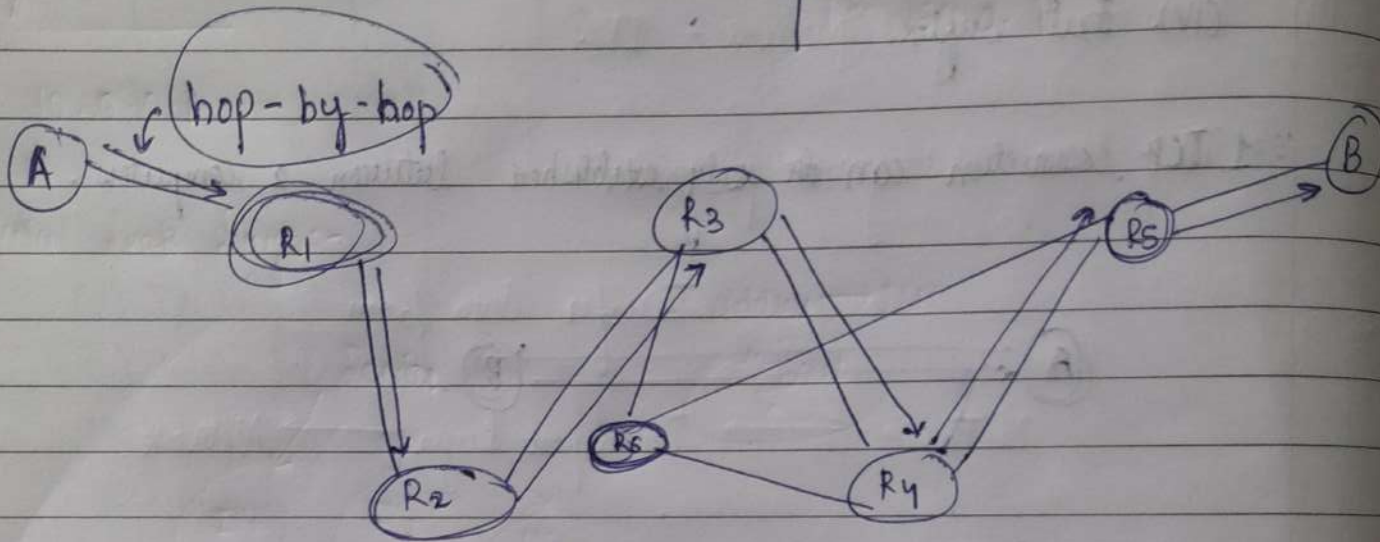

3-way handshake :-

CLIENT   SERVER.

SYN flag

Sequence number : 32
(Random).

Acknowledgement flag

ACK flag
Sequence num (match).   on 32.   => 56

ACK flag
Sequence num (33)
ACK. num = previous seg. num+1
         = 32+1 = 33

• | Network layer:-

(i). Here we work with routers.

Transport $\longrightarrow$ Segment.
Network layer $\rightarrow$ Packets
Data link $\longrightarrow$ frames.

R $\rightarrow$ Router

192.168.2.30
$\underbrace{\qquad}_{\text{network}}$ $\hookrightarrow$ device address.
address

Control Plane :- It is the control plane is the part of the router architecture that is concerned with drawing the network topology, or the information in a routing table.

Router $\longrightarrow$ Nodes

Links $\longrightarrow$ Edges.

(i) Static Routing :-
(ii) Dynamic Routing.

- Internet Protocol :-

    IPv4 ξ → 32 bit, 4-words.
    IPv6 → 128 bits.

- Class A, class B, class C, D, E
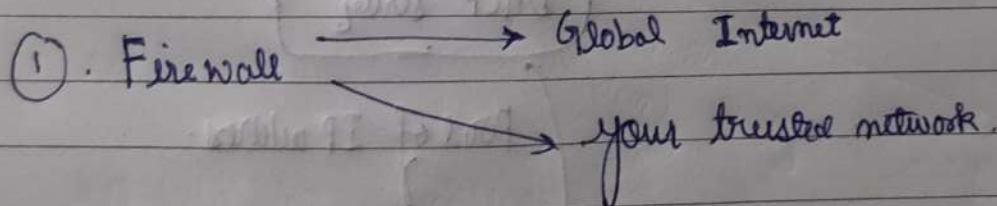
    IPV4 :- 2^{32} ≈ 4.3 billion
    IPV6 :- $2^{32 \times 4} = 2^{128} = 3.4 \times 10^{38}$

    → cons :- • Not backward compatible.
             • ISP would have to shift
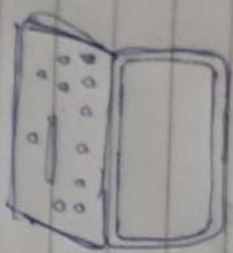
- Middle Boxes :-

    ① . Firewall ⟶ Global Internet
                  ⟶ your trusted network.

- NAT - Network Address Translation.
    It is a method of mapping an IP address space into another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device

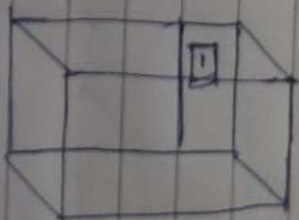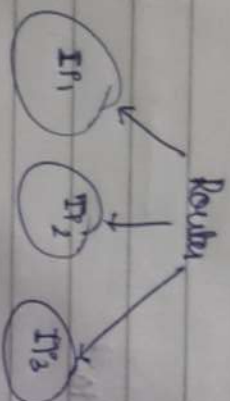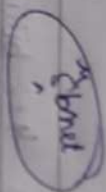Host   NAT + Router   Server

$\rightarrow$ Private network $\rightarrow$ $\rightarrow$ Internet $\rightarrow$

[0.0.0.1]   150.150.0.1   2.00.100.10.1

- Data link layer:-

IP address $\rightarrow$ ISP?

Subnet

Router

IP₁   IP₂   IP₃

DHCP $\rightarrow$ Dynamic Host Configuration Protocol

New device $\longrightarrow$ DHCP server

Pool of IP address.