Networking

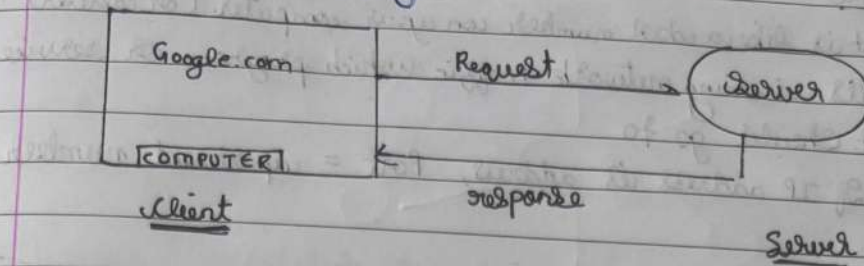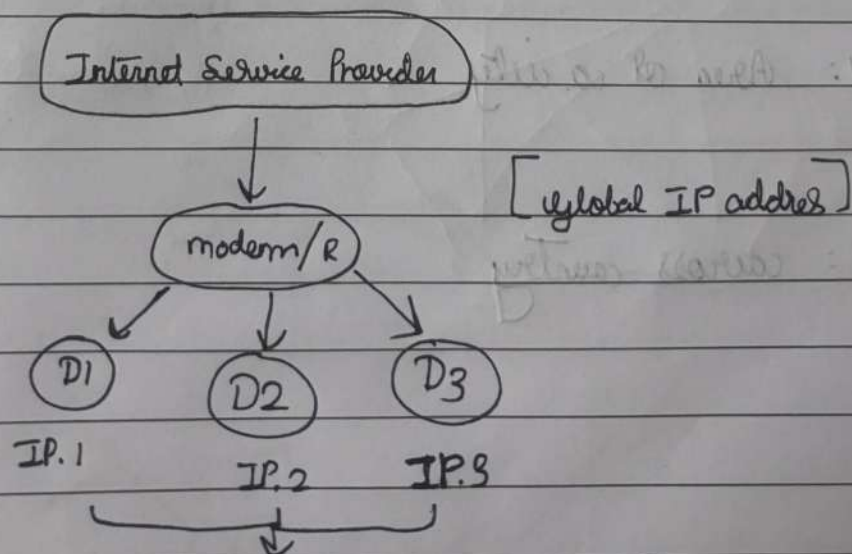| Google.com | Request | Server |
COMPUTER	←	
Client	response	
		Server

Protocols

- TCP - Transmission control protocol - email, vid, photos
  - Your data arrives at correct order, non-missing at final destination

- UDP - User datagram protocol - Ex: video calls, streaming
  - Speed over reliability, doesn't care if packet data is lost.

- HTTP: Hypertext Data Transfer protocol - Ex: APIS, websites
  - language of web browsers & servers on to communicate each other

___X___X___

Data is transferred ?

Internet Service Provider

↓

modem/R

[global IP address]

↙ ↓ ↘

D1   D2   D3

IP.1   IP.2   IP.3

↓

Same IP address [local IP address]

done by DHCP [Dynamic Host Control Protocol]

Port

Port is like a door number on your computer (or server) that tells incoming network traffic which program or service it should go to

If IP address is address, Port = apartment number

- Ports are 16 bit no.
$$\Rightarrow 2^{16} / [65536]$$

(IP/PN) ⟶ (IP/PN)

0-1023 (reserve ports)
1024-49152 [application]

How connected?

Physical: optical fibres, cables
Wireless: bluetooth, wifi
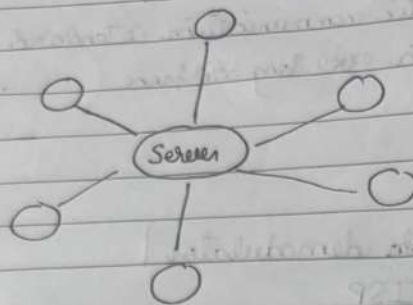
CAN: Small house / building / corporation
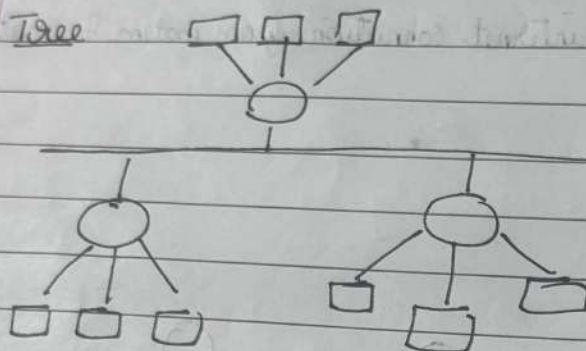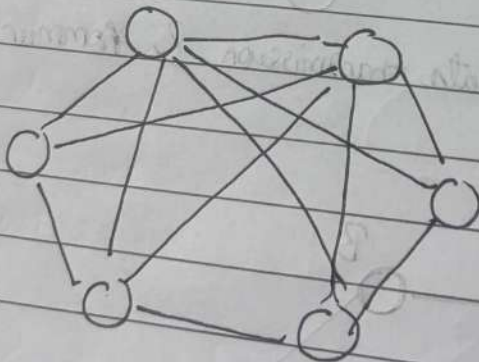[Ethernets

MAN: Area of a city

WAN: across country

③ Star

Connected to one main server

④ Tree

⑤ Mesh

Expensive
& robust

* <u>SONET</u> [Synchronous Optical network]
high speed - fiber - optic communication standard used to transmit
huge amounts of data over long distance
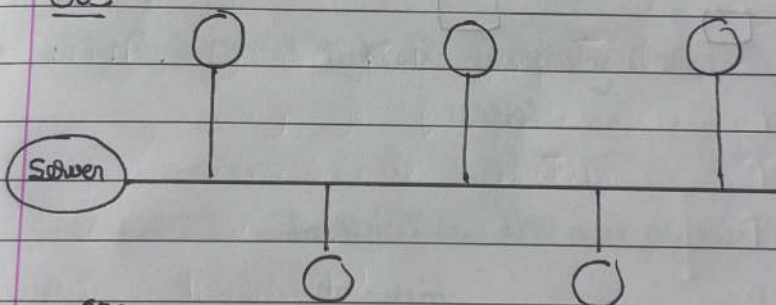from relay

* MODEM [Modulator demodulator]
• Connects you to ISP
- Converts digital data to analog signals for transmission and
  vice versa

* <u>Router</u> : distributes internet connection from modem to multiple
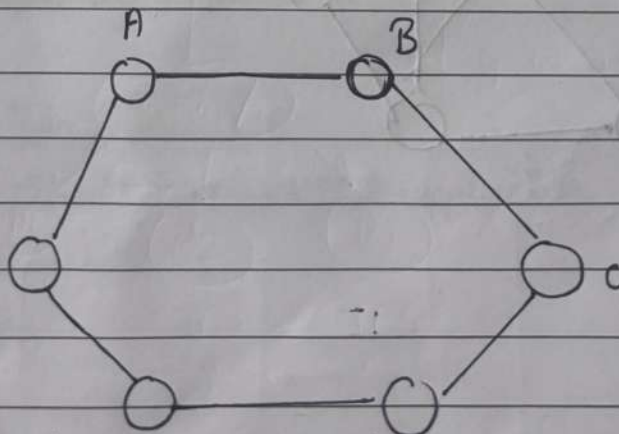devices

<u>Topologies</u>

① <u>BUS</u>

one
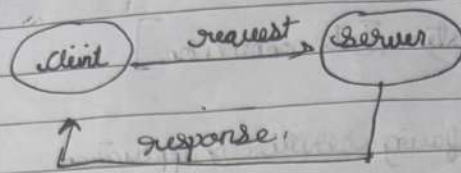has main channel for data transmission & communication
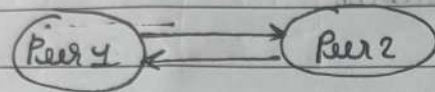
② <u>Ring</u>

here each device communication happens

- Client Server - Architecture

(Client) → request → (Server)

↑ response

- Rur 90 pier
  chire every device (peer) on network act as both client &
  a server.

(Peer 1) ⇄ (Peer 2)

- Protocols
  web protocols
  TCP/IP:
  * HTTP
  * DHCP
  * FTP
  * SMTP
  * POP3
  * SSH
  * VNC
  * Telnet:

- Structure of Network

OSI Model [Open system Interconnection]
↓
- Application → Using-facing service & application   Ex Protocols
  computer   HTTP, FTP
  ,SMTP

- Presentation → Data formatting, encryption compression.   SSL/,JPEG,
  mP3

- Session → Starts, maintains & ends communication   NetBid
  session   RE, RPC

- Transport → reliable delivery error check   TCP, UDP
  segmentation

— x — x —

- Network → Logical addressing & routing   IP, ICMP
  ,Routers

- Data link → Physical addressing (MAC),
  error

- Physical → Transmits raw bits over physical   Cables, wi-fi
  medium

— x ———————————— x —

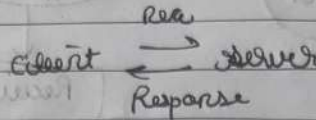TCP/ IP model
developed by ARPANET

- Application layer
- user interact here, consist application [Ex: whatsapp,
- lies on devices
- Protocols

Ports

Ephemeral ports : assign itself random port number

→ **HTTP**
Req
Client ⇌ Server
Response

- uses TCP inside.
- HTTP is a stateless

- Method
① ~~Post~~ GET
② POST
③ PUT
④ DELETE

Error Codes / Status
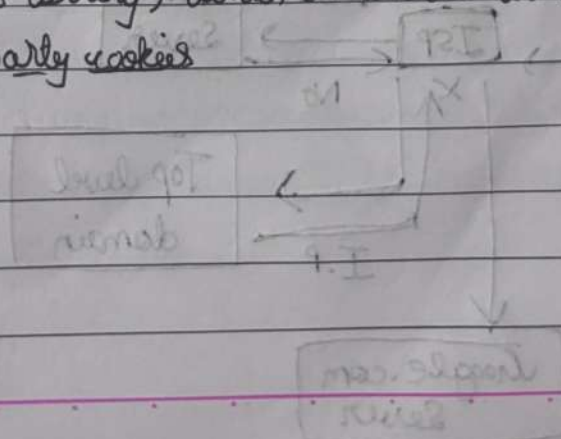
1XX - Informational codes.
2XX - Success
3XX - Redirection
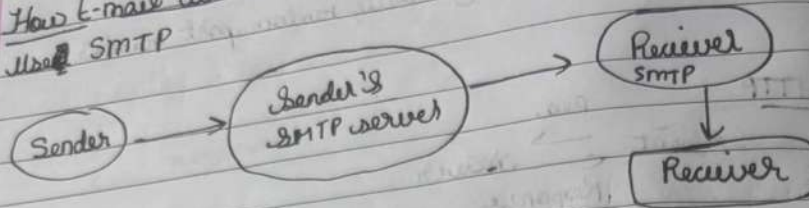4XX - Client Error
5XX - Server Error

- **Cookies**
Unique string, which is stored in a browser.
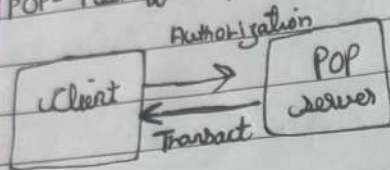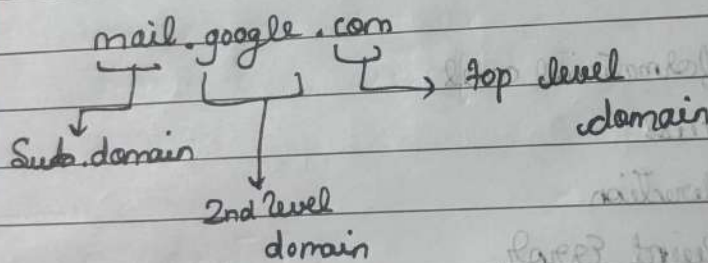- **Third party cookies**

How E-mail works
Use SMTP

Sender → Sender's SMTP server → Receiver SMTP → Receiver

POP - Post office protocol [Port 110]
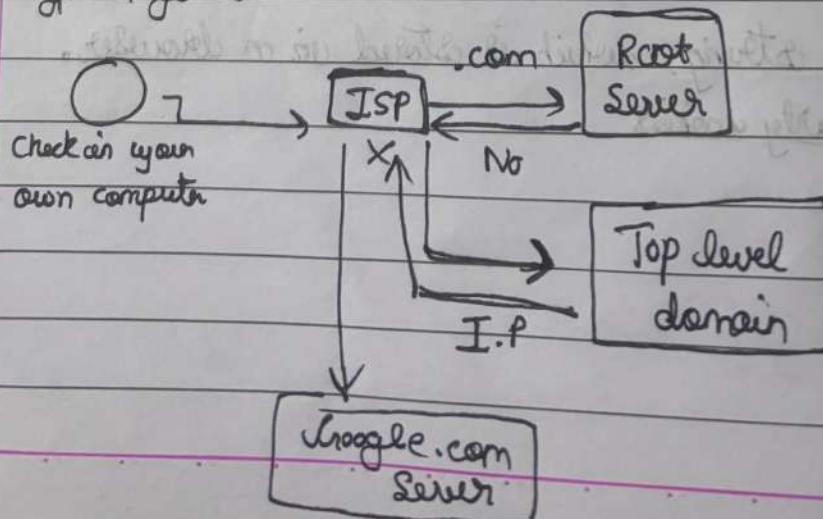
Client →(Authorization)→ POP server
Client ←(Transact)← POP server

• Download & keep email on servers or delete it !

• Domain Name System (DNS) [like a phonebook of Internet]

mail.google.com → Top level domain

Sub.domain

2nd level domain

Example Chart

Type Google.com

○ → ISP → .com → Root Server
Check in your own computer
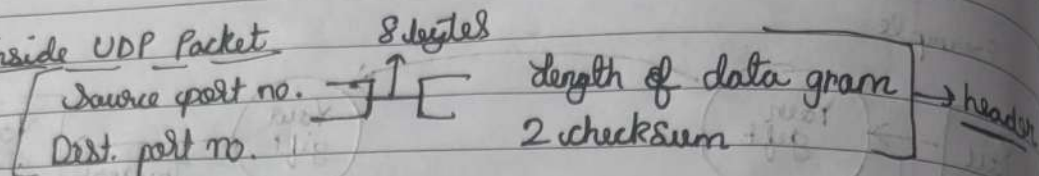ISP ←(No)← Root Server
ISP →X→
→ Top level domain
I.P →
→ Google.com Server

UDP - User datagram protocol
- Data may or may not be delivered
- Data may change
- Data may not be in order

inside UDP Packet   8 bytes
- Source port no. — length of data gram → header
- Dest. port no.   2 checksum

$$Data = [2^{16} - 8]$$

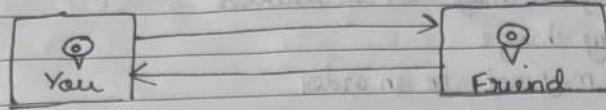- Its faster then other protocol
- Video Confereng
- DNS uses UDP

TCP [Transmission control protocol]
- Congestion control
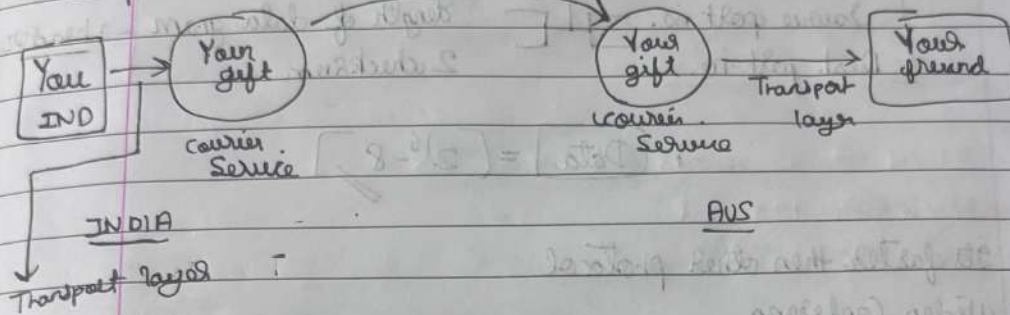 - data does not arrive
  - maintains order of data

Feature
- connection oriented
- Error control
- Congestion control
- Full Duplex

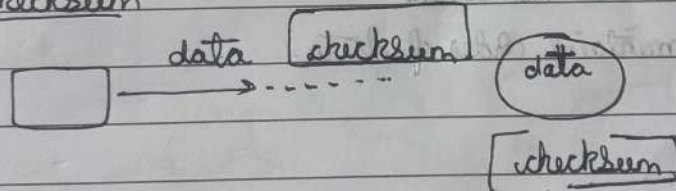2) <u>Transport layer</u> [end to end communication between applications on different device]

Example

INDIA   AUS

Transport layer

* uses TCP/UDP IP

- TCP: Takes care of congestion control
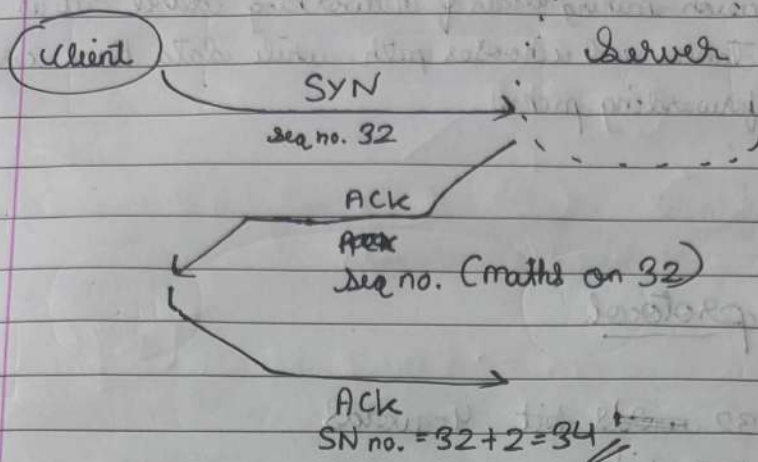 - congestion control algorythm built in TCP

Checksum

Checksum is an error detection technique where a numeric value is calculated from data and compared at sender and receiver to ensure data integrity

Timers

Timers is a countdown mechanism in networking protocol used to manage timeouts, retransmissions, and connection reliability.
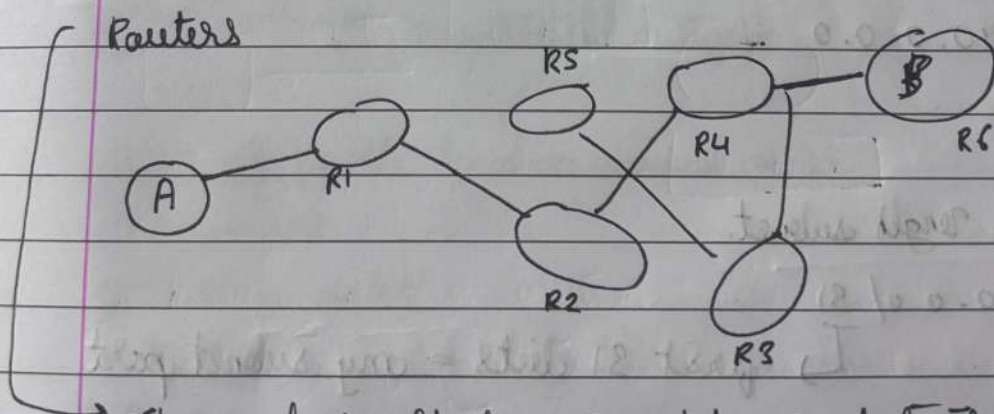
What is 3-way handshake

• It is in TCP which 3 step process (SYN → ~~ACK+ACK~~ → ~~SYN~~) (SYN → SYN-ACK → ACK)
(SYN → ACK → ACK → ACK)
to establish reliable internet connection

• Network layer   [RIP, OSPF, BGP]
→ chue cue awork with router

Routers

Chooses best path to send packets in destination using routing & forwarding table

Control Plane

is a decision making brain of networking device - it is built on routing tables and chooses path, while data Plane carries out the forwarding packet.

Internet protocol

IPV4 → 32 words bit, 4-words
IPV6 → 128 bit

Class of IP address

A - 0.0.0.0
B - 128.0.0.0
C - 192.0.0.0
D - 224.0.0.0
E - 240.0.0.0

variable length subnet

12.0.0.0/31
↳ first 31 biets = my subnet part

192.0.1.0/24
⌄
it will be same

Internet Engineering task force [assign handles IP address
in duries & ISP]

Packet

Packets

header - 20 bytes → IPV6, length, identification no.,
(protocols) address, TTL

IPV4 : $2^{32} \approx$ 4.3 billion unique IP address

IPV6 : $2^{32 \times 4} = 2^{128} = 3.4 \times 10^{38}$

Cons

* Not Backward Compatible
* ISP would have to shift, lot of hardware work.

Middle boxes

1) Firewall → Global network
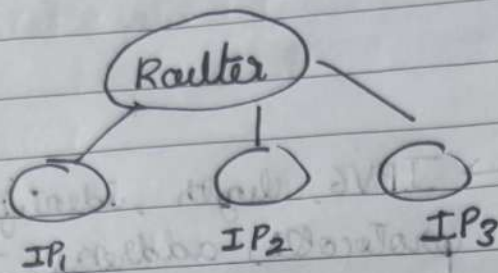   → Your trusted network

Filter out packets based on various rules
→ addresses
→ modify packet
→ Port nos
→ Flags
→ Protocols

2) Network address translation - Maps private IPs to public IP

Datalink layer
DHCP

Router

IP₁   IP₂   IP₃

If new device allocated → DHCP server [Pool of IP addresses]

ARP— when device doesn't know the data link [Address resolution protocol] layer of dist. device the it will ask in all available devices.

Frame: Data link layer address of sender & IP address. of dest.