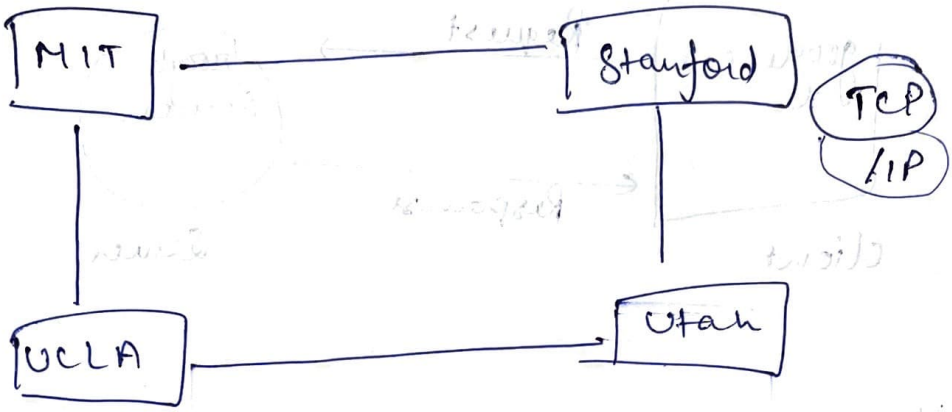
COMPUTER NETWORKING

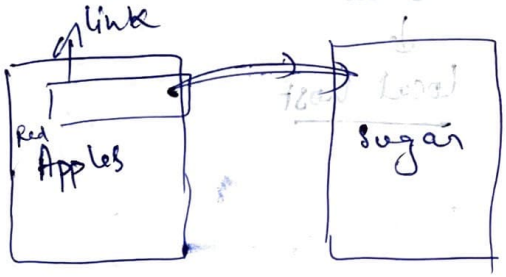
How it Started?

ARPA → The advance Research Projects Agency Network (ARPANET)

↓

4 Different Computers were placed at different location in USA



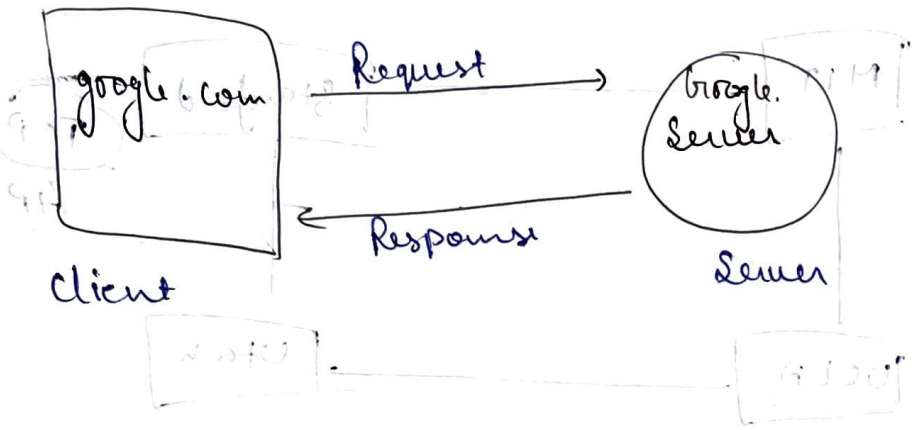


* Tim Berners invented the World Wide Web (www) in 1989.

* World's first Website info.cern.ch

Web Server : A web server is a computer software and underlying hardware that accepts requests via HTTP or its secure variant HTTPS.

* The Internet Society are responsible for Protocols rules over internet.



* Your computer can act as Server and Client both
↓
Local host

Protocols (Set of Rules)

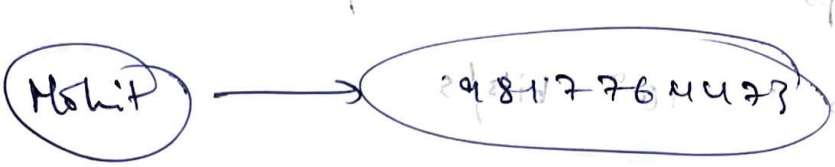
TCP (Transmission Control Protocol)

UDP (User Datagram Protocol) Not all data.

HTTP (Hyper Text Transfer Protocol) used by web browsers.

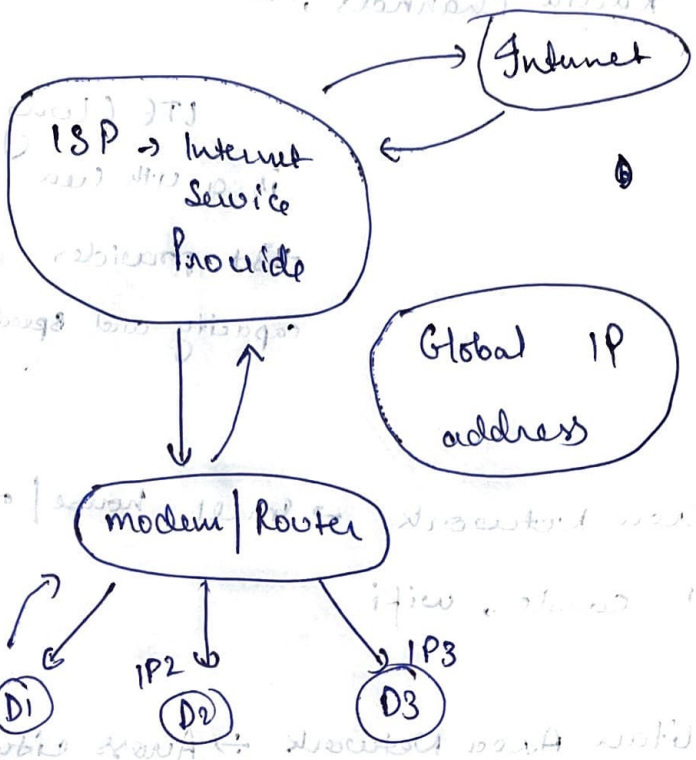
Data is transferred in from of Small Packets

IP Address →



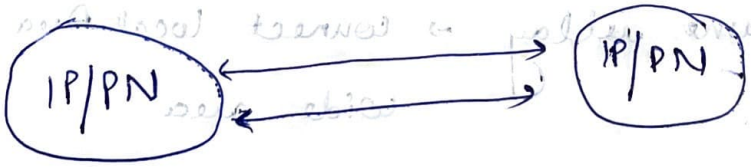
google.com → (x.x.x.x)

(0-255)



Assigned by

* DHCP → Dynamic Host Control Protocol.
* NAT → Network Access Translation.



* Total possible Port Numbers → $2^{16} \simeq 65,000$

HTTP : Port 80

MongoDB : Port 27017

SQL : Port 1433

0 - 1023 → Reserved Ports

1024 - 49152 → Applications

remaining can be used.

1mbps = 1000000 bits/s

1gbps = 10^9 bits/s

1kbps = 1000 bits/s

Physically → optical fibre cables, coaxial cables

Wireless → Radia channels, Bluetooth, wi-fi, 3G, 4G, LTE

LTE (Long Term Evolution) is a 4th Gen wireless standard that provides increased network capacity and speed for cellphones

LAN: local Area Network → small house / office

Ethernet cable, wifi

MAN: Metropolitan Area Network → Across city

WAN: Wide Area Network → Our Countries.

① SONET → Synchronous optical Network

↓

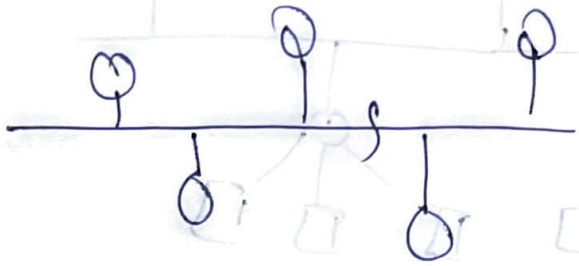
Standardized digital communication protocol

② Frame relay → connect local Area to wide area

MODEM :- Convert Digital Signal into Analog Signal

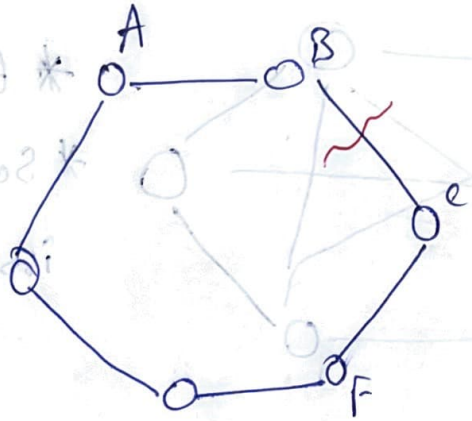
Topologies

① Bus



one person can send data at a particular time.

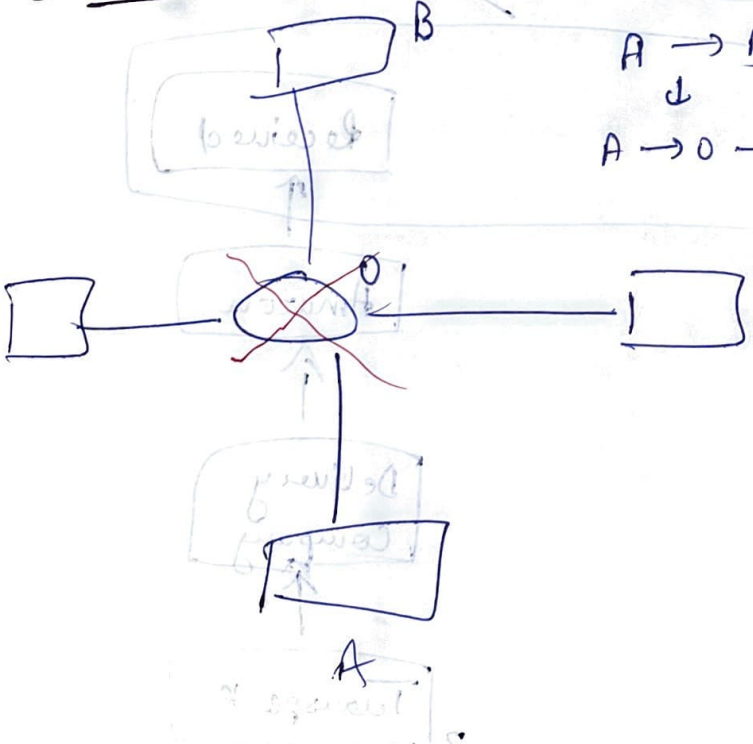
② Ring



A → F

A → B → C → F

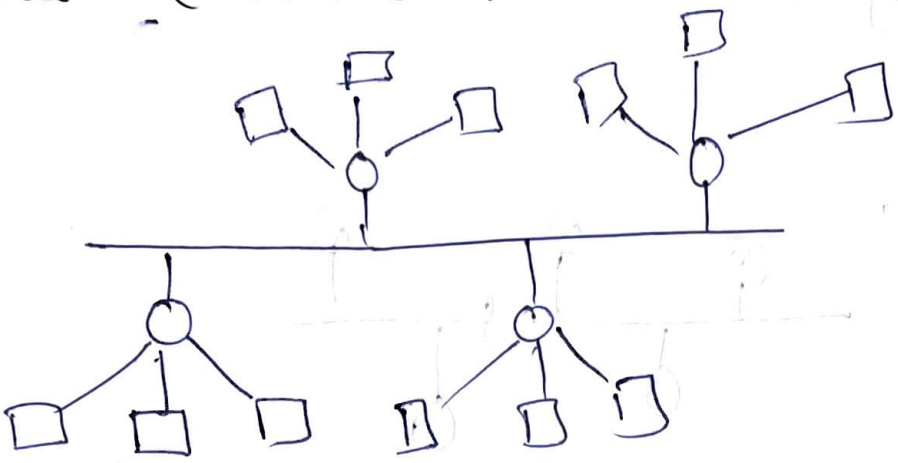
③ Star



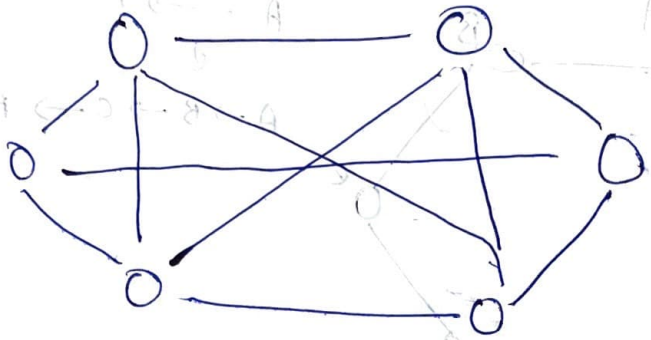
A → B

A → O → B

④ Tree (Bus + Star)

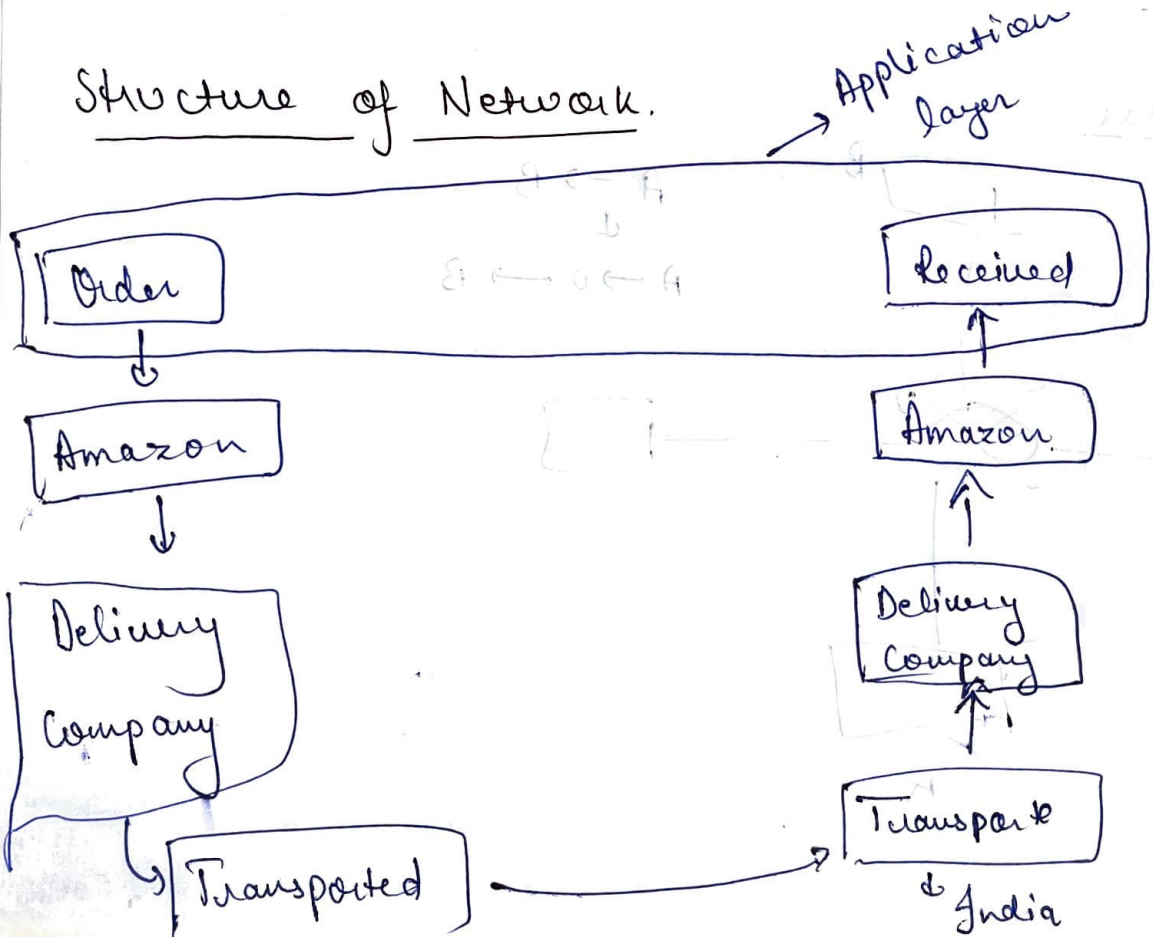


⑤ Mesh



* Expensive
* Scalability issue.

Structure of Network.



OSI Model

(Open System Interconnection Model)

open network

→ Application (Software) → (Users Interact with applications)

→ Presentation → Take data from app. layer and convert character into machine readable format

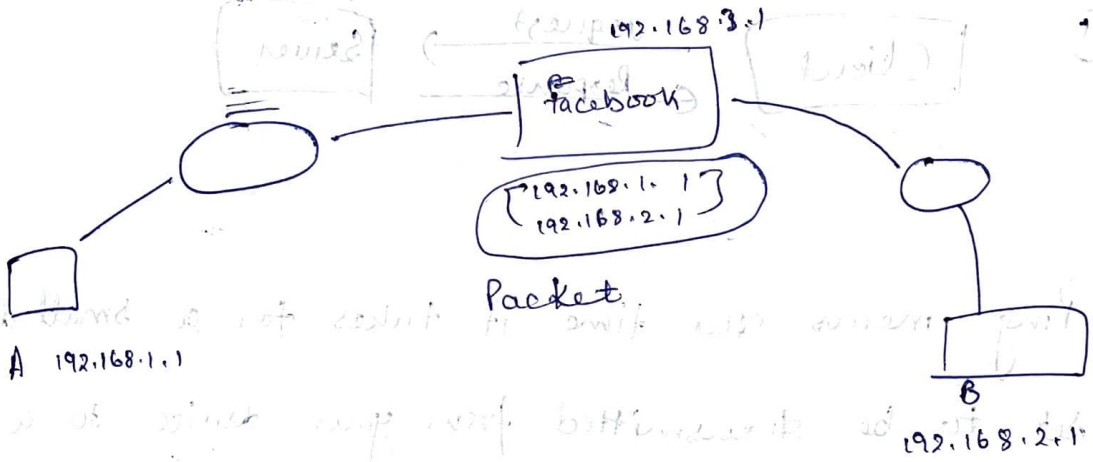
→ Session → Manging connection, Authorization,

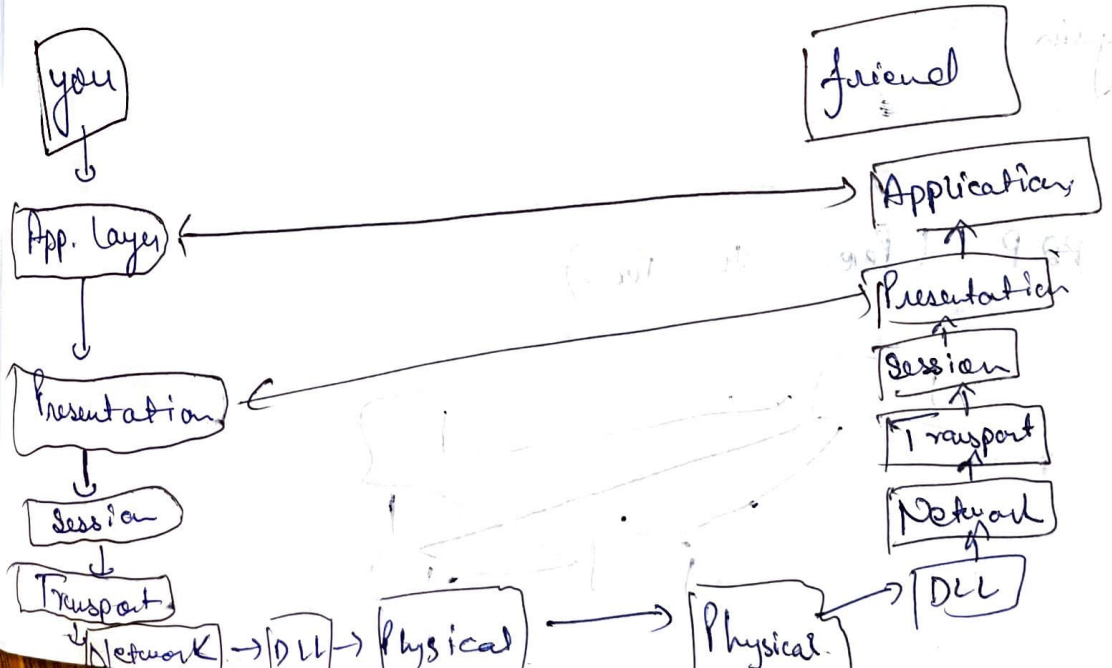
→ Transport → TCP / UDP → checksum

→ Network → Router → logical addressing

→ Data Link → Directly communicate with host. (Frame)

→ Physical → Hardware





TCP/IP Model

↳ Internet Protocol Suit.

5 layers

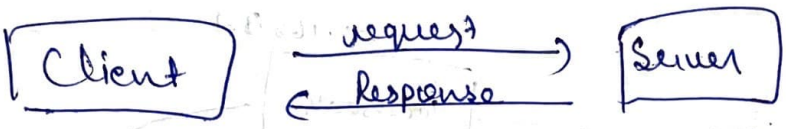
→ Application layer (users interact)

→ Transport layer

→ Network layer

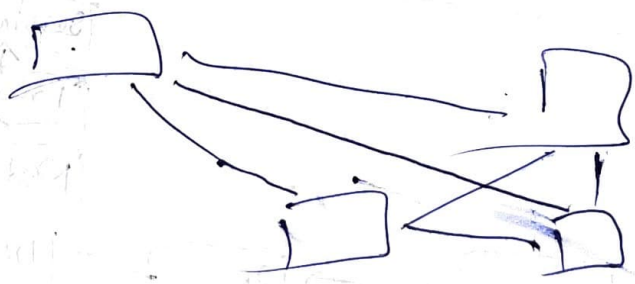
→ Data Link

→ Physical

① 

* Ping means the time it takes for a small data set to be transmitted from your device to a server on the internet and back to your device again

② P2P (Peer to Peer)



Repeater :- A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network.

Hub :- A hub is basically a multiport repeater. A hub connects multiple wires coming from different branches.

→ Active hub

→ Passive hub

Bridge :- A bridge operates at data link layer. A bridge is a repeater, with add on functionality of filtering content by reading MAC address of source & destination.

→ Transparent Bridges

→ Source Routing Bridges.

Switch :- A Switch is a multi port bridge with a buffer and a design that can boost its efficiency and performance.

Routers :- A router is a device like a switch that routes data packets based on their IP addresses. It is a Network layer device.

Gateway :- A passage to connect two networks together that may work upon networking models.

Brouter :- It is also known as bridging router is a device which combines features of both bridge and router.

Protocols :-

Web Protocols :-

TCP/IP :-

- ☆ HTTP
- ☆ POP3 & IMAC
- ☆ UDP
- ☆ DHCP
- ☆ SSH
- ☆ FTP
- ☆ VNC
- ☆ SMTP
- ☆ TELNET: Port 23

Program : Whatsapp

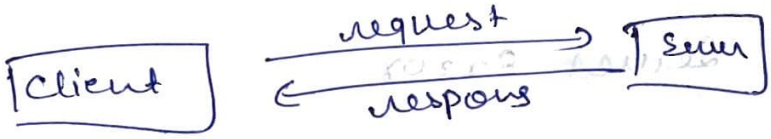
Process : Send a Message → Set up the page

Record a Video → open Camera

Sockets :- Use to Send Messages (software)
↑
Interface between Process & Internet.

Ports :- Ephemeral Ports :- Reserved Ports.

HTTP



↳ It is a Client Server Protocol that determine How request will be made to Server and How server will give response of that request.

HTTP uses TCP → Transport layer

↳ Application layer

↳ Stateless.

HTTP methods :-

① GET ② POST ③ PUT

④ DELETE

Status Codes

1 x x → Information

2 x x → Success

3 x x → Redirecting

4 x x → Client Error

5 x x → Server Error

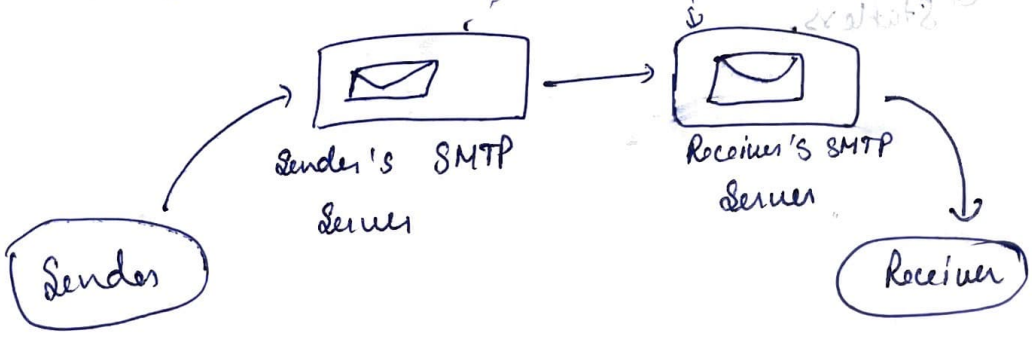
Cookies: Unique String

Stored in my browser

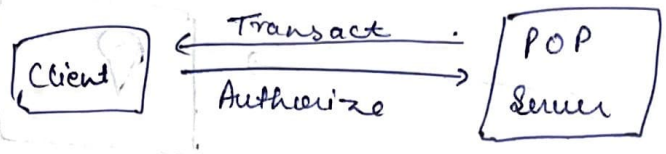
* Third Parties Cookies

How Email works?

SMTP, POP3

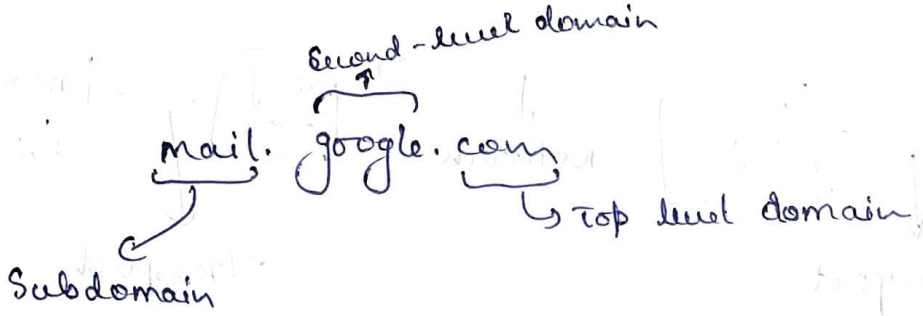


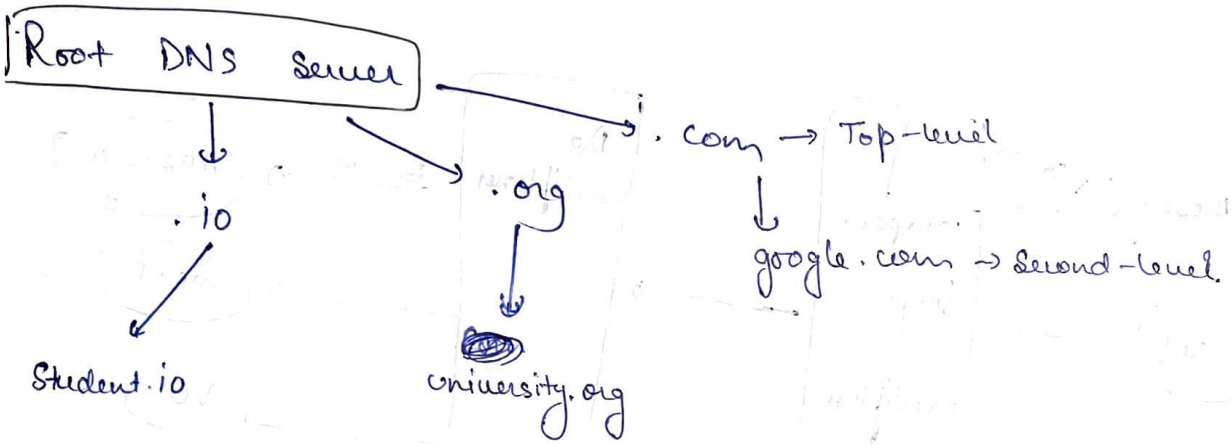
* POP → Post office Protocol → Port 110



* IMAP → Internet Message Access Protocol.

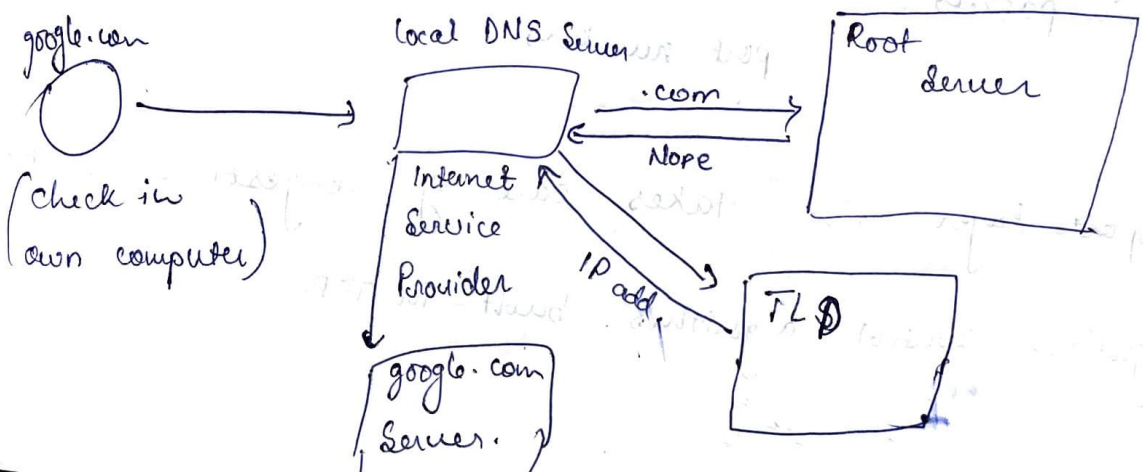
DNS (Domain Name System) (Database Service)



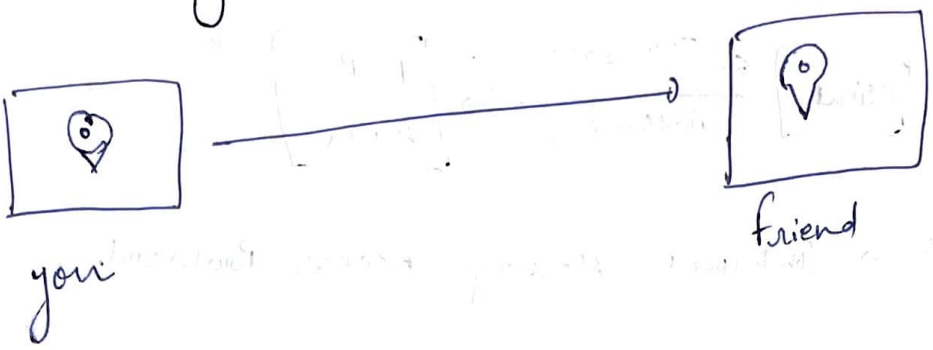


* Root-servers.org → Link.

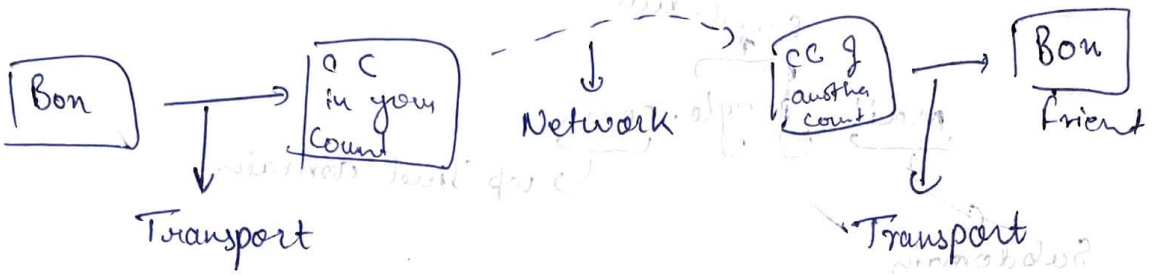
* ICANN

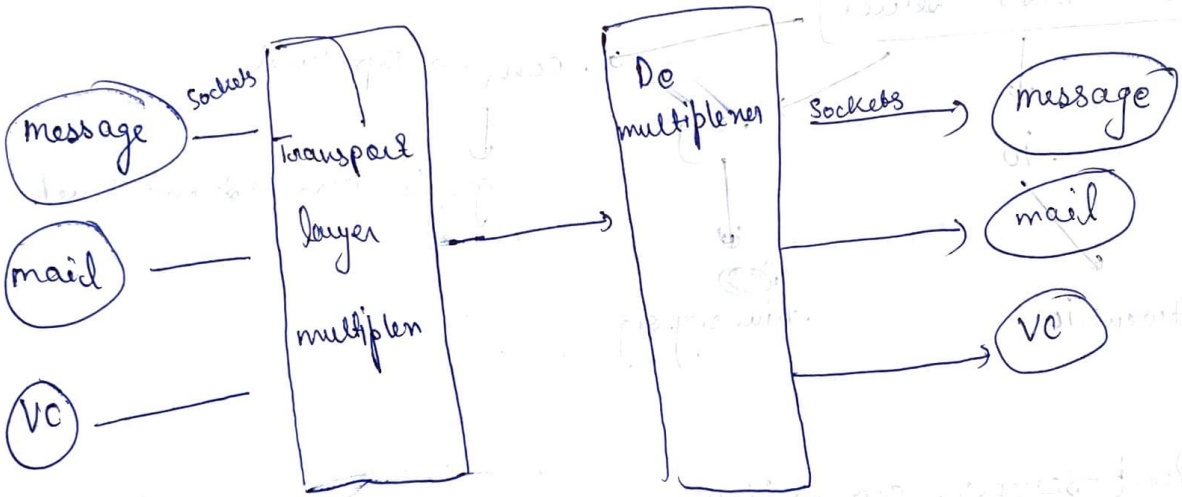


Transport Layer :-



from network to application

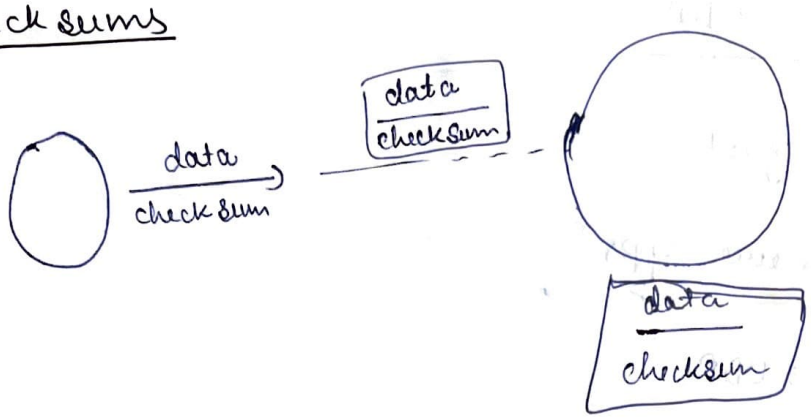




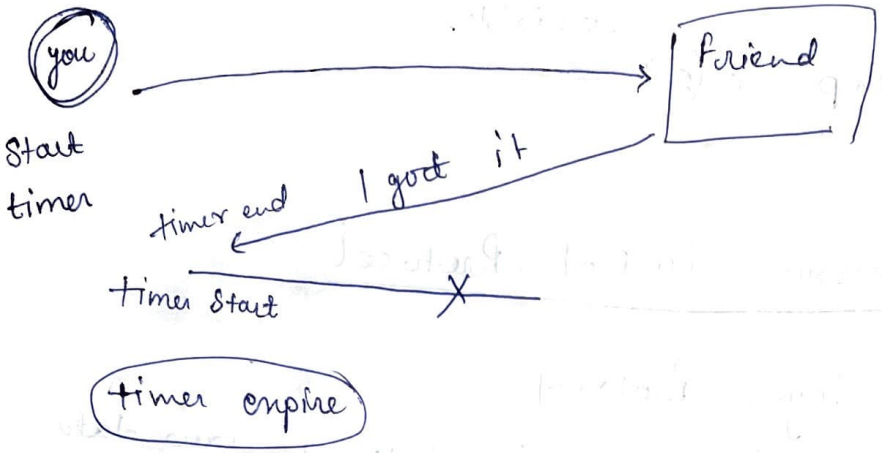
↳ Data travels in packets → Transport layer will attach these Socket port numbers

* Transport layer also takes care of congestion cont
* Congestion control algorithms built in TCP.

Checksums



Timers :-



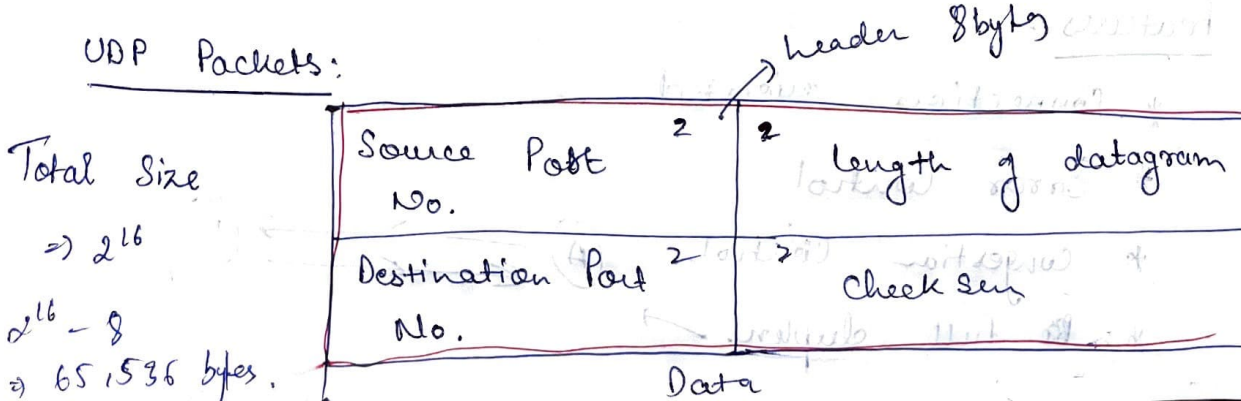
UDP (User Datagram Protocol)

- ☆ Data may or may not be delivered
- ☆ Data may change
- ☆ Data not be in order.

Connection less protocol

UDP uses checksums.

UDP Packets:



Use Cases of UDP:-

* Its very fast
* Video Conference apps
* DNS → UDP
* Gaming

a Sudo tcpdump -c (5) → variable.

TCP - Transmission Control Protocol

* Transport layer Protocol
* Application layer sends lots of raw data

TCP segments this data → divide in chunks add headers. It may also collect the data network layer. etc.

* Congestion Control

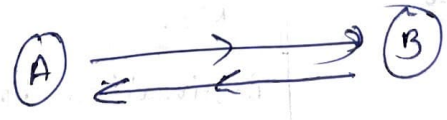
Takes care of

→ when data does not arrive.

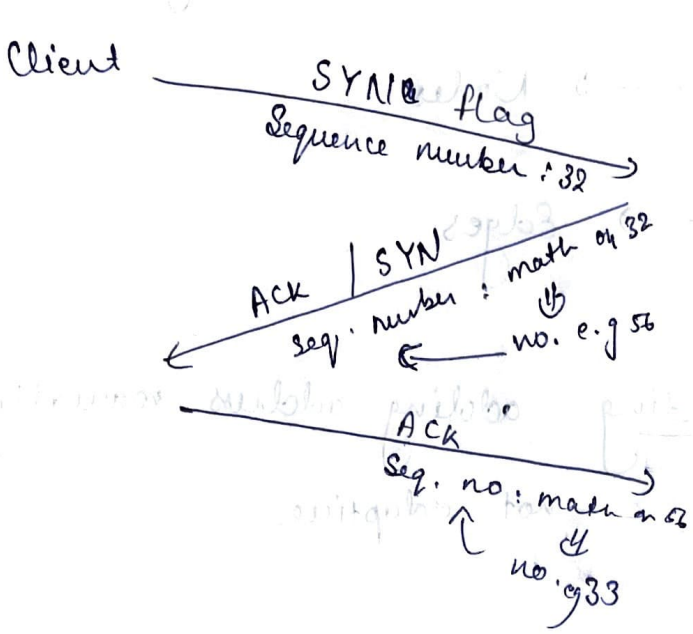
→ maintains the order of data.

Features:-

* Connection oriented
* Error Control
* Congestion Control
* full duplex. →



3 - Way handshake



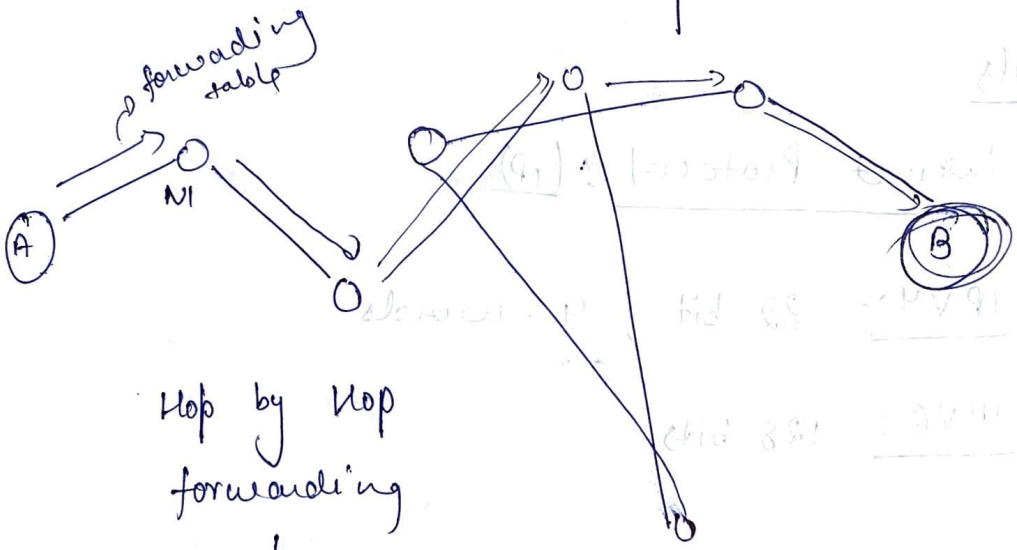
Network layer

Routers comes into play

Transport layer → Segments

Network → Packets

Data link → frames.



Hop by Hop forwarding

↓

hoping routers to router until it reaches correct destination

192. 168. 2. 30

Network address — device address

Control Plane :- Use to build routing table.

Routers ⟶ Nodes

Edge Links ⟶ Edges

① Static Routing :- adding address manually
not adaptive.

② Dynamic Routing :- Evolve according.
Djikstra's algorithm is used

Protocols

Internet Protocol : (IP)

IPV4 :- 32 bit, 4 - words

IPV6 :- 128 bits

5 . 6 . 9 . 14

8 bit 8 bit 8 bit 8 bit

Class of IP address

A 0 . 0 . 0 . 0 — 127 . 255 . 255 . 255

B 128.0.0.0 – 191.255.255.255

C 192.0.0.0 – 223.255.255.255

D 224.0.0.0 – 239.255.255.255

E 240.0.0.0 – 255.255.255.255

* IETF assign IP address to Internet Service Provider

Reserved address

127.0.0.0/8

Ex: localhost : 127.0.0.1
loopback addresses

Packets :- Header is of 20 bytes

IPV, length, identification, flags, Protocols
Checksum, address, TTL (Time to live) etc.

IPV6 :-

IPV4 : $2^{32} \simeq 4.3$ billion

IPV6 : $2^{128} \simeq 3.4 \times 10^{38}$ numbers

Cons

→ not backward compatible

→ ISPs would have to shift, alot of hardware work.

16 bit hexa decimal ← a:a:a:a:a:a:a:a.

Middleboxes

① Firewall :: → Global Internet
→ your trusted Network

filter out IP Packets based on various rules

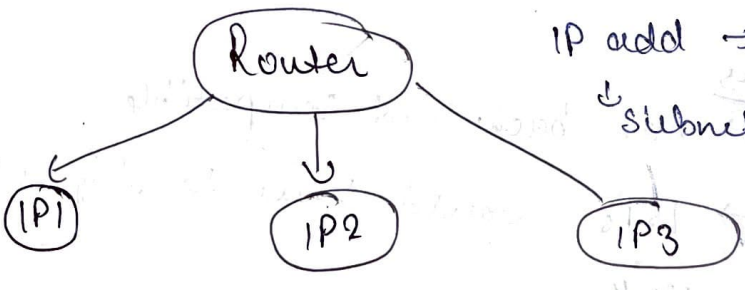
- → Address
- → Modify Packets
- → Port nos.
- → flags
- → Protocols.

Stateless Vs Stateful firewall
↳ more efficient

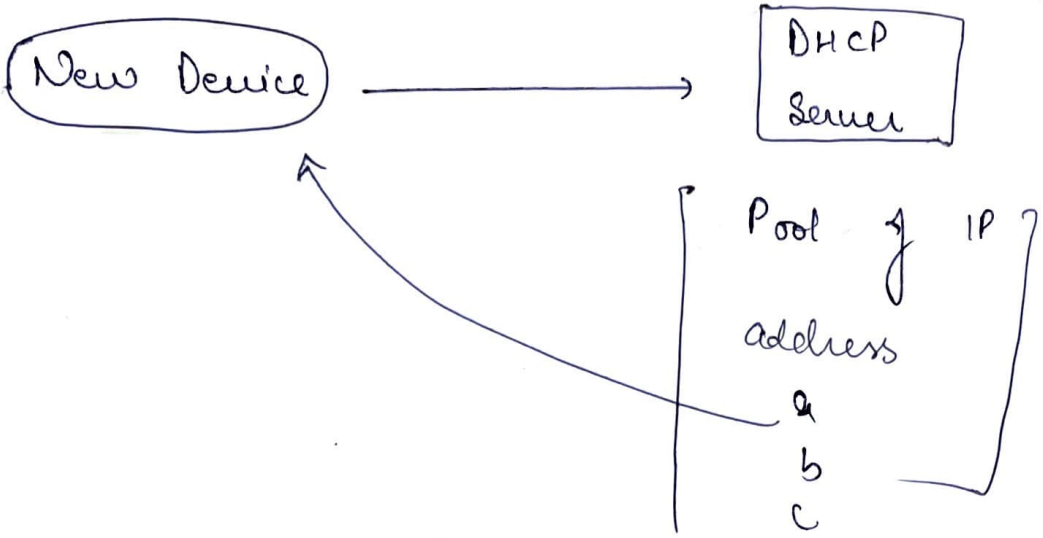
② NAT (Network address Translation)

Data link layer

DHCP

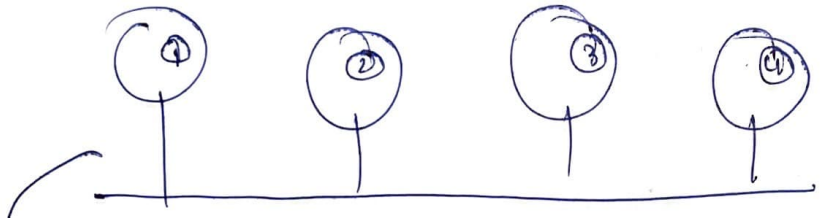


IP add → ISP
↳ Subnet



* DHCP → Dynamic Host Configuration Protocol

Many devices connect in LAN: Data link layer address, ↓ MAC address.



→ cache.

ARP cache

↓

address Resolution Protocol.

frame

↳ DLLA of Sender

↳ IP address of Destination.