# Networking

→ Communication between two computers


→ IP address consist of two configuration

1) Network id

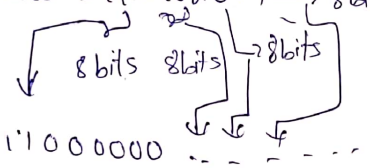
2) Host id

IPv4 = $32^{bits}$ = 4.30 crores approximately.

→ 0 0000000

$2^7$ $2^6$ $2^5$ $2^4$ $2^3$ $2^2$ $2^1$ $2^0$

facebook = 192.168.0.1 → 8 bits




1983 – 1991

classful design ip address

1991

classless Design CIDR

| 10bits | 100bit |
|---|---|
| 0 | 0 0 |
| : | |
| 9 | 0 0 9 |
| 10 | |

4bits = $2^4$ = 16 numbers

$2^1$ = 2 parts

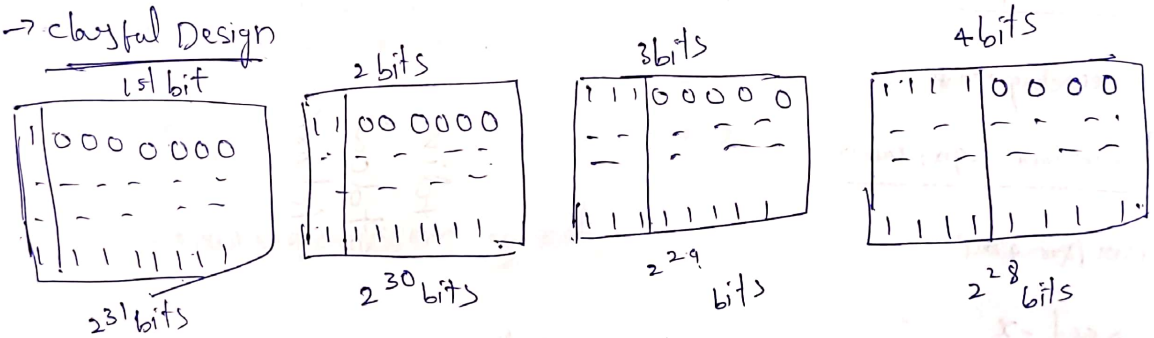
$2^{4-1} \Rightarrow 2^3$ = 8 numbers

K bits = $2^K$ parts

$2^{n-K}$ = each part

2bits = $2^4$ parts = $2^{4-2}$ numbers

→ classful Design




class A  class B  class C  class D

class A = | N/w | host |

= | 8 | 24 |

= 1 bit is fixed so

= $2^7$ networks

= $2^{24}$ hosts

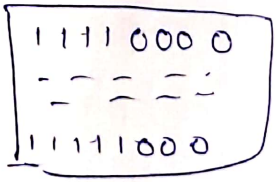
class B

| 16 | 16 |
|---|---|

class C

| 24 | 8 |
|---|---|

class E




→ similar to all 4 classful Designs

→ class D is not used present but using it may use future

→ All ip addresses are under controll IANA

ISP = internet service provider.

IANA

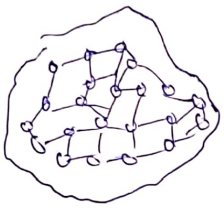
Internet Assigned Numbers Authority.

CIDR

→ classless Internet Domain Routing.

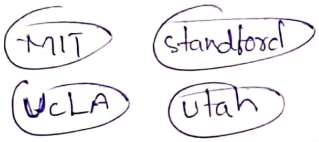
Internet

→ It is a global network where all the computers are connected globally and sharing information amoung them



→ These computers used connected with LAN and these are used connected with MAN and these are WAN is known as internet

→ The first internet established "Arpa net" IN USA it was established in 1969.




→ The first message they send was "login" but at the receiver side receives 'lo' it was crashed.

WWW

→ world wide web often refferred to as the web. It is a system of interconnected hypertext documents that are accersed over the internet

→ The first website launched on the internet is CERN

→ It uses the HTTP and HTTPS protocols to transfer data between server and clients

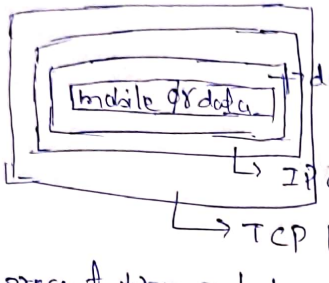
→ By using URL (uniform resource Locator) we can access the data.

protocol

→ Protocol is nothing but set of rules these are defined by internet society.

→ some protocols ~~for the market~~ are available in the market TCP/IP, UDP, HTTP, HTTPS FTP ..... etc.

→ lets crack TCP with amazon courier example



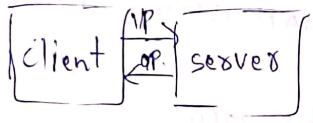

→ TCP is present transport layer it used to transmitts the data 100%.

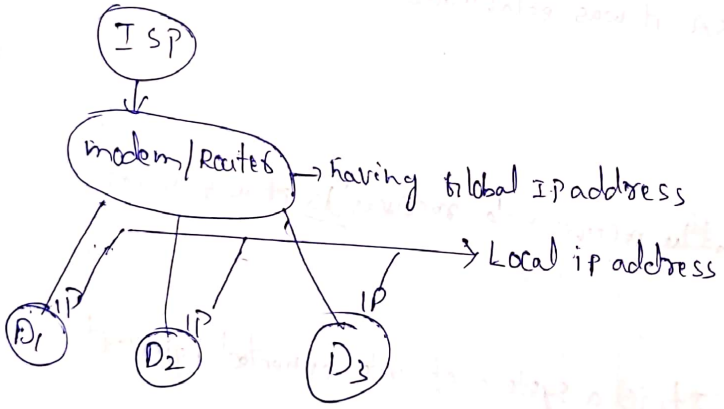
⇒ when UDP is uses in video calling like etc....

→ when data have 5MB it transmitted through the TCP

→ first it will transfer 1MB data according internet speed. after that until it doesn't receives any response from receiver side it doesn't send further data

→ TCP sends the data interms of small packets.




→ modem assigns the local ipaddress using DHCP

→ DHCP is a protocol (Dynamic host configuration protocol.)

→ if any devices make a request and receive a response these are managed by NAT

NAT

Network Access Translator.

→ In which devices which application send request like wattsapp, facebook etc.... these will be resolved by "port Numbers".

→ ports are the 16 bit Numbers

→ Total port number we can create $2^{16} = 65,000$

→ HTTP port is 80

→ HTTPS port is 443

→ ports are that are starting from 0–1023 are reserved ports

→ ports numbers from 1024–49152 are registed # for application

→ others than all ports are we can use

→ 1 mbps = 1 mega bits per sec ⇒ 1000000 bits/sec

→ 1 gbps = 10^9 bits/s

→ 1 KBPS = $10^3$ bits/s

→ LAN = local area Network

→ MAN = Metropolitan area network

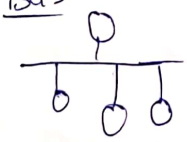
→ WAN = wide area nw → SONET, frame rellay.

## Modem / Router

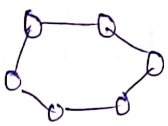
→ It is a hardware device used to convert digital signal to Analog signal and vice versa

## Topologies

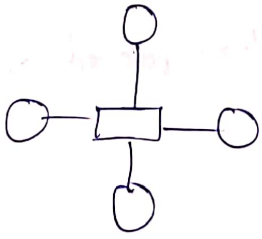
① Bus



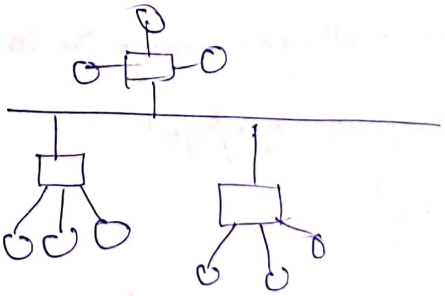
② RING



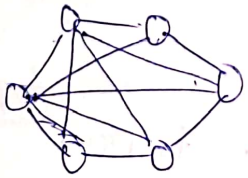
③ STAR



④ TREE (Bus-star)



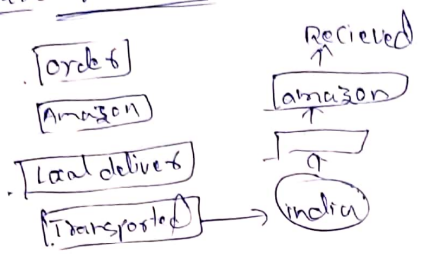
⑤ Mesh



→ Expensive

→ scalability.

## Structure of Network




## OSI Model (Open System Interconnection model)

→ 7 layers are present in OSI

1) Application
2) presentation → converts ASCII into marchine understandable language (binary)
3) session
4) transport
5) Network
6) Datalink
7) physical

### Application

It is implemented in software

### presentation

→ goes under encyption and compresion

### Session

→ Helps to setting or manage the connections followed termination session

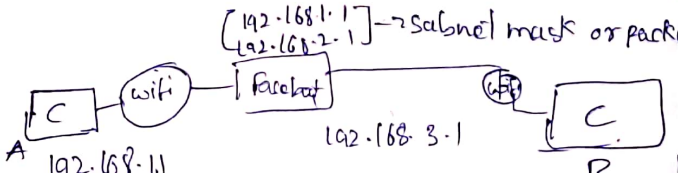
eg authorization, log in/log out

### Transport

→ Here the data transferred using TCP or UDP protocols

### Network

→ Network layer works for the transmission of the receive data segments from one computer to another computer that is located into different network



→ Network assigns the Sender and Receiever ip address to every segments to form a ip packet and also performing logical addressing.

→ Because of this every ip Packet reach correct Destination

## Data link

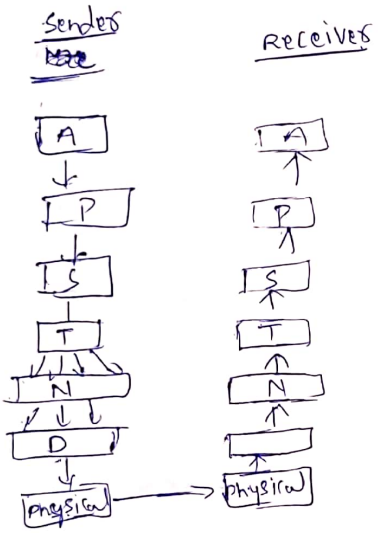
→ This allows to directly communicate with computer or hosts

→ physical addressing eg mac addresses. to form a frame

→ frame is data unit of data link layer

## physical

→ It is a hardware it transmits the bits from the electric signals




## TCP/IP model

→ Application

→ Transport

→ Network

→ Data Link

→ physical

## Application

* Users interact
* Watsapp, web browsers .... etc
* It is in the devices.

40,075 - earth

light - 299,792 km/s

Peer to peer

Networking Devices

→ Repeaters

→ Hub ← Active hub
Passive hub

→ Bridge
- Transparent bridge
- Source Routing bridge

→ switch

→ Routers

Protocols

web protocols

TCP/IP :

- HTTP
- DHCP
- FTP
- SMTPC (simple mail transfer protocol) → to send email
- POP3 & IMAP (to receive email) (post office protocol)
- SSH (secure shell)
- VNC (virtual network computing)
- Telnet
- UDP (stateless connection)

Sockets

→ The interface b/w process and internet

HTTP

→ It is client server protocol

→ It talks about how you send request

→ It is a application layour protocol it requires TCP protocol

→ It is statoless protocol

## Cookies

unique string

→ It ~~sot~~ stores in cliewt browser and its a files

→ Third party cookies (eg ads) It can be expired.

## SMTP

## IMAP

Internet message accers protocol

→ It will allows show our email multiple devices.

## DNS (Domain Name system)

→ when we type google.com it will find the ip addresss ~~for~~ and it will connected through the server

mail.google.com → top-level domain.

↓ → second level domain.

subdomain

ipconfig / displaydns

## Root DNS servers (TLD)

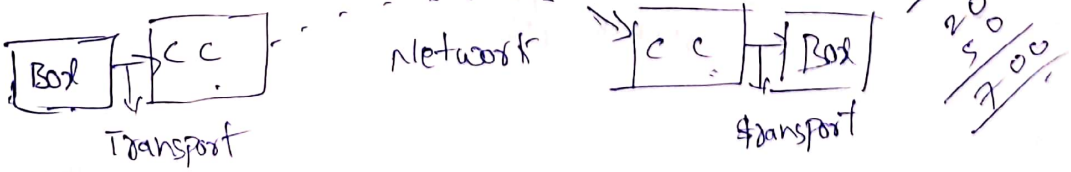
ICANN

→ .io

→ .org

→ .com

## 2) Transport Layer



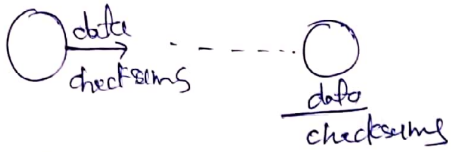

→ Transport will takes care of conjunction control

→ conjunction is nothing but traffic

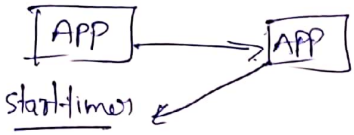
→ Conjunction control algorithms built in TCP

## checksums

→ It is used maintain the same flow at sender to receiver




## Timers




→ If any packet is fails it send again same segments if any acknowledge doesn't received

→ Bad Here one is occurs that duplicates packets

→ to solve this problem using sequence number

## UDP (User Datagram protocol)

→ It is very fast compare to other protocols

→ Data may or may not be delivered

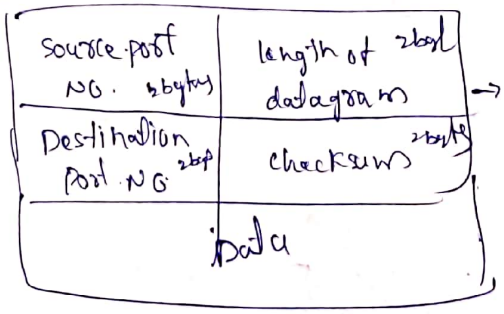
→ Data may change

→ Data may not be in order

→ connection less protocol

→ UDP uses checksums

### UDP packet




→ header 8 bytes

= total size

$= 2^{16}$

$= 2^{16} - 8$

= 65,536 bytes

# TCP (Transmission control protocol)

→ Applical layer sends lots of raw data

→ TCP segments this data divide in chanks, add header. It may also collect the data from network layer

→ congention control

→ It takes care about when data does not arrive

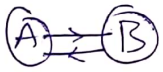
→ maintains the order of data

## Features

→ connection oriented

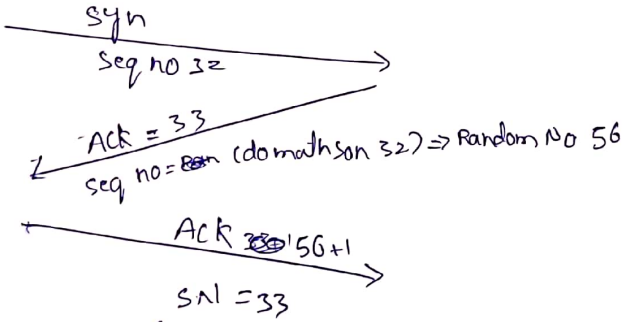
→ error control

→ congention control

→ By directional 

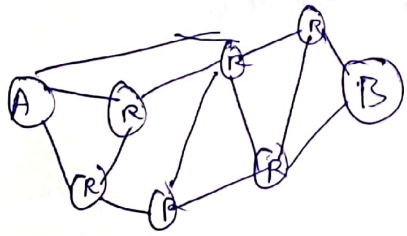

## 3 way handshake

client server




## Network Layer

Here we work with routers




R= Routers

→ hope-by-hop routing

Transport → segment

Network → packets

Data Link → frams

## Control plane

Routes → nodes

links → Edges

① static Routing

* manually

② Dynamic routing

→ Belmen algorithum etc..

## IP (Internet protocol)

IPV4 → 32 bit, 4 words

IPV6 → future → 128 bits

## Classs

A 0.0.0.0 → 127.255.255.255

B 128.0.0.0 → 191 " " "

C 192.0.0.0 → 223 " " "

D 224.0.0.0 → 239 " " "

E 240.0.0.0 → 255 " " "

127.0.0.0/8

eg local host : 127.0.0.1

. loopback addressey

## packets

→ Header is of 20 bytes

IPV, length, identification no, flags, protocols, checksum, address

TTL ..... etc

TTL

Time to leave

IPV6

$2^{128}$ = unique IPs

cons

→ Not backward compatable

→ ISPs would have to shift, lot of hardware work

a:a:a:a:a:a:a:a

↓

Hexadecimal

16 bit

eg ABFE:f001:3210:9182:0:0:1:3

Middle Boxes

1) fire wall < global internet / your owned network

→ It will works with packets

→ filter out IP packets based on various rules

→ Address

→ modify packets

→ port nos

→ flags

→ protocols

stateless vs stateful firewalls

NAT (Network address translation)

Data Link layer

→ frame contains DLLA of sender and ip add of destination.