

\* Internet is collection of computer networks.

APRANET founded TCP.

→ As we are sharing different types of things over the internet, so, different type of rules are required to keep it secure / smooth; so that internet make sure that data has been transferred securely.

So, these rule sets are known as protocols.

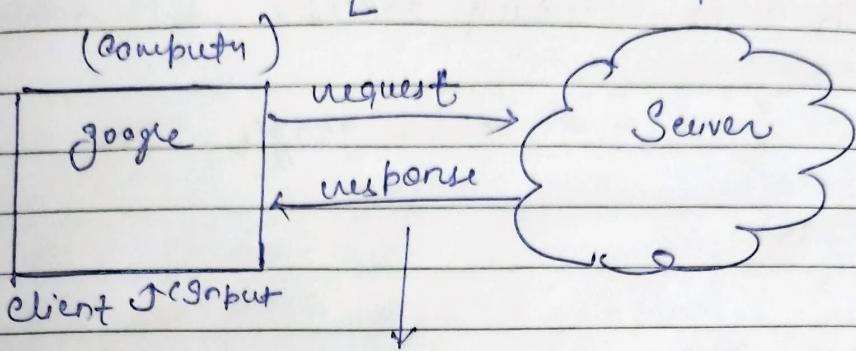
\* In early stage of internet, the automated sharing was ongoing. Then, world wide web (www) come in picture which started to give allowance to store all the links and give access to the shared person.

Links were called Hyperlinks which were published by Web servers.

## # Protocols

Set of rules & regulations created by the Internet Society so that data can be shared over a network and Internet.

### [Client - Server Architecture]



So, many requests are made & responses are generated respectively.

~~Topic~~

\* TCP : Transmission Control Protocol

It ensures <sup>that</sup> data will reach the destination and it won't get corrupted on the way.

\* UDP : Not 100% data can be sent to reach the destination.

<sup>↓</sup>  
(User Datagram protocol) uses Video Conferencing calls.

\* HTTP : Hyper Text Transfer protocol.  
Used by the web browsers.

It defines the format of data transferring between client and server.

\* Data is transferred over Internet through packets. (Not in bulk)

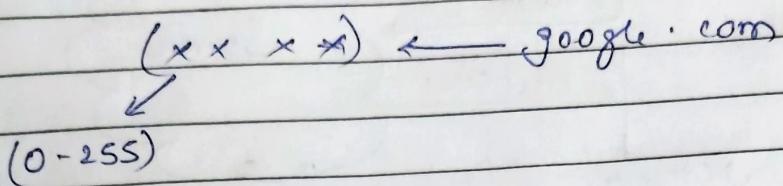
Individual calls of packets are made.

# IP address

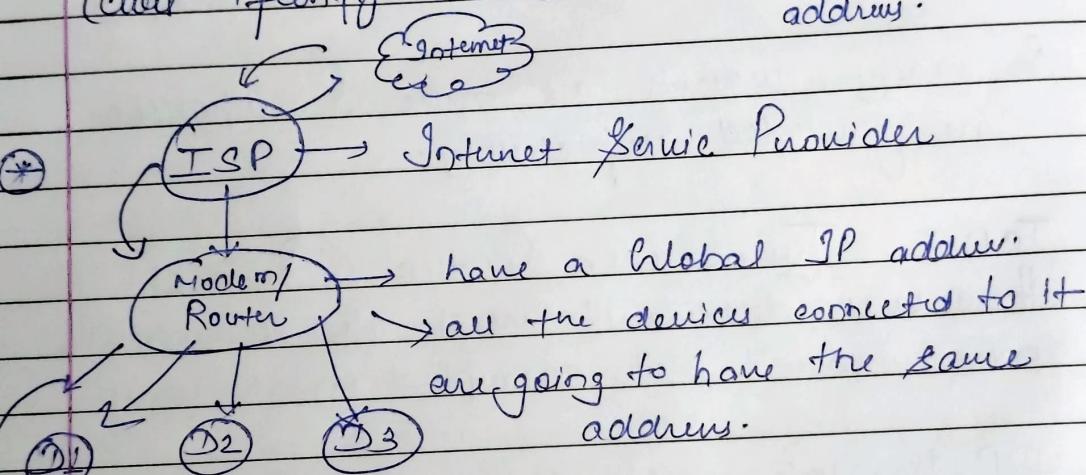
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→ Data packets identifies specific server over internet through specific IP address.

Every devices on Internet connected to each other through specific IP address.



(curl ifconfig.me -s) → command to check IP address.

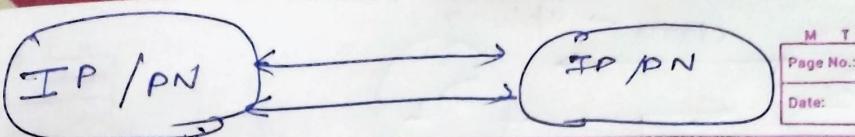


→ Modem will give an IP address to these devices as well, known as local IP address.  
It uses DHCP.

(DHCP)

④ To return data to specific application on the device as,  
IP address determines which device made the request and to which it has to return with response but ports decide which applications will get the data.

Different applications have different port numbers.



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## [ Two devices Interaction ]

DN  $\rightarrow$  16 bit

$\hookrightarrow$  16 cells of 0 or 1.

$\hookrightarrow$  Total port number possible  $\rightarrow 2^{16}$   
 $\approx 65000$

② All the HTTP stuff we do, that happens on PORT 80.

If application (eg - MongoDB)

$\hookrightarrow$  PORT  $\rightarrow 2707$  {SQL  $\rightarrow 1433$ }

0 - 1023 (ports)

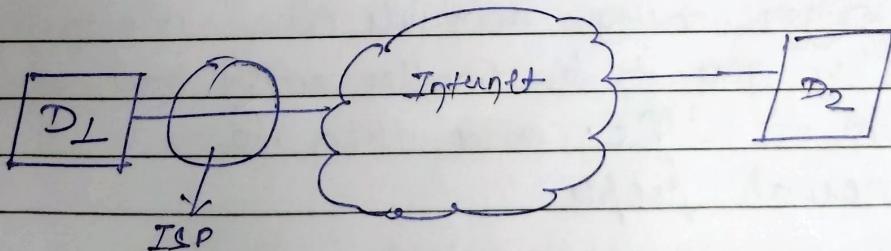
$\hookrightarrow$  reserved ports.

1024 - 49152

$\hookrightarrow$  specific Application.

remaining ones  $\rightarrow$  We can use.

## # Internet

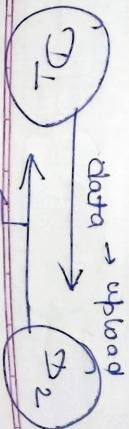


Speed  $\rightarrow$  mbps  $\rightarrow$  megabits per second.

$\downarrow$   
 Transferring 1000000 bits/sec  
 data

$\downarrow$  1 gbps =  $10^9$  bits/sec

$\downarrow$  1 kbps = 1000 bits/sec



Communication happens b/w computers or devices in two ways :

- Guided way
- Unguided way.

In Guided way, the connecting path is already defined such that two computers connected through wires.

In Unguided way, there's no one single path of connection.  
Ex:- wifi, Bluetooth, etc.

So, the connection and data transference is superfest as the countries are connected with each other through optical fibres under the ocean.

A bigger entity controls the internet. They give it to smaller entity and then to ISP's and then to normal people.

(\*) Physically → Optical fiber cables  
Coaxial cables.

(\*) Wireless : Radio channels.  
Bluetooth, wifi / 3G / 4G

④ LAN → Small home / office

↳ Local Area Network.

Ethernet cables, wifi

Network adapter manages all these.

⑤ MAN : Over a city.

⑥ WAN : Over a country.

↳ optical fiber cables.

Internet is a connection of all these three networks.

⇒ WAN :

(i) SONET → Synchronous.

(ii) frame relay → a way to connect LAN to WAN

⑦ Modem → converts digital signals to analog signals. and vice versa.

→ Data on our computer can be converted to electrical signals so that we can transfer it over wires or to reach other destination site which will convert the data.

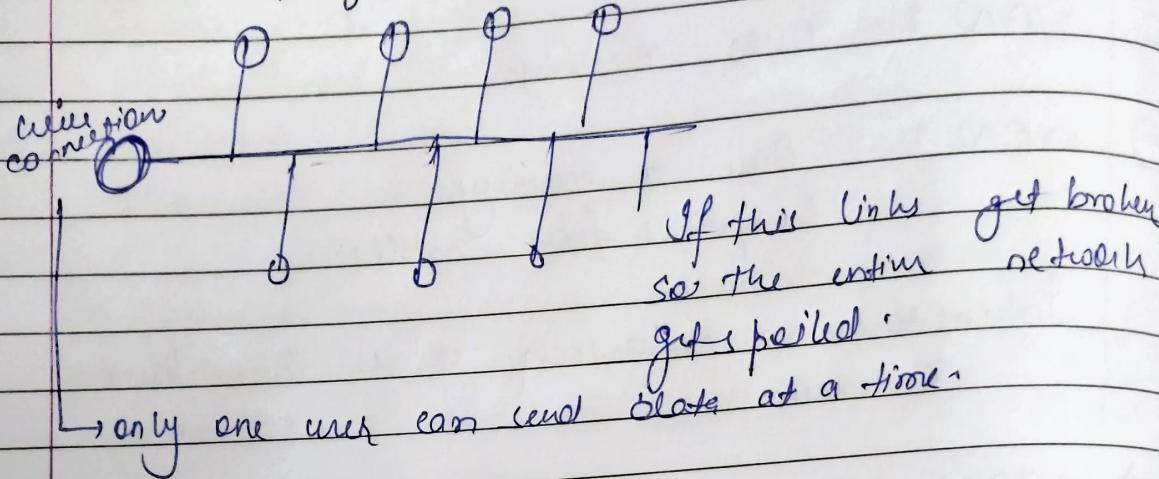
⑧ Router → It is a device that routes the data packets.

## Computer Connection :

### Topologies :

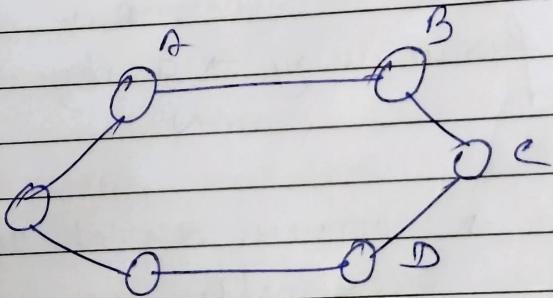
(i)

### Bus Topology :



(ii)

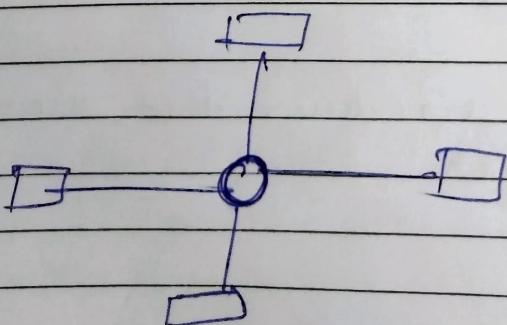
### Ring :



Every system connects from one another.  
one cable breaks so network get spoiled.  
+ lot of unnecessary calls are being made.

(iii)

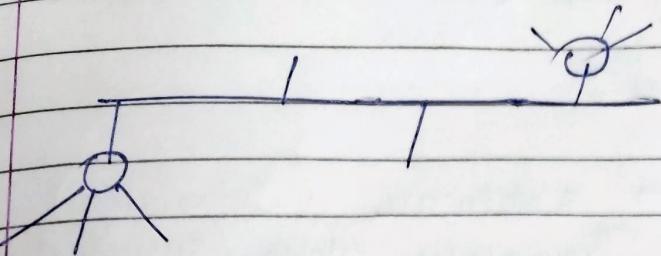
### Star :



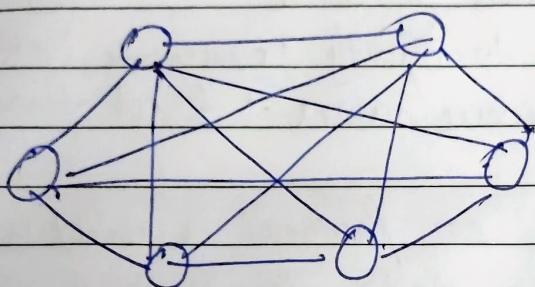
All computers are connected to a same centralised device.

If central device fails, all computers will go down.

(12) Tree : Bus + star combination.

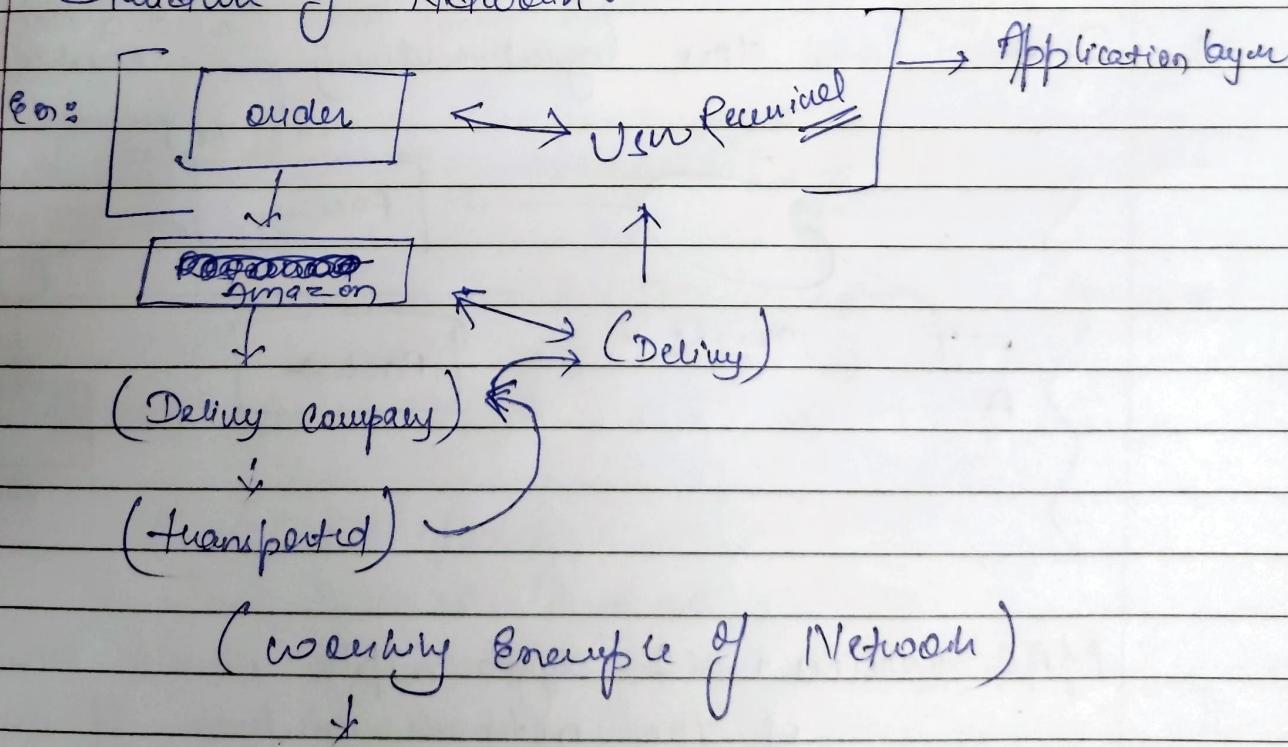


(5) Mesh : Every single computer will be connected to every single.



- (\*) Expensive
- (\*) Scalability issues.

## # Structure of Network :



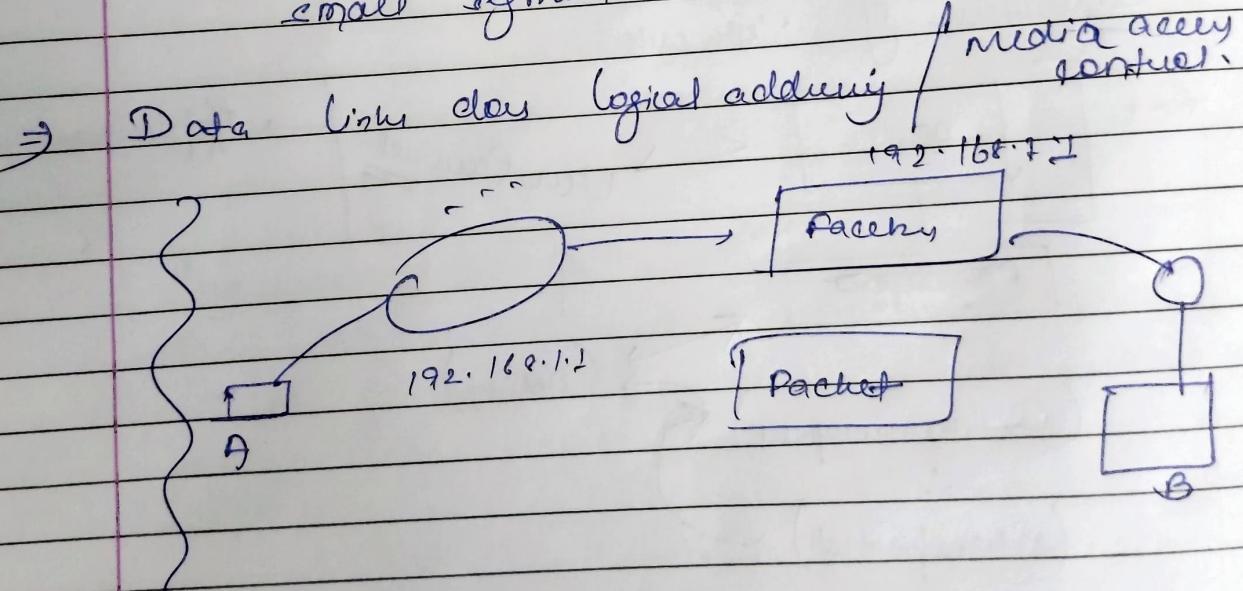
This is how we transfer our data through internet.

## # OSI Model - (Open System Interconnection)

There are 7 layers :

- Application → Software (Requesting)
- Presentation → Translates data (encoding & decoding)
- Session → Helps in managing connections / authentication.
- Transport → Transmitting data to its destination.
- Network → Transmission of data / communicating with devices.
- Data link → Allows to directly communicate with host.
- Physical → Hardware (wires ⇒ signal transmitting).

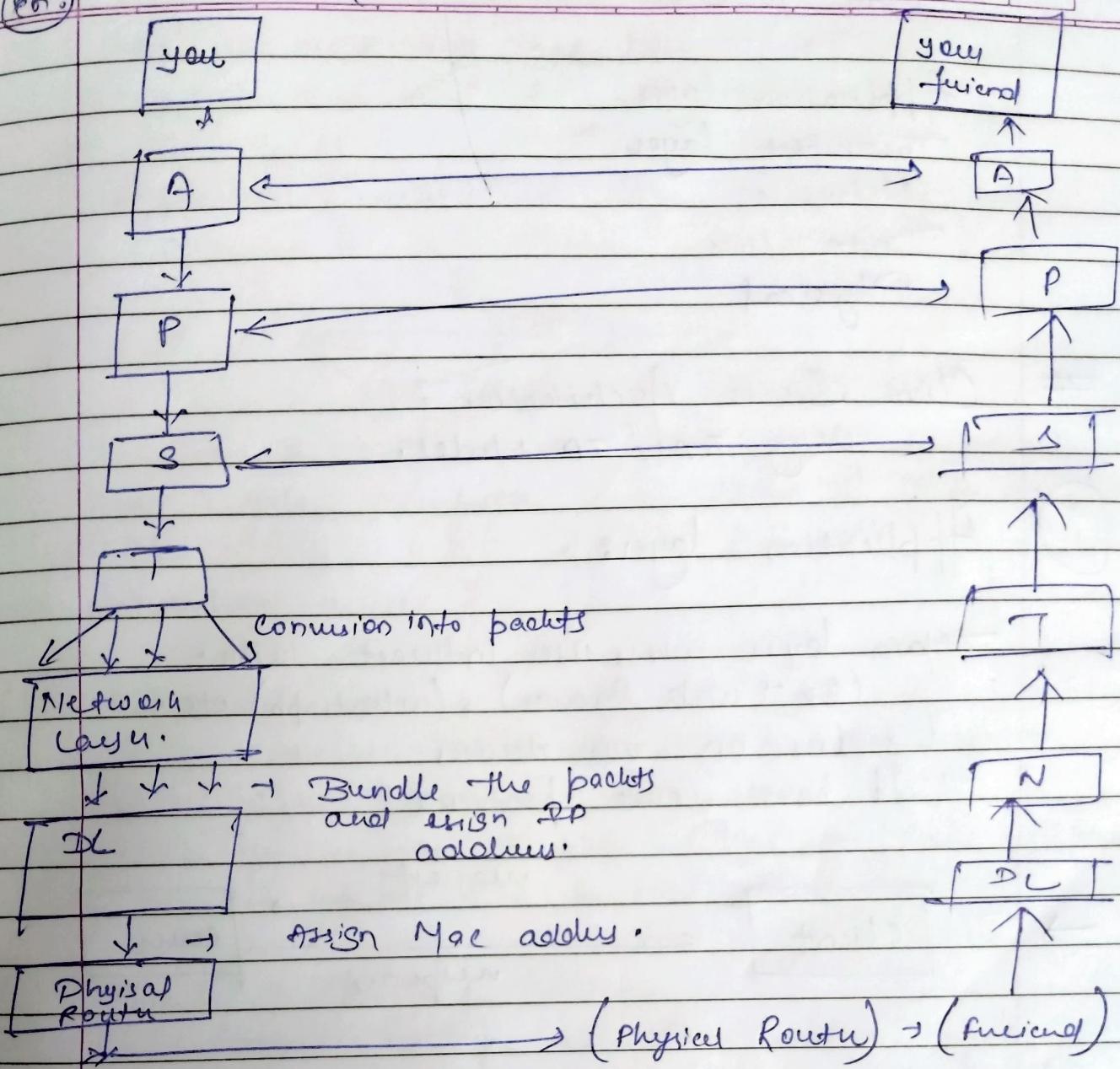
- ⇒ In presentation layer ~~or~~ protocol is used.
- ⇒ In transportation, data is divided into small segments.



MAC address : 12 digit alpha numeric number  
of the network interface of any computer.

wifi/bluetooth etc. can't have different MAC addresses.

(conceptual way)



# Another Model :

TCP / IP Model:

- ↳ The Internet Protocol Suite.
- ↳ Developed by APRA

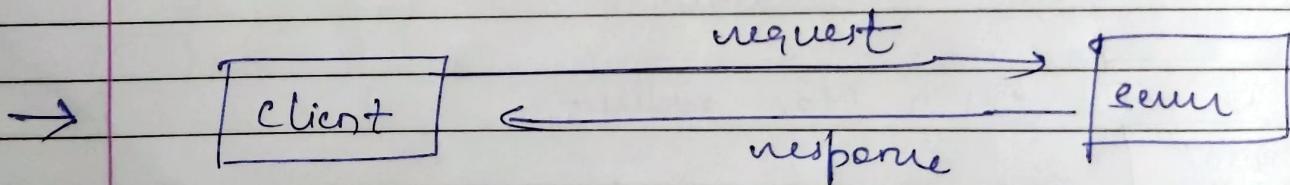
## TCP / IP Model :

Application layer  
 Transport layer  
 Network  
 Data link  
 Physical

⇒ Client Server Architecture :-  
 Using TCP / IP Model.

### ① Application layer:

- ↳ Main layer where user interact with.  
 (Ex → Web Browser), (WhatsApp) etc.
- ↳ lies on our devices.
- ↳ It has some protocols



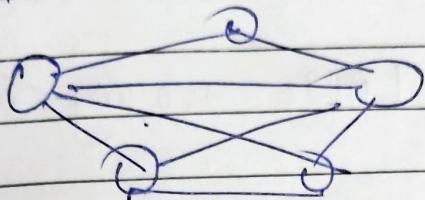
② Server is basically a system that control or processes requests from a client.

- ↳ Ex: Something which controls your website hosting.

Right now, my data packet is of 64 bytes.

→ There's one more way that how client - server are connected, that is P2P (peer to peer)

Applications running on base devices, they get connected to each other.



There are a lot of servers, decentralized network.  
Every single computer is a client & server in itself.

## # Networking devices :

(i) Repeaters — operate at physical layer  
regenerate the signal over the same network  
before signal gets too weak.

They do not amplify — They copy the signal  
bit by bit. 2 port device.

(ii) Hubs → Multifast Repeaters.

Connects multiple wires coming from different  
bunches.

E.g.: Connectors in star topology.

→ Types : Active — Passive

(III) Bridge :-

Operates at data link layer.

A Repeater with add on filters contact by reading the MAC address of source and destination.

↳ Interconnects two LANs working on the same protocol.

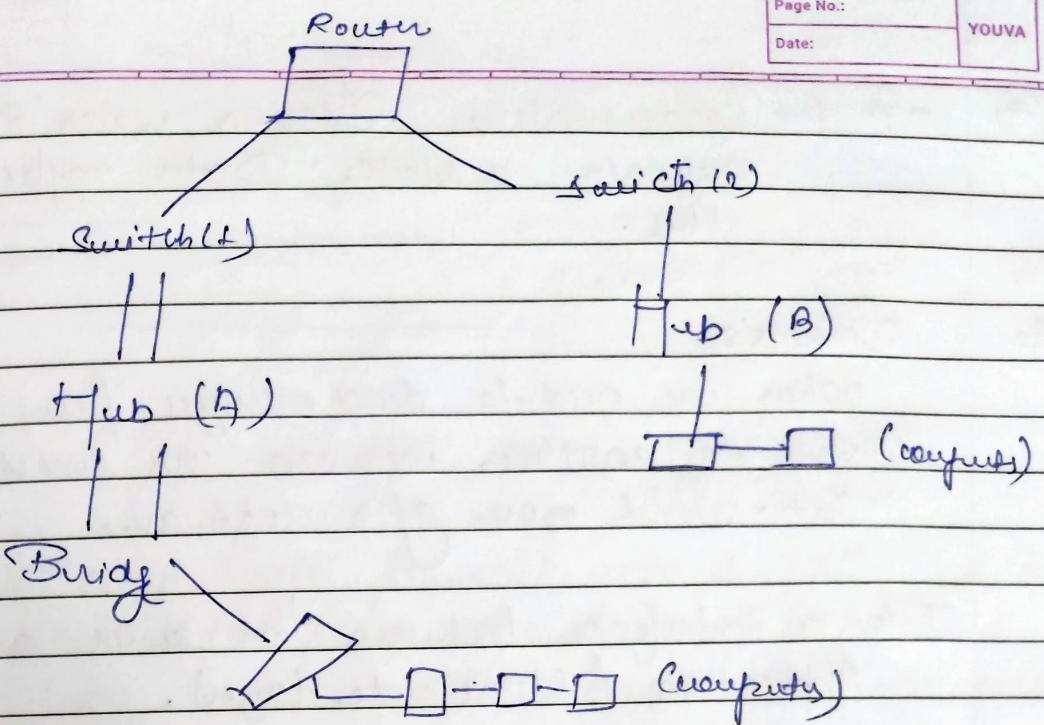
(IV) Switch →

Multi-port bridge with a buffer, boosts the performance.

(V) Gateway :-

Passage to connect two networks together that may work upon different networking models. works as the message gate that data from one system, interpret it and transfer it to another system.

(VI) Brouter :- Bridge + Router.



## # Protocols :

Set of rules and regulations to monitor internet.

→ Web protocols.

(\*) TCP / IP :

→ HTTP

→ DHCP

→ FTP

→ SFTP

→ POP3 & IMAP

→ SSH

→ Virtual Network Computing (VNC)

(\*) TELNET : Telnet is a terminal simulation which enables an user to connect to remote device or host.

(Part 23)

④ UDP : Connectionless Division, which does not maintain a state. Data may be lost in this.

### # Sockets :

When we need to send messages from one system to another, we can use sockets for that. It's one of a software.

It's a interface between the server and Application (client-side layer).

### ⑤ # Socket io

event driven library for real time web applications.  
, websocket provides connection over TCP.

### # Ports :

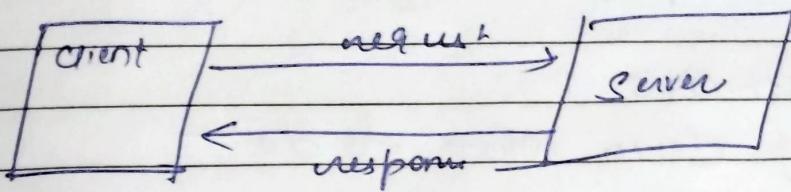
ports tell which application we are working with on a particular device.

→ Ephemeral ports : decides which instance

of a browser gets which kind of data.

Client side ports can be free and randomly chosen while Server side is fixed.

## \* HTTP :



↳ It happens through http protocol.

- \* It is a client-server protocol and it tells us how to request data from the server & also tells us how server will response the data back to client.

So, when a client makes a request to server, it is known as http request and the server's response is called http response.

- \* Basically, there are "application layer" protocols. It has some methods like GET, POST, PUT etc.

- \* There are also transmission layer protocols:  
TCP / IP ; UDP

As HTTP uses TCP.

TCP makes sure that all the data is received and everything.

HTTP is stateless protocol; Server will not store information about the client.

WWW :-

Collection of webpages, links, texts, documents etc. on which there are specific URLs.

## # HTTP Methods :-

Telling Server what to do -

GET :- Requesting data.

POST :- giving information to the server.

PUT :- puts data specific location.

DELETE :- delete request of data.

## # Error / Status Codes .

When you send a request to the Server, it needs some of a way to know whether the data was successfully defined (fail) or whatever happened.

For that, there exist Status Codes.

for ex :- 200 → successful.

404 → Error. Bad request

500 → Internal Server Error.

Status Codes.

(1xx) → if it lies in 100 range, there are basically informational category codes.

(2xx) → 200 range → Success codes.

(3xx) → Redirection purposes.

(400) → Client Error.

(SM) → Server Error.

# Cookies :

Unique Storing

If is stored on the client's browser. When the application is visited for the first time it will set a cookie. After that whenever you make a new request, the request header will have your cookies.

Server gets to know who specific is putting up that request.

Can be used to track your location / access to camera / microphones.

# Third party cookies

↳ Cookies that are set for URLs you <sup>are</sup> not visiting.  
Integrated ad site over different websites.

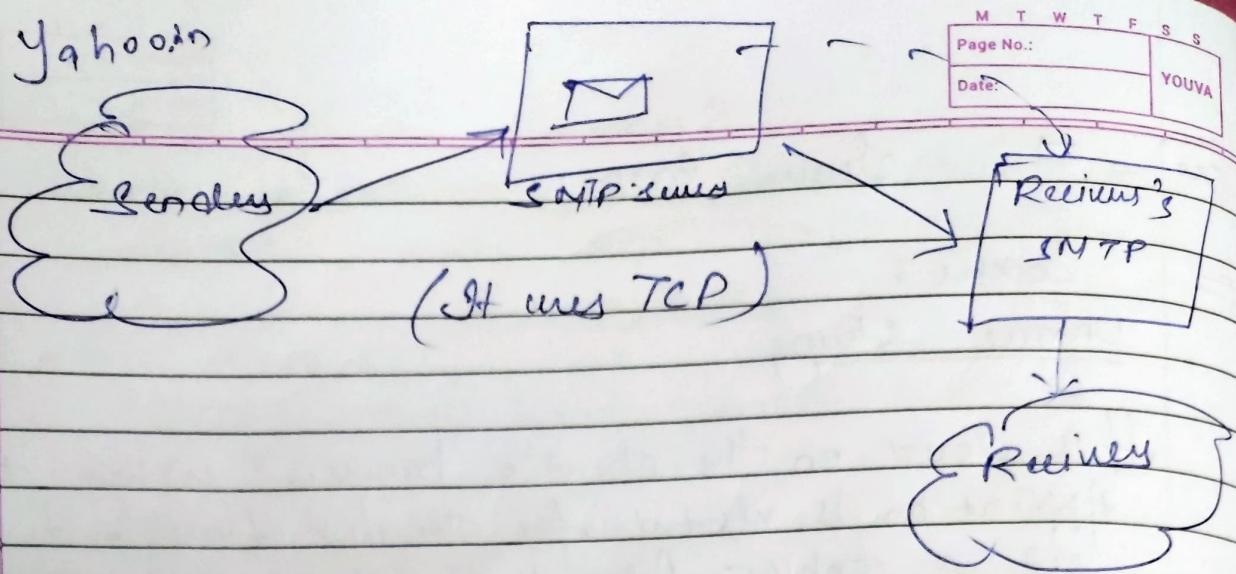
# How e-mail works?

SMTP : Simple mail transfer protocol.

It is used to send e-mail to people.

And in order to receive it, we use POP3.

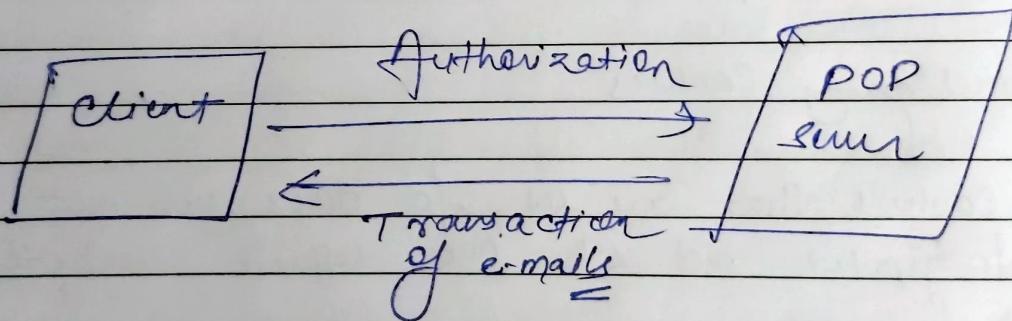
Data is transferred ~~through~~ Transport Layer : TCP. So, their data remains encrypted.



→ If both are google.com then the data is transferred directly.

④ How to download e-mail.

POP - connects via TCP  
at port - 110



⑤ IMAP : Internet Message Access Protocol.

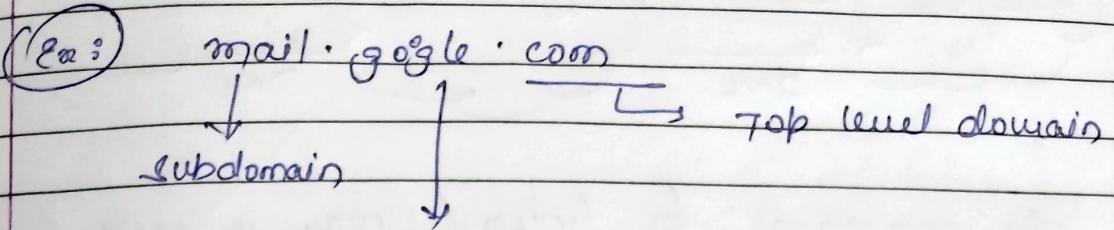
↳ Allows to view e-mail on multiple devices.

# DNS (Domain Name System) :

Mapped to IP address.

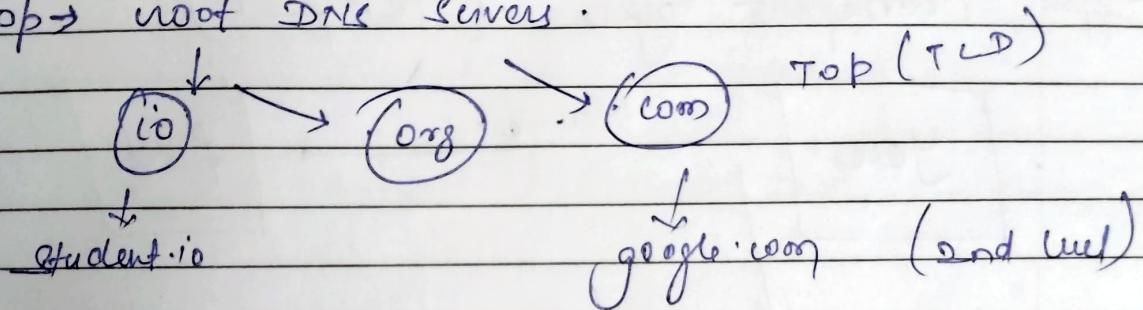
It is used to find specific IP address on Server.

(\*) HTTP requests for DNS from database then place its IP address.

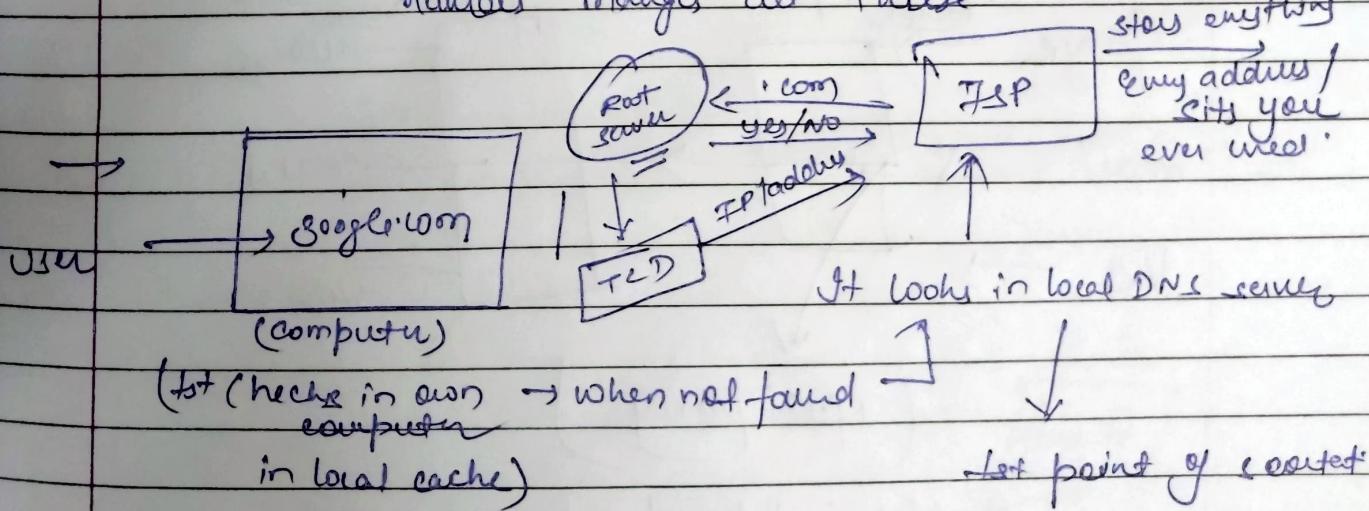


There are multiple databases for these three categories.

Top → root DNS servers.

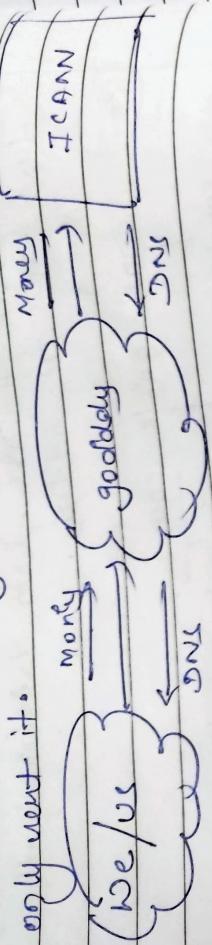


ICANN Internet corporation for assigned names and numbers manages all these.



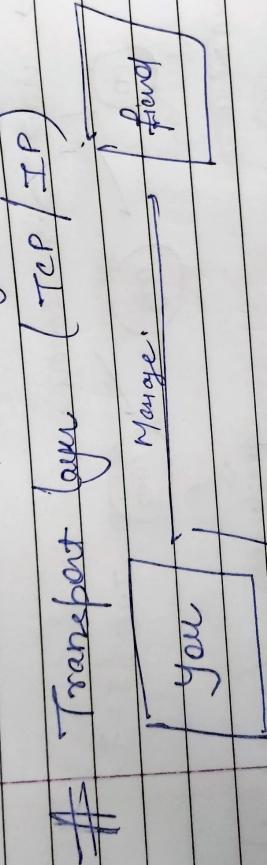
You can never buy domain name.

only went it.

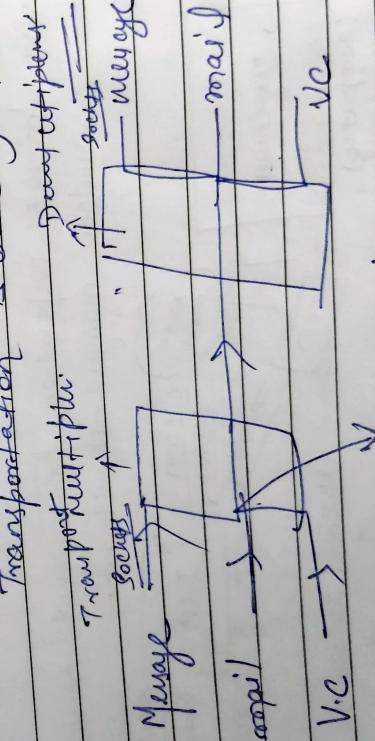


'dig' command for linux / unix is used for  
perforing one lookups.

→ domain information gather.



Transportation is done by network layer.



Multiplexing transformation  
over same medium.

Data packets



Transport layer

will attach their  
port number

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Sockets have port numbers.



Transport layer also takes care of congestion control.



(Traffic)

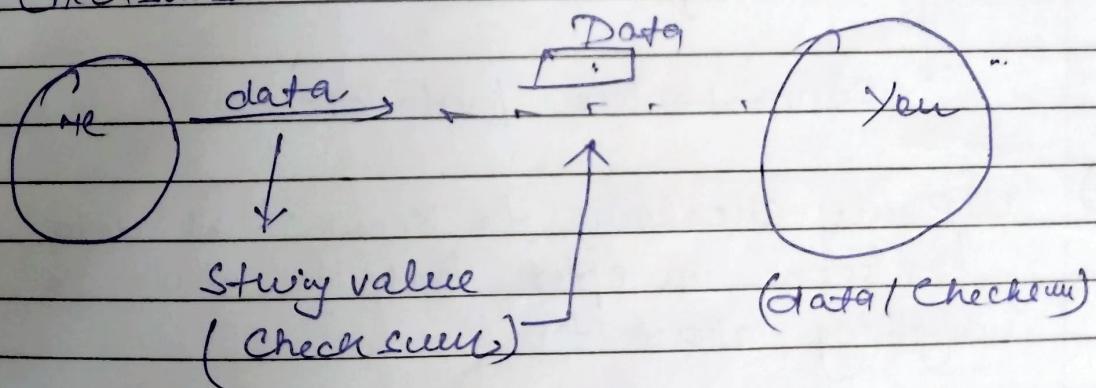
→ occurs when network has lesser bandwidth, and data packets are being transferred so rapidly.

\* follows congestion control algo. built in TCP.

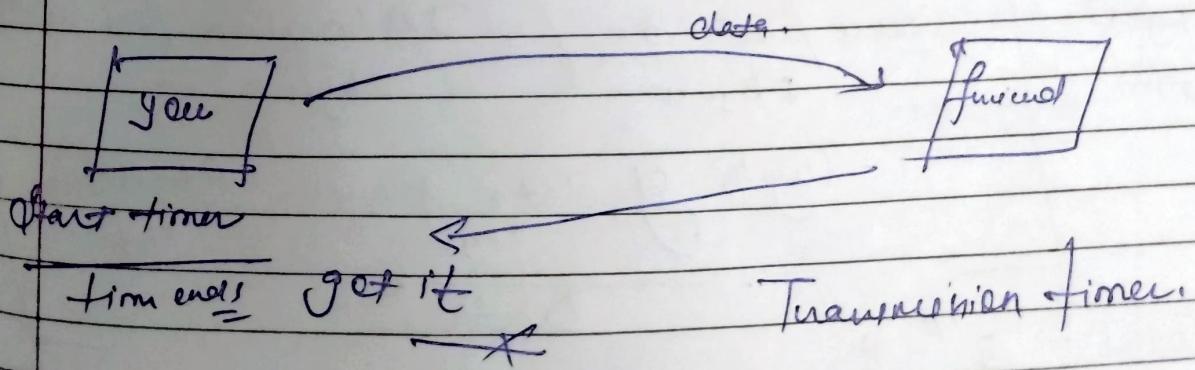
→ sometimes data packet get corrupted.

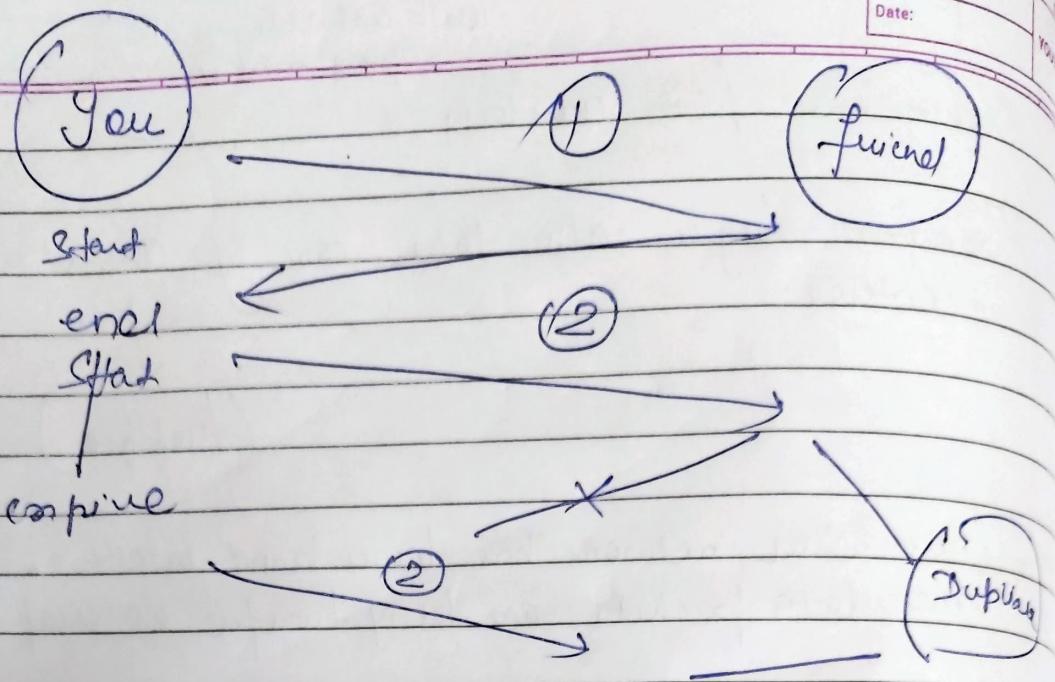
So to avoid that, TCP follows check sums.

\* Checksums :



Timers :





~~#~~ ~~TOPIC~~ UDP :

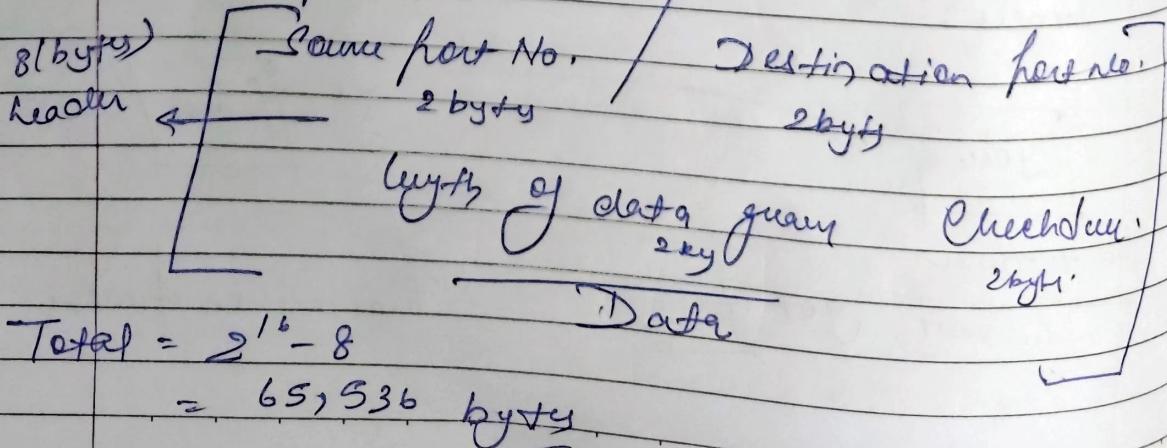
User datagram protocol :

↓  
Here your data may not get delivered.  
data may change on the way,  
data may be not in order.

↓  
connectionless protocol.

(\*) UDP uses checksum to know that data has been accepted but it won't do anything about it.

UDP packet :



UDP is faster because it doesn't check if the data is okay.

Voice, conferencing apps; having.

DNS → UDP

# TCP : Transmission Control Protocol.

Application layer sends a lot of new data.

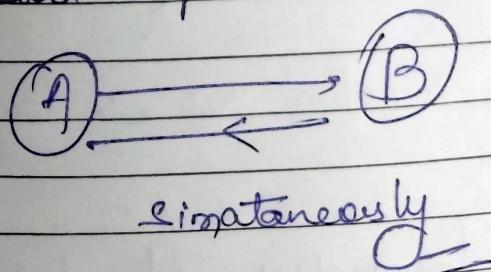
TCP segments these data → divide it in chunks and header.

- \* It may also collect the data between layers.
- \* Congestion control.

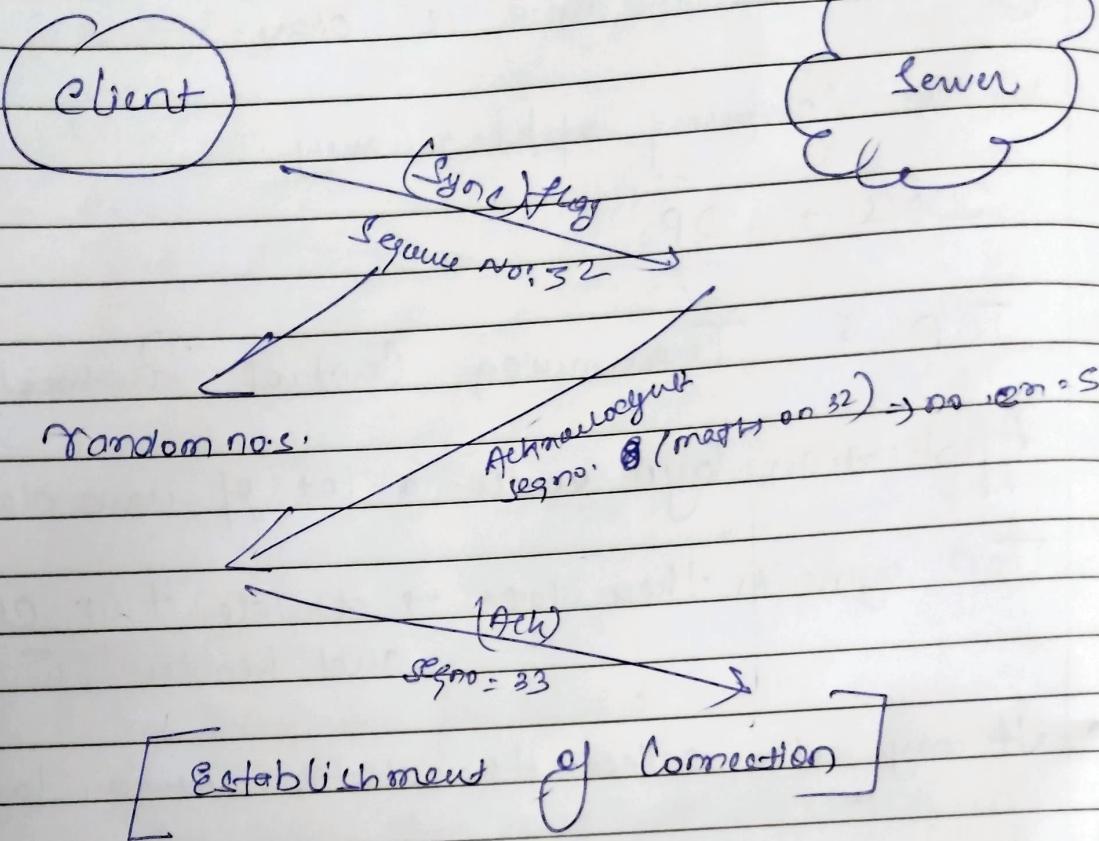
Take care of two things :

when data does not arrive / re-arrives or maintain the order of data.

- \* Connection Oriented.
  - \* Error Controlled.
  - \* Bidirectional :
- full duplex :



## 3-way hand shake :



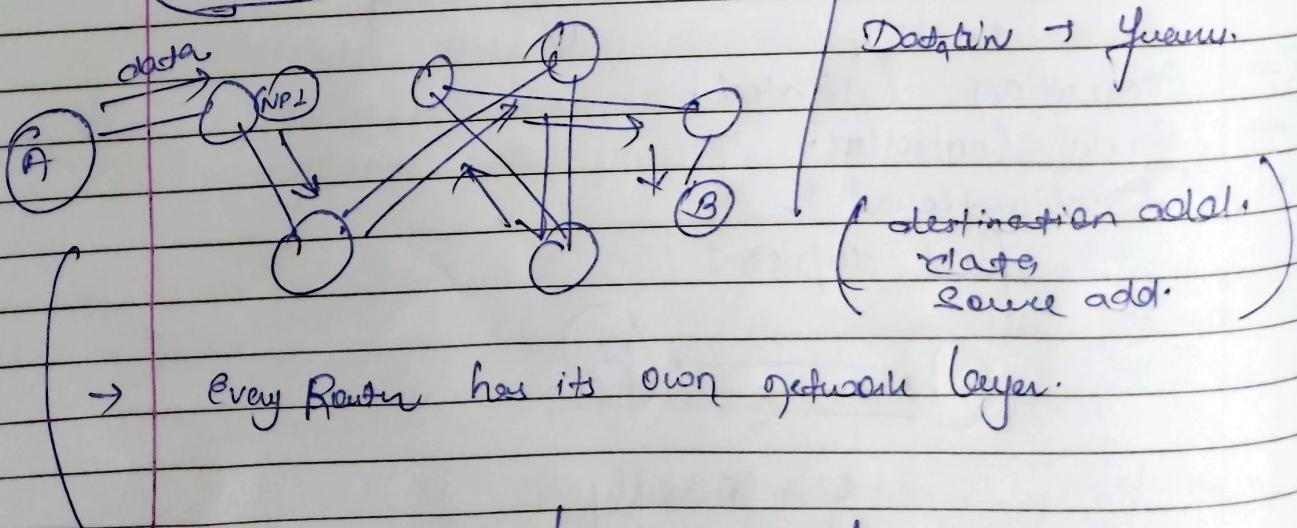
## ## TCP { Network layers }

Transport  $\rightarrow$  segments

Network  $\rightarrow$  packets

Data link  $\rightarrow$  frames

(destination add.  
data  
source add.)



$\rightarrow$  Every Router has its own network layer.

$\rightarrow$  Hop-by-hop forwarding of data.

Hopping neurons to neurons, until it reaches to correct router.