File Transfer Protocol

HTTP RFC, FTP RFC. RFC – Request for comments.

FTP – Port 21 – TCP protocol.

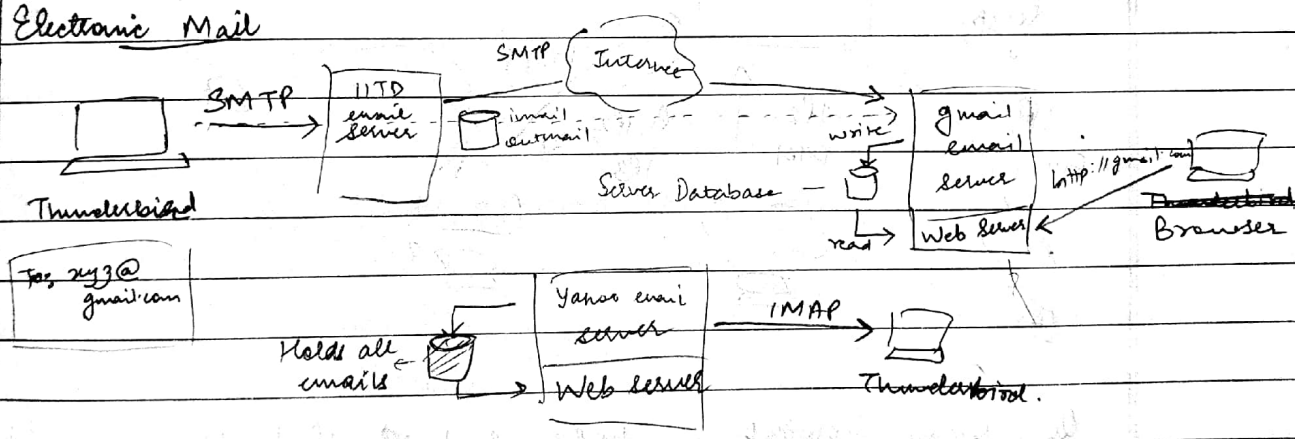
→ Separates control communication from data communication.

→ Client has to coordinate

→ File transfer at port 20.

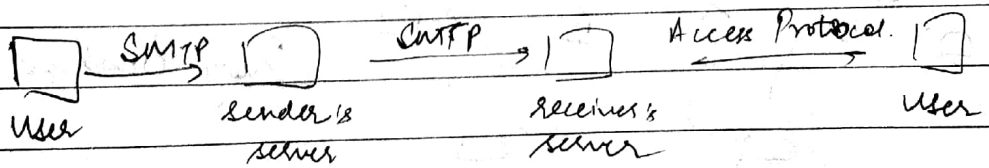
- FTP, HTTP – not secure
- https – encrypted – secure. Encrypts all traffic.
  - → Port 443, not 80.
  - → Within data – still HTTP – Everything encrypted
  - → Wireshark will not be able to know that HTTP was used.
  - → Browser however can see – decrypts everything.
- sftp – secure ftp.

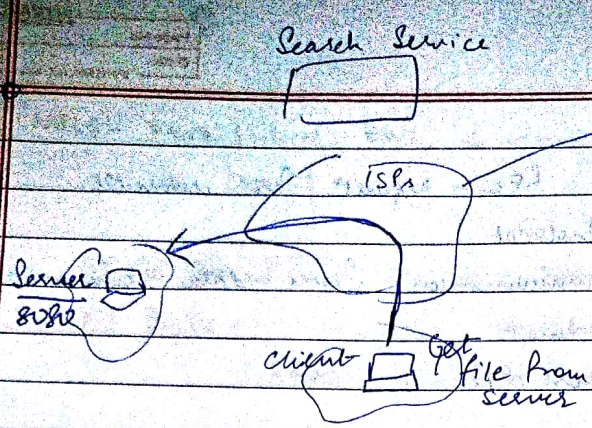
- Electronic Mail



SMTP: simple mail transfer protocol

- Read either via HTTP., or IMAP → talk directly with email server

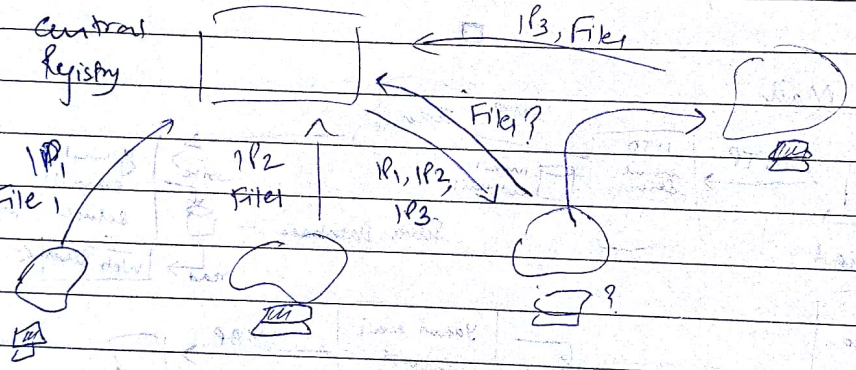




Peer-to-Peer

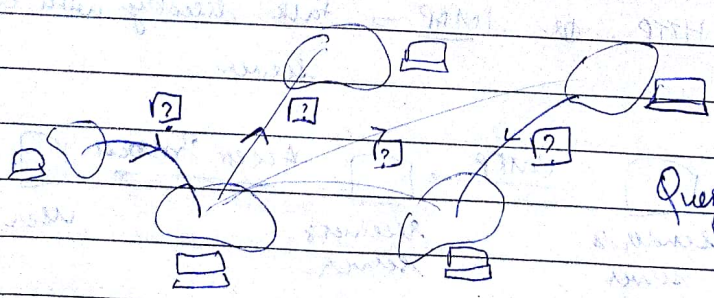
Search service to keep track of which files each peer has.

- Torrents - chunks of files.
  Get different parts of files from different servers.



On receiving content, nodes send IP & file name updates to registry.

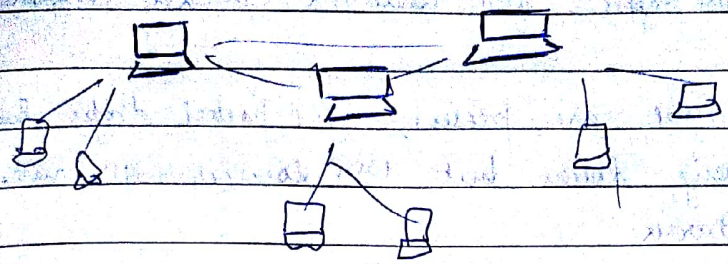
All



Query Broadcast Protocol.

Run queries directly to connected nodes.

Develop hierarchy → Supernodes → online a lot of time.



Peer-to-peer help utilise already-provisioned but under-utilized upload bandwidth

ISPs pay each other based on amt of traffic they carry for each other.

ISP friendly peer ~~selection~~ selection policies

Click Fraud

TCP – in-order delivery

DNS – UDP

Reliability ✓, in-order delivery, bandwidth guarantee, delay guarantee.

↓ ↓ ✗ ✗

TCP TCP (Queuing & Congestion)

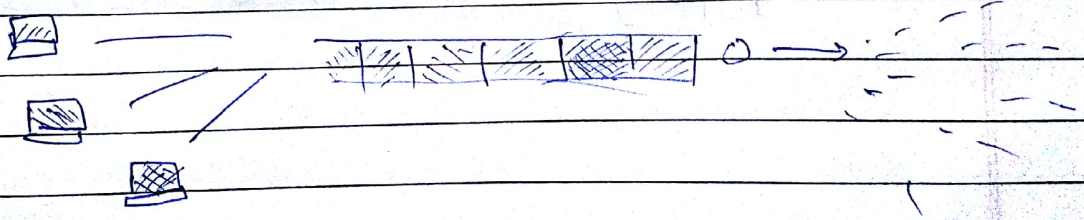
File transfer / email / web

Voice-over IP (VoIP) – 32-64 Kbps ✓ ? UDP

150 ms. ✓

Reliability ✗ 1% Packet loss is OK

- TCP helps avoid congestion → slows down on congestion



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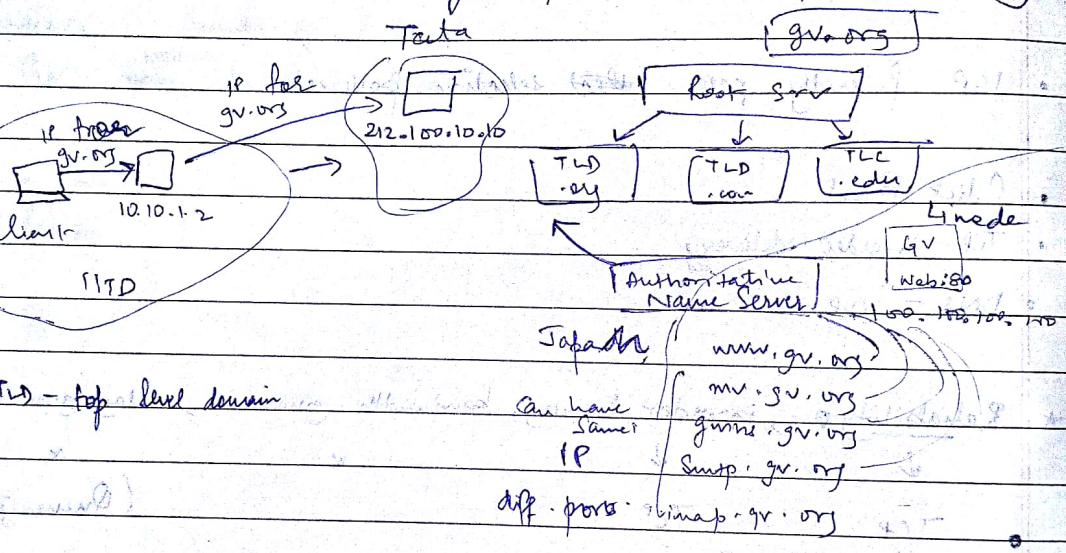
Congestion → Random Drop → higher prob. that node sending too much traffic will have its packets dropped.

→ If both TCP UDP are present, TCP packet drops lead to the source slowing down. but UDP sources will not. ∴ UDP floods the network
→ TCP starvation.

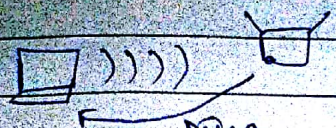
- DCCP - congestion control equivalent of UDP.
- DNS → Large database → leverages spacial & temporal locality



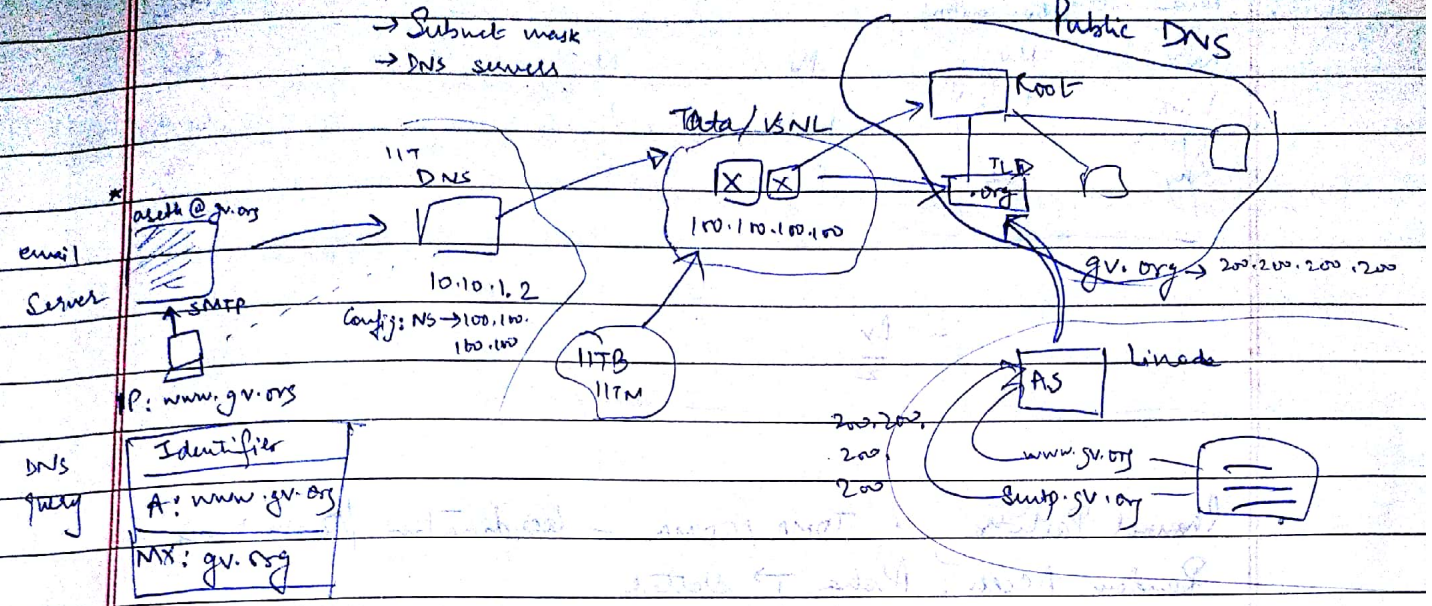
TLD - top level domain

Authoritative N.S. supplies TLD.org with ⇒
Auth. NS. for gv.org = 300.200.200.200. (It's own IP)

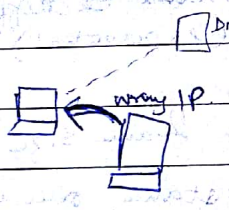
- Can cache data.
  Tata → TLD.org. Gaia
- LRU caching policy



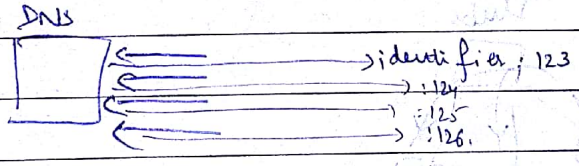
DHCP
→ IP addr.
→ Subnet mask
→ DNS servers



- DNS cache – Cache poisoning → Name servers reply with additional information



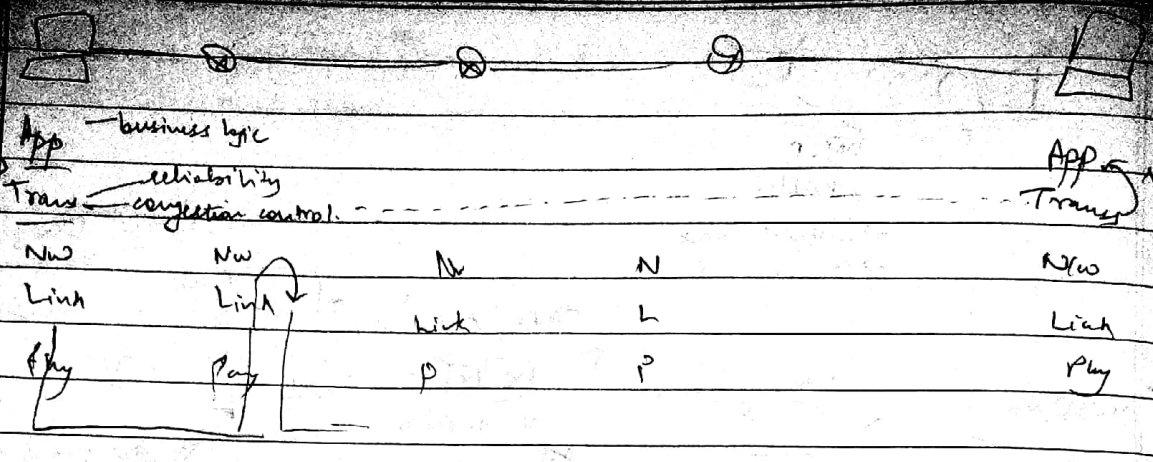
- Birthday attack – rapidly send lots of queries.



You can't sniff data, so don't know identifier. But send spoof replies with random identifier. One may eventually match some identifier.

$$\text{Prob} = 1 - \frac{65535 \times 65534 \times \cdots \times (65535 - n) \cdots}{65535^{2n}}$$ (n requests)] ~90% with just 700 request

- Clever DNS → Consider timing.



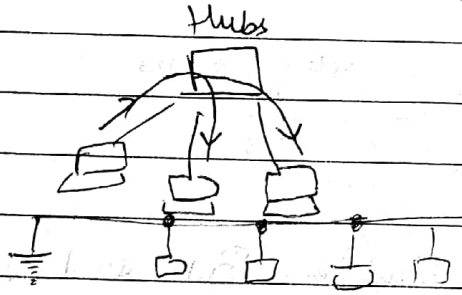
$$\alpha = \frac{fx}{2}$$

- Channel Partitioning : TDMA / FDMA — coordination / Data Phase
  Random Access : Aloha → slotted
  → unslotted

  CSMA

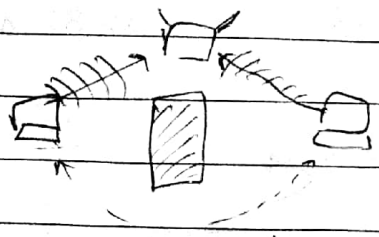
  CSMA/CD — Collision Detection — random backoff (exponential)

  17 in frame size
  ~ Distance over which the ethernet is laid out

- 

  Common bus — everybody listening & transmitting on same wire = wireless

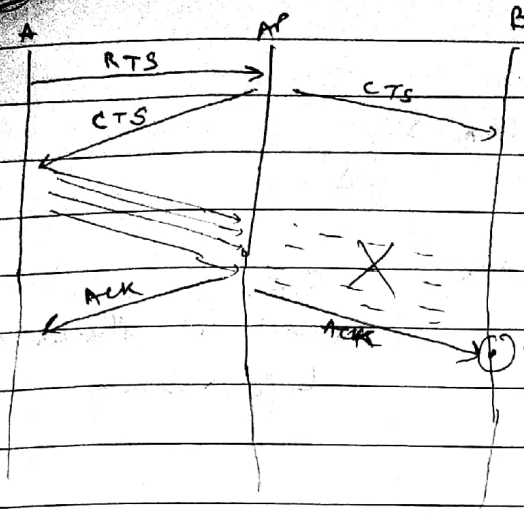
- Hidden Terminal problem in Wireless Networks.

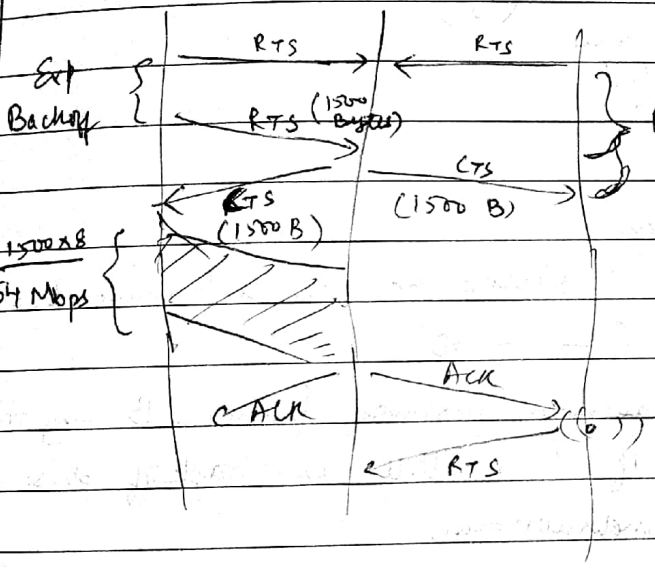


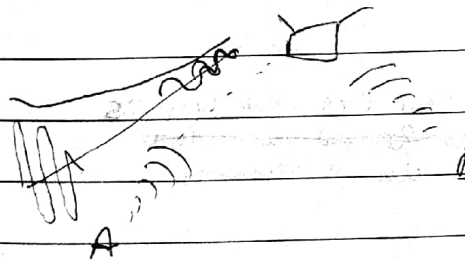
Interference happens at the receiver. Sensing happens locally.

cannot hear each other

Sub (CA) – Collision Avoidance.

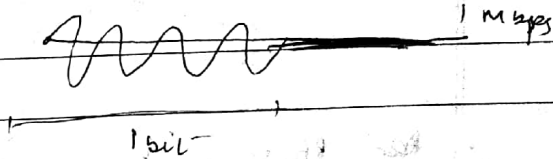


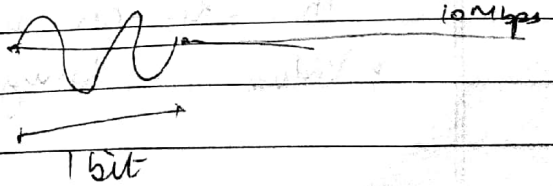


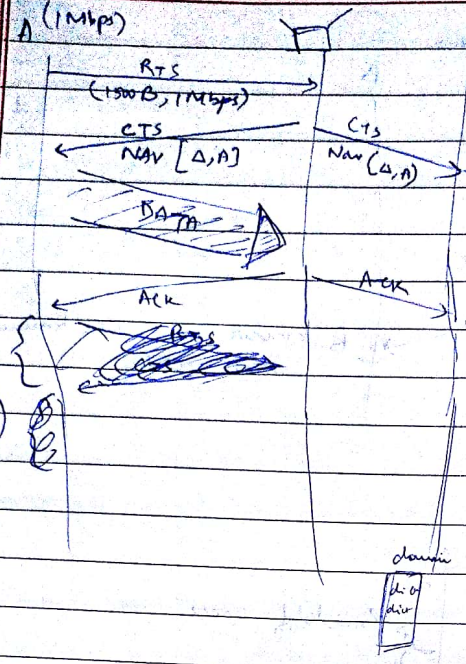


1 Mbps / 10 Mbps / 54 Mbps / 110 Mbps

2.4 GHz







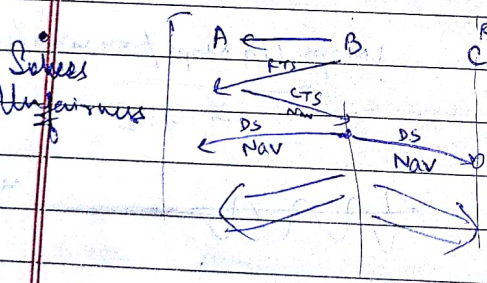
- Exposed terminal Problem

Ideally both B & C should be able to transmit depending

A ← B C → D

RTS-CTS will not even ~~guarantee~~ guarantee fairness. B may transmit again after transmitting if C is still in backoff phase.

→ No fairness + underutilisation.

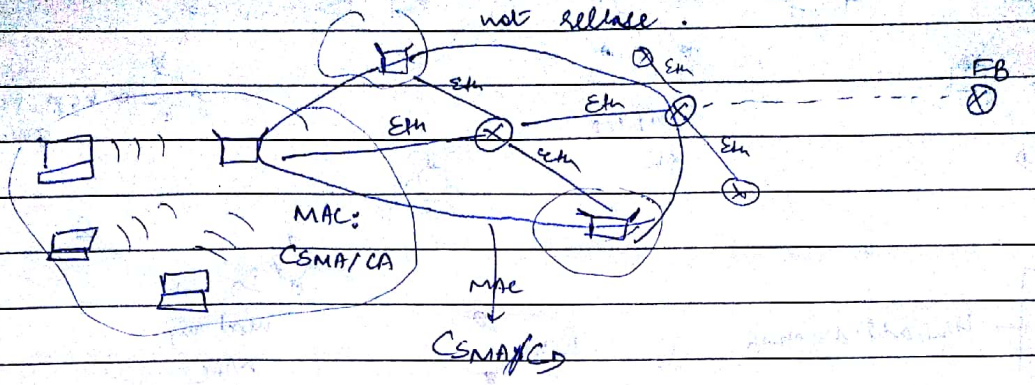


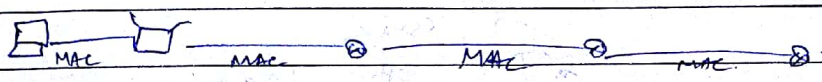
- ~~RRTS~~ RRTS → Request for Rep. to Send

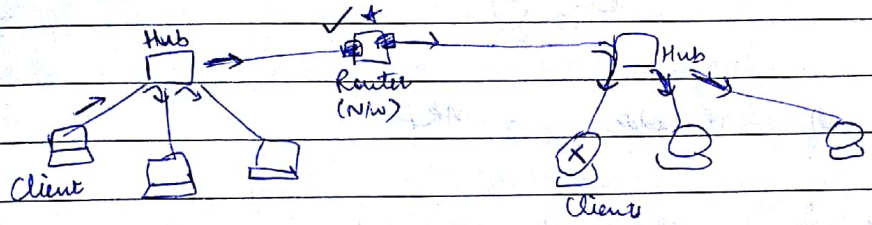
RRTS – RTS – CTS – DS – Data – Ack

- Vaduvur .. Bhargavan '94 [MACAW]

• Token ring disadvantage → malicious/buggy node can capture token & not release.







Eth - 1*. Is the frame meant for me?

• Eth & wifi → data goes to all nodes, need to answer - at high speed.

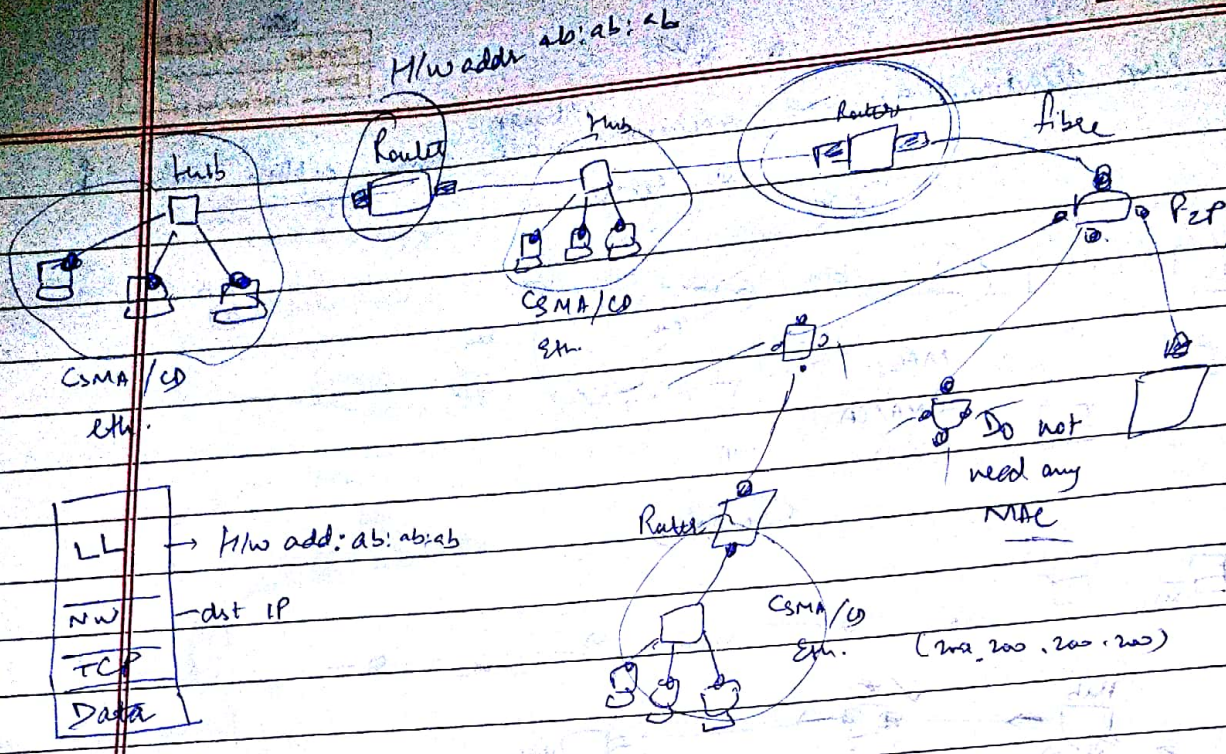
• IP address works at N/w layer.

For high speed → hardware implementation needed. But IP can keep changing.

• Need adapter to filter packets. Send only filtered set of packet up to n/w layer to reduce computation overhead.

Adapter : Hardware address of Ethernet card.

Adapters have a Hw addr (MAC address), built into the adapter. Does not change. IP addr changes depending on the n/w where you are plugged in.



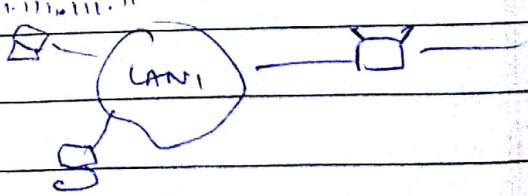
- H/w addr of IP addr → ARP

- Not every frame should be sent to n/w layer.
  H/w addr burnt onto adapter (or n/w card).
  Broadcast ~~MAC~~ address → all 1's.
- Default router → Gateway.
  DHCP server → IP address, IP addr of DNS server, Gateway IP addr.

~~LL puts H/w addr~~
IP addr of final destination but H/w addr of next immediate destination.
To find H/w addr, sender will send (FFF...) to network. All will receive but only ~~Router~~ immediate dest. will process it & reply with its H/w addr.
H/w addr query → ARP.

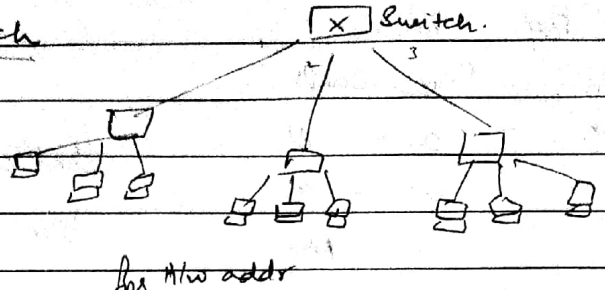
ARP → Mac addr + TTL (for storage in cache).

- DHCP server running in LAN1
  → will assign IP's for 111.111.111.*



DHCP client - server → Port no.

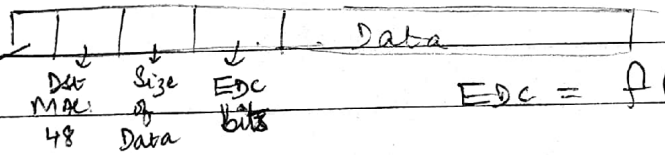
- Link Layer Switch



Switch → like router, but no administrative IP overhead.
→ self-learning → learn which h/w addr went to which branch.

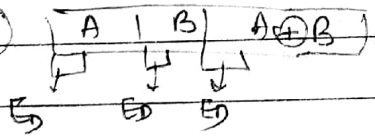
- Read - Spanning Tree Protocol.
- Wired - lesser bit errors Wireless → More } Bit error Rate
  More ← More freq. parity bits.
  overhead.
- Ethernet - LL can choose to retransmit if it knows there has been an error. If it chooses not to, TCP handles.
  Wifi - Retransmissions at LL using ack.
- Ethernet → Cyclic Redundancy Check → CRC.

- LL Header



EDC = f(Data)

- FEC



→ If receives notices error in only A, A = (A⊕B)⊕B

FEC - fwd error correction

Modulation

- Binary Amplitude Shift keying (BASK)
- Freq. Shift keying (BFSK)
- BPSK - Phase Shift.
- QPSK - 00 - 0°
  01 - 90°
  10 - 180°
  11 - 270°

Send info for 2 bits in 1 cycle Phase

- Encoding - Sychronize clocks using signal itself.