Broadcasting :

Broadcast sis generally also allow the possibility of addressing a packet to all destinations by using a special code in the addr field.

Point - to-Point :

n/w consists of many connections b/w individual pairs of machines.

{ geographically localized n/w → Broadcasting
  larger n/ws → Point-to-Point

- Point to Point transmission with one sender and one receiver → Unicasting.

Computer network: single technology.
collection of autonomous machines interconnected by a ; where data is transferred.

- to increase the processing speed (parallel speed)
- resource sharing (with one resource as printer this can be used by many comp[u]

Hardware network:

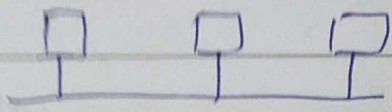
① **By the size:**

- PAN / CAN (Personal area n/w / control LAN)
  - Size: 1-10m
  - Ex: Tv remote, Bluetooth keyboard
- LAN (local area n/w)
  - Size: 10m - 1km (Building, room, campus)
- MAN (metro politican area n/w)
  - Size: upto 10km range (city)
- WAN (wide area n/w)
  - Size: 100km (country)
  - Ex: telephone n/w
- Internet
  - Collection of all n/w
  - Can be considered as WAN

② **By the topology:**

(i) Bus

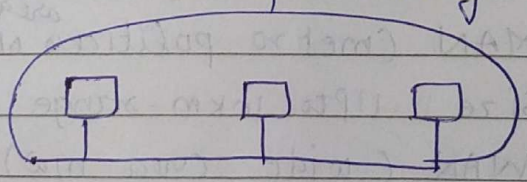
- common cable which having high capability compared to individual user's capabality.



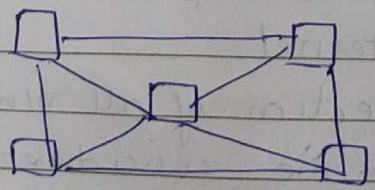
Advantages:
- Broadcasting is easy
- individual node is not important
- maintainice (if one node is not work properly, then it will never effect the complete n/w) (faults easily find)

Disad:
- depends on links (if link is break, it will effect the n/w)

(ii) Ring
- easy to maintain
- Broadcasting is easy
- if link is ~~break~~, then redundant path would be there
- Disad: processing speed

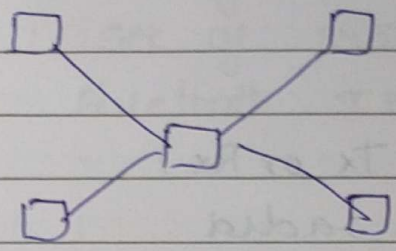


(iii) Mesh



- all computers are connected
- Same speed and High speed
- Secure bcoz directly connected
- Robust n/w
- maintainice is very difficult
- no. of links in mesh = $\frac{N(N-1)}{2}$

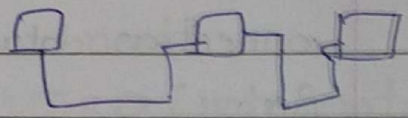
(iv) Star



- center device may or may not be comp.
- speed is also good as compared to Ring & Bus.
- no. of links = N
- maintainace is not that much dyfficult compared to mesh.

(v) Hybrid
- mixture of all topologies
- Ex: telephone n/w

- Dezi chain topology



(3) Connection type:
- wired
- wireless

(4) Communication type:
- Point to point
  - one to one
- Broadcast
  - one to many
- multicast
  - Broadcast to the selected group.

⑤ Communication Mode :

- Simplex
  - (either Tx or Rx)
  - ex: FM radio
- Half Duplex
  - at a time only one either Tx or Rx
- full Duplex
  - at a time both Tx & Rx
  - Ex: Mobile
  - extension of HD

⑥ Connection Service :

Connection less
- we don't fixed the connection blw Tx & Rx.
- wired & wireless may be connectionless or connection orientation.

Connection orientation (when we dial a no. connection link is fixed)
Ex: telephone

Computer n/w V/S Distributed n/w

- Aware about the backend
  - protocols used
  - Path
  - The server
- not transperent
- Ex: Bluetooth

- Not aware about the backend
  - protocols
  - paths
  - where it gets uploaded
- transperent
- Ex: gogle emails

WWW → world wide web

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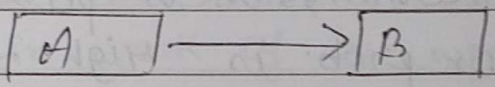
protocols : set of rules for communication
standard : set of protocols
Bluetooth IEEE 802.15.1

Network Software :

- protocols



- addr
- security
- formating
- cap. of B
- timing information
- presentation
- feedback
- Routing
- modulation
- dos (quality of service)

★ OSI (Open SIS interconnect)
- given by the ISO (International standard organisation)
- it's reference model

- OSI having 7 layers
- internet network (OSI model is not a nw

① Physical layer
- in bits only, converted the data into bits
- modulation
- coding & decoding (Codec)
- encription & description is intelligent task, which can't performed by the physical layer bcoz that's not intelligent
- conversion of voltage

- codec (coding can be NRZI, NRZ, RZ)

(2) Data link layer
- framing (bunch of bits)
- flow control (Tx & Rx are synchronized)
- error control (error correction & detection)
  - error correction, when Higher cap. of re-transmission is possible.
  - error prob. is High → correction
    " " " low → Detection

- Own Data link header & tailer, which is extra part of information saved, not the actual part of data.
- MAC (medium access control)
- MAC addr is provided
- MAC addr is unique & 48 bits
- MAC addr is also called as physical addr.

(3) network layer
- Routing
  (n no of diff paths would there b/w Tx & Rx, in which path data is transferred)
- QOS (BW, How much is required)
- Packets (10-15 frames)
- NW header (N_H)
- it provide the IP addr (internet protocols)
- IP is also called as Logical

- 32-bit IPV4
- 128 bit IPV6

(4) Transport layer
- end-to-end data delivery
- flow & error control
  - for error & flow control, data link helps the transport layer.
  - main work of transport layer is the error & flow control.
- packets are converted into the segments.
- having ower Header (TH)

(5) Session layer
- deal with timing

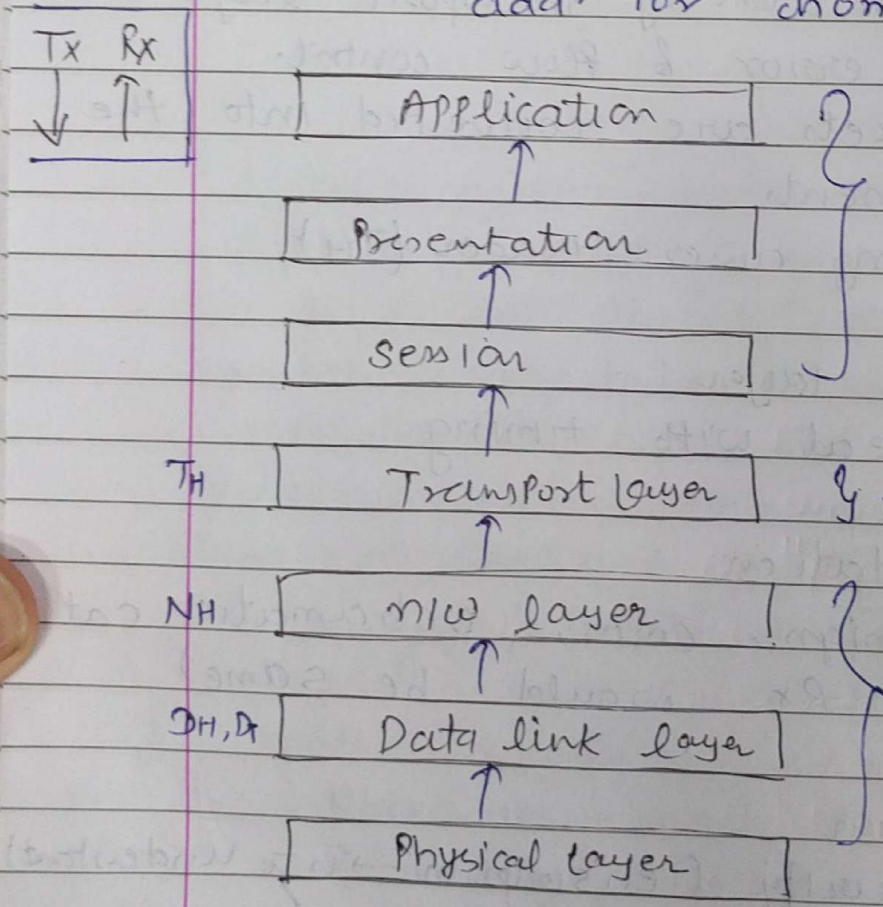
(6) presentation
- Design, color, schamatic cat (Tx & Rx would be same)

(7) Application
- security (ensuription → is to understand)
- Password
- Searching
- log in / out
- Port addr of 16-bit

- MAC addr & - Unique addr
  - used for local area
  - 48-bit

- IP add^r & To access the internet. diff^r path blw Tx & Rx, many ~~no of~~ diff^r IP add^r would there.
- Path Port add^r & is based on application.

Ex: for computer mac add^r is unique, having diff^r Port & IP add^r
i.e. add^r for firefox
add^r for chrome



↳ - bridge blw user and n/w

Ex:- If a message which is transmit
A b c * + ε f _
By app. layer (menage GUI
presentation (seen the formating and take care the formating)
session (dealing with time)

device itself take care

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transport: divide into segment and add the TH

| TH | A b C * | | TH | + E F- |

n/w : divide into packets and TH is also data for the n/w layer and add the NH

| NH | TH A b | | NH | C * | | NH | TH + E | | NH | F- |

Data link layer: divide into the frames and add the DT & DH

| DH | NH TH | DT | | DH | A b | DT | | DH | NH C | DT |

physical layer: then data convert into the bits.

- every header having a specific addr which are required in the communication
- every layer only understand their own header and tailer.
-

DH NH TH DT DH Ab DT

NH TH Ab data link

↓

TH Ab n/w layer

↓

Ab transport layer

- Data link and transport layer is take care about the error. If data is with error, then these layer detect and/or correct the data and then transmit the data. By these layer error data is discarded and retransmitting the data or correction of data is done.
- every device (i.e. router) having all the layer present.

point to point (device to device)

- there is a dedicate line b/w the Tx & Rx.
  - Trans Tx ⟶ Trans Rx
  - N/w Tx ⟶ N/w Rx

layer to layer is "peer to peer" comm^n transport Tx layer is communicate with the transport layer of Rx.

⇒ TCP/IP : or → Transmission Control Protocol

Application layer	(combine of App, Presentation, session)
Transport layer	(transport layer)
IP layer	(n/w layer)
Host-to-n/w	(combine of Physical & Data link)

Host to n/w layer is not control the flow and error control.

Ex:- A Group of friends wants to create their own n/w with the help of OSI ref. model. They want to communicate with one another in the area of 20 m radius. They don't want to access internet and only want to send text messages. suggest Topology, mode of comm^n & the layers of OSI model they should use.

Ans.

Topology : Mesh (By using this S/S would be complexity)

Mode of Comm^n : ~~Half~~ Full Duplex

OSI layers : Except the n/w layer all layers are required.

Connection type : ~~wired~~ / wireless (becoz we want to used in mobile Phone)

- wired → Ring / Bus topology
- wireless → TDM (Mesh)
  FDM, CDMA (Star)

Ans~~:~~ wired / wireless → Star / Point to Point and half duplex

layer : Physical layer, Data or transport layer, Presentation(is not required if keyboard) & Application layer

menage is sent

- In mesh topology, we don't required the Routerbcoz every Phone or device is point to point connected.
- wireless is without wire, ~~but~~ and at a particular freq. data is transmit by the wireless connection.

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chp-2 Physical layer

Transmission Medium:

- Wired (Guided)
- Wireless (Unguided) - air

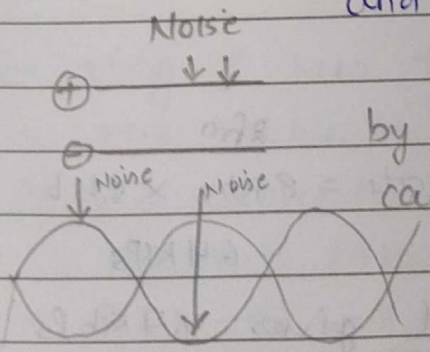
- as the Physical layer peer to peer is also same as point to point.

- Wired Transmission line
  - Twisted Pair Cable
  - Co-axial Cable
  - fiber optic Cable

(A)
- telephone
- ethernet

Twisted Cable:

BW is dependent on thickness of wire and distance travels.



by making twisted, noise will cancelled out.

distance of 1 inch twist-1 → " category-1"
twist-2 → " " -2"

Upto 7 Possible

- in telephone 2 Pairs
- in ethernet 4 Pairs

(a) UTP
- Unsheibled twisted Pair
- always 2 Pairs are ~~alwa~~ there.
- In one pair one is Plastic covering cable & second one is carrying data.
- categories of UTP :

Category	BW	Speed (Mbps)	Digital / Analog	Use
1	Very low	< 100 KBPS	Analog	telephone
2	< 2 MHz	2	Ana / Digl.	T-1 lines
3	16 MHz	10	D	LANs
4	20 MHz	20	D	"
5	100 MHz	100 MbPs	D	"
6	200 MHz	200	D	"
7	600 MHz	600	D	"

(b) STP
- Sheilded twist Pair
- more immune to noise
- used by IBM

- PCM

Voice → 4 KHz

Sampling rate = 8 KHz × 8 bt (2fm)
= 64 KBPS

1 PCM channel gives 64 KbPs speed

T_1 = 24 × PCM → channel in india
= 24 × 64 KbPs =

$T_2 = 4T_1$

$T_3 = 7T_2$

$T_4 = 6T_3$

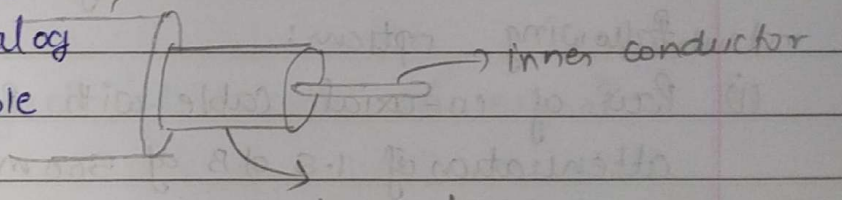
E_1 having 32 channels in Europe

RJ-45 female or male connector are used.
↳ register jacks
NIC → n/w interfacing card

- 3 dB attenuation is tolerable
for removed the attenuation in
analog → Amplifier are used
Digital → Repeater

→ (thickness of the cable) is more
- low gauge → thick cable → less attenuation
- UTP (Analog & Digital both)
- low gauge → thickness of cable more → attenuation less

(B) Coaxial cable :-
- 50Ω cable, for digital Tx
- 75Ω cable, for analog transmission and cable television.
- cable television → ring & bus topology



- this cable is not used for networking.
- BW capacity is Higher as compared to twisted cable (as same cost) & noise immunity is more.
- RG → radio govt.

Category	Impedence	Use
RG-59	5Ω	Cable TV
RG-58	50Ω	Thin ethernet
RG-11	50Ω	Thick "

- BNC connector is used

BNC-T connector

(c) fiber-cable
- principal - TIR
- propagation mode
  - Multimode
  - Single mode
- SC connector
  ↳ subscribed channel
- latency And Delay
- magnetic media is Powerful but not used bcoz of latency & reliability.

Qo Two parties A & B are located 10 Km apart. Both want to transfer data of 10 GB per day. with following options:

(i) Pair of co-axial cable with BW of 200 MbPs with attenuation of 1.5 dB of 500 m → one time cost 50 Rs. Per 10 m

(ii) A fiber cable with the end point data rate 750 MbPs attenuation 0.01 dB/Km → 1 time cost 500 Rs Per 1 meter.

(iii) A Box of DVD which has 10 DVDs of 1 GB capacity each. 1 time cost 15 Rs/DVD and has 45 min. of average time to travel b/w two parties. find out cost per bit and amplifier requirement and suggest your choice.

Ao

	Cost Per bit	time of comm.	Bit rate
DVD	150 ~~GB~~	45 x 60 = ___	10GB/45x60
coaxial	50K		200MbPs

↳ Preferred bcoz cost is less

fiber	50L	750 MbPs

Chp-3

practically 200Mbps ⟶ speed in one direction → coaxial

750Mbps ⟶ speed in both direction → fiber

So far duplex communication; 2 200 Mbps coaxial cable is required.

Definition:
- Noise
- Distortion
- Attenuation
- Latency

Parameters
- Through Put (bps)
- Bit rate (bps)
- channel capacity (bps)

Noise: not generated by the source ⟶ addition of some external elements.

Distortion: effect of noise on signal.

Attenuation: occurs because of increase in distance b/w source and sink.
- decrease in power and amplitude of a signal.

$10 \log(P_2/P_1) = \alpha$

Through Put: System output

Bit rate: bit per unit time

$$\text{Bit rate} = 2 \times BW \times \log_2 L$$ → nyquist

BW ⟶ max. frequency

$\log_2 L$ ⟶ levels of quantisation

↑ coding scheme

Bit rate depends upon: - Bandwidth
- levels of quantisation
- System of coding

- channel capacity = BW × $\log_2(1+SNR)$ → shannon's

channel capacity → achievable capacity
Bit rate → max. bit rate → can't be actually covered.

Q. With a channel of 1MHz BW, the SNR is given as 63. find out the appropriate bit rate and no. of levels.

Ans: SNR = 63 , BW = 1MHz

channel capacity = BW × $\log_2(1+SNR)$
= $10^6 \times \log_2(2^6)$
= 6 MbPs

Bit rate = $2 \times BW \times \log_2 L$
∴ 6Mbps = $2 \times 1MHz \log_2 L$
$L = 8$

* ThroughPut — maximum o/p possible → s/s bit rate

Bit rate → max. Possible bit rate / capacity → can't be achieved.

channel capacity — achievable bit rate / capacity

Channel bit rate — channel capacity & through Put can be same.

If end points are slower, then throughput < channel capacity

latency : "Parts"

1. Propagation delay = $\frac{\text{Distance}}{\text{speed of signal}}$

(in case of fibre, speed = speed of light)

→ max. time taken by 1 bit

2. Transmission delay = $\frac{\text{size of message}}{\text{BW of cable}}$

- total time taken to transmit the data.
- achievable time to send whole data.

3. Queueing delay
- the amount of time taken by data in buffer while in queue.

4. Processing delay
Time taken in modulation, removing of noise, quantization etc.

Ex: A file of 12 Mbytes is to be transmitted. A n/w with BW of 10 MbPs. can pass only an average of 12000 frames of 1000 bytes per min

(i) throughput of the n/w

(ii) what will be propagation delay if the distance b/w TX & Rx is 1000 and propagation speed is 10×10^7 m/s in the cable.

(iii) if queuing time is 2 ms then assuming the processing time as zero, what will be the latency?

Sol:

(i) channel capacity = 10 MbPs

Throughput = $\frac{12000}{60} \times 1000$ bytes/sec

= 0.2 MbPs

(ii) propagation delay = $\frac{\text{distance}}{\text{speed}} = \frac{1000 \text{ m}}{10 \times 10^7 \text{ m/sec}}$

= 100 μsec

(iii) latency = transmission = $\frac{\text{Msg. BW}}{\text{throughput}}$

= $\frac{12 \text{ Mbyte}}{0.2 \text{ Mbyte/sec}}$

= $\frac{60 \text{ sec}}{1 \text{ min}}$

Latency ≅ tran

High speed Digital Access:

DSL, cable modem and SONET

- separate cables are used for data and voice, bcoz of 4K filter are used in cable for transmitting the voice signal so we can't used that cable for Tx the data.

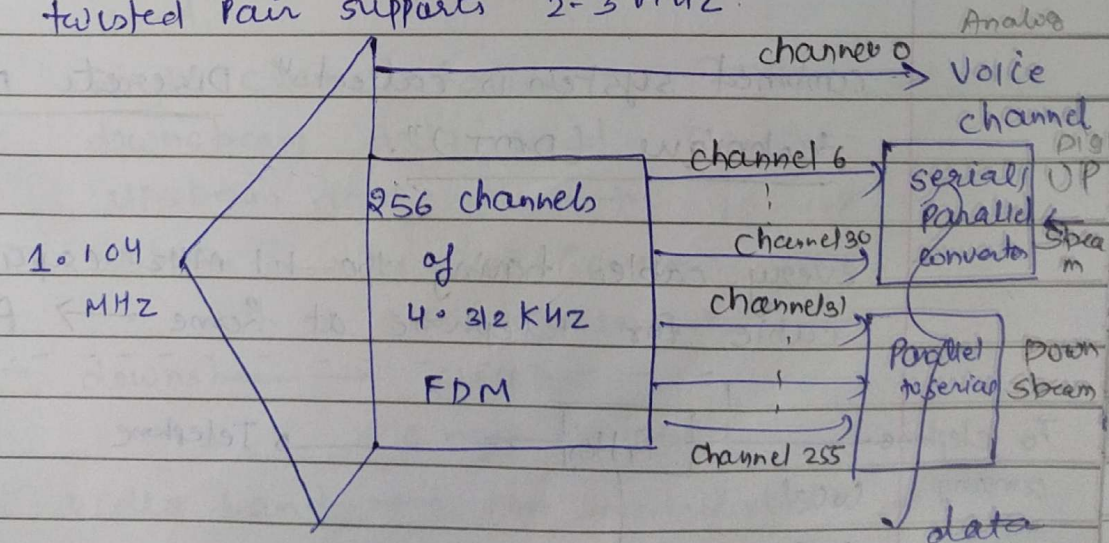
ADSL:

asymmetric digital subscriber line or link

- its suitable for residential user, not for the businesses.

Asymmetric → Upload and download speed is not same for same user.

- existing liner are we used
- existing local loops can handle B.W upto 1.1MHz.
- twisted pair supports 2-3 MHz



channel - 0 → voice comm^n

channel 1 to 5 → are not used / separation data

6 to 30 → upstream data

31 to 255 → downstream data

- every channel used QAM
- channel - 6 to 30 are using | 15 bits/baud QAM |
- for upstream data

  25-channels

  • 1 is used for control

  • and 24 → 24 × 4K × 15 = 1.44 Mbps

  practically 500 to 600 Kbps are achieved

- for Downstream data

  225 channels

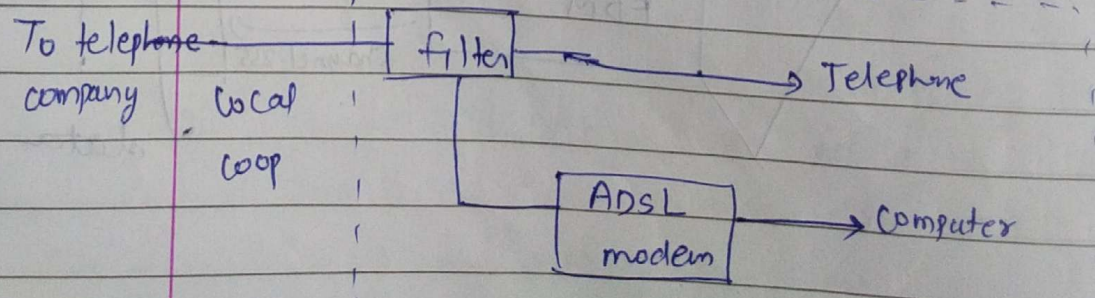
  • 1 is for control

  • and 224 → 224 × 4000 × 15 = 13 Mbps

combined system is called "Discrete multi tone technique (DMT)".

- every cable having the 1.1 MHz capacity.

cable for telephone at home → ADSL



DSLAM → Digital sub line access multiplexing (reverse of fig. 1)

- more speed → less distance

technology	Downstream	Upstream	distance	twisted	Line code
ADSL	1.5-6.1 Mbps	16-640 Kbps	12,000	1	DMT
HDSL	1.5-2 Mbps	1.5-2.0 Mbps	12,000	2	2 BIQ
SDSL	768 Kbps	768 Kbps	12,000	1	2 BIQ

↳ symmetric DSL

Cable modem :

- Cable TV n/w is Unidirectional.
- To make this bi-directional, ampr must be modified.
- By using fiber cable → "Bidirectional"
- in future ~~future~~ fibers (FTH) to Home technique is used.
- single channel having the 7MHz capacity.
- downstream data used 64-QAM
- upstream data rate → 12 Mbps
- Upstream → 64 QPSK (6 MHz)

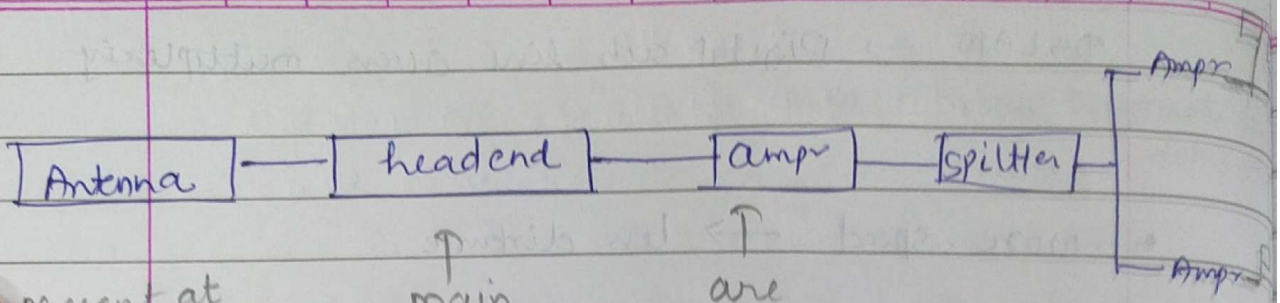
  6 MHz × 2 = 12 Mbps
- downstream → 64 QAM

  6 × 5 = 30 Mbps

Video band → AM modulated

Upstream & downstream → Digital

video, guard



present at service provider

main office

are Unidirectional

Wireless Commn :

- Ground propagation (below 2MHz)
  - Sky " (2 to 30 MHz)
  - LOS " (UP to 30 MHz)

Radio & mw | infrared

3KHz | 300GHz | 400THz

used for multicast commn such as radio and television

Unicast commn such as cellular telephone, satellite mw and wireless LANs.

used for short range commn in closed area using LOS propagation

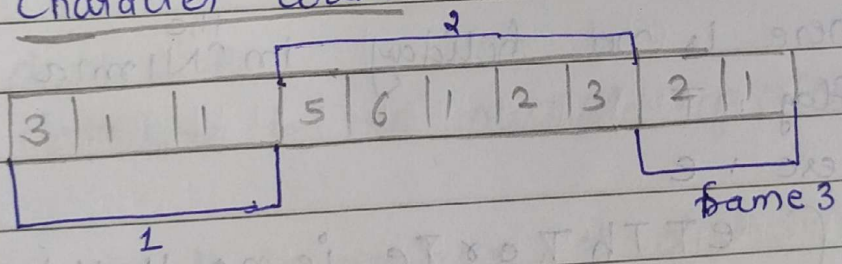
Chp-3 Data link

Data link
- framing (added to DH & DT) — Chp-3
- flow control
- error control
- MAC Addr (Chp-4,5)

Framing :

SOF (start of frame) & EOF (end of frame)

- blw two consecutive data, provide or sent break to identify the SOF & EOF.
- Character count



- first represent the size of data or char.
  - → size (data size is equal to the extra char)
  - → error (If one bit error is there, the whole data transmitted is wrong or with error)
  - → Wastage of header (If 3 then 2 bit (max size of header must be provided)

header is required, if we given the fixed header size, then if data is less as 3 then only we required 2 bit but we have set 10 bit so 8 bit is (wasted)

⇒ (A) Character stuffing :
- By using flag

F - EOF → flag

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Chp-3 **Data link**

Data link
- framing (added to DH & DT) } chp3
- flow control
- error control
- MAC Addr (chp-4,5)

Framing :

SOF (start of frame) & EOF (end of frame)

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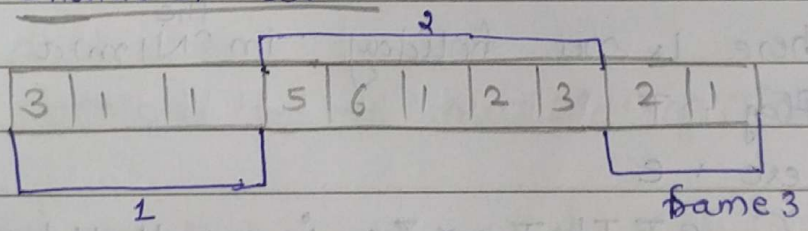

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header is required, if we given the fixed header size, then if data is less as 3 then only we required 2 bit but we have set 10 bit so 8 bit is wasted)

⇒ (A) Character stuffing :
- By using flag

e → SOF - EOF → flag

ABC → eABCe

→ etreee → tr (at Rx end)
(if flag is equal to the data then problem will occurs)

- tree

esc-f
flag-e

etrfefee

*(when esc is in (tree) data then add esc)
*(when flag = data then add the esc char)

- fine bee

effinfetrfefe e

finetree

Ex: There is no holiday in the ^Nirma

{ flag : T
esc : e

-

flag-e
esc-e

eTThTerTe is no Holiday in the Nirmae

There is no holiday in the Nirma

flag-T
esc-e

Te Theeree is no holiday in ethee NirmaT

There is no holiday in the Nirma

- we are adding the 'e' → byte
so data of size is increases or very large.

- adding the extra char in data is called

- when flag = data and esc same as data, then add the esc char in the data.

the "character stuffing."

Ex: flag - 1101
esc - 1001

(i) 1010 1101 1001 1111 0110 1101 1001

1101 1010 1001 1101 1001 1001 1111 0110 1001 1101 1001 1001 1101

(ii) 1011 1011 0110 0011 1001

its not possible, bcoz data is not multiple of flag.

* ~~if~~ data & flag bit size must be same
- data is the multiple of flag.size.

Problem in char stuffing
- data size
- data size is the multiple of flag
- overall transmission of data size is 7 ses in char stuffing.

⇒ (B) Bit stuffing :

F = 01111110

data = 01111110 01111110

Tx : 01111110 01111101001111101001 01111110
flag flag

consecutive 5 1s came Rx, we added 0 and then continous transmitted our signal.

Rx 01111110 01111110

if data = 0111110
then also Tx: 0 F 01111100F
boz at Rx side, 0 is removed after getting 5 consecutive Ones.

Destuff the following:

① flag - 1001 Escape - 0110
(char/byte stuffing)

1001 0110 1001 0110 0110 0110 1001 1111 1001

1001 0110 1001 1100 1111

② 01111110 01111110 10011111 01111110 01111110

(bit stuffing)

01111110100111111 11111

- flags — flow
  — error

- protocol - set of rules - rules are made of diff^{r} techniques

protocol

flow:

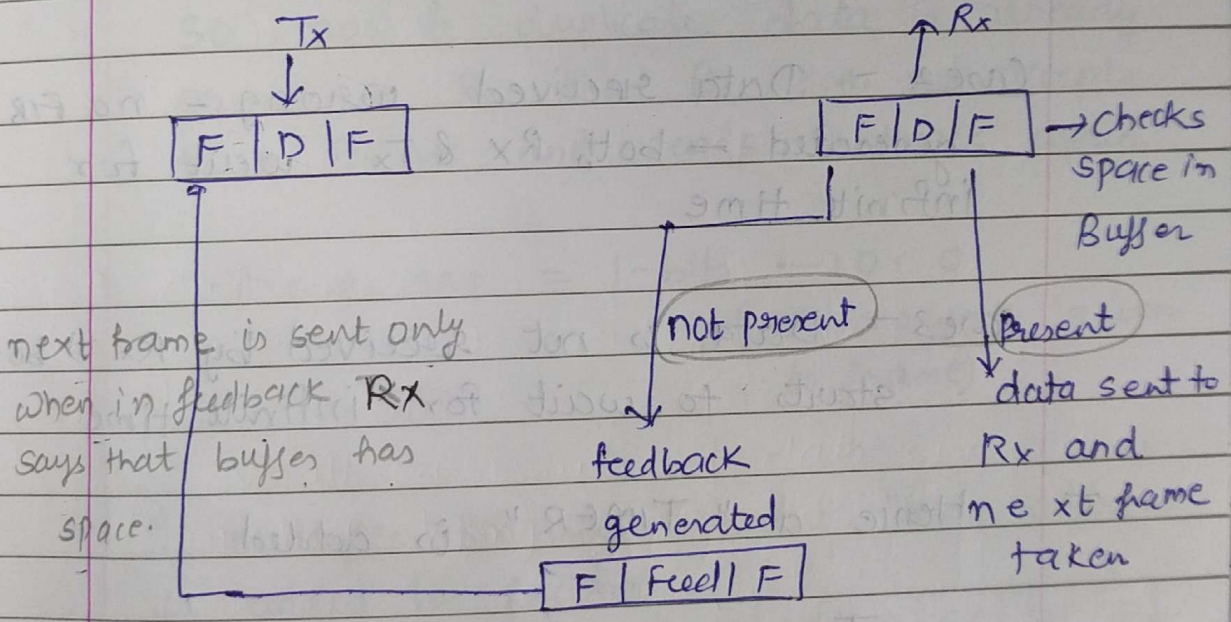
Assumption — ① Simplex comm^{n}
② Infinite buffer size
③ No noise/error

(A) protocol 1 — Simplex unrestricted

↓Tx ↑Rx

F | D | F ⟶ F | D | R

- This is not possible as infinite buffers is not possible.
- So, finite buffer present
  ⇒ if Tx speed < Rx speed → no problem
  " " " > " " → comm^n fails
- when comm^n failure may occur then Rx has to send feedback to Tx that it is unable to get data sent ⇒ Simplex comm^n assumption is dropped.



→ error Possible:
① Data frame changes
② No data received
③ No feedback received

- error correcting code is added at Tx and at Rx side error correcting code is computed to check data is error less or not.

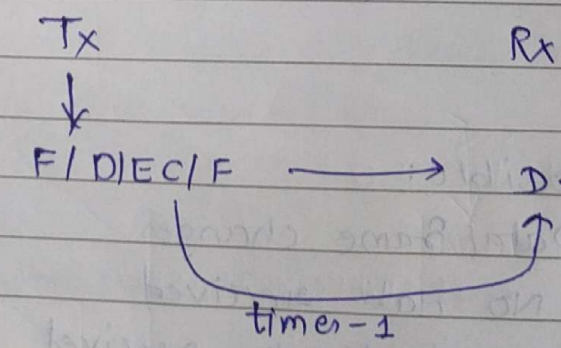
- The same is alone with feedback – Rx adds EC code.
- Case 1 – Rx sends feedback when ready and when not ready. So here 2 feedback signals are to be sent. So instead feedback sent only when Rx is ready.

Possibility of F/B not received at Tx so both waits → even if data received is correct at Rx.

Case 2 – Data received wrong – no F/B generated – both Rx & Tx wait for infinite time

Case 3 – Data is not received by Rx ⇒ both starts to wait for infinite time.

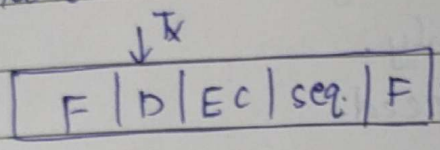
– Hence a "TIMER" is added



- Tx waits for some time as set, if feedback not received then Tx sends the same data again.
- Now, if feedback received is wrong or gets lost then Tx sends the same

data again even if Rx has received data 1st time correctly ⇒ duplication of data occurs at Rx as it receives same data twice.

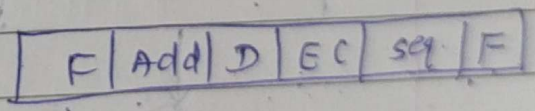
- Hence "Sequence Number" is added in frame.



So, now if duplicate data is already present in Rx then Rx does not accepts that frame and sends feedback again.

Size of seq = 1-bit → 1 or 0
(alternatively given to frame)

- If multiples Rx are present then address is added to frame.



- Now, in feedback frame - address, seq no is also added.
- Each Rx may work with different times or all the receivers work with same times.

- EC — tells us something is wrong and not 'what' is wrong.

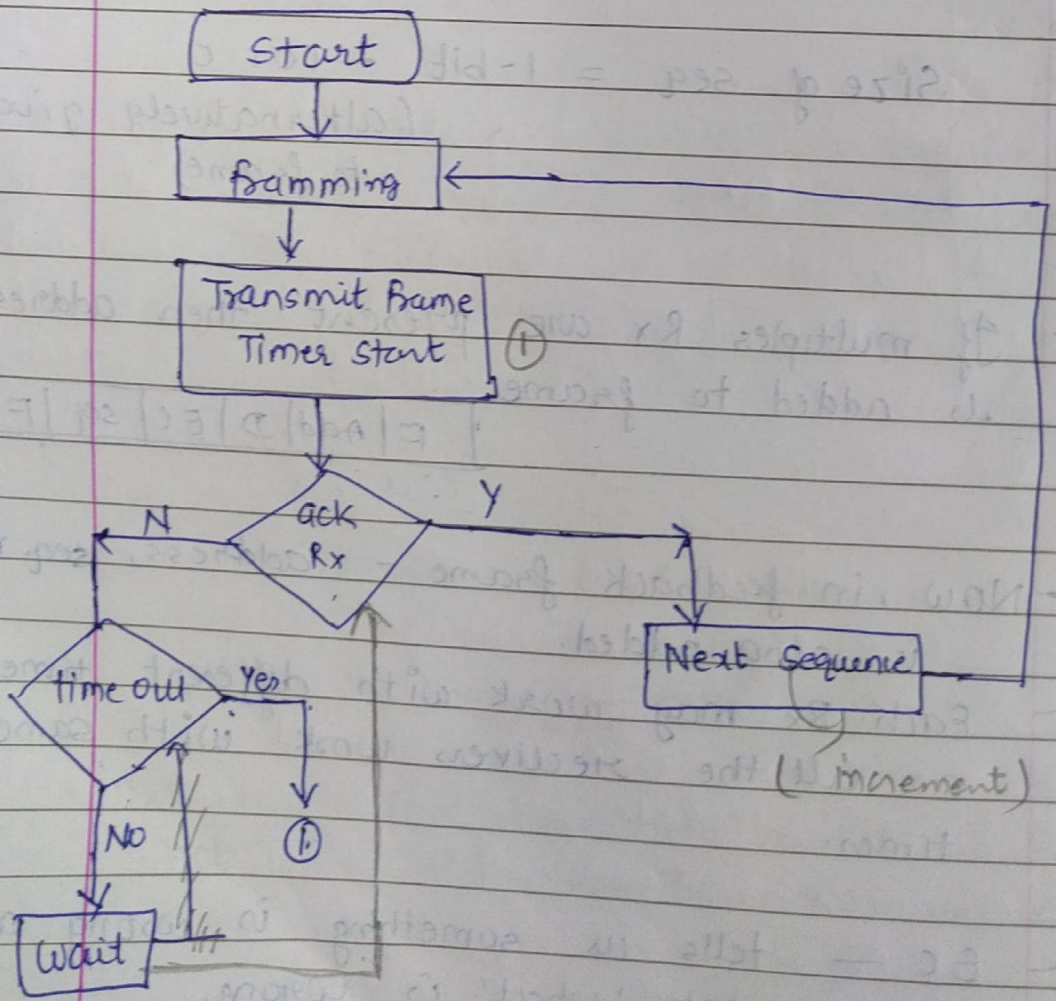
- EC code is chosen depending upon the protocol used.

- This protocole is used in Bluetooth
- It is called as "stop and wait Protocol"
- Here, only 1 frame is Tx and Rx and next frame is only sent when data is received properly.
- Slow data speed.

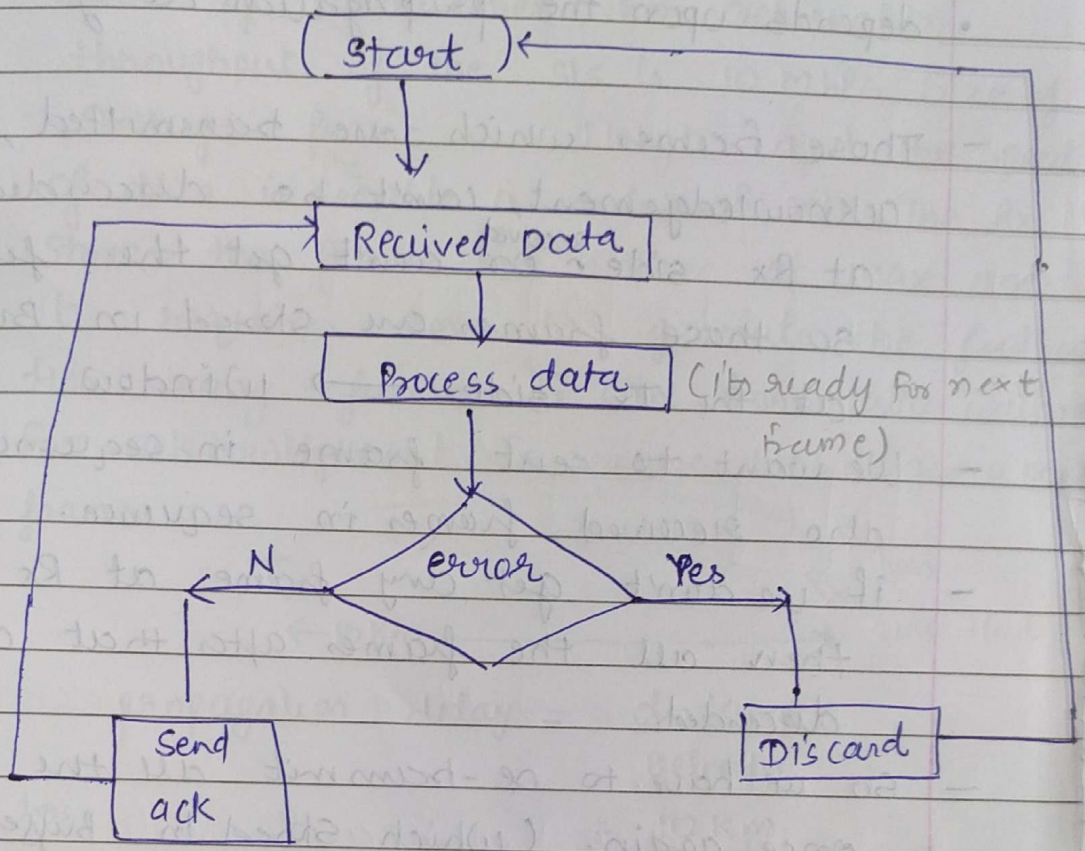
⇒ STOP & wait ARQ

Flow chart: (ARQ) → automatic repeat request

Transmitter



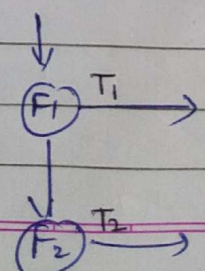
Receiver



Process data :
- Data De-frame
- check error
- frame is ready or not

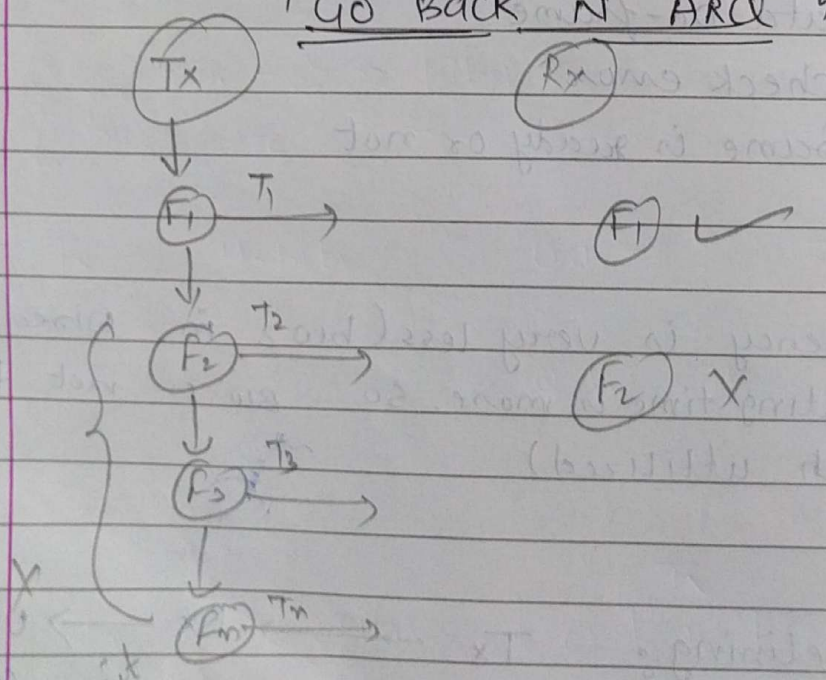
Drawback :
- efficiency is very less (bcoz in wired comm^n waiting time is more, so BW is not that much utilized)

(B) Pipelining : Tx ⟶ Rx ⟶ Upper layer (sequence)



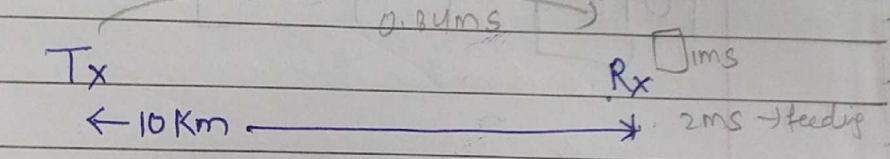
- without waiting for acknowledgement
- depends upon the propagation delay

- Those frames which are transmitted, without acknowledgement, can't be discarded, till at Rx side Received or can't get the feedback so those frames are stored in Buffer at the Tx side ⟶ Window
- We want to sent frame in sequence and also received frames in sequence.
- if we don't get any frame at Rx in sequence then all the frames after that all are discarded.
- So we have to re-transmit all the frames once again. (which stored in Buffer ⟶ so Keep Buffer size as small as possible)
- 4 GO BACK N ARQ 4



Ex: Two communicating computer are 10 km aparts of each other. The achievable throughput of the S/S is 10 MbPs. Size of average frame is 1Kbyte and the speed of data in the cable is 2.4×10^8 m/s. The Rx stores the frame for 1 msec at max and it requires 2ms to generate the feedback How many frames Tx can transmit w/o waiting for acknowldgement. Tx require 1 ms to gen a new frame.

Sol:



$$\text{propagation delay} = \frac{\text{distance}}{\text{velocity}}$$

$$= \frac{10\ \text{km}}{2.4 \times 10^8}$$

$$= 41\ \mu\text{sec} = 0.04\ \text{ms}$$

$$\text{Transmission delay} = \frac{1000 \times 8}{10 \times 10^6} = \frac{\text{data size}}{BW}$$

$$= 0.8\ \text{ms}$$

$$1\ \text{ms} + 2\ \text{ms} + (0.8\ \text{ms} + 0.04\ \text{ms}) + 0.84\ \text{ms}$$

$$= 4.68\ \text{ms}$$

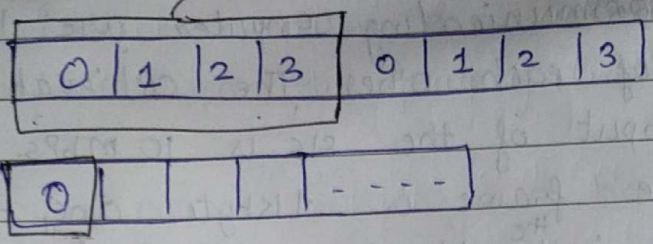
5 → frames

"Pipelining"

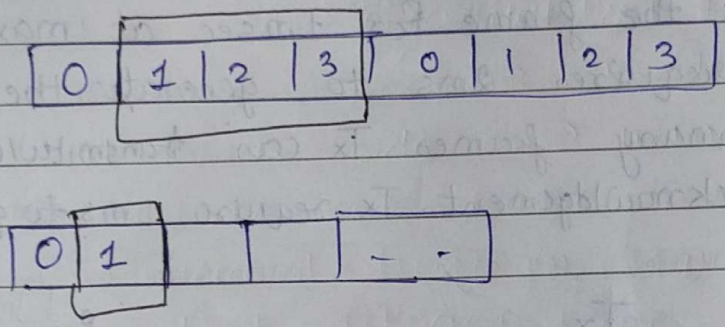
To store the frame at Tx side → Buffers → window

Sliding window

(i)



(ii)



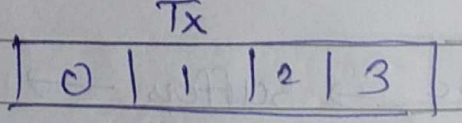
Window is slidding, when acknowledgement is getting.

- so it's also known as "Sliding window"

{ seq. no. ⟶ n-bits
buffer size

- Tx 4-bits 0,1,2 -- 15 ⟶ 16 frames can stored
0,1,2 -- 14 ⟶ 15 frames are true

-

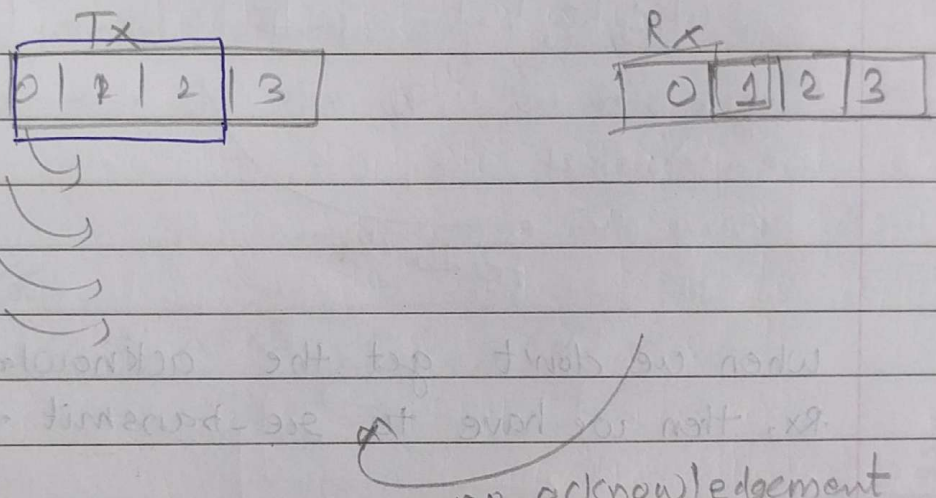


Tx window $(2^n - 1)$

n ⟶ no. of bit

Rx window = 1

Tx window size is $(2^n - 1)$ choosen bcoz when Rx is not acknowledge the frames to the Tx then, Tx re-sent all the frames. So Rx take it as new frame, not as repeated one. So Tx window in size is kept 1 less than 2^n.



1-Aug

Ex: A station uses 4-bits to indicate the frame no. If a single frame requires 2 ms of time to be receive at Rx. what is the worst case time to receive all the frame saved in transmitting window if they are to be re-transmitted once.

Sol:

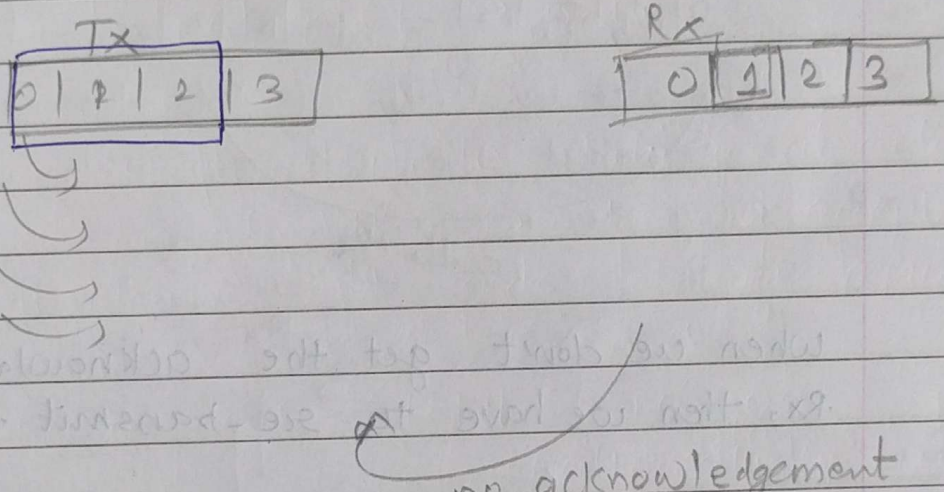
n = 4-bits

15 frames

Tx $\xrightarrow{30\text{ ms}}$ (15)

$\xrightarrow{30\text{ ms}}$

Tx window size is $(2^n - 1)$ choosen bcoz when Rx is not acknowledge the frames to the Tx then, Tx re-sent all the frames. So Rx take it as new frame, not as repeated one. So Tx window is size is kept 1 less than 2^n.



1-Aug

Ex: A station uses 4-bits to indicate the frame no. If a single frame requires 2 ms of time to be receive at Rx. what is the worst case time to receive all the frame saved in transmitting window if they are to be re-transmitted once.

Sol:

n = 4-bits

15 frames

Tx $\xrightarrow{30\text{ ms}}$ (5)

$\xrightarrow{30\text{ ms}}$

time out = 30ms

30 + 30 = 60 ms

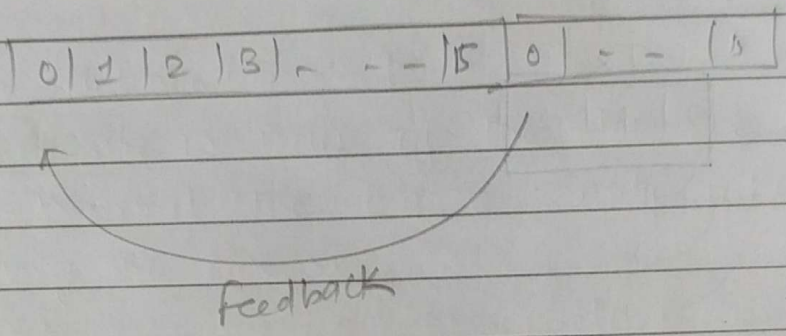
(i)

To remove the frams from the Tx buffer

= 60 ms + 30 ms

= 90 ms

(ii)

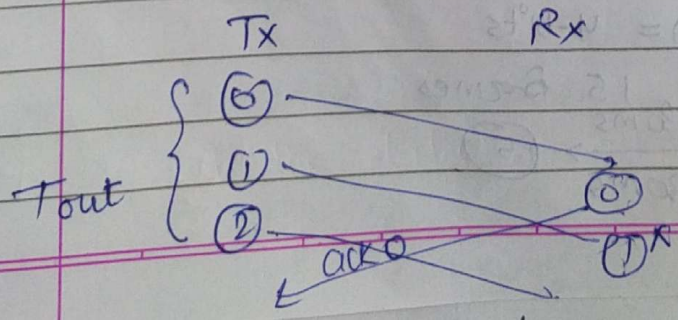


When we don't get the acknowledgement from Rx, then we have to re-transmit the frame

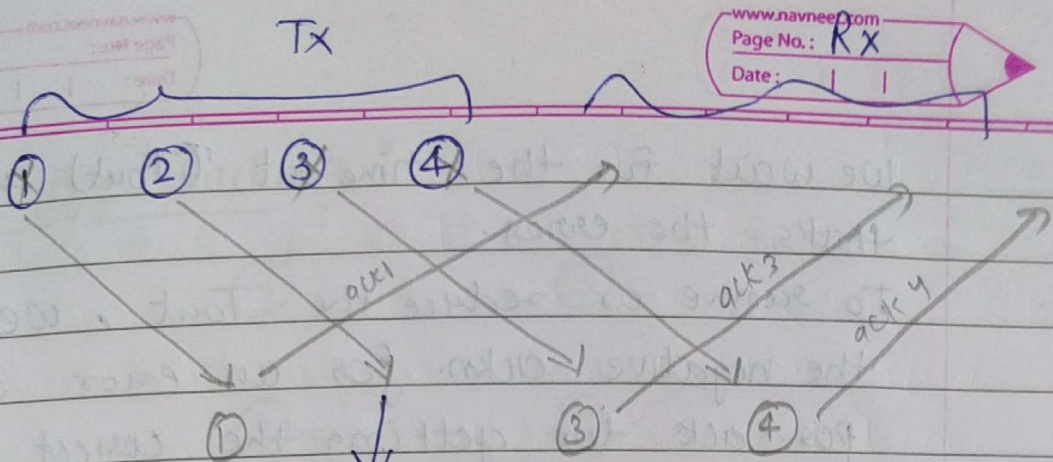
- worst case (frame 1) and best case (frame 15) times are same.
- when we don't get the acknow. of the frame-15 and we want to re transmit the frame-15 only then

30ms + 28 ms + 2ms

- 30ms : all frame-15 are sent
- 28 ms : waiting for ack. of all the frame till 14
- 2ms : re-transmit the 15-frame



Page No.: Date: / /



we don't get the frame-2

before the time out, we can find the error in any frame.

- Tx window size = $2^m - 1$
  Rx " " = 1

- Rx

Tx

~~0 1~~

| 0 | 1 | 2 | 3 |

| 0 | 1 | 2 | 3 |

| 0 | 1 | 2 |

| 3 | 0 | 1 |

$2^n - 1$

If 0 is not ackn., then we have to re-transmit the frame 0, previous one. But at Rx we get next frame

(c) Selective Repeat

Tx

| 0 | 1 | 2 | 3 |

| 0 | 1 | 2 | 3 |

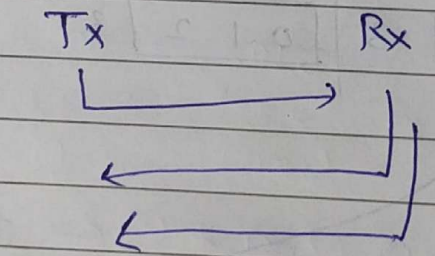
Rx

| 0 | 1 | 2 | 3 |

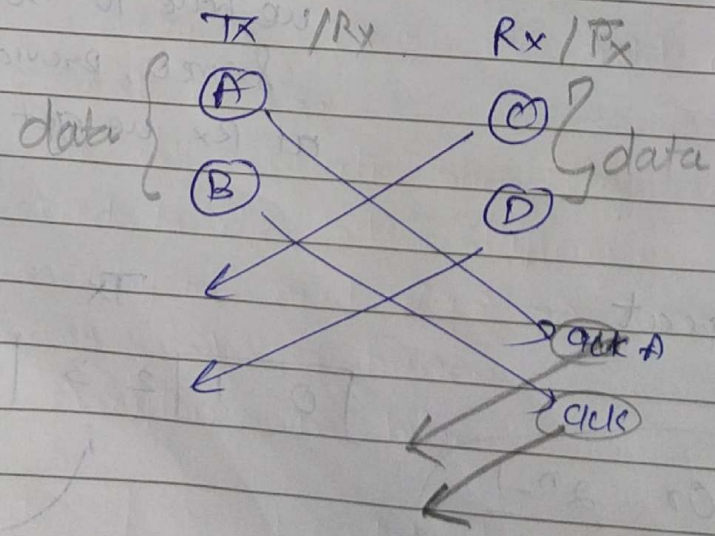
$2^n - 1$ Or $\frac{2^n - 1}{2}$

We wait for the time out (Tout) time, that's the error.
To remove or reduce the Tout, we feedback the negative ackn. for an error and pos. ack for getting the correct frame.
So Here's new concept of neg. ack from the Rx in the Pictue.

- neg. acknowldgement
- Buffer size is Half of the ~~data size~~ previous size
- re-transmit the frame, only which are having the errors.

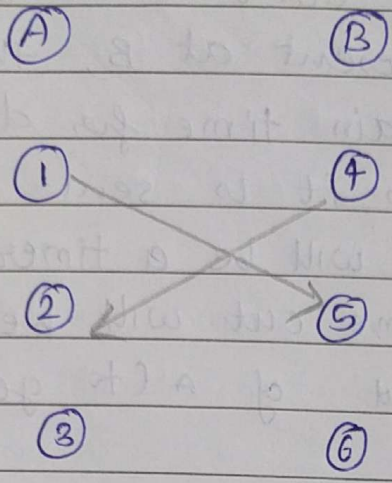


Both working as Tx & Rx



Sent the data, acknowldgement

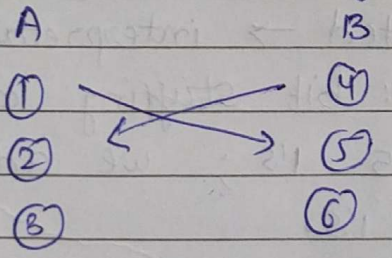
"piggy-backing"



We have transmit the frame-3 (data) and generate the ack for 4

011 } — and A transmit the combine
100 } of both.

When A & B both works as Rx & Tx
→ then should data & ack by A or B should be in diff frames or same?



received at this time i.e. when 5 is Tx by B

So, now A has a data to be sent and also ack ⇒ ack is generated and A sees whether any data is left to be transmitted any data is left to be transmitted or not. If data is left then data & ack are combined and sent to B.

This protocol is called "Piggy backing"

- Now if only ack is to be sent and no data is present at B, then ack waits for a certain time for data to get combined and then it is sent.
  ⇒ There will be a timer at B (Rx) also whose time out will be less than the time out of A (to get ack).

8-Aug

IBM → made first protocol and gave the name SDLC (Syn. datalink control Protocol)

- ANSI (ADCCP)
- ISO (HDLC)
- CCIIT (LAR)

(D) HDLC → High Data Link Control Protocol

- Bit oriented → interpretation done using bits
- Advantage: bit stuffing can be used → after every 5 1's; we add 0 so as to prevent 6 1's.
- To differentiate blw flag and data, we need to do bit stuffing.
  Why we need flag? → for start of frame and end of frame.
- everything in bits.

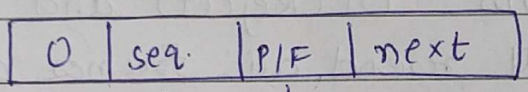
Flag	Addr	control	Data	CRC / Fcs	Flag
8	8	8	⇒0	16	8

CRC → cyclic redundancy check

HDLC is the combination of three techniques
- Stop and wait
- Go back to ARQ
- Selective repeat

Three types of control frames:

(i) I - information
- when first bit of control is 0.

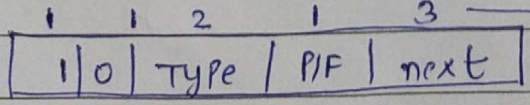


3-bit sequential number

P/F → Pole & final
- if F=0, the Receiver would understand that it's possibly the last frame.
- If P=1, it means those trasmitter want to transmit the data. However server decides through which it shall send the data

next → acknowledgement sent in the form of no. of the next frame, saying send me this frame.

(ii) S - Supervisory frame
- for supervising the comm^n



2 bits → 4 possibilities
- connection managment

Generate at the receiver's side

00 – receiver ready

01 – Reject → if frame has errors or it does not want to receive.

10 – Reciver is not ready for the next frame

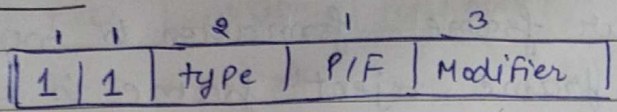
11 – Reject frames written in 'Next' has to be resend ⇒ Selective Reject.

- Difference b/w 01 (Reject) and 11 (Reject)

01 → it will resend all frames after the no. mentioned in 'Next'

11 → selective reject → it will only resend the frame whose no. is written in 'next'.

(11) U-frame :



- Un-numbered frame
- does not have any acknowldgement
- no data is present
- Only used for control Purpose

$2 + 3 = 5 \longrightarrow \underline{32}$

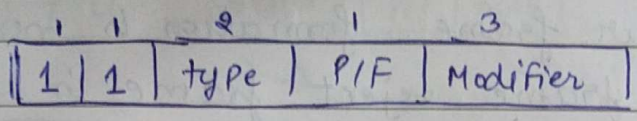
i) DISC
- Discontinous comm^n

ii) SNRM (set nomal response mode) / SNRME (Extented)
- continous to comm^n

(HDLL, ADLLD)

SABME iii) SABM (set asynchronous balanced mode)
- if frame is transfered to a particular computer
- we assume the previous transfered frame
- we don't have start to the intial 0' frame.

(III) U-frame :



- Un-numbered frame
- does not have any acknowldgement
- no data is present
- Only used for control Purpose

2 + 3 = 5 ⟶ 32

i) DISC
- Discontinous comm^n

ii) SNRM (set nomal response mode) // Extend SNRME
- continous to comm^n

(HDLL, ADLLD)

SABME iii) SABM (set asynchronous balanced mode)
- if frame is transfered to a particular computer
- we assume the previous transfered frame
- we don't have start to the intial 'O' frame.

(iv) FRMR (frame reject frame)

- if our frame formation is not proper than frame reject frame is used.

- A ⟶ B — (frame)

| F | Add | control | Data | CRC | F |

It does not have flag data

- after removing data frame becomes of 24-bit so, if the formation of frame is not proper than this command is used. So, in this command in which there is frame (data) of same type so Tx can know where is the error.

Ex°:- Add^{r} A: 11011011
B: 00011001

i) A has received frame NO. 1 from B and sending frame 7 to B

ii) A is not ready for communication & last Received frame is 6.

Sol°:

Flag	Addr	Control		Data	CRC	Flag
01111110	00011001 (addr of B)	0111	P/F 010			

010 → 2 has send after Receiving 1 By A

Block addr of frame which (jisko send krna hai)

7 has send to B

I-frame

0	seq.	P/F	next

(iv) FRMr (frame reject frame)

- if our frame formation is not proper than frame reject frame is used.

- A ⟶ B — frame

F	Add	control	Data	CRC	F

↑ It does not have flag data

- after removing data frame becomes of 24-bit so, if the formation of frame is not proper than this command is used. So, in this command in which there is frame (data) of same type so Tx can know where is the error.

Ex:- Addr A: 11011011
B: 00011001

i) A has received frame No. 1 from B and sending frame 7 to B

ii) A is not ready for communication & last Received frame is 6.

Sol:- Flag Addr Control

01111110 00011001 0111 P/F 010 Data CRC Flag

(addr of B)

(block addr of frame ~~whic~~ jisko send krna hai)

7 has send to B

2 has send after Receiving 1 By A

I-frame

0	seq.	P/F	next

(ii) S-frame → (control)

1 0	type	P/F / next

→ 111 (6 is Rx and ready)

10 → Rx is not ready

flag	Addr	control	Data	CRC	F

01111110 11011011 1010 P/F 111 Data CRC F

Ex: Data : 110 111 00 11110

CRC : XXXX

(iii) 01111110 11011011 1011 P/F 110 XXXX 01111110

- flag is removed
- → Addr of A

S-frame

10 11 P/F 110

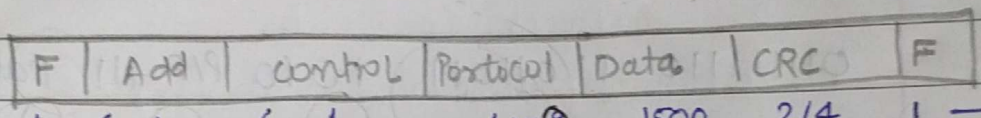
S-frame — selective reject — next 6 frame means till 5 frame is send

- B send to A
- S-frame / selective Reject

(E) Point to Point Protocol :

- used for Point-to-Point Commn
- router to router, Dialup Commn → applic
  using mesh topology

- application of PPP
  - Router to Router
  - Home user ISP
- Byte orientation (char stuffing)
- flag and escape both are used in this frame.
  flag = 01111110



bcoz of Point to Point

11111111 → broadcast

00000000 → self addr

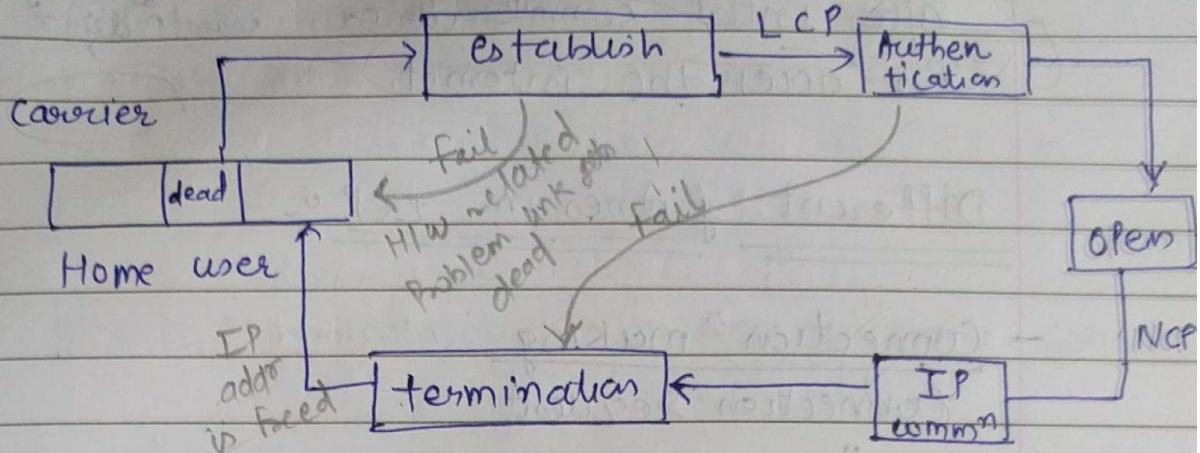
Compatible with other protocols [00000011]

- in Data → default size is 1500 byte
  LCP, NCP } does not send any data, but it transmit the protocols
  (for analogy or example if HDLC Protocol is sent through the PPP → then in Data, HDLC Protocol are there)

- defaults size of protocol → 2 byte
  in protocol we only indicate the either LCP or NCP Protocol is sent into the Data.

- We can change the size of Data & protocol & CRC.
- default size of CRC is 2 bytes

- LCP → link control protocol } two diff Protocols
- NCP → network " Procedure
-



- internet service provider, provide the IP addr for the comm^n. In dialup comm^n always diff^r IP addr is provided by the service provide to complete the connection.
- Once service provider, provide the IP addr to user, than link is established. else connection fails.
- if both parties are agreed ~~by~~ by LCP Authentication is there. either it fails and comm^n is not done. But there physical connection is there but both parties are not ready can't communicate each other.
- NCP & LCP are only used for negosiation and provide the IP addr.

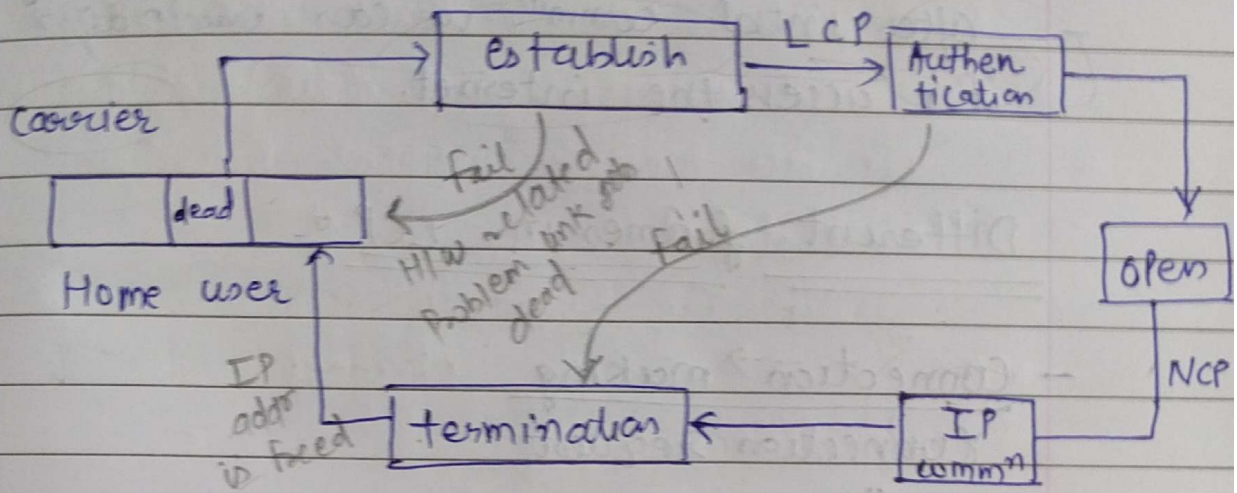
For initial comm^n

- for handshaking in the PPP, then LCP is used. and for getting the IP addr, NCP is used.

In starting

After that once comm^n is established then we can used any protocol to transmit the data

- LCP → link control protocol } two diff Protocols
- NCP → networ " Procedure



- internet service provider, provide the IP addr for the comm^n. In dialup comm^n always diff^t IP addr is provided by the service provide to complete the connection.
- Once service provider, provide the IP addr to user, than link is established. else connection fails.
- if both parties are agreed ~~by~~ by LCP Authentication is there. either it fails and comm^n is not done. But there physical connection is there but both parties are not ready can't communicate each other.
- NCP & LCP are only used for negosiation and provide the IP addr.

For initial comm^n

- { for handshaking in the PPP, then LCP is used. and for getting the IP addr,

- LCP → link control protocol } two diff Protocols
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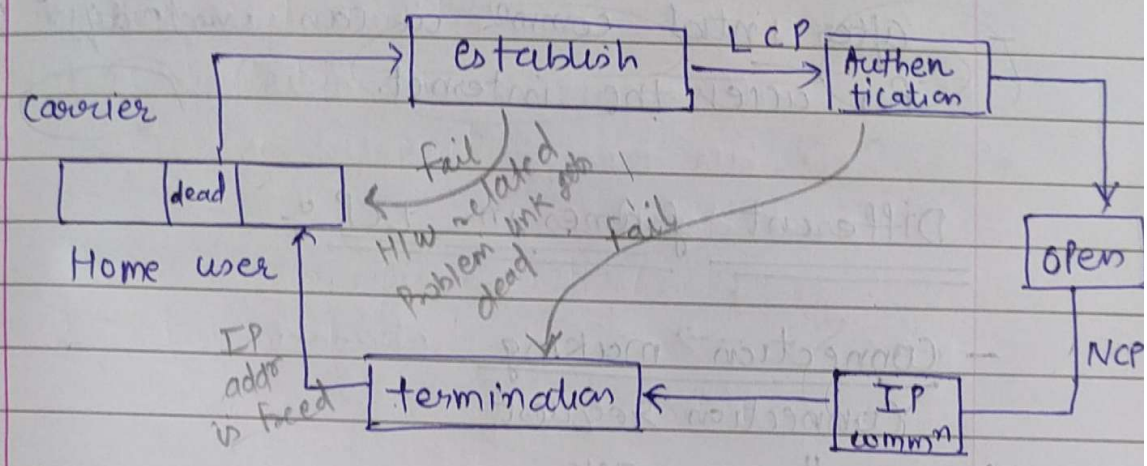

- internet service provider, provide the IP addr for the comm^n. In dialup comm^n always diff^r IP addr is provided by the service provide to complete the connection.
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- NCP & LCP are only used for negosiation and provide the IP addr.

For initial comm^n
- for handshaking in the PPP, then LCP is used. and for getting the IP addr, NCP is used.
  (after that once comm^n is established then we can used any protocol to transmit the data)

in starting

- Via service provider, we can access the internet once IP addr is getting.
- after intial comm we can used so many diff protocols for access the internet. (as google, Yahoo)

Different frames in LCP :-

- **Connection making**
  - Connection request
  - " ack
  - " negative ack (again sent the req)
  - " reject (in this req is reject can't sent same req again)
- **termination**
  - termination req.
  - " ack
- code reject (we are asking for the particular specific applications / tool) if not available Protocol
- Protocol reject
- echo request (retransmission of signal, when frame or data is not Rx properly, we are req to resent it)
- " reply
- Discard

(at starting we transmit the frame, to only check the connection) (for ex: in telephone at starting we say "Hello" type of signal)

So 11 frames are there in LCP.

- localized communication → HDLC and PPP are been used.

LCP → (initial negotiation is done)
- controls link b/w the users.
- which protocol to be used.
- error correction code
- size of fields in frame

NCP → · Provide IP addr

LCP & NCP → negotiates which protocol, what size etc. is been used.

for handshacking → PPP is used for initial connection.

UPto NCP → Comm^n is b/w user and ISP → till then LCP & NCP can only be used.

Once IP is given → ISP works as gateway → and from now, any protocol can be used.

Dial UP process – done when individual is accesing Internet through ISP.

Chp- 4

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MAC → medium acess control
(MAC layer decide that who will transfer)
(for ex: all computers are connected by the ring or bus topology. in this which comp. who^ will transfer first data)

MAC → Single channel

↓

Channel Allocation

Static (fix)

for ex: TDMA
we gives the fixed time slot for particular user
- FDMA, SDMA, CDMA
(before the start the comm^n we have to fixed the time / freq. for ~~com~~ throughout the whole^ transmission of data)

issue:
- no. of users is fixed. we can't ~~be~~ that. (if we want to ~~be~~ the no. of user, H/w & S/w is also change)
- wastage of freq. / time. (if one freq. is not used by particular allocated user, that can't be used by another user, this means its wastage of freq.

Utilization of channel is not

Dynamic
- ALOHA
- Unrestricted
- error due to noise/ collision ~~occ only~~.

errors occur
- break of cable
- collision
- noise

(A) **ALOHA:**

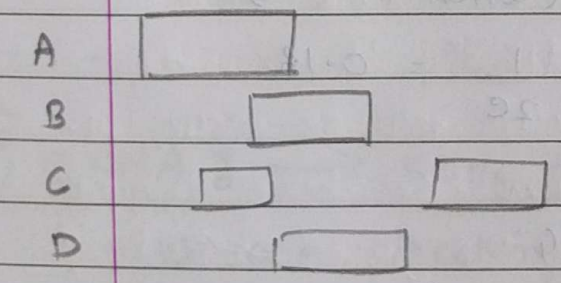
- all the transmitter are allowed to transmit the data individuals or freely w/o any fixed algorithm.
- we have to find the efficiency

N → initial no. of frames

K → retransmit frames

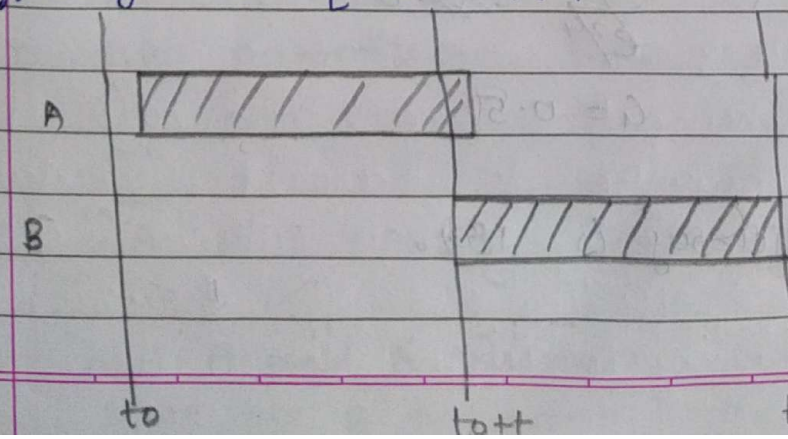
G → total no. of frames (as generated + repeated)

$N \leq G$ → at t time



$$P(K) = \frac{e^{-G} G^K}{K!}$$

efficiency → $\eta = P.G$

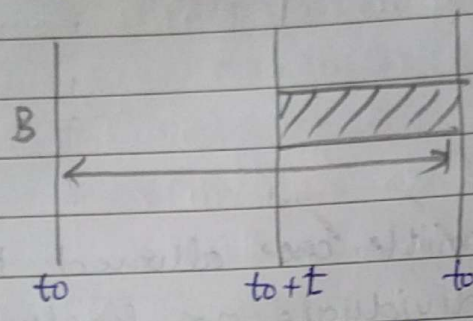


standard time for a single frame 't'

then b/w A and B collision is there.

- in one frame time 2t0

- In t0 time we have permit the G frames
- So 2 t0 time we have to transmit the 2G frames.



$$P(k) = \frac{e^{-2G} \cdot G^k}{k!}$$

when $k = 0$ ⟶ best case when b/w

$$P_0 = e^{-2G}$$

$$\eta = e^{-2G} \cdot G$$

(when $G = 0.5$)

$$= \frac{1}{2e} = 0.18$$

for max value of G

$$\frac{d}{dG}\left(e^{-2G}\right) = 0$$

$$\frac{e^{-2G}}{-2} = 0$$

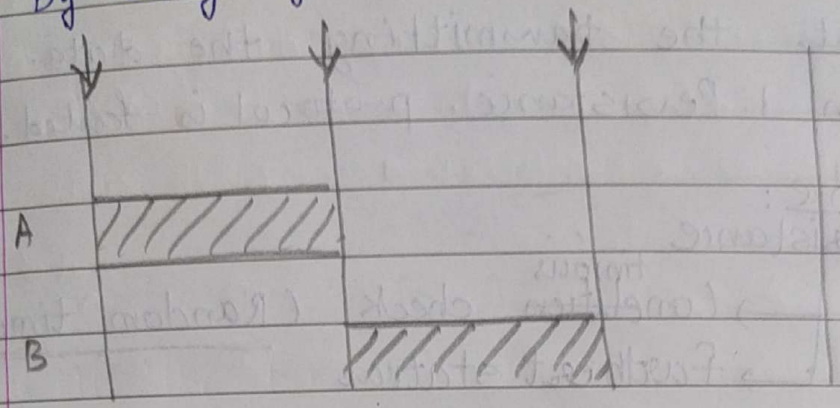
$$e^{-2G} \frac{1}{e^{2G}} = 0$$

$$G = 0.5$$

- its efficiency is 18%.

(B) Slotted ALOHA

By using global clocks at t0, t0+t



anyone can transmit at only global clocks.

$$P(K) = \frac{e^{-G} \cdot G^K}{K!}$$

at t time, we transmit the G frame

at $K = 0$;

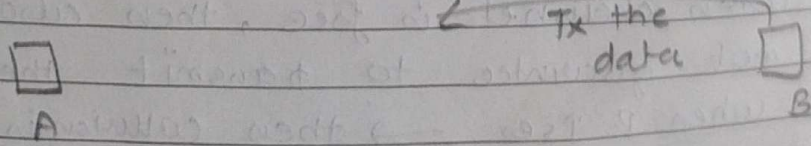
$$\eta = 36\%$$

⇒

(C) CSMA : → 50% → efficiency

1 - Persistance :

- We are checking the channels CSMA (carrier sense multiple access)
- 1 Persistance (we continously keeping the checking the channel until channel is empty free and start transmit
  (efficiency is 100%, when channel is free)
- all the transmitter the looking or checking the channel then its possibility that two transmitter sent the data simultaneously



b/w A and B distance is more, than A don't sense the B than transmit the data, then A

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Starts the transmitting the data.
then 1 Persistance protocol is failed.

Non-Persistance:
- 1-Persistance
  - → Continuous check (Random ^ time out of)
  - → farthest station

10 are device
↓
1 → 9
is 5 are ready for transmission
transmitting
data

non-persisting

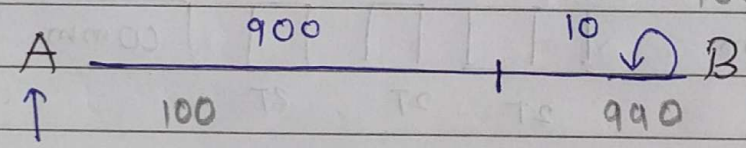
When we check the channel, we have to wait for the random time, that is different for individual computers may or may not. to avoid the collision, we have wait for some time (that is the random out of time) → so we are not continous checking to avoid collision → " Non-Persistance " (Non continous checking)
Efficiency is 70%.

P-Persistance:
When channel is free, then also it may not guarintee to transmit the data.
when P ↑ses → then collision is ↑ses and efficiency is also ↓ses. bcoz we use the max. using the channel.
- efficiency is 90%.

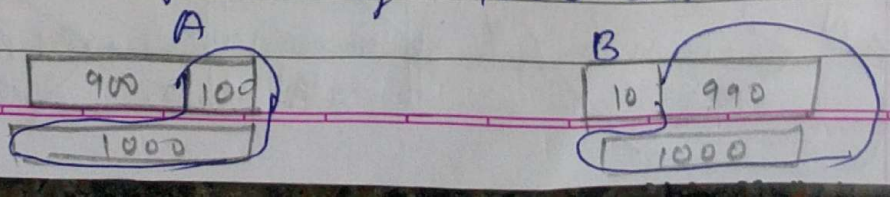
- lesser P, efficiency is Tses, but we have to wait for more time.
- efficiency means the no. of uncollided frames, which are transmitted.
- (for example P = 0.01 means, ~~its~~ comp. 1 having the 100 chance to transmit the data but, that's transmit only 1 time means 99 times he has wait and he gives the chance to another computers to transmit the data 99 times. so efficiency Tses, time is more)

When farthest station: (CSMA/CD)

1000 bits — 1000 bit → 1 frame



- when A checks, channel is free and A starts the transmit the data and B also checks the channel and its also starts to transmit the data.
- collision will occurs at A (900 bits) and B (10 bits)
- and after collision A has to retransmit the 100 bit and B have to 990 bits retransmitted. that's the total wastage
- so for B that's the loss 990 bits of transmission.
- Both A and B have to retransmit the frames of 1000 bits.

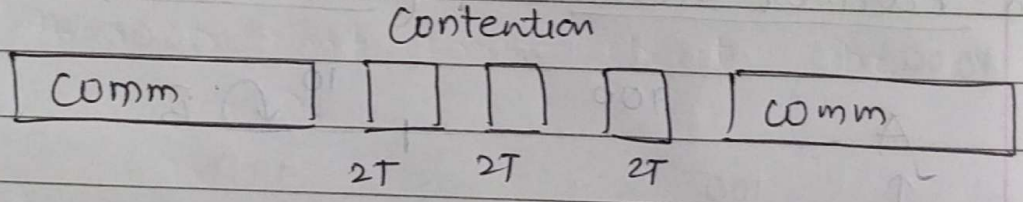


- We have to stop the communication when collision occurs. and retransmitting the data(frames). ⟶ CSMA/CD
[carrier sense multiple access with collision detection

- A B

1 bit ⟵⟶ 2T time
transmit

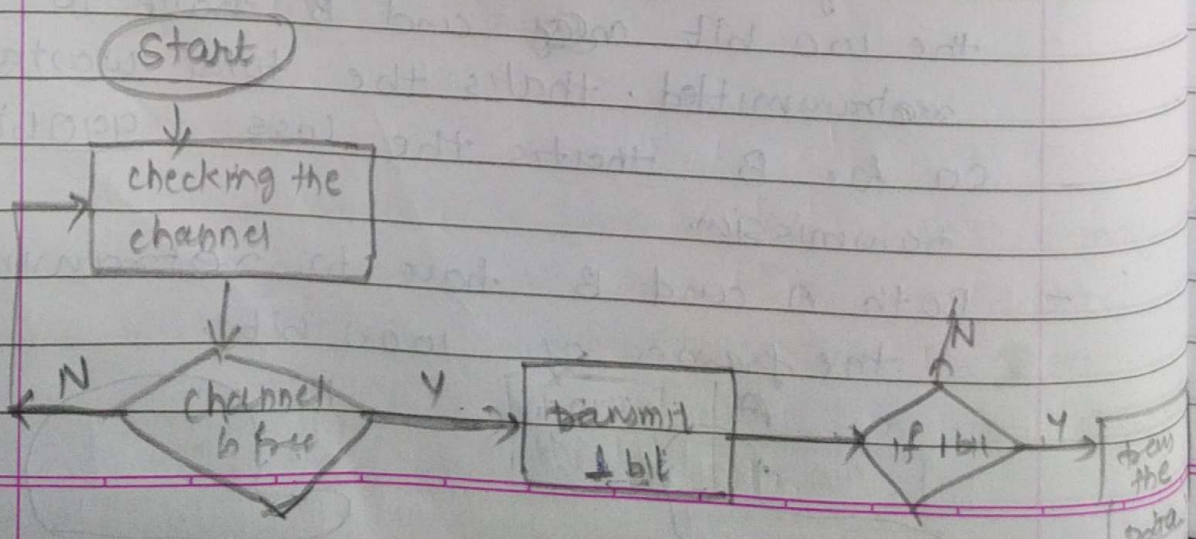
- if collision is occur 1 bit is changes → channel is not empty.
- if we Rx 1 bit same as it, then channel is free. and we received 1 bit back in 2T time.



- its only worked in wired comm^{n}.
- its wait for 2T time.

Ex: Draw the flow chart of CSMA-CD, ~~Non Persistance~~ and 1-Persistance and p-Persistance.

=> flow chart



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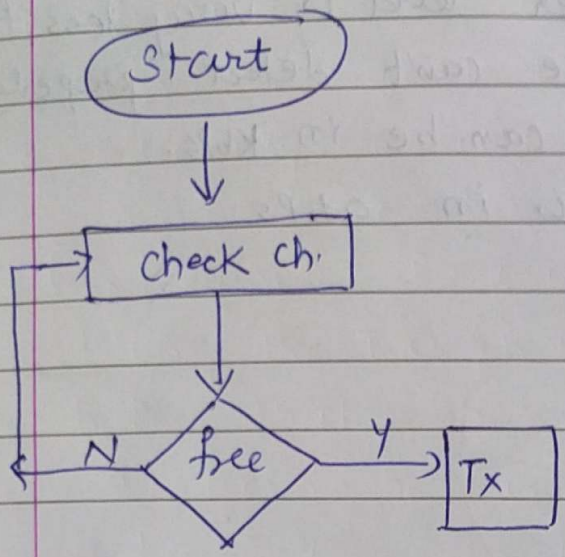
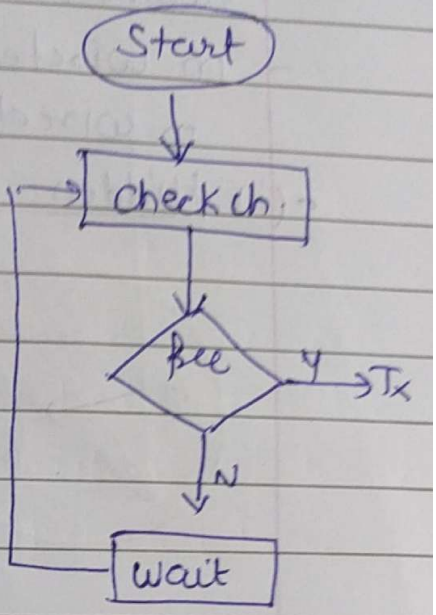
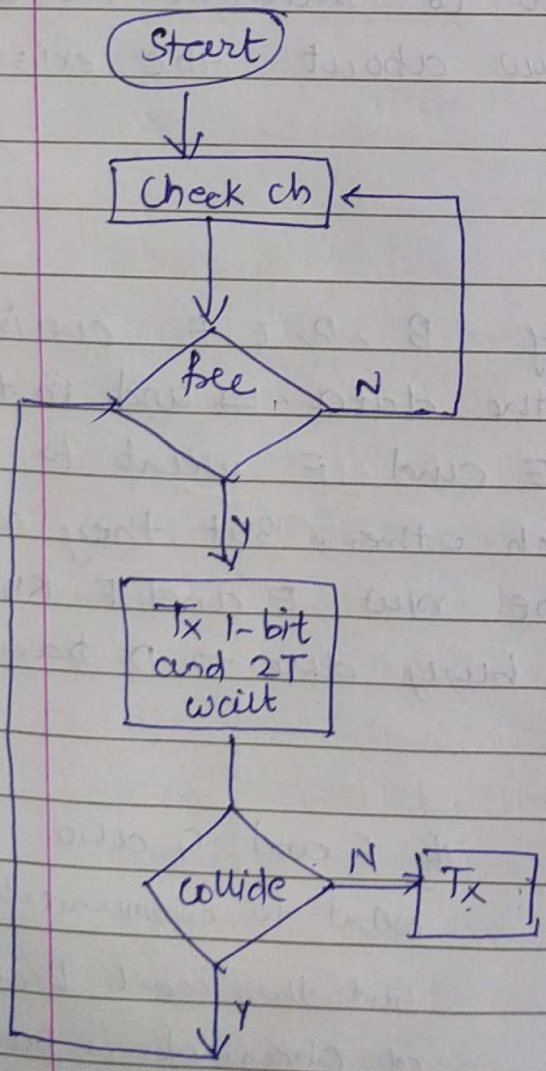
1-Persistance



P-Persistance



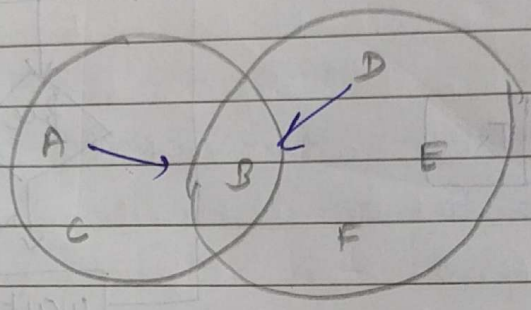
CSMA-CD



In wireless, power level is very less for farthest signal, we can't detect properly.

- in wireless, speed can be in Kbps.
  in wired, speed is in gbps.

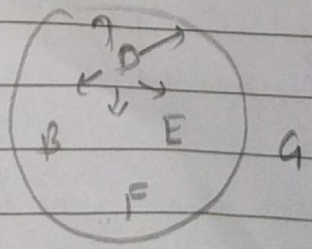
-(i) Hidden station.



if A wants to transmit the data, B and and D also want to transmit the B then D don't know about the existence of station A.

-(ii) exposed station

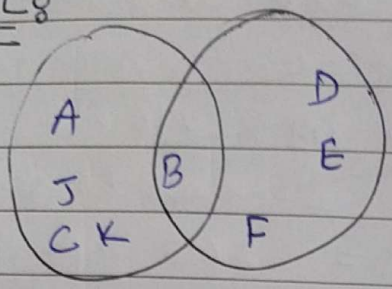
in the range of B, D, E, F are in one n/w if D is transmit the data. ~~in~~ and in the same n/w if E and F want to communicate each other, But they can't do. Because in the n/w E and F knows that channel is busy due to D transmitting the data.



If F and G also want to communicate but they can't becoz of channel is busy. while D Tx the data.

these two problems occurs in wireless.

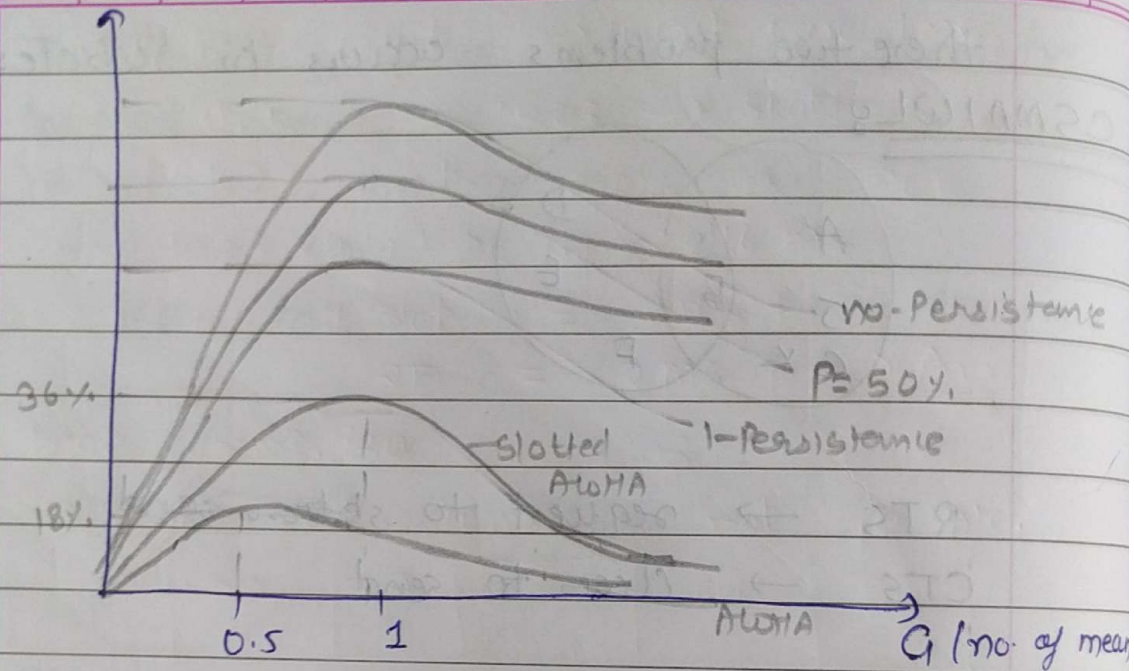
CSMA/WLs



RTS → request to ~~send~~ send
CTS → Clear to send

i) A and D transmit the RTS to B, for transmitting the data or commⁿ. if both are at same time, then they will collide.
ii) if A and D again Tx the RTS to B if their time are diff then reached the RTS ~~to~~ ~~B~~ to B. then B Tx the CTS to all. ~~and~~
iii) then if A received the CTS, then commⁿ b/w A and B starts and
iv) bcoz of CTS by B, send to all which are in the range of B and they all come to know that, B commⁿ with A.
(v) and A Tx the B to RTS, it also send to all the ~~users~~ comp. in the range of A and all thy D, B, C, K comes to know than A commⁿ with B. So all come to know about the who is Tx and who is Rx then problem is solved.

efficiency



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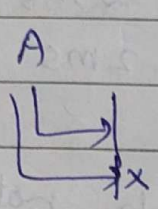
Data Link Layer:

Random time:

2T - 1 Slot

Binary Backoff exponential



if collision is occur
- 0th slot - 2T
- 1st, 0th - 2T, 4T
- 2nd, 1st, 0th - 2T, 4T, 8T

- after 10th to 16th collision time is fixed as
  - 9th, 0th ~~to~~ 10th slot
  - 2T ---- 1023T
- after 16th collision, commn is not possible.
- $(2^i - 1)T$ $i \rightarrow$ collision
  - if $i = 0$ → when no collision then we don't have to wait.
- when collision is occur, we have to wait for random time.

Ex: In the nw of 100 computers comp A tries to acess the channel. In one of the attempt it waits for 2046 ms. Again it checks the channel and waits for the same amount of time and then give up the commn. If the waiting time is worst possible time, then find out the round trip propagation delay of the nw

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Q01: 2046 ms wait → worst case time

0, 1, ... 1023 → slots

1023 → slots

1023 slots time = 2046 ms

1 slot = 2 ms

2T = 2 ms → Ans.

give up the
bwz ^ commn. is 0

after 16th slot, commn is not possible.

LAN:

- Ethernet (simple ethernet, speed = 10 MbPs)
  max. dist = 2-2.5Km
- cabling
- frame

Cable:

limitation of cable

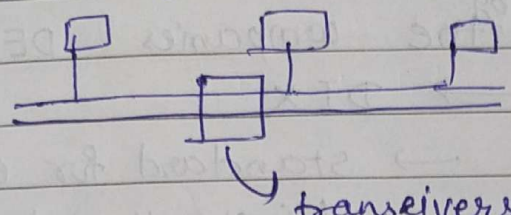
	Name	type	Distance/ seg. length	node/ seg.
1.	10 Base 2	thin coax	200m	30
2.	10 Base 5	thick coax	500m	100
3	10 Base T	Twisted Pair	100m	1024
4.	10 Base F	fiber optic	2000 m	1024

its the limitation of the central terminal/switch

10 MbPs, Base band signal (no modulation is applied)
(↳ unmodulated signal)

distance = 200m

- w/o amplifier, 30 computers is the n/w
- in (1.) & (2.) bus or ring topology

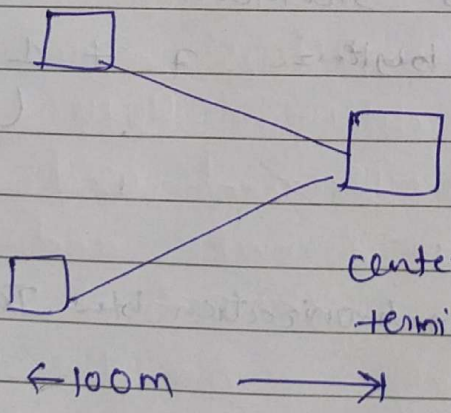


- Transivers checks the channel is free or not. ↳ it detect the collision ↳ its sense the channel

if collision is there, then transeivers gen. the noise and divide or cut the frame into pieces. And pieces size are not more than the 64 bytes.

- connection b/w computer and cable → BMC connector is used.
- TDR used to find cable breaks

(3.) In Twisted pair star topology is used



- very less complex n/w

(4.) Fiber optic → back bone comm^n topology : mostly used in mesh topology.

frame format:

(A)

- ethernet given by the companies DEC, intel and xerox ⟶ DIX
- IEEE 802.3 ⟶ standard for ethernet (simple ethernet, speed = 10 Mbps)
- frame format for IEEE 802.3

Pre-amble	DA	SA	length	Data	Pad	CRC
Byte ⟶ 8	6	6	2	≥0	0-46	4

(i) Preamble ⟶ Pilot signal (base band signal)

8 byte = 64 bits
= 6.4 μs

for 6.4 μsec square wave is there (10101010)

- its not the part of the data
- By IEEE 802.3 standard

Preamble 8 byte = 7 + 1
↳ Start of Frame

through that synchronization b/w Tx and Rx is done.

- offset null ⟶ when we Tx the sine wave and in the path, over data getting the 90° phase shift then we don't get the o/p at Rx side.

In this By doing the PLL, we reduce the path effect.

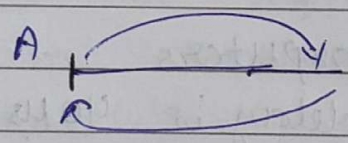
(ii) DA → Destination addr (MAC addr)
SA → source addr
6 Byte = 48 bits
if MSB in the 48 bits
↳ 0 → individual addr
↳ 1 → multicast addr
(Broadcast in a group)

- for same device wired and wireless mac addr are different
- In DIX : instead of length, type was present

(iii) length → size of data

(iv) CRC → cyclic redundant check
used for the error ~~corre~~ detection

(v) Pad



Transceiver would tell about collision but for comp to detect that it is its frame before ack frame size > 64 bytes.

~~For ethernet~~ ⇒ ~~2T = 50 Msec~~
~~= 500~~

even if all precautions to avoid collision is done but still collision occurs after transmission. So for detection of collision, frame should be greater than 2T time.

2T - 50 μs for ethernet
⇒ 500 bits
+12 Precautionary bits
512 bits → total ⇒ 64 bytes

(12 is added bcoz to make in 2^n Power)

hence every frame should be of 64 bytes.

- 6 + 6 + 2 + 4 = 18 bytes → will be always present in frame
  DA SA length CRC

So, if data is less than 64 - 18 = 46 bytes then padding is done depending upon the size of data.

Eg:

if data = 0 pad = 46 bytes

data = 8 Pad = 46 - 8 = 38 bytes

If frame is less than 64 bytes then all comp in nw will discarded the frame.

depending upon speed - length of padding will change.

Ex:- A nw of 100 computers max round trip delay is 40 μs. The speed of the nw is 100 Mbps and uses standard IEEE 802.3 frame format and size of data = 20 Bytes. Then find out the size of padding required.

Sol:

100 Mbps x 40 μs = 4000 bits

4000 bits = 500 bytes

data = 20 x 8 = 160 bits

~~so Padd = 4012 = 160~~

~~= 3852 bits~~

~~= 8 963 bytes~~

500 bytes → frame size

20 → data

18 → for other addr

(DA + SA + Length + CRC)

↓

6 + 6 + 2 + 4 = 18

So padding size = 500 − 200 − 18

= 468 byte

(B) * IEEE 802.3 → 10 MbPS (simplest ethernet)

IEEE 802.3M → 100 MBPS (fastest ...)

(speed is Tser, so ~~data~~ Padding size, we have to Tser)

- in ethernet, manchester coding is used
- for fast ethernet we can't used the same cable, bcoz as speed is Tser, so that's not supported by the cable which used in simple ethernet)

IEEE 802.3 M :

fast ethernet

Name	type	Max. segment	coding
100BT4	Twisted Pair cat-3	100m	8B/6T
100B Tx	Cat-5 'TP'	100m	4B/5B
100B FX	fiber	2000m	—

4 Twisted Pair → 8 cables are there

hence every frame should be of 64 bytes.

- 6 + 6 + 2 + 4 = 18 bytes → will be always present in frame
  DA SA length CRC

So, if data is less than 64 - 18 = 46 bytes then padding is done depending upon the size of data.

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Sol:

100 Mbps × 40 µs = 4000 bits

4000 bits = 500 bytes

data = 20 × 8 = 160 bits

~~so padd = 4012 - 160~~

~~= 3852 bits~~

~~= 963 bytes~~

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500 bytes → frame size

20 → data

18 → for other addr

(DA + SA + Length + CRC)

↓

6 + 6 + 2 + 4 = 18

So padding size = 500 − 20 − 18

= 468 byte

(B) * IEEE 802.3 → 10 MbPs (simplest ethernet)

IEEE 802.3M → 100 MbPs (fastest ")

(speed is Tsec, so ~~data~~ padding size, we have to Tsec)

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100B Tx	Cat-5 'TP'	100m	4B/5B
100B FX	fiber	2000m	—

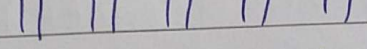
4 Twisted Pair → 8 cables are there

* 4-Twisted Pair
  - 1 Twisted Pair
    - 1-cable → To Hub
    - 2-cable → From Hub
    - 3-cable →
  - 3 cables are in one direction
  - Binary coding BR = $2BW \cdot \log_2 L$, ternary coding is used
  - 'Cat-3' → 20 to 25 MbPs speed for Twisted Pair
  - one cable → 25 MHz, but we required 100 MbPs, But here we have only three cable so possibilites is 75 MHz. By Binary coding we can't acheived the speed of 100 MbPs (Possibilites $2^3 = 8$
  - So By ternary coding we can achieved the 100 MbPs speed, by three cable only and (Possible comb^n Possibilites is $3^3 = 27$)
  - (if we have 4 cables of binary coding, we can acheived the speed and Possibility comb^n is $2^4 = 16$)
  - Disadvantage:
    - Asymmetric
    - more complex voltage level

* 'Cat-5' Twisted Pair
  - 125 MbPs
  - two cables

boz Point 11111 00000

- 5 twisted Pair
- we don't required all the pair so one Pair is used for the controlling.
- Symmetric



4 bits / 5 bits

* fiber cable
  - Synchronization is difficult.

(c) IEEE 802.3 z ⟶ 1000 MbPs
1 GbPS

Name	Type	Max. seg.	Coding	
1000 BSX	fiber	550 m	8B/10B	Multimode
1000 BLX	fiber	5000 m		Single mode
1000 B CX	STP	25 m		
1000 B TX	'cat-5 UTP'		QAM	4 cables

* 1000 BSX
  - ~~Single~~ Multi mode fiber
  - due to dispersion, distance is less
  - 8B/10B

Coding 8B/10B

8 bytes is used, by transmitting 10 bytes
- ~~6's~~ 6 1's and 6 0's are there in 10 bits and 4'0 are

Scanned by CamScanner

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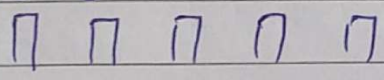

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  - ~~6's~~ 6 1's and 6 0's are there in 10 bits consecutive 4'1 and 4'0 are allowed in 10 bits.

Coding
8B/10B

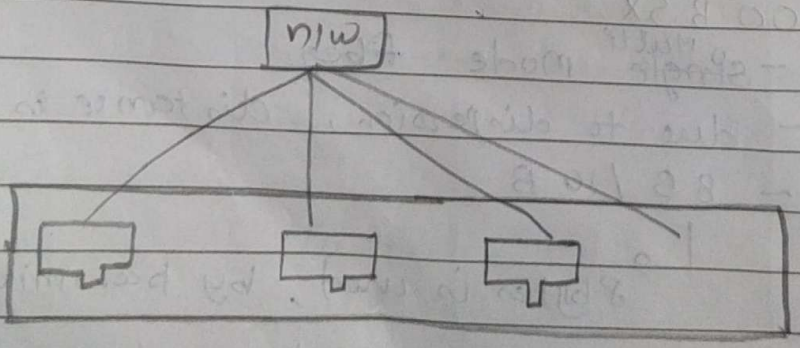
* 1000 B LX
  - single mode fiber
  - distance is more

* 1000 B CX
  - Sheilded twisted Pair
  - High data rate, and ~~cable length is~~
  - for less transmission distance

* 1000 B TX
  - 'Cat-5' UTP
  - 125 MHz
  - 4 cables are used

    ↳ in one cycle 2 bits are transmitted
    (125 MHz x 4 = 500 MbB)
    but we required 1000 MB
    so in one cycle 2 bits
    are Tx.

- Hub



- instead of using Hub, we are using S/W
- CSMA/CD, speed is not achieved as 100 MbPs

ethernet → cable

www.navneet.com
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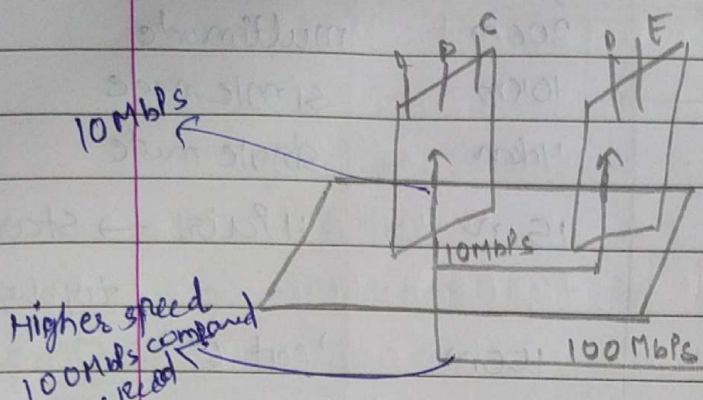
- Switch

"Switched ethernet"



- 32 to 48 cards would there in ethernet switch.
- each card having the capability of connecting the 8 computers.
- its not wait for the eT 'time, all the transmitter are transmitting the signals
- full duplex
- NO CSMA / CD required
- direct comm^n is done b/w A and B
- NO checking the channel, efficiency is 100%.
- This known as "Switched ethernet."
- NIC ~~speed~~ card (is used for the negotiation the speed)

* In back bone n/ws and wide area n/w IEEE 802.3 → 10 GBPs speed

(D) 802.3 :

- wired n/w
- used in back bone networks
- 10 GBPs speed
- cable used are fiber optics due to speed
- Star topology is used
- wide area network

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Name	type	segment	
10 GbPs B CR	fiber	300m	multimode
LR		10Km	singlemode
ER	64/66B	40km	single mode
CX4	coaxial cable	15m	4 Pair → star topology
T4	UTP 6	100m	'Cat-6'

↓ Coding scheme

8B/10B is used by all the cables and specially By 10GbBs Base ER → 64B/66B coding scheme is used.

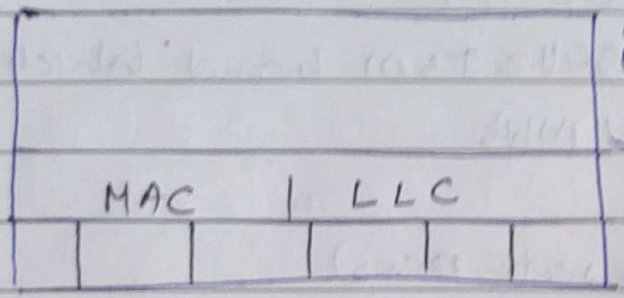
bcoz Point 11111 00000

Wireless Communication

IEEE 802.11 ⟶ wifi standard
- protocol stack
- frame
- services

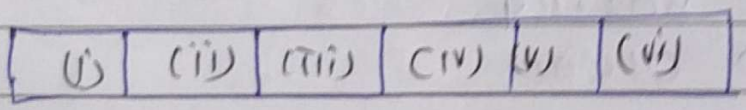
Protocol Stack:

- reference model is "OSI model". bcoz of IEEE standard is there.



- only two layer are different for any nw

- physical layer:



infrared → diffuse IR
→ Omni directional
→ 1/2 Mbps
→ it cant propagate through walls

{ DSSS (Direct sequence spread spectrum)
{ FHSS (freq hoping spread spectrum)
{ OFDM

(i) → both are used 2.4 GHz ISM band, which are freely available. we have

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Date: 5 | Sept

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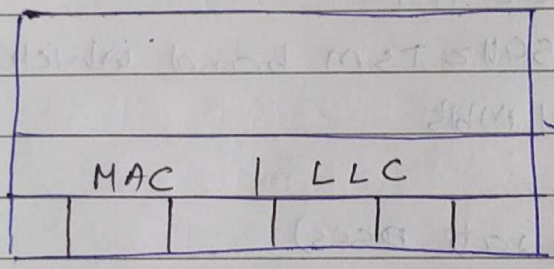

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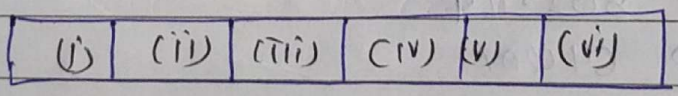
- **physical layer:**



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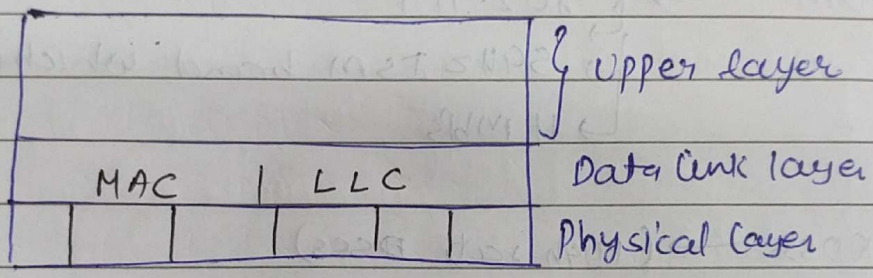

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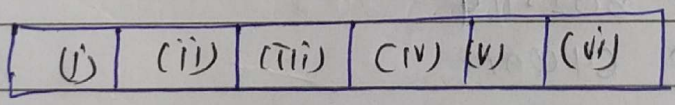
- ## physical layer:



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- DSSS (Direct sequence spread spectrum)
- FHSS (freq hoping spread spectrum)
- OFDM

(i) → both are used 2.44 GHz ISM band, which are freely available. We have

faced the High interferenced through many n/w.

(ii) FHSS → 79 channels of 1 MHz wide
- Due to that interference is less.
- Pseudo random seq is used and seed seq is used at Tx and Rx which are same.

(iii) OFDM → 802.11g
- 5GHz ISM band, which is licensed payable
- 11 Mbps

bcoz Point 11111 00000

(iv) HRDSSS → (High rate DSSS)
- 1/2/5.5/11 Mbps
- 802.11B

(v) OFDM
- at 2.4GHz ISM
- 802.11g
- 64 QAM
- 54 Mbps speed achievable (with gives the max speed of 54 Mbps which used 802.11g → at 2.4GHz ISM band)
- device are movable

(vi) 802.11M
- OFDM + MIMO
- many links are present each with 54Mbps ⇒ speed Is es
- used now a days (2009)

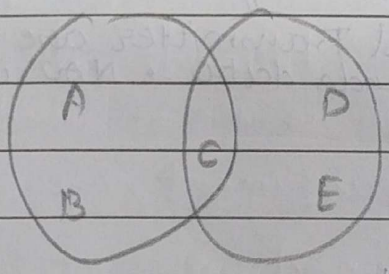
LLC

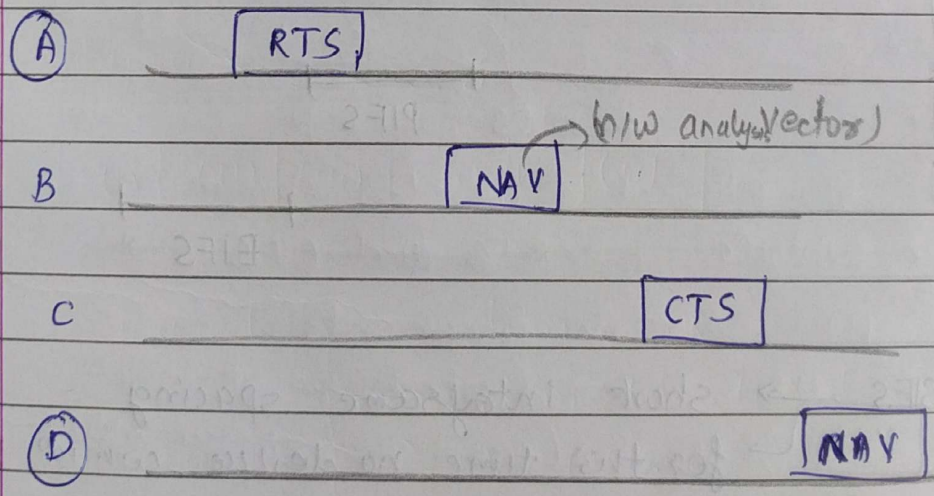
(logical link control)

- LCC is responsible for the frame conversion blw lower layer to upper layer.
- 802.3 to 802.11 → for data link layer
  → By LCC conversion is done.

two mode of comm^n:

- (i) DCF (Distributed coordination function)
  CSMA / CL
  - hidden and exposed station are solved





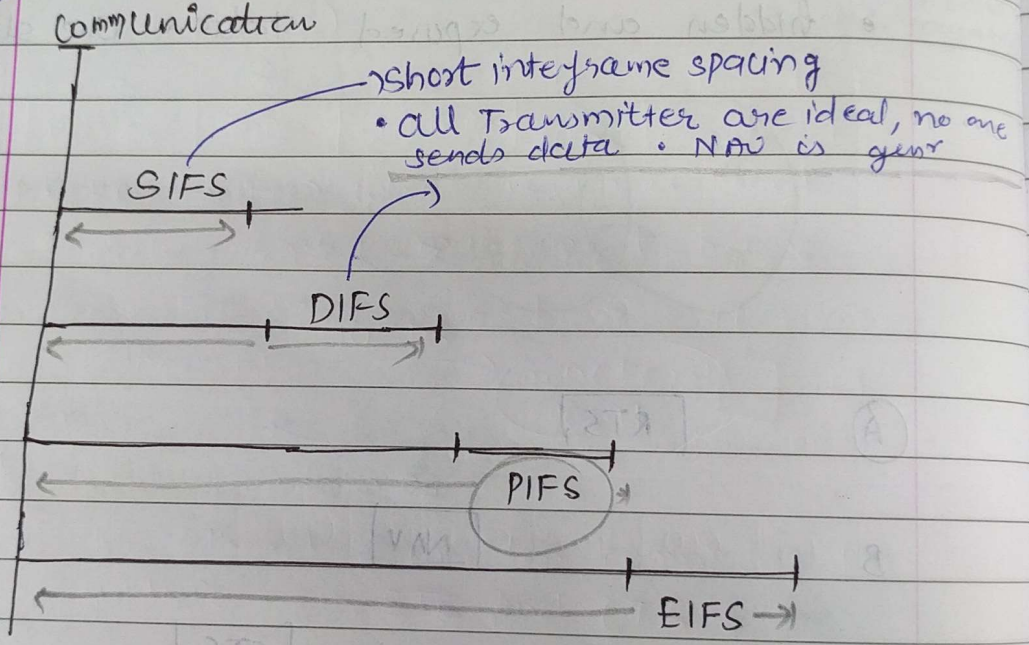
A, D both wants to communicate with 'C'.

NAV — n/w analysis vector
contains the info about for how much time A and C will communicate

- direct comm^n blw nodes.

(ii) PCF (Point coordination function)
- Client server type model
- there should be base station.
- Base station will decide, who is Tx or Rx.
- Ex: - xender (PCF) if one user is send and two or more user receive data than xender → PCF
if b/w two user than xender → DCF

⇒



SIFS → short interframe spacing
└ for this time no device comm^n present after NAV is gen.

DIFS — Distributed Interframe spacing
└ DCF is used

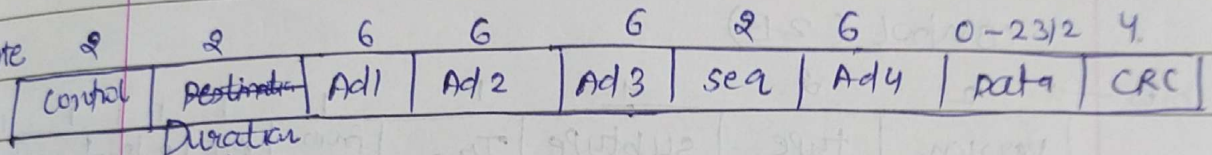
PIFS — Point IFS
└ PCF is used
└ server polls who will Tx/Rx if anyone

wants to do.

EIFS — extended IFS
control signal, ack or any extra frame which is left during other spacing (SIFS, DIFS, PIFS) is done then.

- This happens only when both DCF & PCF are present. — This spacing is always present after comm^n gets over.

frame :

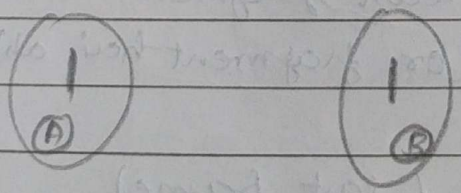


for generate the nav, required time is provided into duration.

Ad1, Ad2, ~~Ad3~~, ~~Ad4~~ ⟶ 4 MAC addr

- in ethernet we are having 2 MAC only for source and destination.

[4 mac addr ⟶ 2 addr (customer), 2 addr (Base station)
DCF ⟶ 2 MAC addr
PCF ⟶ 4 MAC addr)



1 — destination } individual computer
2 — source }

3 — destination } to which tower
4 — source } (central terminal)

- Sequence (2B)

16 → 12 + 4
- 4 → fragment no.
- 12 → tells about the frame no.

0000 0000 0111 1001
- 0000 0000 0111 → frame
- 1001 → fragment no.

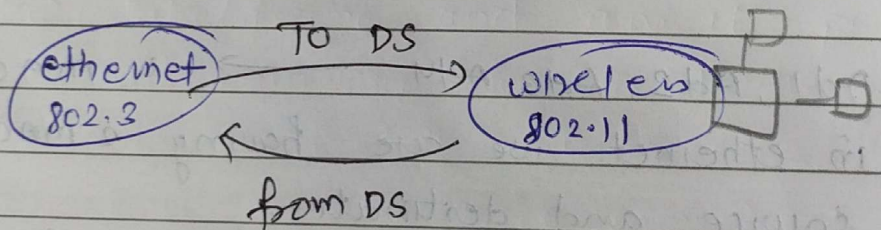
frame can be divided into fragments and then transmitted.

- control (2B)

bits →

2	2	4	1	1	1	1	1	1	1	1
Version	type	subtype	To DS	From DS	MF	R	Power	More	W	O

- Version → which version is used
- data, control, management frame → type



- b/w ethernet & wireless comm^n is there.
- subtype → RTS and CTS
- MF → more fragments
  - MF = 0 → last fragment
  - MF = 1 → (or fragment hai abhi)
- More → 0 (last frame)
  - MORE → 1 (more frame are coming)
- Power
  - Power = 1 → sleep mode (for a particular base station goes to sleep

12-Sep

Servi

(i)

(i) T

- W → WEP (wire equivalent Privacy)
  W=1 encryption is there.
  W=0 → normal msg, no encryption is there
- O → order
  O=1 → strictly received the data in order
  O=0 → data received in any order.

12-Sep.

MORE	W	O	

Services:

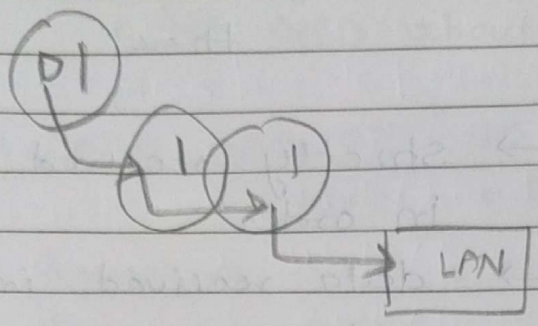
(i) intercell (b/w cells)
(ii) intracell (within the cell)

(i) Intercell:

it provide 5 services in intercells:

- Association
- De-association
- Re-association
- Intigration → converting the frame, when distribution is done

- Distribution → if multiple n/w are there whereas we want to send the data, is allowed



bcoz Point

(9i) Intracell :

- Authetication → if we properly decode the data/frame and are it properly to the Base station then and only we can used the services

- De-authetication →

- Data dilvery →

- Privacy → WEP (wire equivalent Privacy)
  - provide security to data

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⇒ 802.16 :

Wireless LAN and MAN

802.11	802.16
- LAN ↳ wireless	- Wireless MAN
	- its covered large area.
- 2.4 GHz	- 10 - 66 GHz (Upper ISM Band) (noise interface is very high bcz f is High)
- error detection	- Error correction/ Detection
- Mobile (moving devices, we can used this)	- Stationary devices (bcz data is very large)
- Omnidirectional commⁿ	- line of sight commⁿ
- Phy. layer → FHSS, OFDM many diffˢ Phy. layer	- FDD, TDD in Physical layer
- DCF, PCF	- PCF
- Ex: wireless LAN	- Ex: wireless cable n/w

- Wireless cable n/w is the example of 802.16

Protocol stack :

- layer and work of each layer
- OSI model is used

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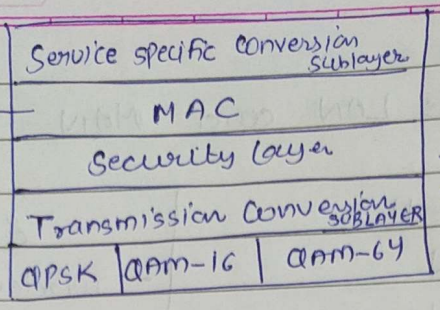
Upper layer



- QOS ←

Physical layer:

QPSK → 2 bit/baud (for large distance)
16-QAM → 4 bit/baud
64-QAM → 8 bit/baud (for small distance)

Transmission Convergence sublayer →

← boz Point IIIII

- Haffman error correction is done by Trans. conv. sublayer

Security layer → encryption of data is must

MAC →

- it provide the QOS (quality of service)
  - (i) Constant bit rate service
    (used for voice commⁿ → slot time is fixed so that Bandwidth & data rate is fixed → no one can change if initialization of commⁿ is happened)

  (ii) real time bit rate
  - (used for video file)
  - DPCM — only difference b/w frames is sent.
  - change of bit rate is possible with the predefined time
  - During polling → It is asked if bit rate is to be used or not by central terminal during a specific time period.

Service

(iii) Non-Real time bit rate

- Base station may or may not ask for bit rate fixed
- depends on if BW is available with base station or not
- asks user whenever BW is available ⇒ no specific time fixed

(iv) Base effort

- it available in all the n/ws.
- During Polling — every time high bit rate is asked
- Now if base station is able to give — it gives else not.
- No security of getting high bit rate.

- PCF is used so MAC — does not has to decide where and when who will transmit.
- Central terminal decides time slots
- FDD, TDD is used — for user & Base station
- full Duplex
- in wifi - half duplex is possible
- MAC does uplink & downlink time division b/w users.

Service specific convension sublayer →

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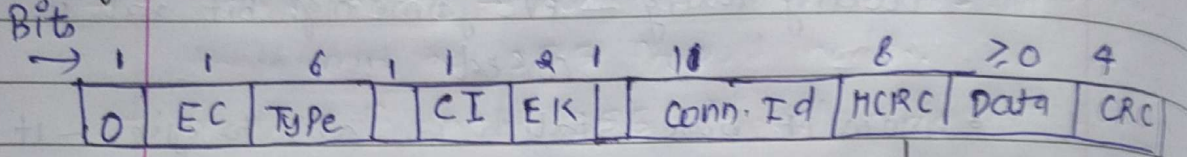
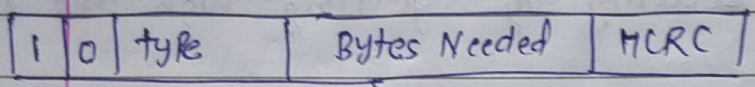
Service specific convension sublayer →

- Physical layer provide the frame conversion and also error correction is done at this layer → in 802.16 standard

frame format :



↳ generic frame



↳ BW request frame
When BS asked for more data rate, then this frame has to send by user to Base station (BS).

EC → encrypted msg
can be present or not, mostly present

type → type of frame (real, non real, information, supervisor)

HCRC → header CRC
Huffmann coding, for error detection

CI = 1 → CRC is there
CI = 0 → CRC is not there

EK → encryption key

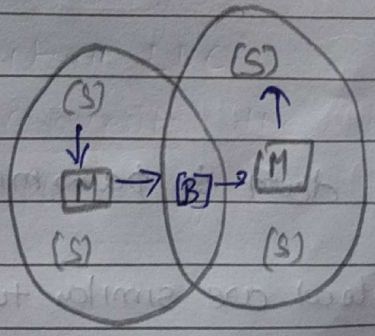
HCRC → used as error correction for header
- 0 (then no extra CRC for data present)

CRC → may be omitted as Huffman code is used

- customer and Base station is always Half duplex.
- HCRC → header CRC → used for 1st (24 bits)
- Byte needed → BW request is been done
- CI → check sum indication

⇒ 802.15.1 Bluetooth

SIG → special interest group
INTEL, TOSHIBA, NOKIA, IBM, ERICSON
- does something which is not present for themselves
- cheap comm^n w/o wire
- IEEE standardized only two layer data and physical layers for BT.
- SO BT is not followed the OSI model.
- range → 10m



- 8 active slave node and 1 master node in the range of 10m

- every 10m BT device having the master node.

- Slave node having the capability to become the master node.
- Two Slave can't commⁿ directly, if present in Piconet.
- Bridge node b/w two master node.
- Scatter node → more than 10m range
- Park node → nodes are not active, in a Piconet there can be 255 Parked nodes.
- in one Piconet (10m), 255 Parked node is there
- 10m area is called "PICONET"
- Bridge node behaves as master node b/w 2 max nodes of diff Piconet.
- Total nodes present in Piconet - 255 +1

Services / Profiles :

Slave - client ; master -

① Generic Access :
is for initially link management.

② Service Discovery :
- what kind of device and which are active
- what service is provided by them.

its compulsory in all cases if there are no present BT applications or it perform

③ Serial Port :
- Through BT, data is transmitted serially only.
- Serial commⁿ Protocol are similar to wired serial comm.

④ Generic Object Exchange :
- link management - client service model connection done.

Xender → 802.11
Hotspot →

BT → 802.15

- Control and Hand shaking is done.
1, 2, 3, 4 → link management.

5. LAN
We have to comm^n with the existing n/w as 802.11 or 802.3

6. FAX
- specially used for FAX.
- similar to modem

7. Modem
- bT established for modem comm^n
802.11 → modem — than through this device, by BT for internet wifi can be shared.

8. Telephony
- using BT, we can comm^n via walkie-talkie
- uses very low ISM Band - RF comm^n

9. Cord-less
using BT, headset and BS are connect

10. Head Phone
- using BT.
- wireless ear phones, BT speaker etc.

11. Object Push
for small data is been transferred.

12. File transfer
for large data is been transferred.

13. Synchronisation
BT device and stationary device →
Ex: google drive

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- its use stop and wait protocol → speed is very less in BT.
- only changes are updated in the file which are already present in the other devi connection done through bT.
- Reqwired when BT connection gets on and off.
- BT is cheapest commⁿ.