Topologies (LAN) :-

(i) Physical Topologies (Mesh, Star, Bus)..

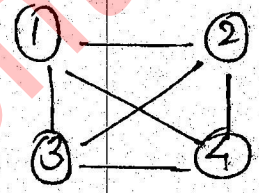
(ii) Logical topologies (IEEE 802.3, IEEE 802.11..)

Physical Topologies :- It will tell how physically systems are connected in the LAN.

Logical topology :- Logical topologies will tell logically how the systems will transmit the data in the LAN.

Physical Topologies :-

(1) Mesh Topology :- In mesh topology every system is connected to every other system by a dedicated link (cable).



4 devices, 6 links required.

n devices, $^nC_2 \Rightarrow \frac{n(n-1)}{2}$ links.

Dipadvantages :-

100 devices, $\frac{100 \times 99}{2} = 4950$ links

→ cost is high

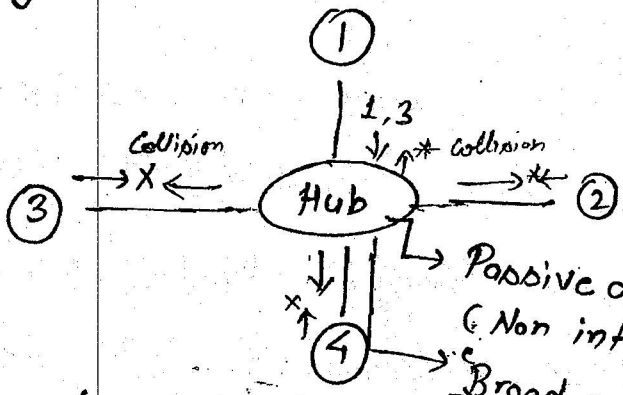
→ maintainance difficulties.

Advantage :-

→ good for small group & project.

→ Reliable, fault tolerant, Secure.

(2) With topology :-



→ 4 devices, 4 links
→ 100 devices, 100 links.

★ 'Hub' is a broadcast device because whenever a packet comes to Hub it will simply divert in all directions, except the point of origin.

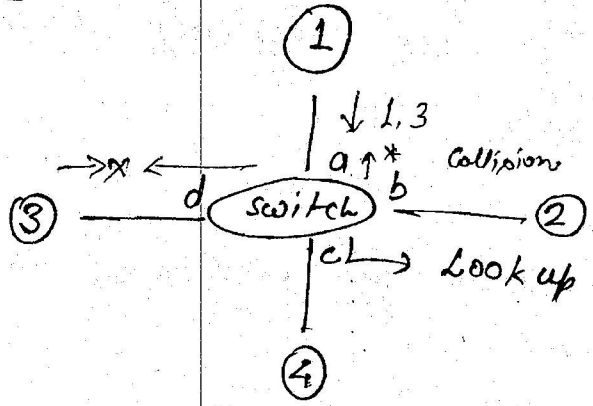
★ Collision :- Two or more systems data interfere each other then there is a possibility of collision.

★ Collision domain :- The Place or area where the collisions are confined to, is known as collision domain.

★ Note :- (1) By default Hub is not a collision domain seperator.

(2) If Hub is used as centric device then entire Network has a same collision domain.

:- With Switch :-



→

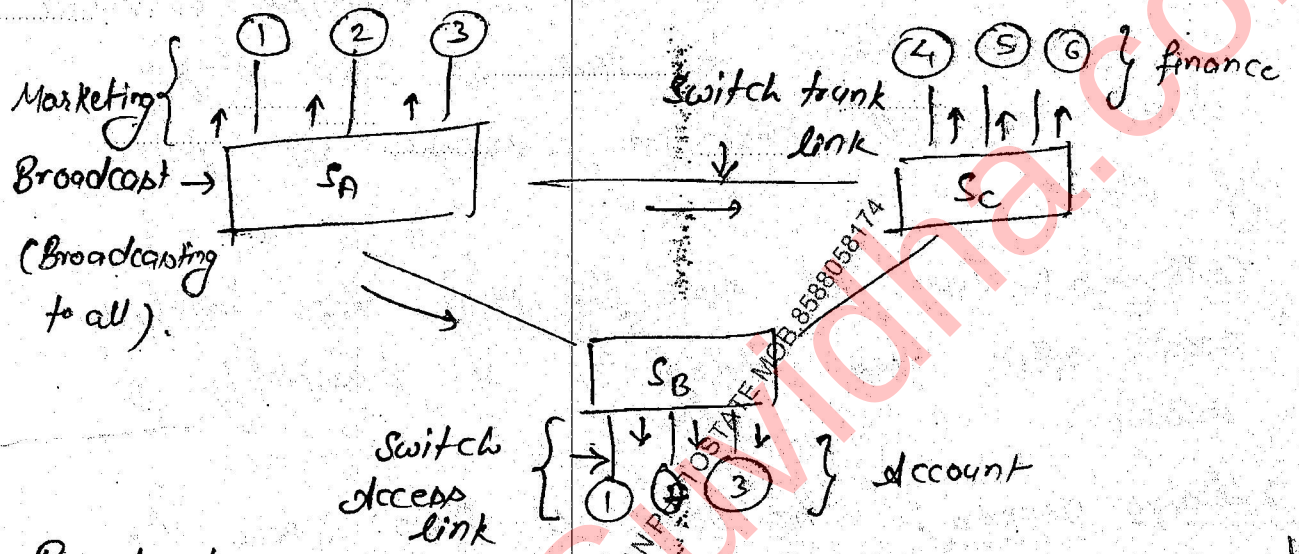
Table

a	1
b	2
c	4
d	3

★ By default switch is a collision domain seperator.

★ If switch is used as a centric device then each port has a seperate collision domain.

Note :- Computer, Bridge, Router will have the physical address { MAC address }.

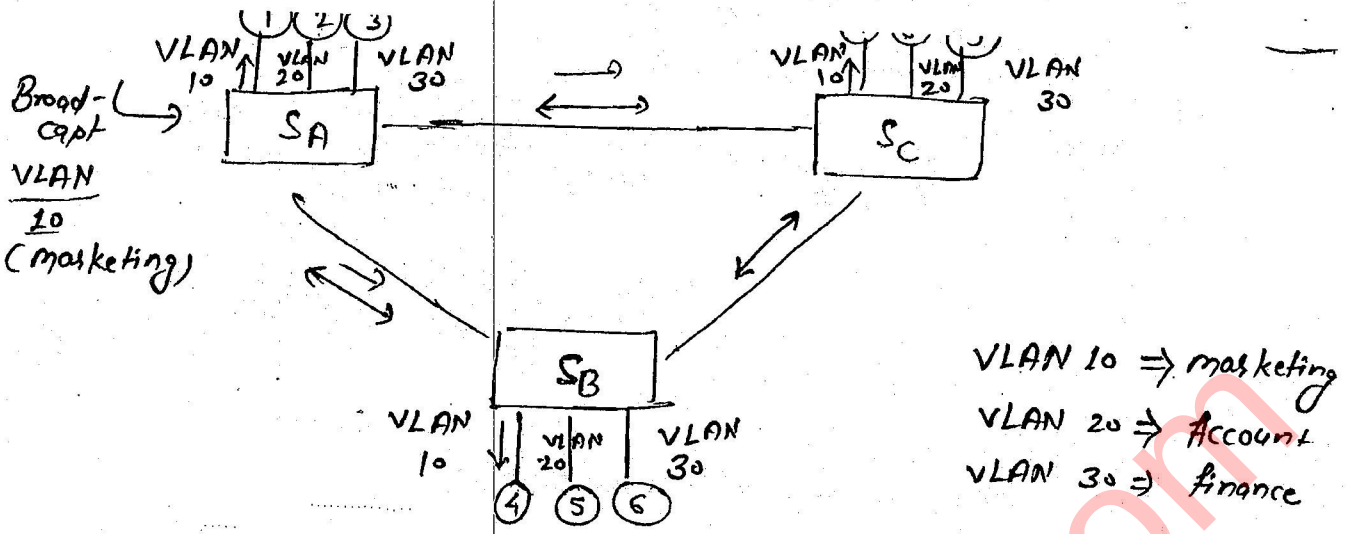


Broadcast Domain :- The place or area, where broadcast has been done is known as Broadcast domain.

Note :- By default switch is not a Broadcast domain seperator.

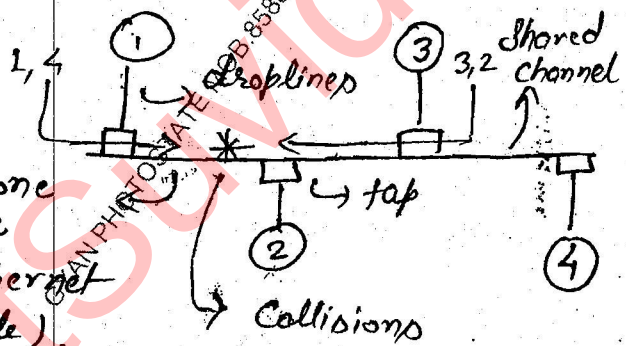
"VLAN" :- Physically systems can be placed anywhere but they are logically connected to their groups only.

VLAN ⇐ LAN
↳ can be formed by configuring the Ports of switch.



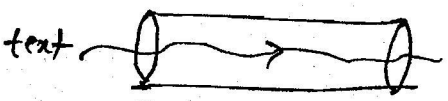
★ If A LAN is converted into VLAN then Switch will act as a Broadcast domain seperator.

"Bus Topology" :-

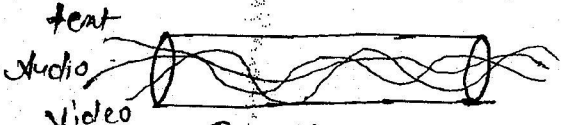


(Standard ethernet cable).

- 10 base 2 or 10 base 5
  - length = 200 m
  - length = 500 m
  - Bandwidth = 10 Mbps
  - Baseband signalling.



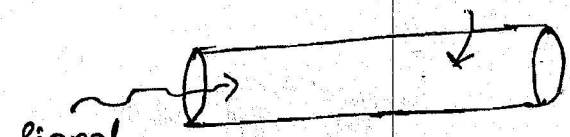
Baseband signalling



Broadband signalling.

★ (1) If only one type of data is alotted is known as baseband signally

(2) If More than one type of data is allotted is known as broadband signalling.



$\left(\frac{S}{N}\right)_{\text{ratio}} = \log_{10} \frac{\text{signal Power}}{\text{Noise Power}}$ bels

$= 10 \log_{10} \left(\frac{S_p}{N_p}\right)$ decibels ✓

(bel x 10 = decibels)

(1.) Signal Power = 100 milli ~~seconds~~ watts

Noise Power = 10 milliwatts

$\left(\frac{S}{N}\right)_{\text{ratio}} = 10 \log_{10} \left(\frac{S_p}{N_p}\right)$

$= 10$ dB (+ve)

Signal power is dominating noise Power.

(2) Signal Power = 10 milliwatts

Noise Power = 1000 milliwatts

$\left(\frac{S}{N}\right)_{\text{ratio}} = 10 \log_{10} \left(\frac{S_p}{N_p}\right)$

$= 10 \log_{10} \left(\frac{10}{1000}\right)$

$= 10 \log_{10} (10^{-2})$

$= -20$ dB (-ve)

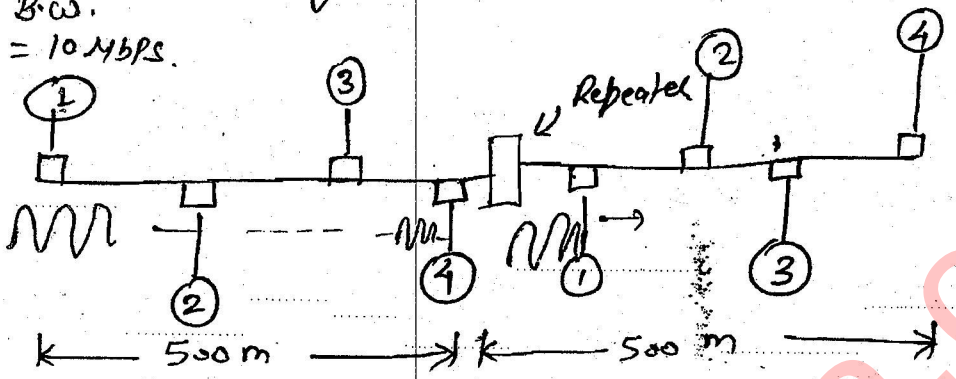
Noise Power is dominating the Signal Power.

$$\text{max data rate} = B \cdot \log_2\left(1 + \frac{S}{N}\right)$$

B → Bandwidth

10 base 5 ⇝ length = 500 m

↳ B.W. = 10 Mbps.



★ 'Repeater' is a regenerator device i.e. it regenerates the signal to its original strength.

★ Repeater is used to increase the length of the LAN

★ Both Hub and repeaters are passive device.

★ Hub is a multiport device while a repeater is a two-port device.

O.S.I Model :- 7 layers :-

- Application layer
- Presentation layer
- Session layer

"message"

[A.H.] Data

↓

[P.H.] [A.H.] Data

All layer switch

Port address (16 bit) → Transport Layer → 'segment' TCP, 'Datagram' UDP { Gateway }

IP Address → Network Layer (WAN) → 'Packet' { Router } - 3 layer switch

MAC Address → Data link Layer (LAN) → 'frame' { Bridge } - 2 layer switch

- Physical Layer → 'bits' { Hub, repeater } (Passive devices)

Note :- Network Architecture is known as protocol 'stack' Architecture, because the last Header that is added at the Sender's side is the first Header that is removed at the reciever's side.

★ 'Data link Layer' is responsible for 'Node-to-Node delivery' with in the LAN

★ 'Network Layer' is responsible for 'Source to destination delivery' b/w the Networks.

★ 'Transport layer' is responsible for 'process to process or End to End delivery.'

★ Combination of Port and IP address is known as 'Socket Address.'

① Does packet Encapsulate frame or frame encapsulate packet ?

Packet ⇒ | N.H. | T.H. | - - - | Data |

frame ⇒ | D.H. | N.H | T.H | - - - | Data |

→ Packet

frame

② M is a message that should be transmitted, H is the header that is added at every layer. 'N' layers are present in hierarchy then calculate the fraction of data in the whole content that is transmitted ?

N Layers So No of headers will be added = N

So whole data :- $\overline{NH + M}$

∴ fraction of message to be transmitted = $\frac{M}{NH+M}$

∴ fraction of header = $\frac{NH}{NH+M}$

* Services of layers :-

:- Application Layer ⇒ Application services like : http, ftp, SMTP, DNS etc.

:- Presentation Layer ⇒ Syntax and Semantics data

:- Session layer ⇒ Dialog control and session management.

Note :- Seven Layers of OSI model has been reduced to five layers of TCP/IP Model by including the functionalities of the presentation and session layer in Application layer.

:- Transport Layer ⇒ Segmentation, flow control, error control, Congestion policies.

:- Network Layer (WAN) ⇒ Traffic shaping, Routing, fragmentation.

:- Data link Layer (LAN) ⇒ flow control, error control, Access control, framing.

:- Physical Layer ⇒ Physical and electrical characteristics of cable.

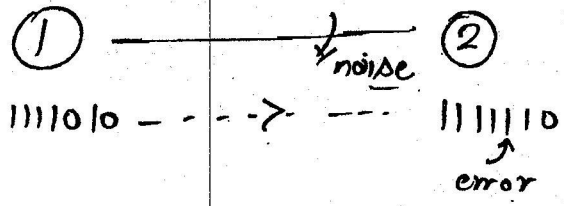
:- Flow Control :-

(1) intel ← (2) Dell

↳ flow Control policies

1) Stop and wait ARQ
2) Go Back N ARQ

ARQ :- Automatic repeat Request.

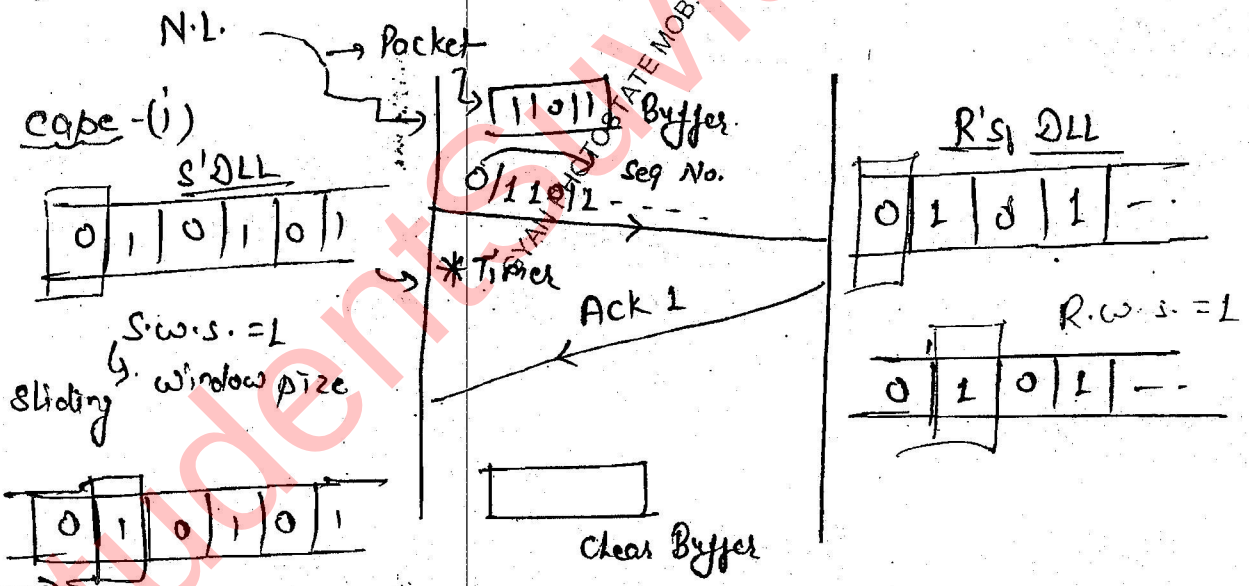


Error Control Policies

- **Error Correction Policies**
  - Ex: Hamming code
- **Error detection Policies**
  - Ex:- Parity, checksum, CRC.

★ Flow control policies of D.L.L :-

1) Stop & wait ARQ

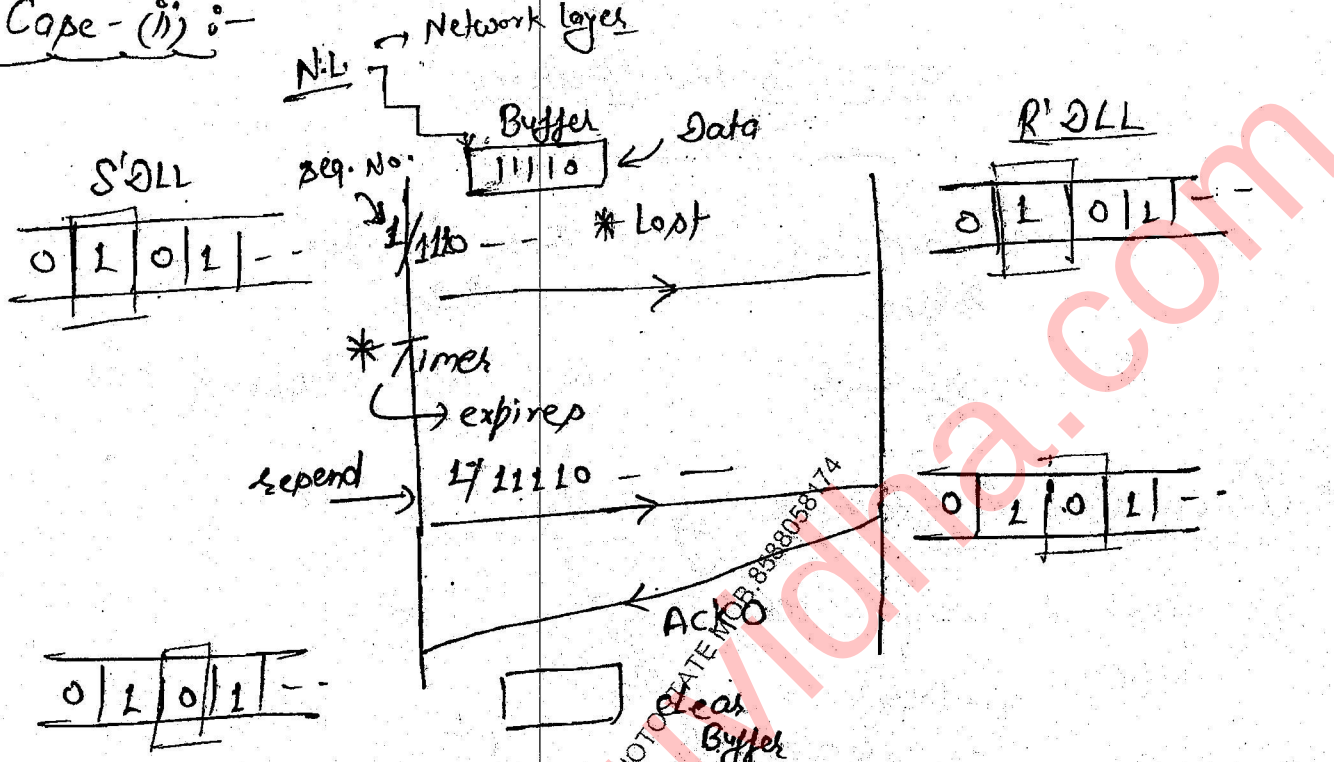


★ Once the data reaches to recieves the sequence Number of the data is compared with recieves's Sliding window Number, if there is a match data is accepted and recieves window will slide by 1 bit.

★ If there is a mismatch data will not be accepted.

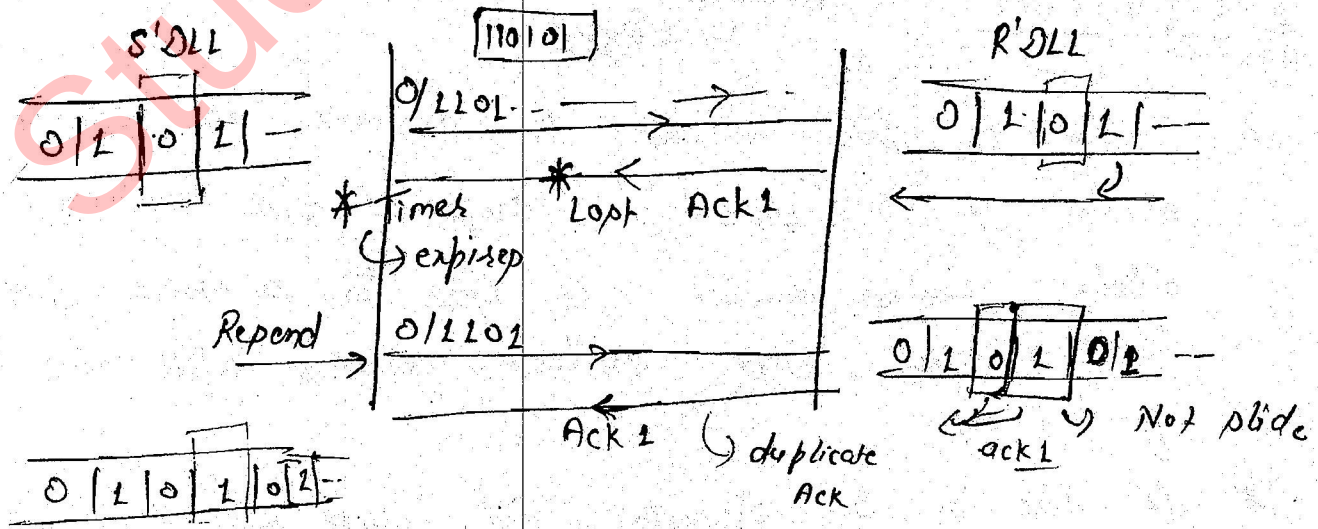
★ The Acknowledgement Number will always be the sequence Number of Next expected data then only acknowledgement is accepted.

Case - (ii) :-



★ once the data is lost automatically the timer will expire then protocal will resend the data and this data is accepted.

★ Case - (iii) :-



* In Stop & wait ARQ It supports only individual frames and individual acknowledgements.

* In Sliding window Protocols Sender's window size indicates Number of frames that are transmitted in round trip time (R.T.T.)

* In All Sliding window protocols the maximum Sender window + maximum reciever's window will always be equal to distinct sequence number count.

⇒ The Drawback of Stop & wait ARQ is Bandwith utilization is less because we are transmitting only one frame in round trip time. (R.T.T.)

(Q)
B.W. = 50 Mbps
R.T.T. = 25 μsec
frame size = 25 bits.

→ 1 sec = 50×10^6 bits

→ 25 μsec = $25 \times 10^{-6} \times 50 \times 10^6$ bits

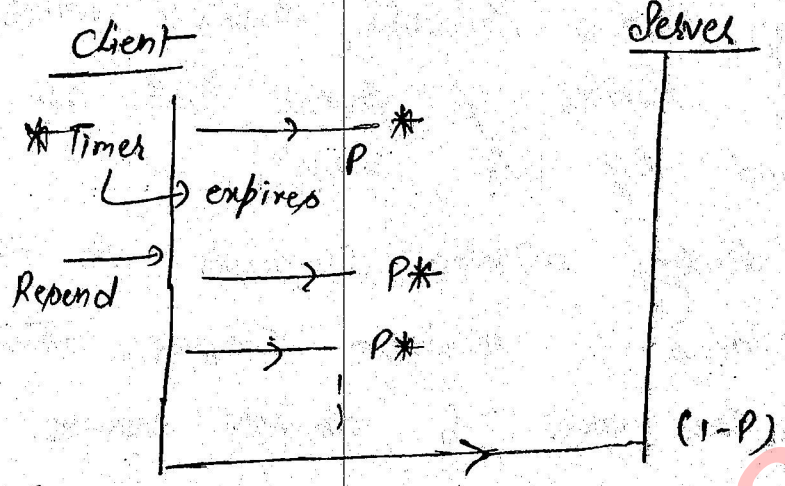
No of bits in R.T.T. = (25×50)

→ No of frames = $\frac{25 * 50}{25}$ = 50 frames.

% B.W. utilization = $\frac{1}{50}$ ← No of frames in stop & wait ARQ. $* 100 = 2\%$

(1) Probability of frame being lost is 'p'

mean no of transmissions of a frame is :



P, P, P, - - - (1-P)

k transmission

(k-1)

mean no of transmissions of a frame :-

$$E(k) = \sum_{k=1}^{\infty} k P(k) \quad \text{or} \quad \int_{k-1}^{\infty} k P(k)$$

$$= \sum_{k=1}^{\infty} k * P * (1-P)^{k-1}$$

$$= (1-P) \sum_{k=1}^{\infty} k * p^{k-1}$$

$$= (1-P) \left[1 + 2p + 3p^2 + 4p^3 + \cdots \right]$$

$$= (1-P) * (1-P)^{-2}$$

$$\left\{ (1-x)^{-1} = 1 + x + x^2 + x^3 + \cdots \right.$$

$$\left. (1-x)^{-2} = 1 + 2x + 3x^2 + 4x^3 + \cdots \right\}$$

mean no of transmissions of a fram with lost probability p.

$$= (1-P)^{-1} = \frac{1}{1-P}$$

(2) Probability of frame reaching safely is φ then mean no of transmissions of a frame is : $\frac{1}{\varphi}$ ⇐ $\frac{1}{1-p}$ formula

∴ Lost Probability = $(1-\varphi)$

(3) Probability of frame reaching safely is '0.1' then mean no of transmissions of a frame is = $\frac{1}{0.1}$ = 10 times

Sequence bits — Sequence No.

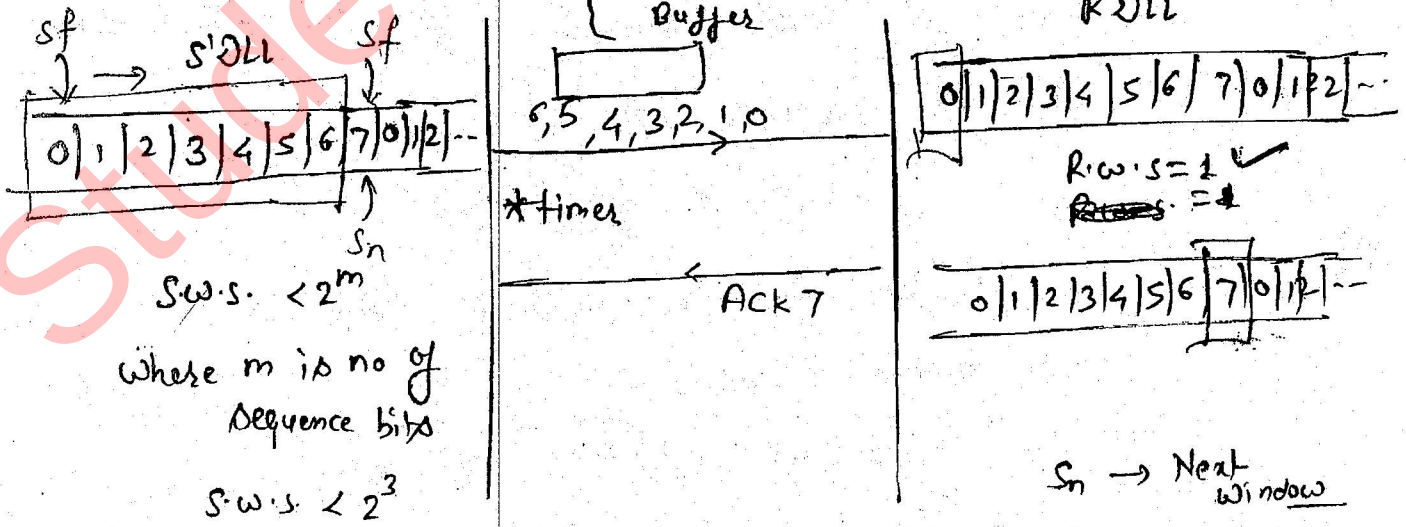
1 → 0, 1

2 → 00 (0, 1, 2, 3)
01
10
11

3 → (0 - 7)

"Go Back N ARQ" :-

Case - 1st :-



S.w.s. $< 2^m$

where m is no of sequence bits

S.w.s. $< 2^3$

Sn → Next window

★ Go back N ARQ supports cumulative frames and cumilative acknowledgements.

★ Sf will shift to the position that is pointed by the ack number.

(1) 6 bit sequence number is used in Go back N ARQ for S.w.s & R.w.s.

S.w.s	R.w.s
$2^6 > 63$	1

(2) max size of sender window in go back N ARQ = 7. No of sequence bits = ?

$S.w.s < 2^m$ m → no of sequence bits

$S.w.s_{max} <= 2^m - 1$

$\Rightarrow 2^m = (1 + S.w.s_{max})$

$\Rightarrow \boxed{m = \log_2(1 + S.w.s_{max})}$

(3) Max size of sender window = 8 in Go Back N ARQ

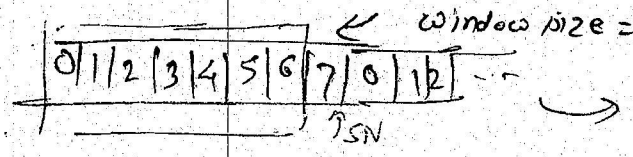
No of sequence bits = ?

$\Rightarrow m = \log_2(1+8)$

(4) Max seq. Number in Go Back N ARQ = k

max sender window :-

a) k-1 b) k+1 c) k d) none



← window size = 7

max. seq. no = 7

Condition i.e. $S.w.s < 2^m$, when $m = 1$

It behaves as: Stop & wait ARQ.

Note:- Go Back N ARQ supports both individual Ack's and cumulative Acks. (acknowledgements).

(6) B.w. = 50 Mbps

R.T.T. = 20 μsec

frame size = 10 bits.

what would be the window size =

No of sequence bits = in Go Back N ARQ

1 sec = 50×10^6 bits

20 μsec = $20 \times 10^{-6} \times 50 \times 10^6 = 1000$ bits

No of frames in R.T.T = $\frac{1000}{10} = 100$ frames.

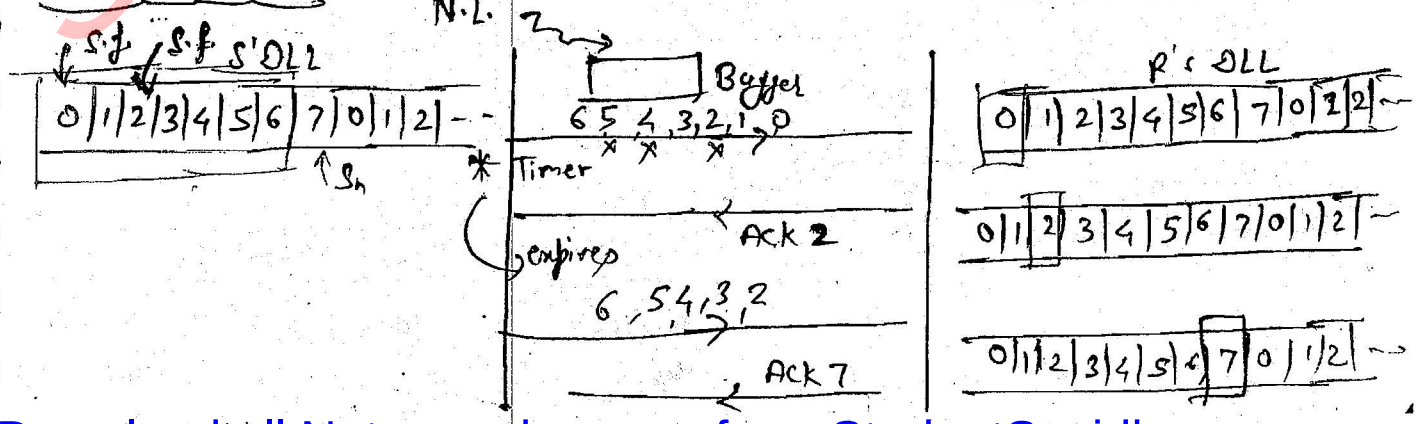
Window size = No of frames in R.T.T

= 100 frames

No of sequence bits = $2^7 = 7$ bits.

S.w.s	Rws
127	1

Case - II nd :-



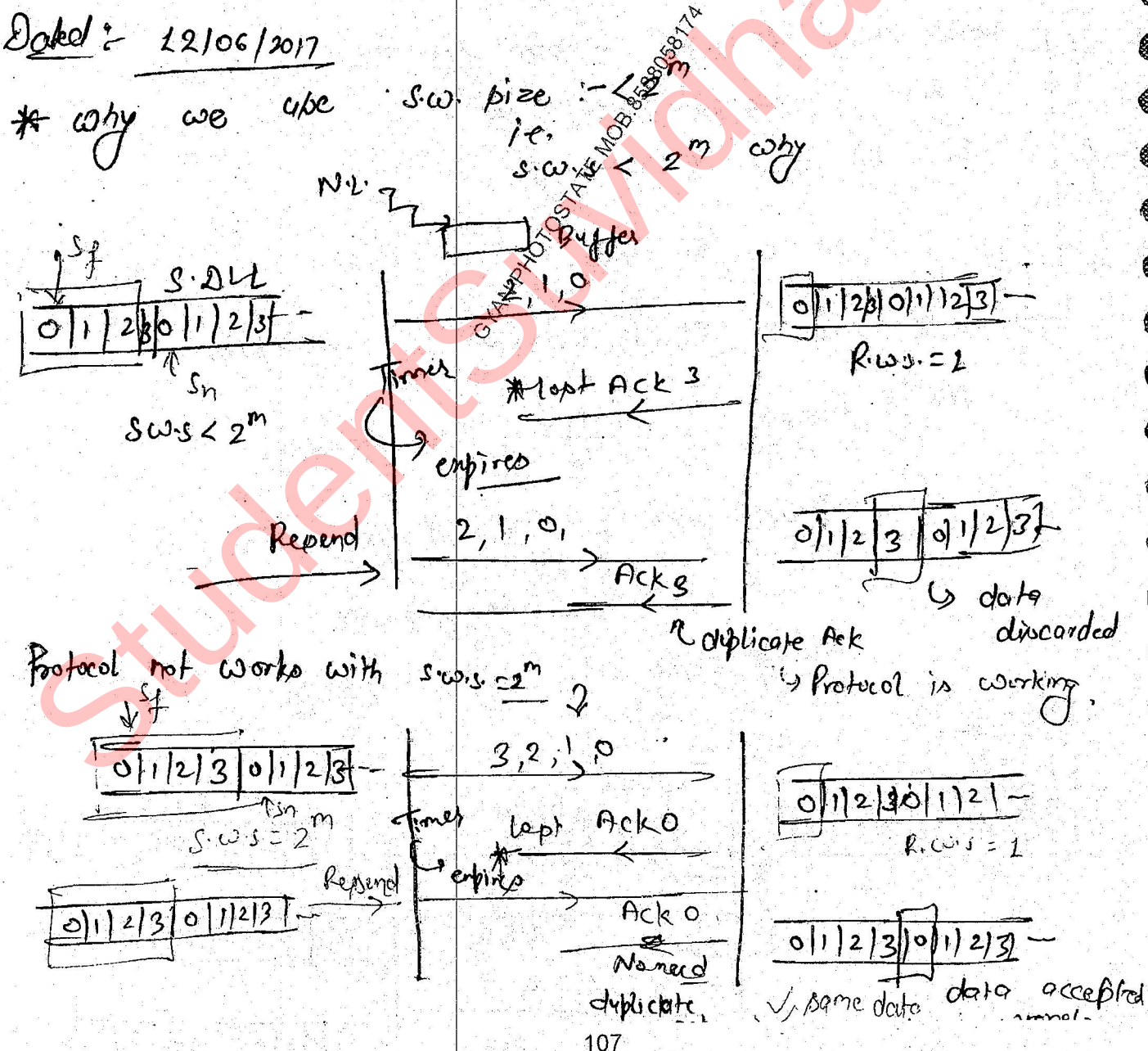
★ In Go Back N ARQ, If a frame is lost then the frame that is lost as well as all following frames should be retransmitted.

Drawback :- for Noisy channels there are more No. of retransmissions, in Go Back N ARQ, so overall utilization will decrease.

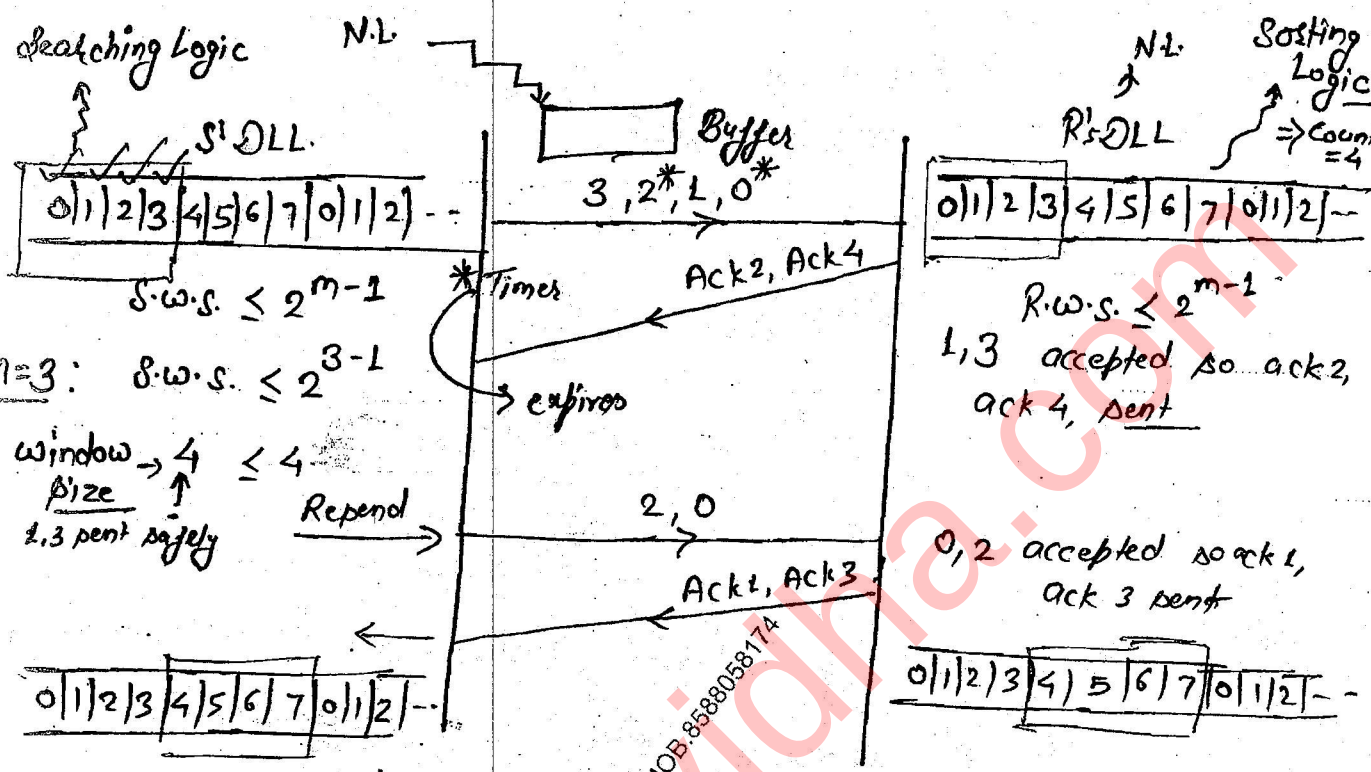
★ There is no pipelining in stop & wait ARQ. so utilization is less, there is pipelining in Go Back N ARQ.

Dated :- 12/06/2017

★ why we use s.w. size :- $\leq 2^m$ i.e. s.w.s $< 2^m$ why



Selective Repeat ARQ :-



★ In Selective Repeat ARQ, it supports only individual acknowledgements.

★ In Selective Repeat ARQ, the Numbers of Retransmissions are less compare to Go Back N ARQ.

★ Sorting logic will be applied when all four frames will be recieved.

★ Reciever's window size ≤ Sender's window size

① 6 bit sequence number is used then

	S.w.s.	R.w.s.	
Go Back N ARQ	63	1	$2^m - 1$
Selective Repeat ARQ	32	32	2^{m-1}

(2) max size of sender window in selective repeat ARQ = 4

No of sequence bits = ?

S.W.S. in selective repeat $\leq 2^{m-1}$

$S.W.S_{max} = 2^{m-1}$

$S.W.S_{max} = \frac{2^m}{2}$

$2^m = 2 * S.W.S_{max}$

$\Rightarrow \boxed{m = \log_2(2 * S.W.S_{max})}$

(3) max size of sender window = ϕ in selective repeat

No of sequence bits = $\frac{\log_2(2\phi)}{\log_2 2 + \log_2 \phi}$

$= 1 + \log_2 \phi$

Note :—

* By default for maximum utilization Go Back N ARQ is used.
* for Noise channels, for maximum utilization Selective repeat ARQ is used.

(4) max sequence number in selective repeat ARQ = 7

maximum size of sender window = ?

$= \frac{7+1}{2} = 4.$

0	1	2	3	4	5	6	7	0	1	2	—

$\phi = 4$ ⟩ max. sequence No + 1

(2.) max sequence numbers in selective repeat ARQ is = "N"

max size of sender window in selective repeat = $\frac{N+1}{2}$

(max sequence no.)

Note :- "Buffer requirement" is 'less' in 'Stop & wait ARQ' where as it is 'High' in Go Back N ARQ, and it is moderate in "Selective repeat ARQ."

★ When the Bandwidth is limited selective repeat ARQ performance is good, compared to Go Back N ARQ.

Note :- "Stop & wait is a theoritical protocal whereas the Stop & wait ARQ is a practical protocal with sliding windows."

Note :- Stop & ARQ and Go Back N ARQ accepts the frames on recievers end in-order. while in selective repeat ARQ, the all frames of window (sliding) recieved out of order then they are sorted, when all frames recieved safely.