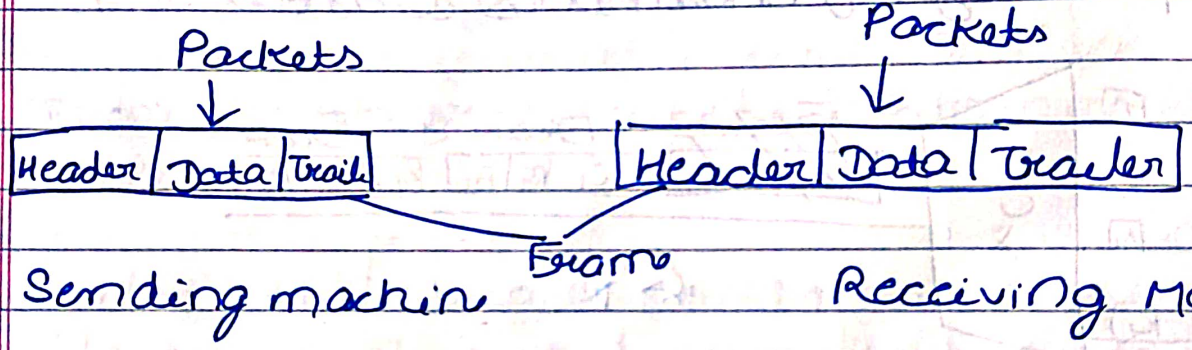
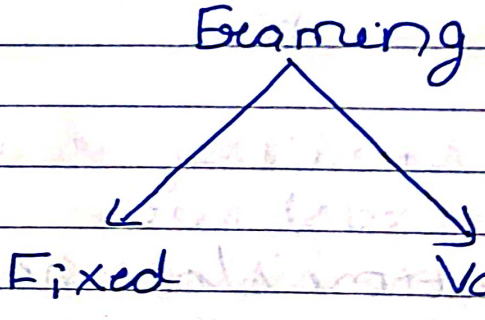
Unit-4

- **Framing**

Framing is a function of the data link layer. It provides a way for a sender to transmit a set of ~~bits~~ bits that are meaningful to the receiver. Frame are the units of digital transmission in computer networks and telecommunication.

Frame is continuosly used in Time Division Multiplexing process



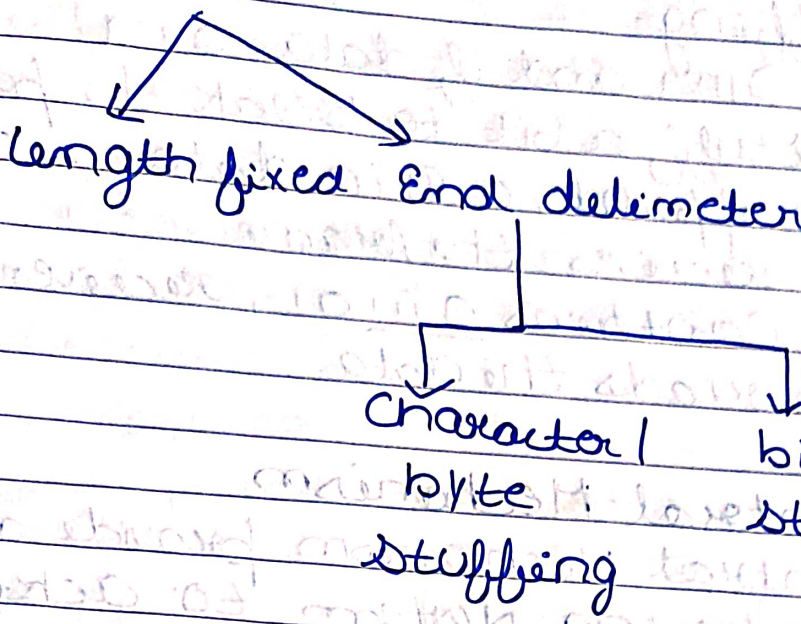


1. Fixed size ÷ Frame is of fixed size and length of the frame itself acts as a delimiter.

Drawback ÷ Suffers internal fragmentation

Solution ÷ Padding

2. Variable size -



i Length fixed: In a frame we can define the length field to show length of frame

Draw back: length field might get corrupted.

ii End delimeter: We introduce an ED (pattern) to indicate the end of the frame.

SED	H	PID	T	ED

Problem can be solved by

a) Character / byte stuffing:
In character stuffing sender data link layer insert special character just before byte ($)

A receiver end data link layer remove the special special character ($).

H	$	01	$

Dis: Very Costly

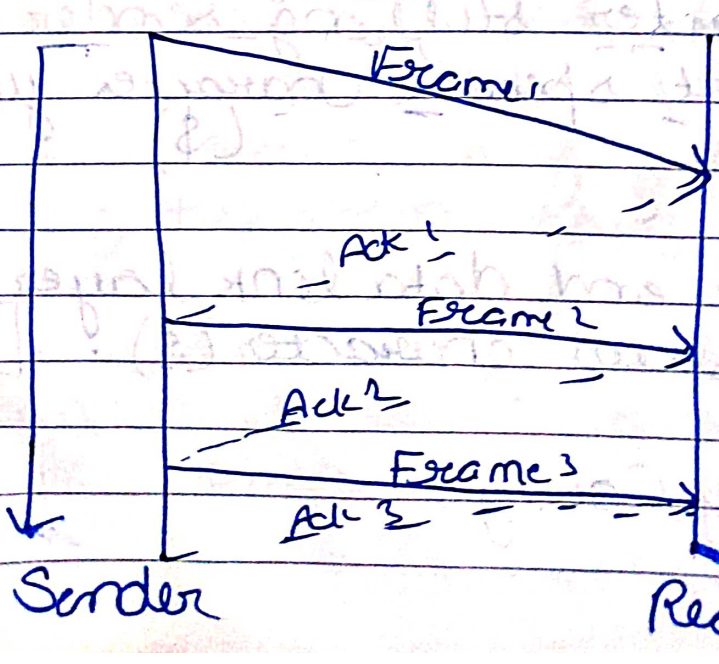
b) Bit Stuffing:
Let ED = 01111 and if data = 01111
→ sender stuff a bit to break the pattern i.e Here apperds a 0 in data = 011101
→ Receiver receives the frame.
→ If data contains 011101, receiver removes the 0 & reads the data.

- Flow Control Mechanism
Flow Control Mechanism provide a way for a receiving system to acknowledge that it has received a packet and a way for the sender to know that it must retransmit lost or corrupted pac

There types of mechanism

1. Stop and wait
→ Sender wait for acknowledgment after every frame send.

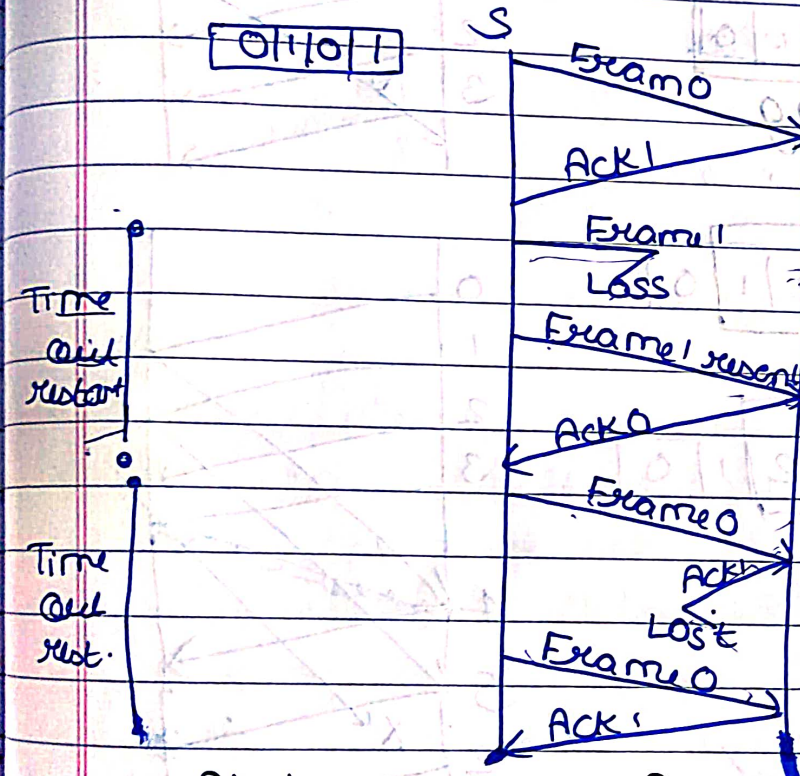
→ When acknowledgment received then only next frame is sent.



Working

The above figure shows the working of the stop and wait protocol. If there is a sender & receiver, then sender sends the packets. The sender will not send the second packet without receiving the acknowledgment of the first packet. Once the acknowledgment received, sender send the next packet.

Disadv.



Sliding Window Protocol

OR

2 Go-back N ARQ

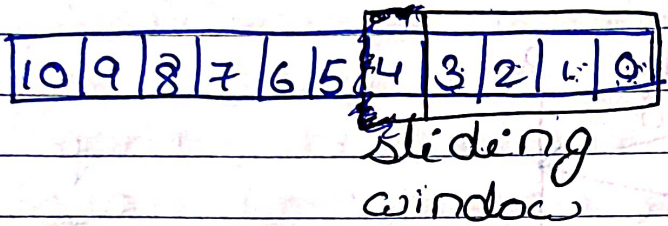
→ It uses the concept of pipeling i.e sender send multiple frame before receiving ack of first frame.

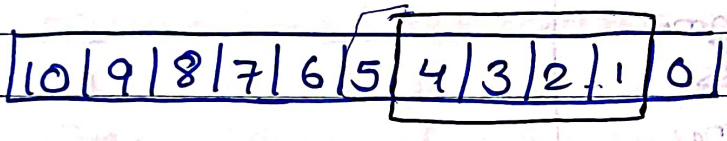
→ The number of frame depend on size of window(N).

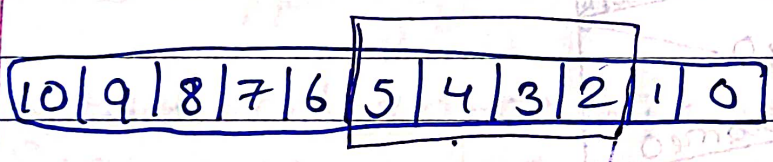
→ If Ack not received of a frame within time period then all the frame in current window are retransmitted.

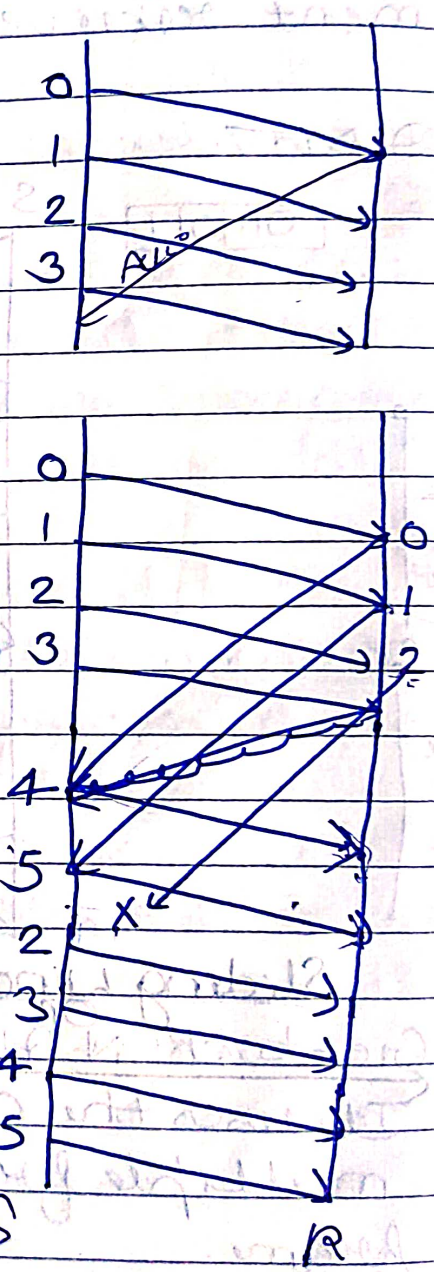
→ The size of window determine the sequence number of frame.

window size = 4









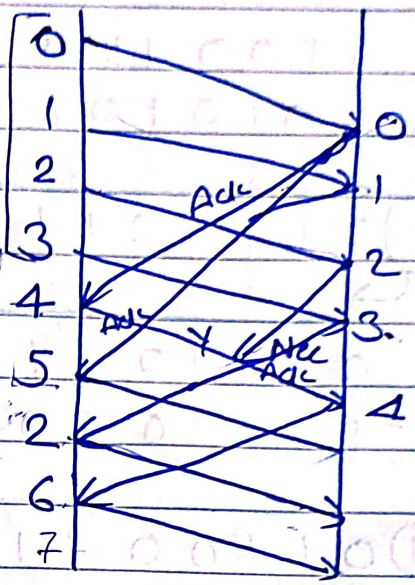
3/ Selective Repeat ARQ

3 Selective Repeat ARQ

In selective repeat ARQ only lost of frame are retransmitted while correct frame are received. The sender will send / retransmit frame for which negative ack recieved.

10	9	8	7	6	5	4	3	2	1	0

window size = 4



⊙ Checksum

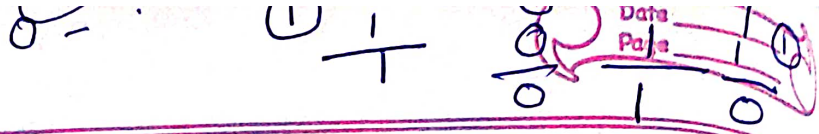
For error detection by checksum data are divided by equal size of frame. checksum detect all error in odd no. of bit & most error in even no. of bit.

Sender

1. Add segment using 1's complement arthimetic to get sum.
2. If then complement to get checksum
3. Send data along with checksum.

Receiver

1. Add the incomming segment along with checksum using 1's compliment arthimetic to get sum.



2 Complement 1's
3 If result is zero frame accepted otherwise rejected.

eg 11001100 , 10101010, 11110000, 11000011

```
  11001100   F1
+ 10101010   F2
-----------
1 01110110
  |_____|
  01110111
+ 11110000   F3
-----------
1 01100111
  |_____|
  01101000
+ 11000011   F4
-----------
1 00101011
  |_____|
  00101100
```

Sender

1's = 11010011 Checksum

Receiver

```
  00101100   F4 / Resultar
+ 11010011   checksum
-----------
  11111111
```

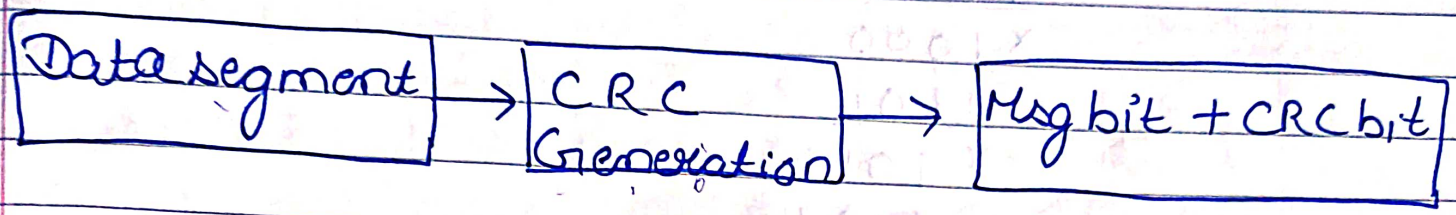
1's = 00000000 Accept data

Imp

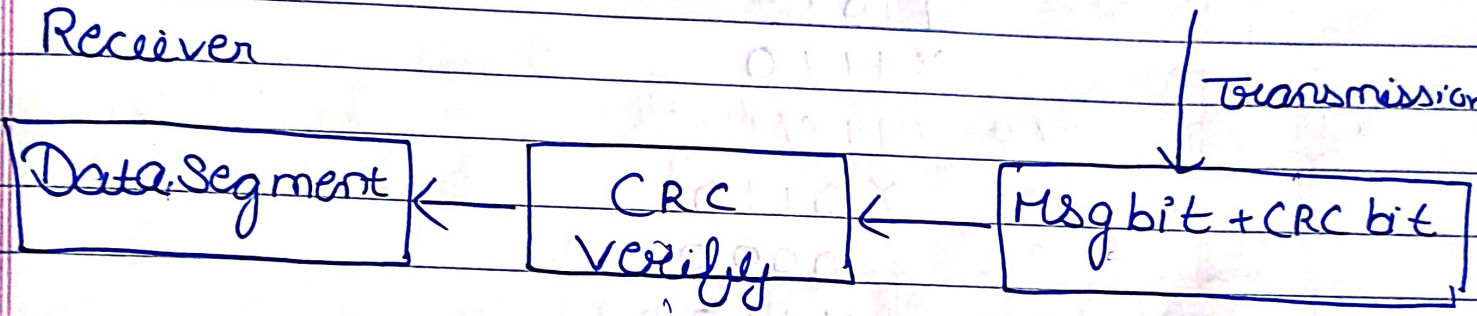
- Cyclic Redudency Check (CRC)

CRC is most powerful technique and it is used based on binary division. CRC involve binary division of data bits sent by predetermined divisor.

Sender



Receiver



CRC generation

1. Find length of divisor
2. Append L-1 bits '0' to original msg
3. Perform binary division operation
4. Remainder of division = CRC
5. Transmitted msg = msgbit + CRC bit

CRC verify

1. Received data is devided by divisor
2. If no remainder the data is correct & Accept
3. Otherwise data is rejected.

eg:- Msg :- 100100

divisor :- 1101

L = 4

L-1 = 3

```
          111101
      ------------
1101 ) 100100000 (
       1101
       ----
       X1000
        1101
        ----
        X1010
         1101
         ----
         X1110
          1101
          ----
          X0110
           0000
           ----
           X1100
            1101
            ----
            X001   = CRC
```

Sender

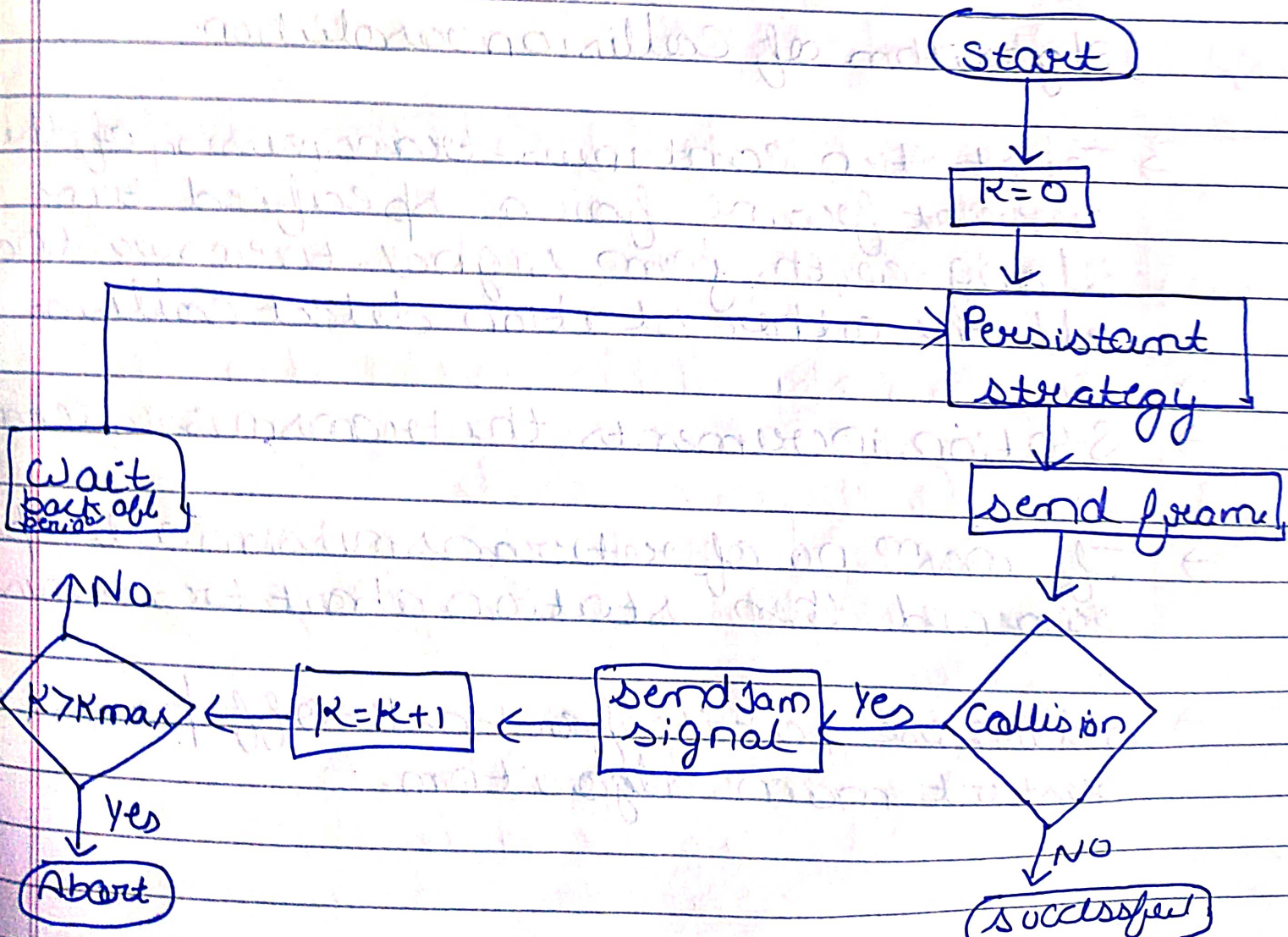
Receiver

```
          111101
      ------------
1101 ) 100100001 (
       1101
       ----
       X1000
        1101
        ----
        X1010
         1101
         ----
         X1110
          1101
          ----
          X0110
           0000
           ----
           X1101
            1101
            ----
            X000
```

Accept

- Carrier Sense Multiple Access (CSMA)
It is a carrier sense access based media access protocol to sense the channel (idle or busy), if channel is idle, the station can send data otherwise wait until the channel becomes idle.

- Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
In this method any station can send data, the station then monitor the medium to see if transmission was successful, if there was collision the frame need to sent again.



Algorithm of CSMA/CD

→ When frame is ready, the transmission station check whether the channel is idle or busy.

→ If channel busy, wait until channel becomes idle

→ If channel idle, the station starts transmitting & continually monitors the channel to detect collision.

→ If collision detected, station starts the collision resolution algorithm.

Algorithm of collision resolution.

→ The station continues transmission of the current frame for a specified time along with jam signal. to ensure that all the other station detect collision

→ Station increments the transmission counter

→ If max^m no. of retransmission attempts reached then station abort transmission

→ otherwise, waits for back-off period & restart main algorithm.

- Hamming distance
The number of bit positions at which two code differs called hamming distance.

eg: 1 0 0 1
0 1 0 1 = Hamming distance = 2

The hamming distance between two strings, a & b is denoted as d(a,b).

It is used for error detection or error correction when data is transmitted over computer network.

- Minimum hamming distance
It is the smallest hamming distance b/w the all possible codes in the given encoding scheme.

Q Find the hamming distance b/w the codes word of C
C = {(0,0,0,0), (0101), (1011), (0111)}

Ans x = 0 0 0 0
y = 0 1 0 1
z = 1 0 1 1
w = 0 1 1 1

d(x,y) = 0 0 0 0 = 2
0 1 0 1

d(x,z) = 0 0 0 0 = 3
1 0 1 1

$d(x, w)$: 0 0 0 0 = 3
0 1 1 1

$d(y, z)$ = 0 1 0 1 = 3
1 0 1 1

$d(y, w)$ = 0 1 0 1 = 1
0 1 1 1

$d(z, w)$ = 1 0 1 1 = 2
0 1 1 1

- High level data link protocol (HDL)
HDLC is a bit oriented data link protocol, and it is designed to satisfy many of data control requirements.

Following mode of operation are possible in HDLC:

i) Normal response mode

ii) Asynchronous balanced mode

a) Normal response mode
This mode is suitable for point-to-point as well as point-to-multipoint configuration.

b) Asynchronous balanced mode
This mode is applicable to point-to-point comm b/w combined station.

Difference b/w Go-Back-N and Selective Repeat

Go-Back-N	Selective Repeat
i) Retransmits 'N' no. of frames in Case of any error.	i) Retransmits only those frames that have problem.
ii) if Error-rate is ↑, it wastes lot of Bandwidth.	ii) Less wastage of Band-width.
iii) Less Complicated.	iii) More Complex (Storage, Sorting)
iv) Sorting is not Req.	iv) Required.
v) Most often used.	v) Less used due to ↑ Complexity

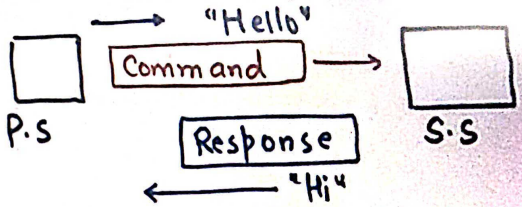
HDLC [High Level Data Link Control]:- It is a bit-oriented protocol for communication over point-to point and multipoint links.

Transfer Modes:-

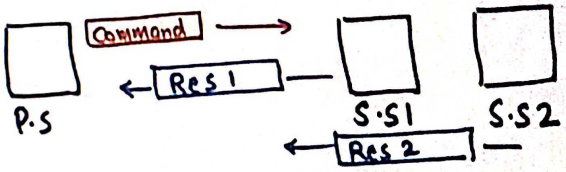
Normal Response Mode (NRM)
↳ Station Config. is Unbalanced.
* One Primary station
↳ Send Commands.
* Multiple Secondary Station
↳ Respond
→ Point to point and Point to multipoint

Asynchronous Balanced Mode (ABM)
↳ Configuration is Balanced.
* Point to Point
* Each Station Can function as Primary & Secondary.

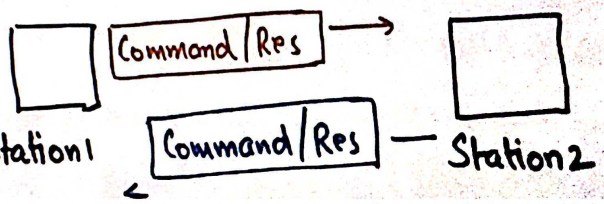
Point to Point (NRM):-



Point to Multipoint (NRM):-

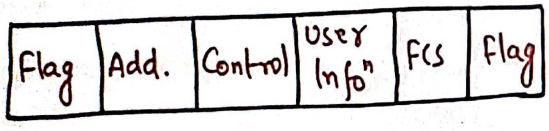


Point to Point (ABM):-

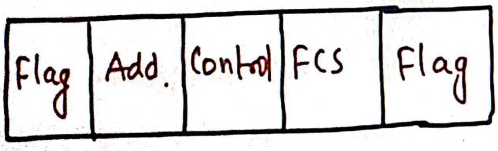


Types of Frames in HDLC:- There are three types of frames supported by HDLC.

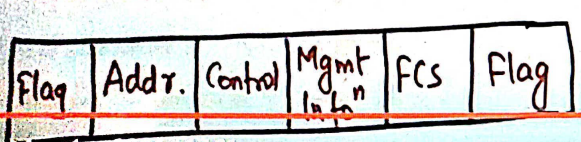
i) Information (I) Frames:- Transport → user data, Control info^n



ii) Supervisory (S) Frames:- Transport only Control Inf



iii) Unnumbered (U) Frames:- Reserved for System Mgmt.



Frame format of HDLC:- There are Six (6) types of fields. (↳ upto)

i) Flag → Beginning, End of the Frame. | Serves as Synchronization pattern for receiver.

ii) Address → Contains the Address of the Station (Secondary) P.S — 'to' S.S — 'from'

iii) Control → used for Error and Flow Control.

iv) Information → user's data or Management Info^n.

v) FCS → Frame Check Sequence.
↳ HDLC Error detection field.

Point-to-Point Protocol (PPP):- It is the most Common protocol for point-to-point access.

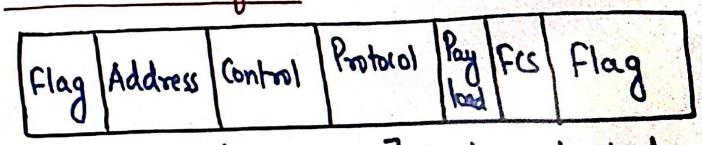
Services provided by PPP:-

i) Defines format of frames.
ii) Defines Link establishment process.
iii) Defines Data exchange process.
iv) Defines How N/w Layer data are encapsulated in data link frame.
v) Defines Authentication process b/w two devices.

Services Not provided by PPP:-

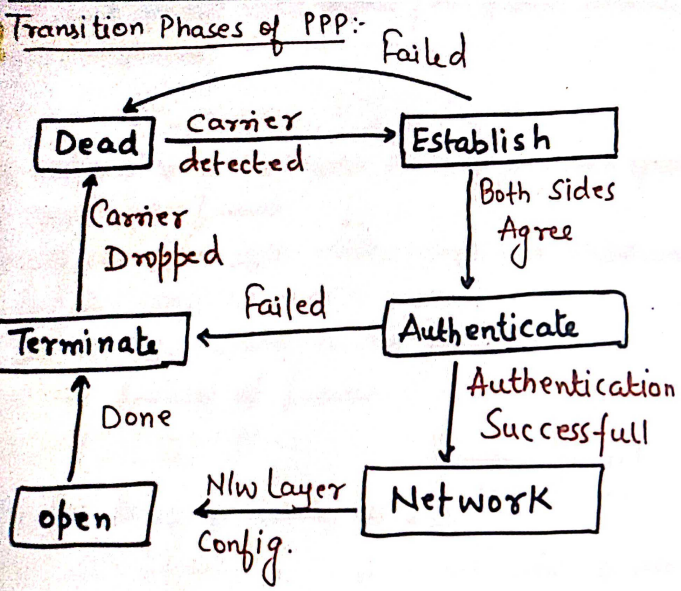
i) Flow Control.
ii) Very Simple mechanism for Error Control.
iii) No addressing mechanism to handle frames in multipoint Configuration.

Frame Format of PPP:-



i) Flag: → Start] of the frame] Byte-Oriented Protocol.
  → end]
ii) Address: Constant Value 11111111] → Broadcast Address.
iii) Control: Constant Value 11000000
  → Not needed Generally.
iv) Protocol: defines what is Carried in data field → User data / → other Info^n.
v) Payload Field: → Carry either userdata or other Info^n.
vi) FCS :- Frame check Sequence

Transition Phases of PPP:-



i) Dead:- Link is not used.
ii) Establish:- Node starts comm^n.
iii) Authenticate:- optional
iv) Network:- Negotiation of Nlw layer protocols.
v) open:- Data transfer
vi) Terminate: Conn^n is terminated.

PPP Stack:-

↳ i) Link Control Protocol (LCP):- Establish, Maintain, Configure, Terminate } links

ii) Authentication Protocols:- → PAP (Pwd)
↳ CHAP (Challenged Handshake)

iii) Network Control Protocol (NCP):-