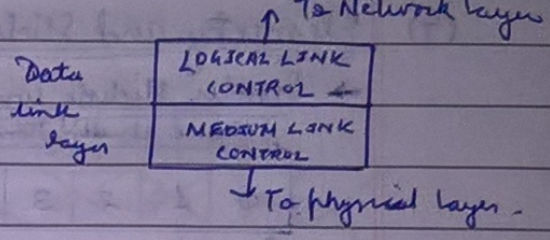
UNIT-2

DATA LINK LAYER

LOGICAL LINK LAYER
MEDIUM ACCESS LAYER CONTROL

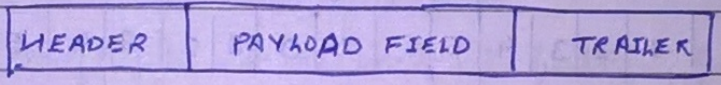
① **Need of data link layer** - (functions)
(1) Access to Media
(2) Provide reliable transfer of data across media
(3) Transmit frames node to node based on station address
(4) Provide service interface to the network layer.

② **Design Issues** -
(1) Service provided to network layer
(2) Framing
(3) Error Control
(4) Flow Control

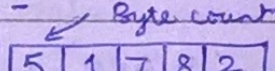


③ **Services provided to network layer** -
(1) Unacknowledged connectionless service
(2) Acknowledged connectionless service
(3) Acknowledged connection-oriented service.

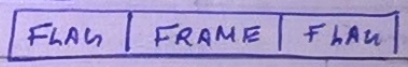
④ **Framing** -



Three ~~Four~~ methods of framing -
(1) Byte count -



(2) Flag bytes with byte stuffing -



(3) Flag bits with bit stuffing -
Five consecutive incoming 1 bits, followed by a 0 bit, it automatically delete the 0 bit Eg - 01111110 → 011111010

⑤ **Flow Control** -
When sender is fast and receiver is slow. To prevent this measure -
(1) feedback based flow control
(2) Rate based flow control.

ARQ → Automatic Repeat Request

⑥ Error Control –

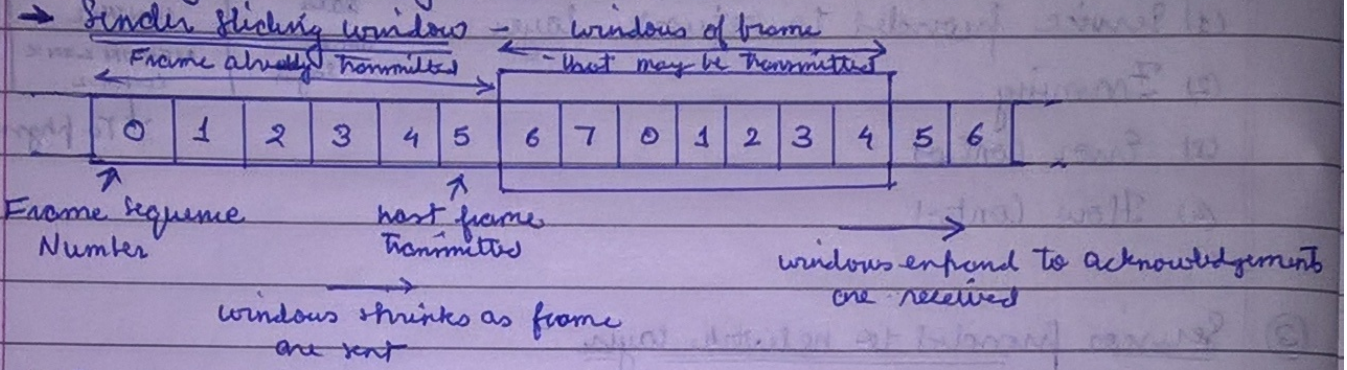
Use of acknowledgment

A timer at sender's and receiver's end is introduced. Also seq numbers to the outgoing frames are maintained so that the receiver can distinguish retransmissions from originals.

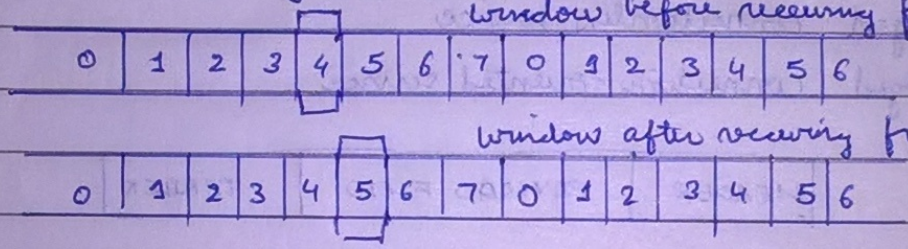
DATA LINK LAYER PROTOCOL –

⑦ Elementry and Sliding Windows protocol –

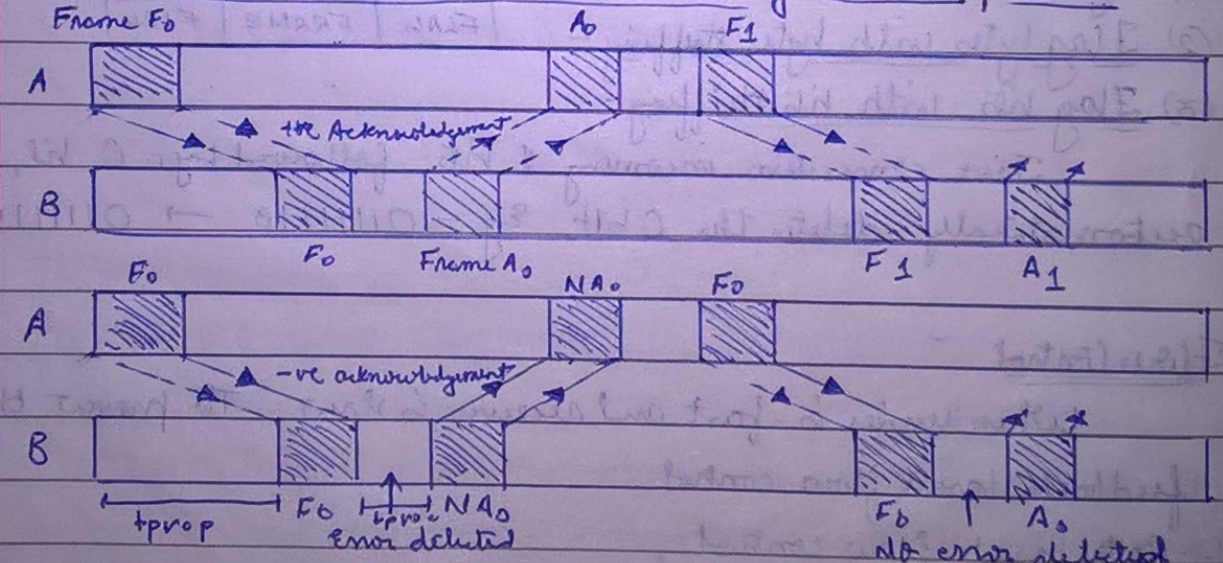
→ Sender sliding window –



→ Receiver sliding window –



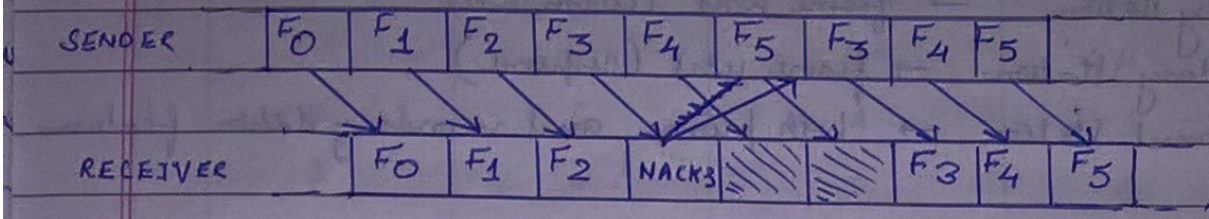
(1) One bit (Stop and wait ARQ) sliding window protocol –



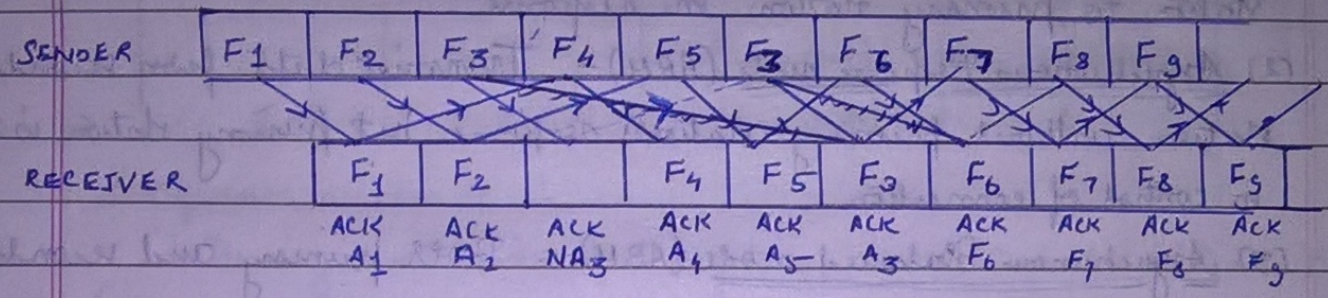
tprop → propagation delay

tproc → processing delay.

(2) Go back N ARQ Sliding window protocol -



(3) Selective Repeat ARQ -



(4) Hybrid ARQ - Combination of above 3.

(8) ~~BIT~~ Bit oriented protocols -

→ SDLC (Synchronous Data link control) protocol -

No extra bits (start/stop). A defined bit pattern for preamble and postamble with the entire data is used. (Size → 1 byte = 8 bits known as synchronizing bits). Uses Go-back-N. , part of SNA

→ BISYNC (Binary synchronous control) protocol -

Support three codes - ASCII, EBCDIC, and transcode, synchronous two way alternate communication.

→ LAP (link Access Protocol) -

Used for packet-switched networks and ISDN. It is used for framing and transmitting data across point to point links.

→ LAPB (Balanced) - Updated version.

It is a data link protocol for X.25.

→ HDLC (High level data link protocol) -

Uses on both point to point and multipoint data link

→ Three types of stations are -
(1) Primary Station → frame sent (commands)
(2) Secondary Station → frame sent (response)
(3) Combined Station → both primary and secondary station features

Transfer Modes of HDLC -
(1) Normal Response mode (NRM) - Only transmit data from secondary station to primary station in response.
(2) Asynchronous Response mode (ARM) - Transmit data from secondary station without primary station's response but primary station is still in control of connection.
(3) Asynchronous Balanced mode (ABM) - Both primary and secondary station have equal status.

Frame Types -
(1) Unnumbered frames (U-frames)
(2) Information frames (I-frames)
(3) Supervisory frame (S-frames) → used for error and flow control purpose

Frame Format -

8	8 or 16	8 or 16	variable	16 or 32	8
FLAG	ADDRESS	CONTROL BITS	DATA	FCS	FLAG

FCS → Frame Check Sequence.

HDLC Operation - Initialization, Data Transfer and Disconnect

⑨ Protocol Verification -
(1) Finite State machine model -
States, Transitions, Initial State → (0, 0, 0) (X, Y, Z)
X → Sender's frame, Y → Receiver's frame, Z → State of channel.
During normal operation, transitions 1, 2, 3 and 4 are repeated repeatedly. In each cycle, two packets are delivered, bringing the sender back to the initial state of trying to send a new frame via

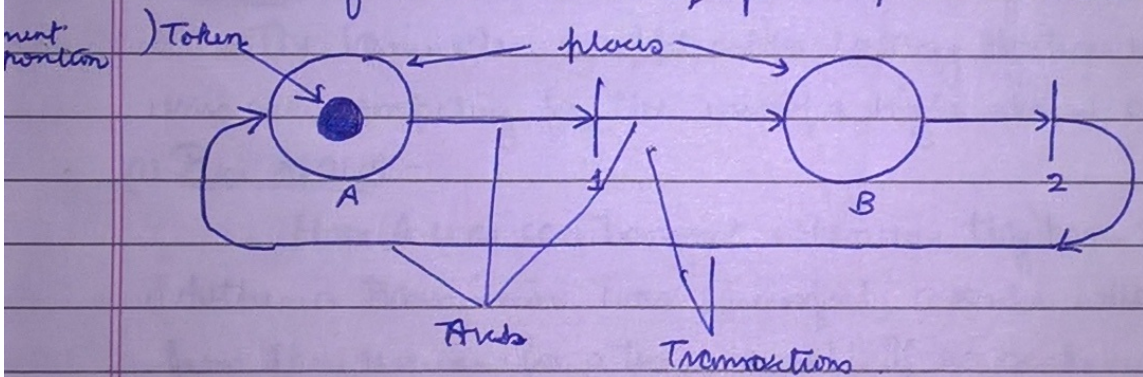
Transition	Who runs?	Frame Accepted	Frame Emitted
0	—	(Frame	lost)
1	R	0	A
2	S	A	1
3	R	1	A
4	S	A	0
5	R	0	A
6	R	1	A
7	S	(time out)	0
8	S	(time out)	1

sequence number 0.

During red's time out system moves back to initial state (Transition 7). The loss of an ACK requires two transition 7 and 5 or 8 and 6 to repair the damage.

(2) PetriNet Models- (No composite states)

four basic elements → places, transactions, arcs and tokens.



Piggybacking -

The technique of temporarily delaying outgoing acknowledgments so that they can be hooked onto the next outgoing data frame.