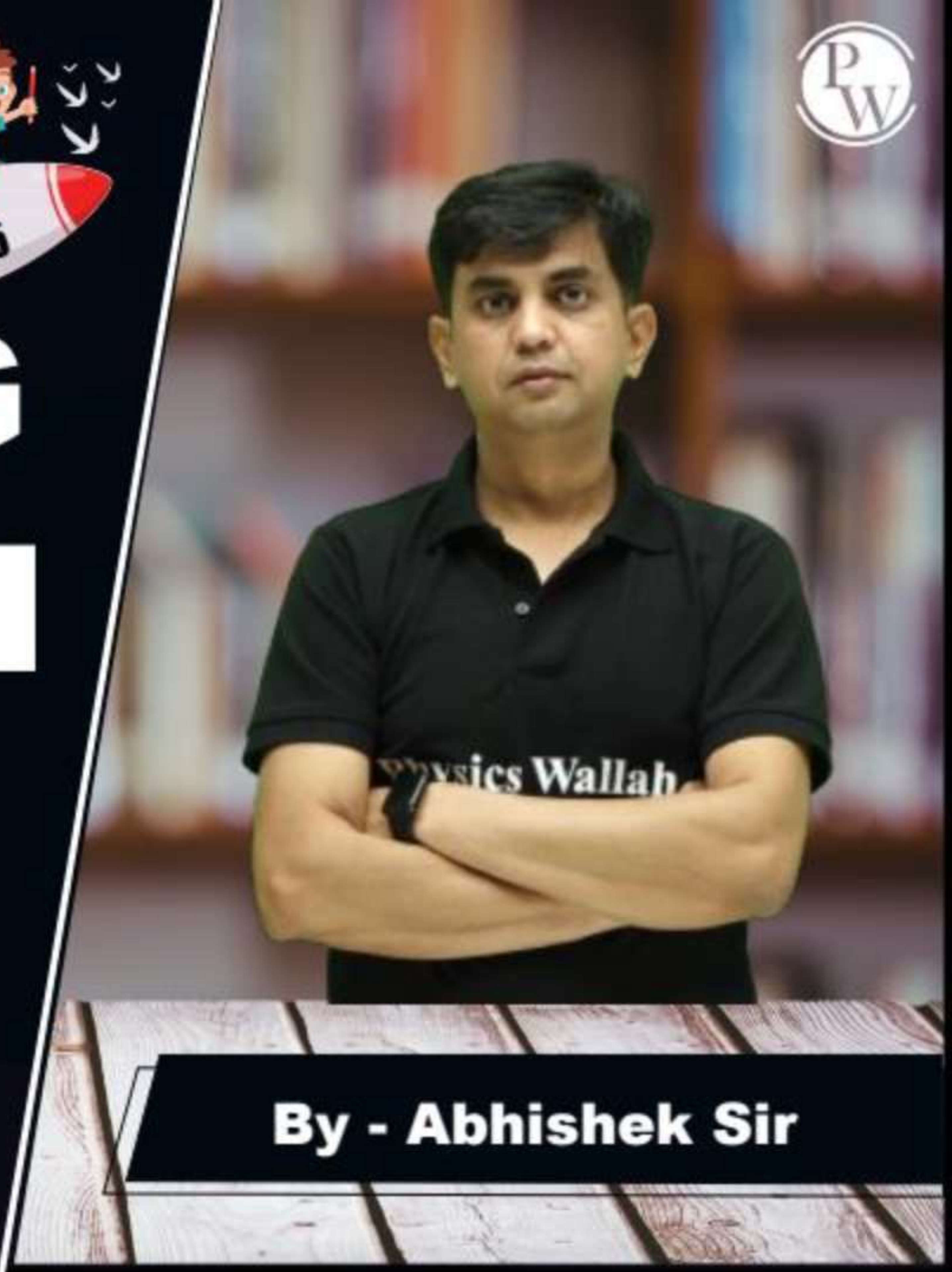
CS & IT ENGINEERING

Computer Network

Flow Control

Lecture No. - 04



By - Abhishek Sir

Recap of Previous Lecture

Topic Flow Control

Topics to be Covered

Topic Stop and Wait ARQ

ABOUT ME

Hello, I'm Abhishek

- GATE CS AIR - 96
- M.Tech (CS) - IIT Kharagpur
- 12 years of GATE CS teaching experience

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Topic : Stop-and-Wait ARQ

→ Transmitter transmit one frame and wait for an ACK

→ Receiver send ACK (positive ACK) for every successfully received frame

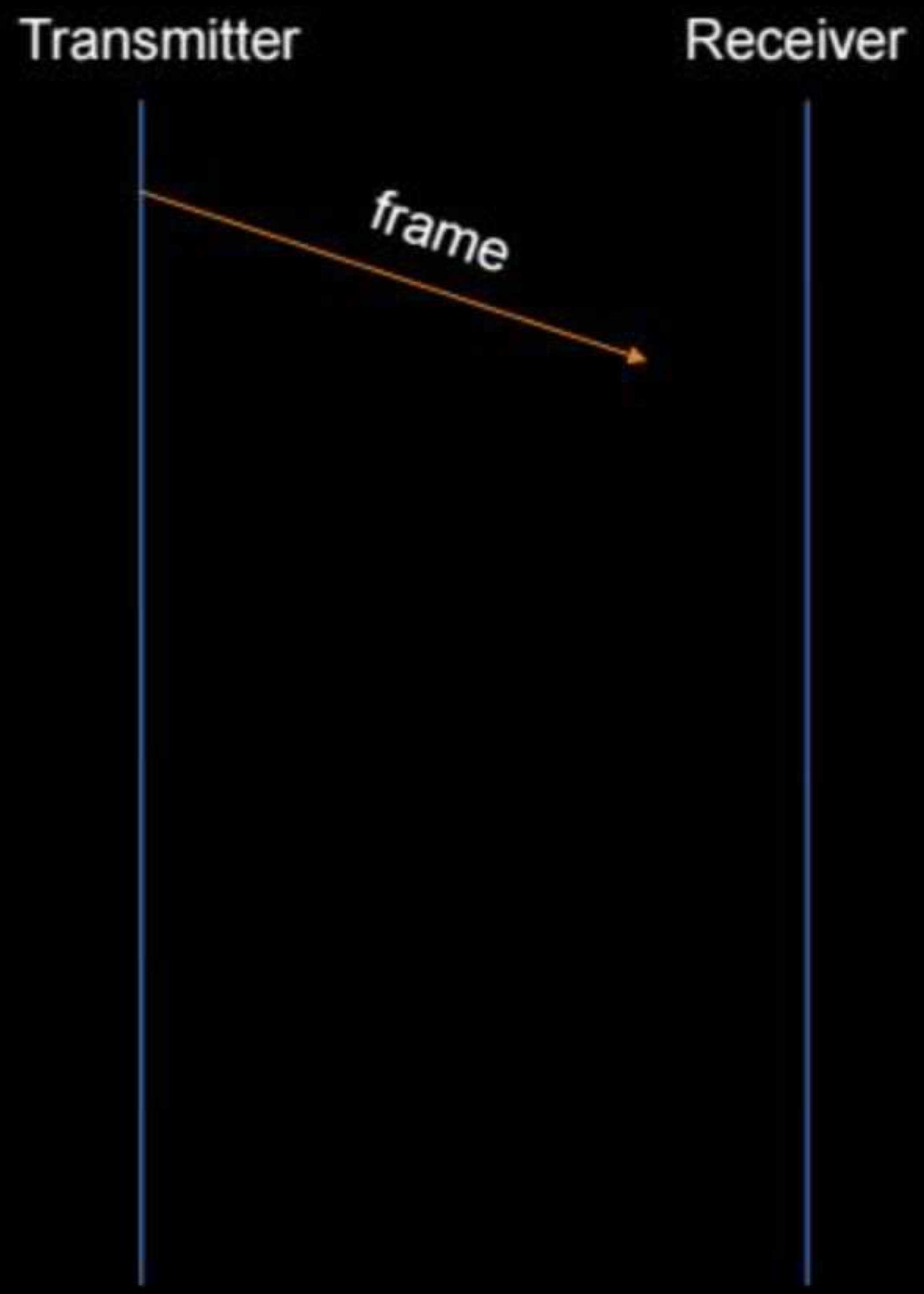
→ Transmitter transmit next frame
only after receiving ACK of transmitted frame

Topic : Stop-and-Wait ARQ

Case I :

→ Either frame or ACK gets lost in the channel

→ Transmitter may goes in indefinite wait for ACK



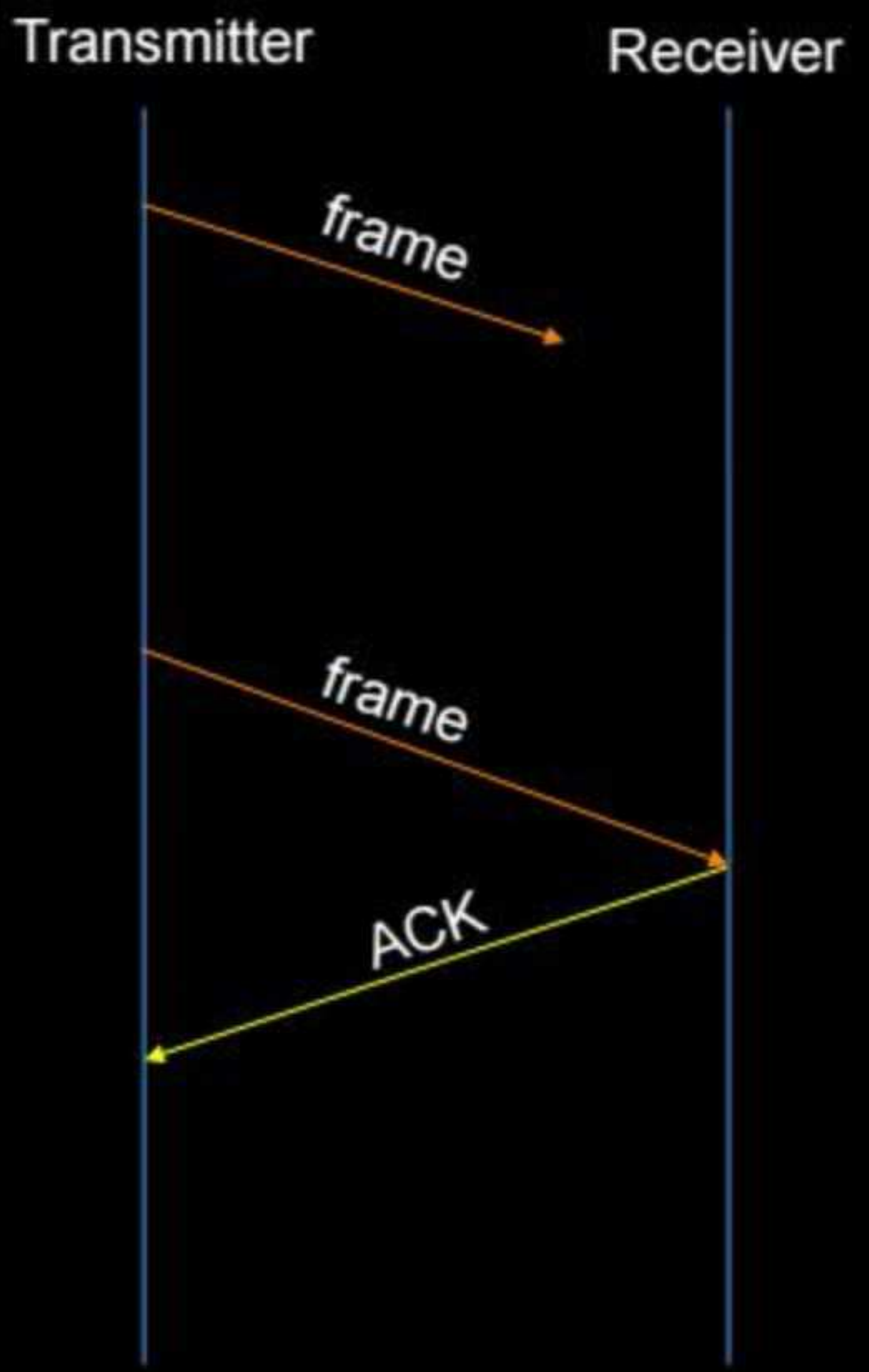
Topic : Stop-and-Wait ARQ

→ To prevent from indefinite wait time at transmitter transmitter uses "Automatic Repeat Request" (ARQ)

Automatic Repeat Request (ARQ) :

→ After transmission of a frame, transmitter wait for an ACK upto time-out

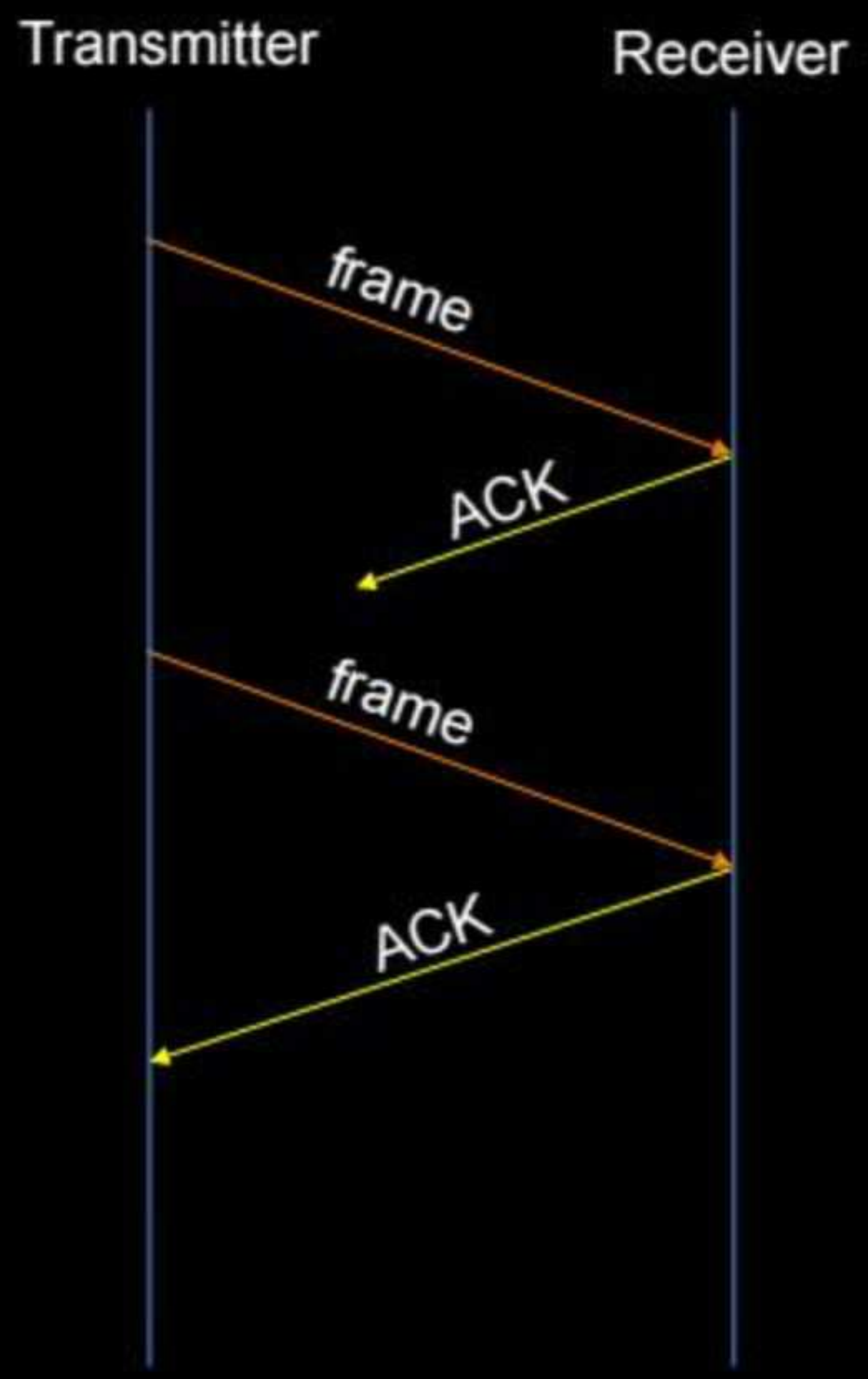
→ After time-out, transmitter retransmit the frame



Topic : Stop-and-Wait ARQ

Case II :

→ Receiver may not able to identify duplicate frame



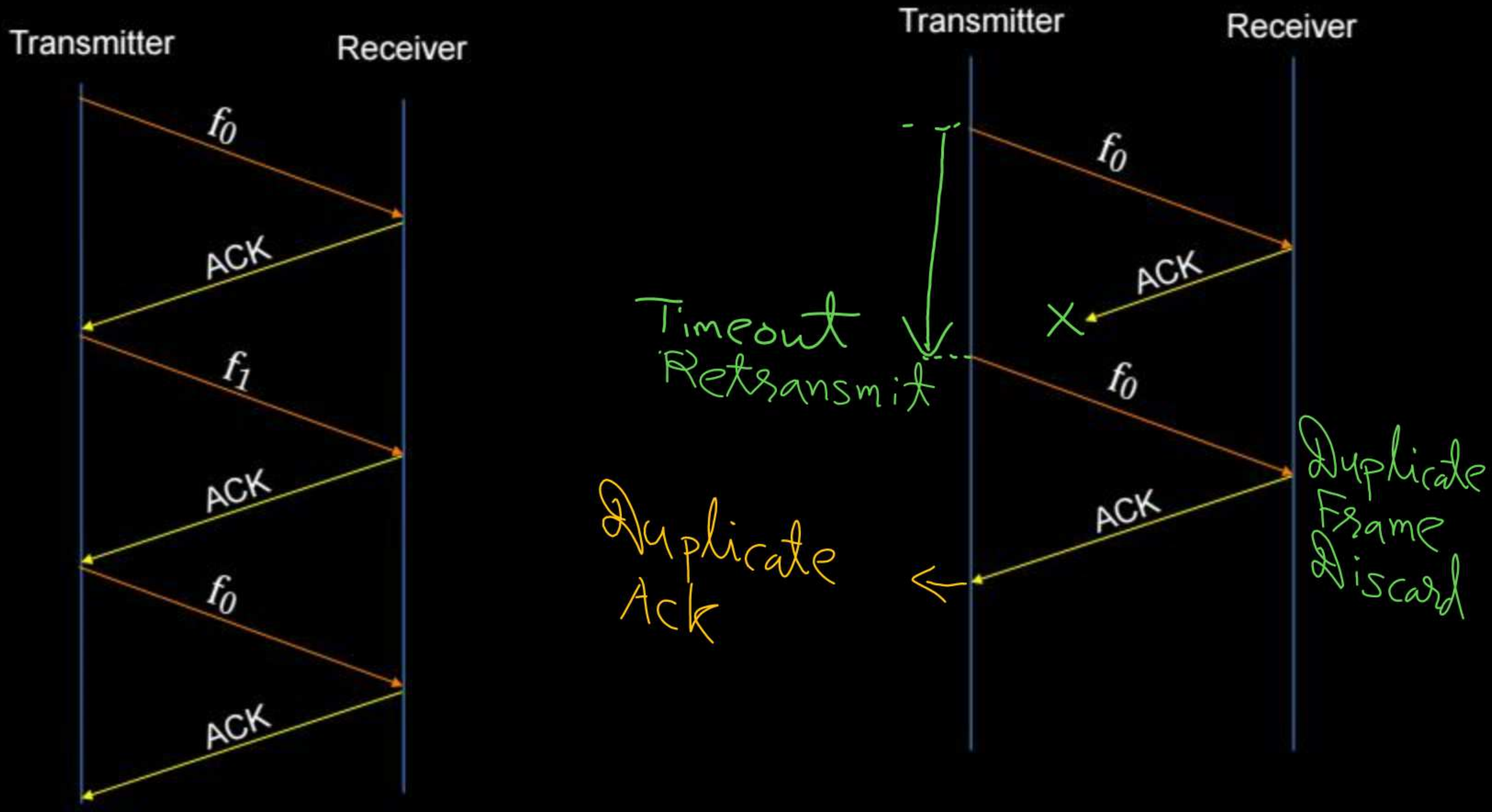
Topic : Stop-and-Wait ARQ

→ To identify duplicate frame at receiver transmitter uses "$\underbrace{\text{Sequence Number}}$" field in the frame

$$\boxed{\text{Sequence Number} \leftarrow (\text{Frame Number}) \bmod 2}$$

→ Stop-and-Wait ARQ is also known as "$\underbrace{\text{Alternate bit protocol}}$"

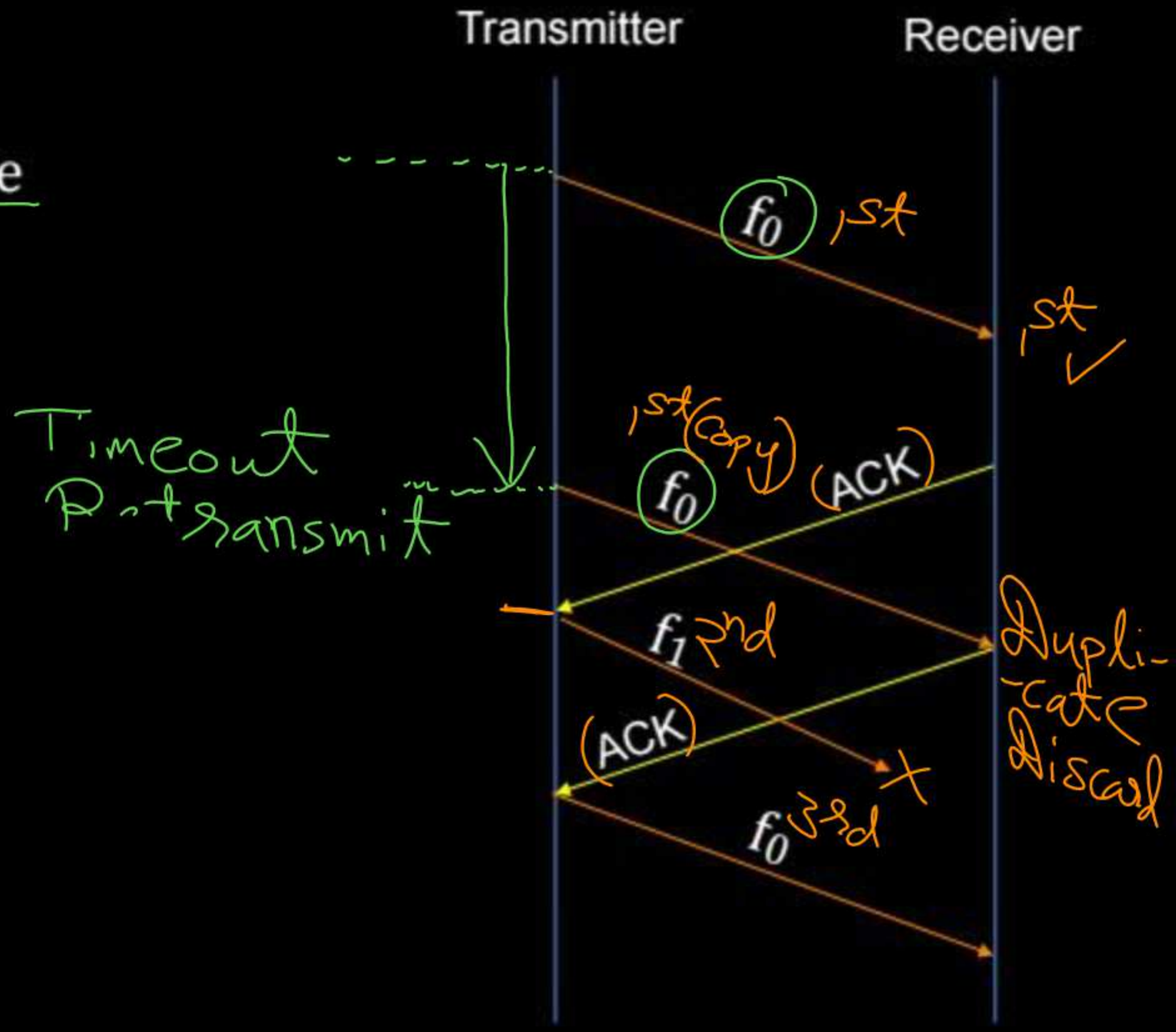
Topic : Stop-and-Wait ARQ



Topic : Stop-and-Wait ARQ

Case III :

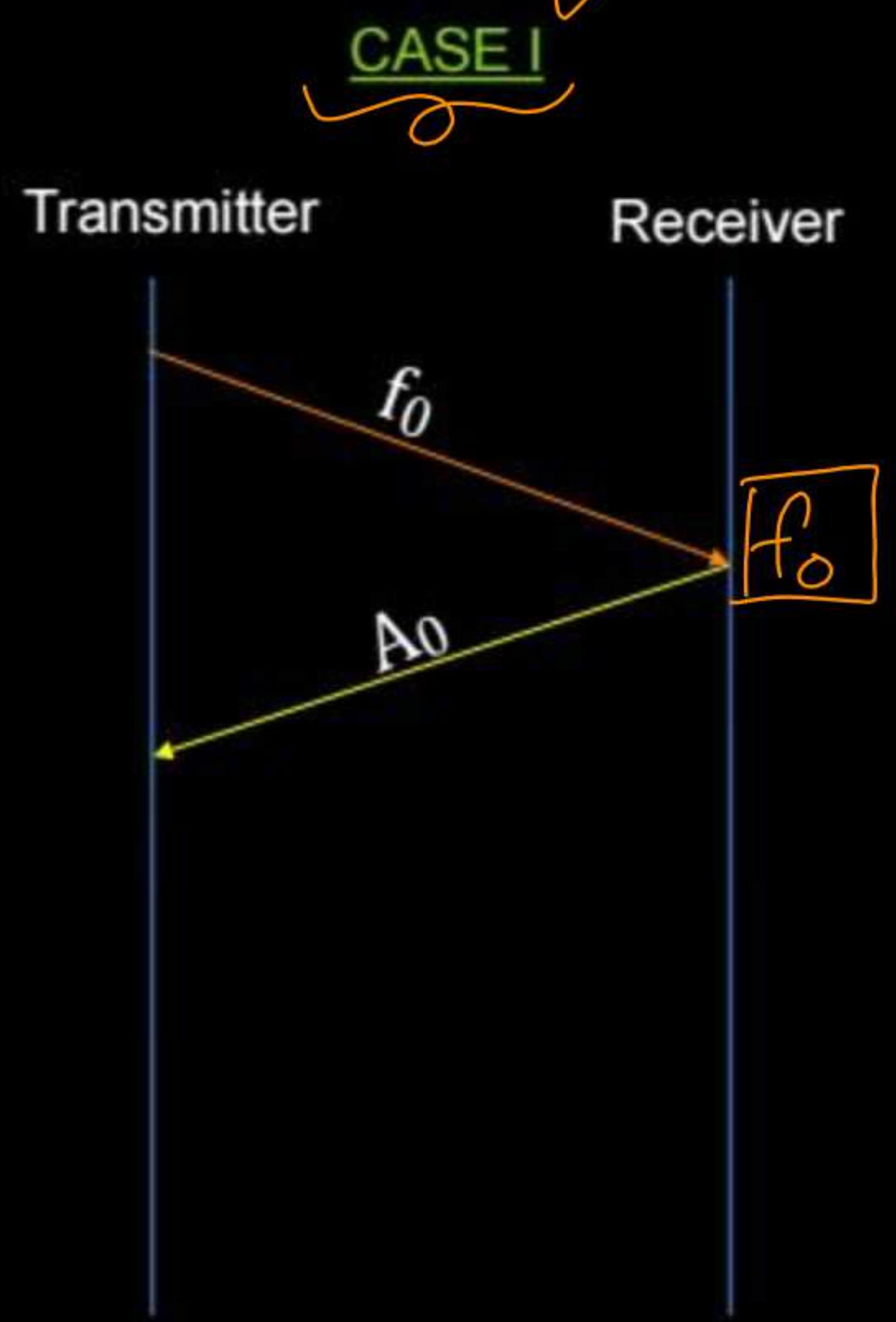
→ Transmitter may not retransmit lost frame

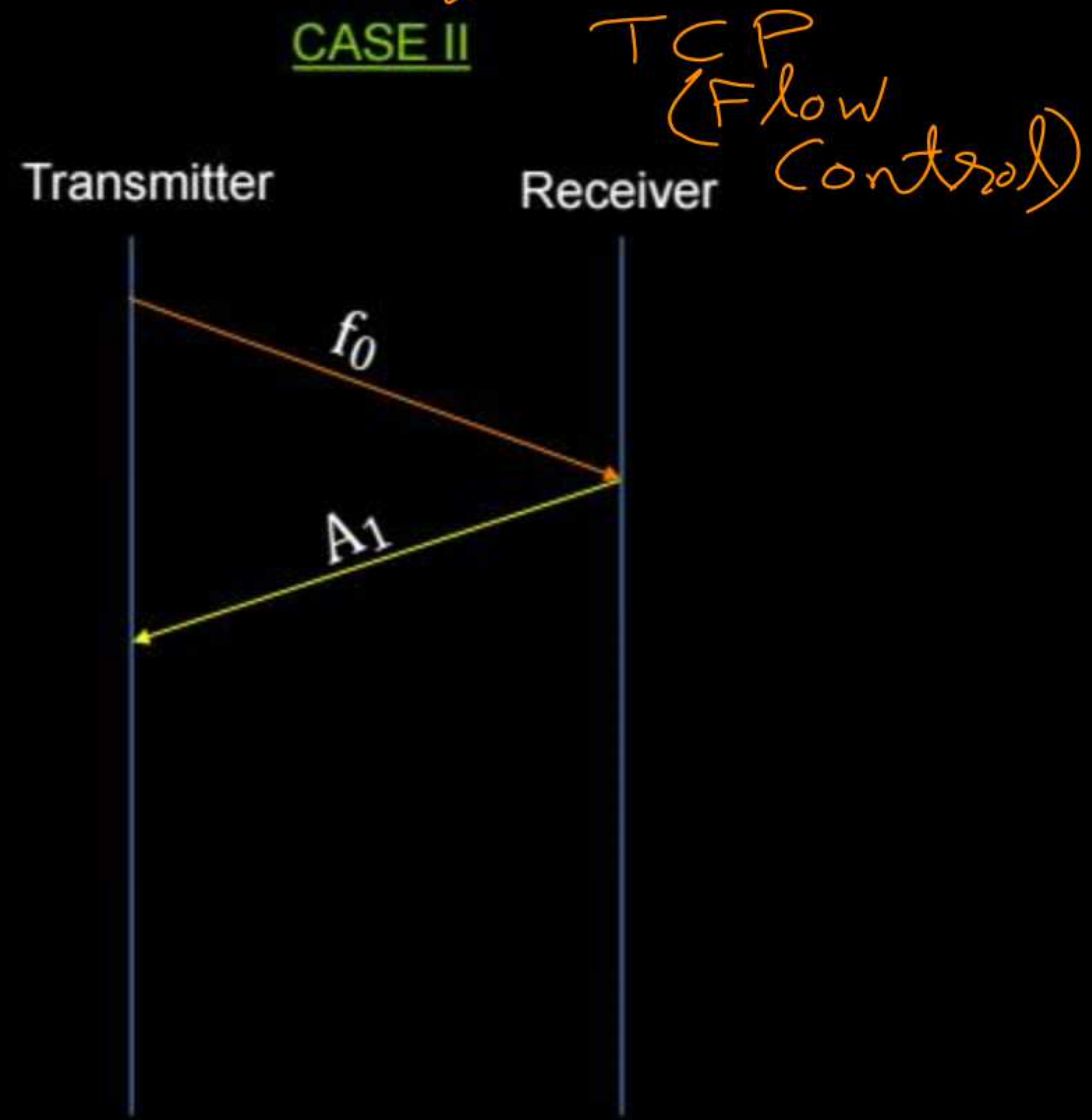


Topic : Stop-and-Wait ARQ

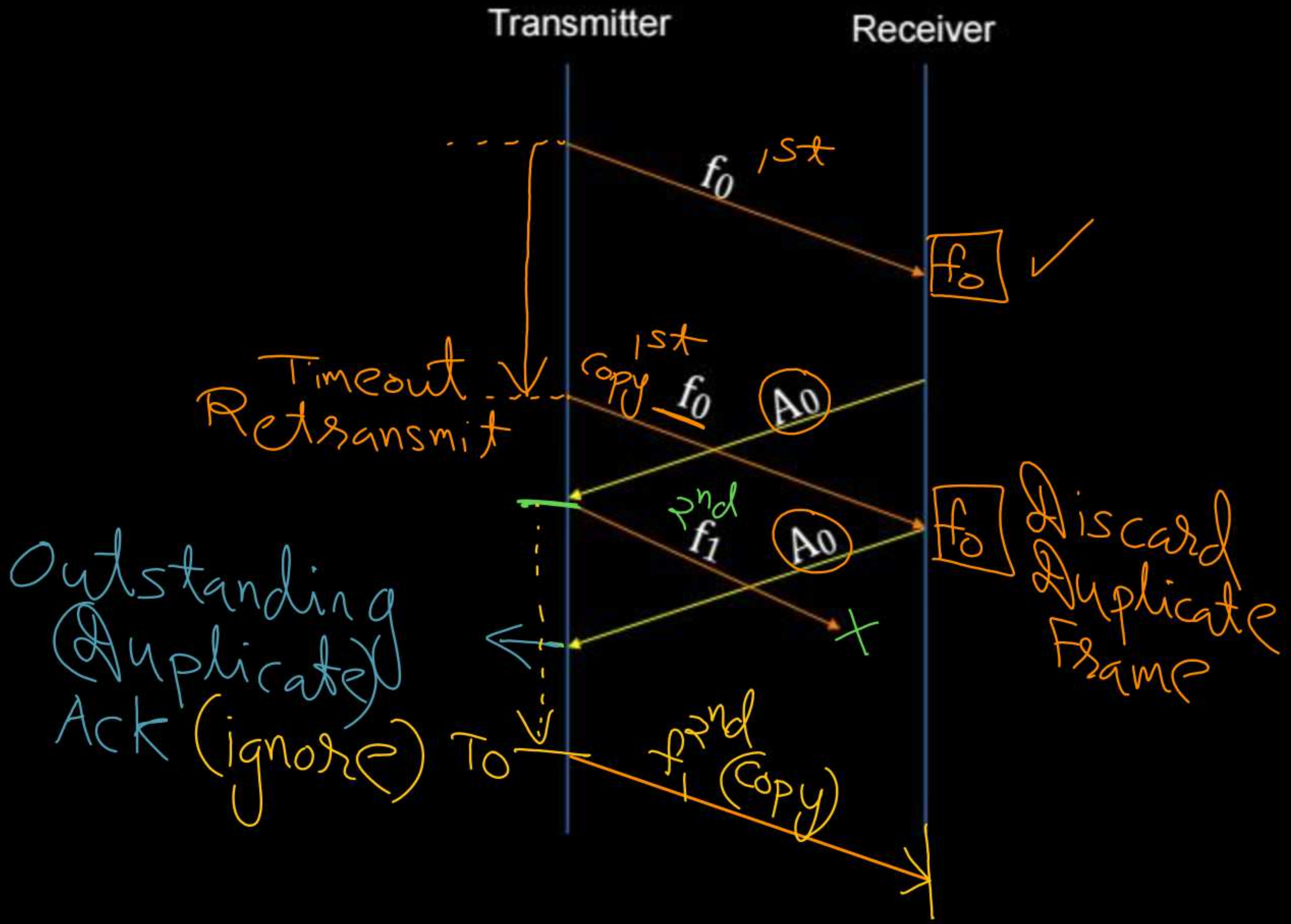
→ To ensure retransmission of every lost frame at transmitter receiver uses "Acknowledgment Number" in the ACK

Topic : Stop-and-Wait ARQ





Topic : Stop-and-Wait ARQ



Topic : Stop-and-Wait ARQ

Transmitter Protocol :

→ Transmitter transmit one frame (with sequence number) and wait for ACK of it until time-out

→ After time-out, transmitter retransmit the frame (same sequence number) and wait for ACK of it until time-out

→ Transmitter transmit next frame only after receiving ACK of transmitted frame

$$\text{Sequence Number} \leftarrow \text{Frame Number} \bmod 2$$

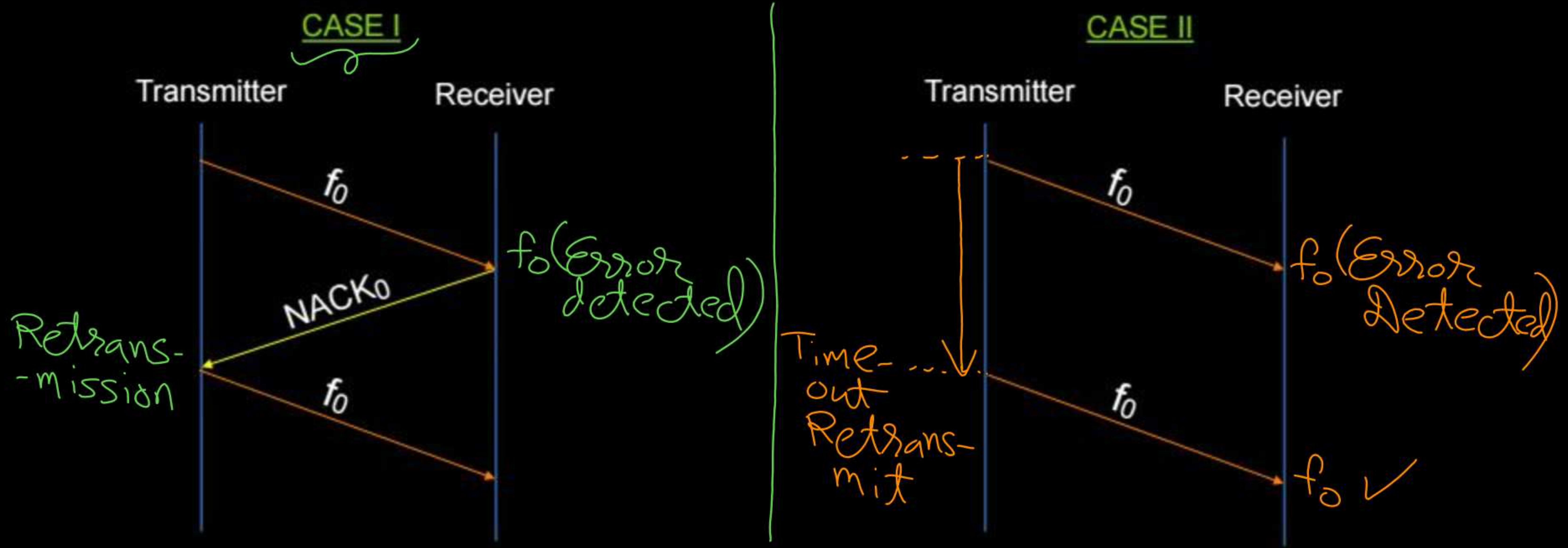
Topic : Stop-and-Wait ARQ

Receiver Protocol :

→ Receiver transmit acknowledgment for every received frame after processing

→ Acknowledgments carry corresponding frame sequence number

Topic : Stop-and-Wait ARQ



ACK (positive acknowledgment) : Leads next frame transmission

NACK (Negative acknowledgment) : Leads retransmssion of the frame

Time-out : Leads retransmssion of the frame

Topic : Stop-and-Wait ARQ

→ Transmitter's transmitting window size = 1

→ Receiver's receiving window size = 1

→ Total number of sequences = 2

[zero or one]

Transmitter

① Transmitting Window

② Receiving Window

Receiver

① Transmitting Window

② Receiving Window

Topic : Cycle Time

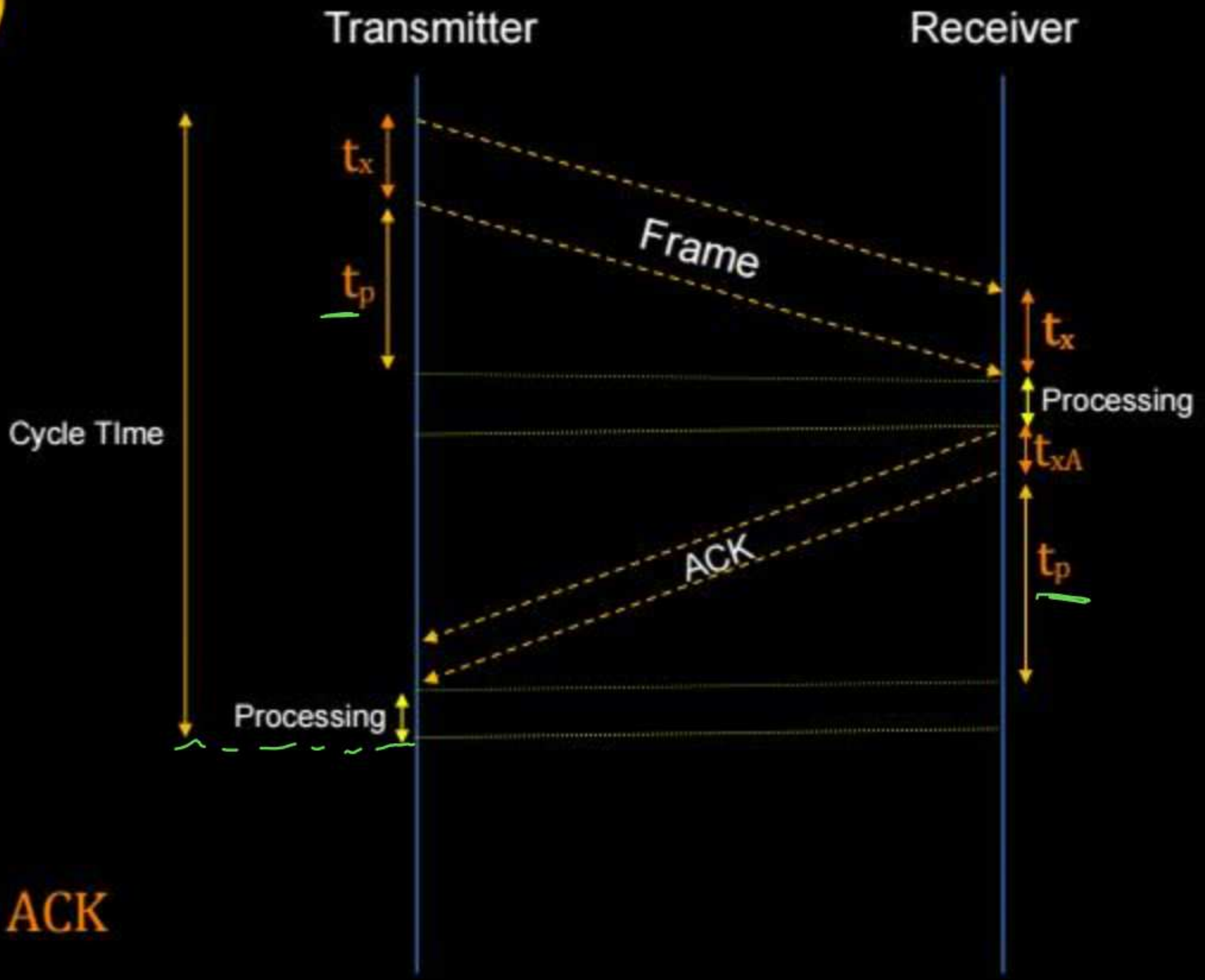
Cycle time = (Transmission delay + Propagation delay)

+ (Queuing delay at receiver + Processing delay by receiver for frame)

+ (Transmission delay for ACK + Propagation delay)

+ Queuing delay at transmitter + Processing delay by transmitter for ACK

Topic : Cycle Time



$$t_{xA} = \frac{\text{ACK Size}}{\text{Bandwidth}}$$

t_{xA} : Transmission delay for ACK

$t_{xA} << t_x$

Topic : Cycle Time

$$\boxed{\begin{aligned}\text{Cycle time} = {} & \text{Transmission delay} + \text{Propagation delay} \\ & + \text{Queuing delay at receiver} + \text{Processing delay by receiver} \\ & + \text{Transmission delay for ACK} + \text{Propagation delay} \\ & + \text{Queuing delay at transmitter} + \text{Processing delay by transmitter}\end{aligned}}$$

Suppose queuing and processing delays are negligible at both the end.

$$\boxed{\begin{aligned}\text{Cycle time} = {} & \text{Transmission delay} + \text{Propagation delay} \\ & + \text{Transmission delay for ACK} + \text{Propagation delay}\end{aligned}}$$

$$= (t_x + t_p) + (t_{xA} + t_p)$$

Topic : Cycle Time

Cycle time = Transmission delay + Propagation delay + Transmission delay for ACK + Propagation delay

Suppose Transmission delay for ACK is also negligible.

Cycle time = Transmission delay + Round Trip Propagation delay

$$= [t_x + 2t_p]$$

Topic : Round Trip Delay

$\boxed{RTT}$

For Data Link Layer :

Round Trip Delay / Time (RTT) = Cycle time

For Transport Layer :

Round Trip Delay / Time (RTT) = Round Trip Propagation delay

$\approx 2t_p$

Topic : Efficiency

→ For Stop-and-Wait ARQ :

$$\text{Efficiency } (\eta) = \frac{\text{Transmission delay}}{\text{Cycle Time}} = \frac{t_x}{\text{cycle time}}$$

$$\text{Efficiency } (\eta) = \frac{\text{Transmission delay}}{\text{Cycle Time}} * 100\,\%$$

$$\boxed{0 < \eta < 1}$$

Example 7 :-

Consider two hosts A and B directly connected through point to point link using stop and wait ARQ for flow control. Suppose packet size is 1000 bytes, link bandwidth is 1 Mbps, distance is 2 Km and signal speed is 4 milisecond per kilometer. Calculate efficiency in percent (round off to nearest integer) ?

Solution:-

Packet Size = 1000 bytes = $8 * 10^3$ bits

Bandwidth = 1 Mbps = 10^6 bits / sec

$$t_x = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{8 * 10^3 \text{ bits}}{10^6 \text{ bits / sec}} = 8 \text{ ms}$$

Distance = 2 Km

Signal Speed = 4 ms/Km

$$t_p = \text{Distance} * \text{Signal Speed} = 8 \text{ ms}$$

$\text{Cycle time} = (t_x + 2 * t_p) = \underbrace{24 \text{ ms}}_{0}$

For Stop-and-Wait ARQ :

$$\text{Efficiency } (\eta) = \frac{\text{Transmission delay}}{\text{Cycle Time}} = \frac{8 \text{ ms}}{24 \text{ ms}} = \frac{1}{3}$$

$= 0.3333$

$= 0.3333 * 100 \%$

$= 33.33 \% \approx 33\%$

$\boxed{\text{Ans} = 33}$

#Q. The values of parameters for the Stop-and–Wait ARQ protocol are as given below.

Bit rate of the transmission channel = 1Mbps
Propagation delay from sender to receiver = 0.75 ms
Time to process a frame = 0.25ms
Number of bytes in the information frame = 1980
Number of bytes in the acknowledge frame = 20
Number of overhead bytes in the information frame = 20

Assume that there are no transmission errors. Then the transmission efficiency (expressed in percentage) of the Stop-and–Wait ARQ protocol for the above parameters is _______ (correct to 2 decimal place).

[GATE 2017]

IIT-R
H.W.

#Q. Suppose two hosts are connected by a point-to-point link and they are configured to use Stop-and-Wait protocol for reliable data transfer. Identify in which one of the following scenarios, the utilization of the link is the lowest.

[GATE 2023]

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H.W.

A Longer link length and lower transmission rate

B Longer link length and higher transmission rate

C Shorter link length and lower transmission rate

D Shorter link length and higher transmission rate

2 mins Summary

Topic Stop and Wait ARQ

THANK - YOU