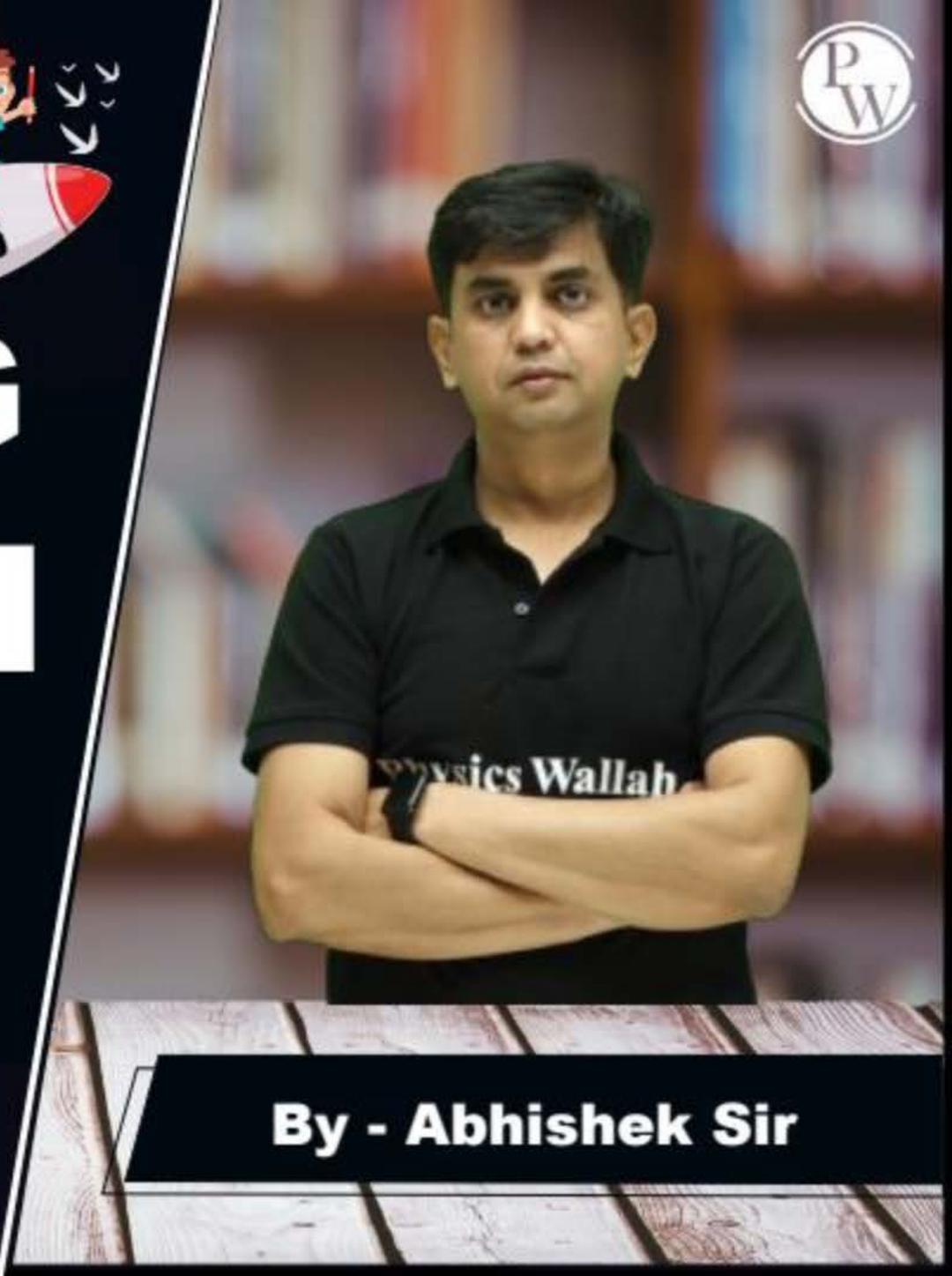
CS & IT ENGINEERING

Computer Network

Flow Control

Lecture No. - 07



Recap of Previous Lecture

Topic Sliding Window ARQ

Topics to be Covered

Topic Sliding Window ARQ

Topic Go Back N 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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#Q. Host A is sending data to host B over a full duplex link. A and B are using the sliding window protocol for flow control. The send and receive window sizes are 5 packets each. Data packets (sent only from A to B) are all 1000 bytes long and the transmission time for such a packet is 50 microsecond. Acknowledgement packets (sent only from B to A) are very small and require negligible transmission time. The propagation delay over the link is 200 microsecond. What is the maximum achievable throughput in this communication?

[GATE 2003]

(A) $7.69 * 10^6$ bytes per sec

(B) $11.11 * 10^6$ bytes per sec

(C) $12.33 * 10^6$ bytes per sec

(D) $15.00 * 10^6$ bytes per sec

Ans: B

Solution:-

t_x = 50 µs

t_p = 200 µs

Cycle time = $(t_x + 2 * t_p)$ = 450 µs $= 450 * 10^{-6}$ sec

$= (50 + 2 * 200)$ µs

Window Size (N) = 5

Packet Size = 1000 bytes

For Sliding Window ARQ :

$$\text{Throughput} = \frac{\text{Window Size} * \text{Packet Size}}{\text{Cycle Time}} = \frac{N * \text{Frame Size}}{\text{Cycle time}}$$

$$= \frac{5 * 1000 \text{ bytes}}{450 * 10^{-6} \text{ sec}} = \frac{500}{45} * 10^6 \text{ bytes/sec}$$

$$= \frac{100}{9} * 10^6 \text{ bytes/sec}$$

$$= 11.11 * 10^6 \text{ bytes/sec}$$

Topic : Sliding Window ARQ

→ Transmitter's transmitting window size = N [N>1]

→ Receiver's receiving window size = N

→ Total number of sequences = N [0 to (N-1)]

Total number of sequences
= Transmitter's transmitting window size

Sequence number ← (Frame number) mod (N)

Topic : Sequence Number

Minimum number of bits required for sequence number field

$$= \lceil \log_2 [\text{Total number of sequences}] \rceil \text{ bits}$$

#Q. The distance between two stations M and N is L kilometers. All frames are K bits long. The propagation delay per kilometer is t seconds. Let R bits/second be the channel capacity. Assuming that processing delay is negligible, the minimum number of bits for the sequence number field in a frame for maximum utilization, when the sliding window is used, is

[GATE 2007]

IIT - K

Solution:-

Packet Size = K bits

Bandwidth = R bits / sec

$$t_x = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{K \text{ bits}}{R \text{ bits / sec}} = \frac{K}{R} \text{ Sec}$$

Distance = L Km

Signal Speed = t Sec / Km

$$t_p = \text{Distance} * \text{Signal Speed} = L \text{ Km} * t \text{ Sec / Km} = Lt \text{ Sec}$$

Cycle time = $(t_x + 2 * t_p) = \left(\frac{K}{R} + 2 * L * t\right)$ sec

$= \left(\frac{K + 2LtR}{R}\right)$

Optimal Window Size = $\left\lceil \frac{\text{Cycle Time}}{\text{Transmission delay}} \right\rceil = \left\lceil \frac{\text{cycle time}}{t_x} \right\rceil$

$= \left\lceil \frac{\left(\frac{K + 2LtR}{R}\right) \text{sec}}{\frac{K}{R} \text{ sec}} \right\rceil = \boxed{\left\lceil \frac{K + 2LtR}{K} \right\rceil}$

For Sliding Window ARQ :

Total number of sequences = Transmitter's transmitting window size

Minimum number of bits required for sequence number field

$$= \lceil \log_2 [\text{Total number of sequences}] \rceil \text{ bits}$$

$$= \left\lceil \log_2 \left\lceil \frac{K + 2LtR}{K} \right\rceil \right\rceil \text{ bits}$$

Statements for Linked Answer Questions :

Frames of 1000 bits are sent over a 10^6 bps duplex link between two hosts. The propagation time is 25ms. Frames are to be transmitted into this link to maximally pack them in transit (within the link).

#Q. What is the minimum number of bits (l) that will be required to represent the sequence numbers distinctly? Assume that no time gap needs to be given between transmission of two frames.

[GATE 2009]

IIT-R
HW

A $l = 2$

B $l = 3$

C $l = 4$

D $l = 5$

#Q. Suppose that the sliding window protocol is used with the sender window size of 2^l where l is the number of bits identified in the previous question and acknowledgments are always piggybacked. After sending 2^l frames, what is the minimum time the sender will have to wait before starting transmission of the next frame? (Identify the closest choice ignoring the frame processing time.)

[GATE 2009]

H.W

A 16 ms

B 18 ms

C 20 ms

D 22 ms

Topic : Sliding Window ARQ

→ Types of Sliding Window Protocol :

1. Go Back N ARQ
2. Selective Repeat ARQ

Topic : Go Back N ARQ

→ Transmitter's transmitting window size = N (N > 1)

→ Receiver's receiving window size = 1

→ Total number of sequences = (N+1) [0 to N]

Range

Total number of sequences =

Transmitter's transmitting window size

+ Receiver's receiving window size

Sequence number ← (Frame number) mod (N+1)

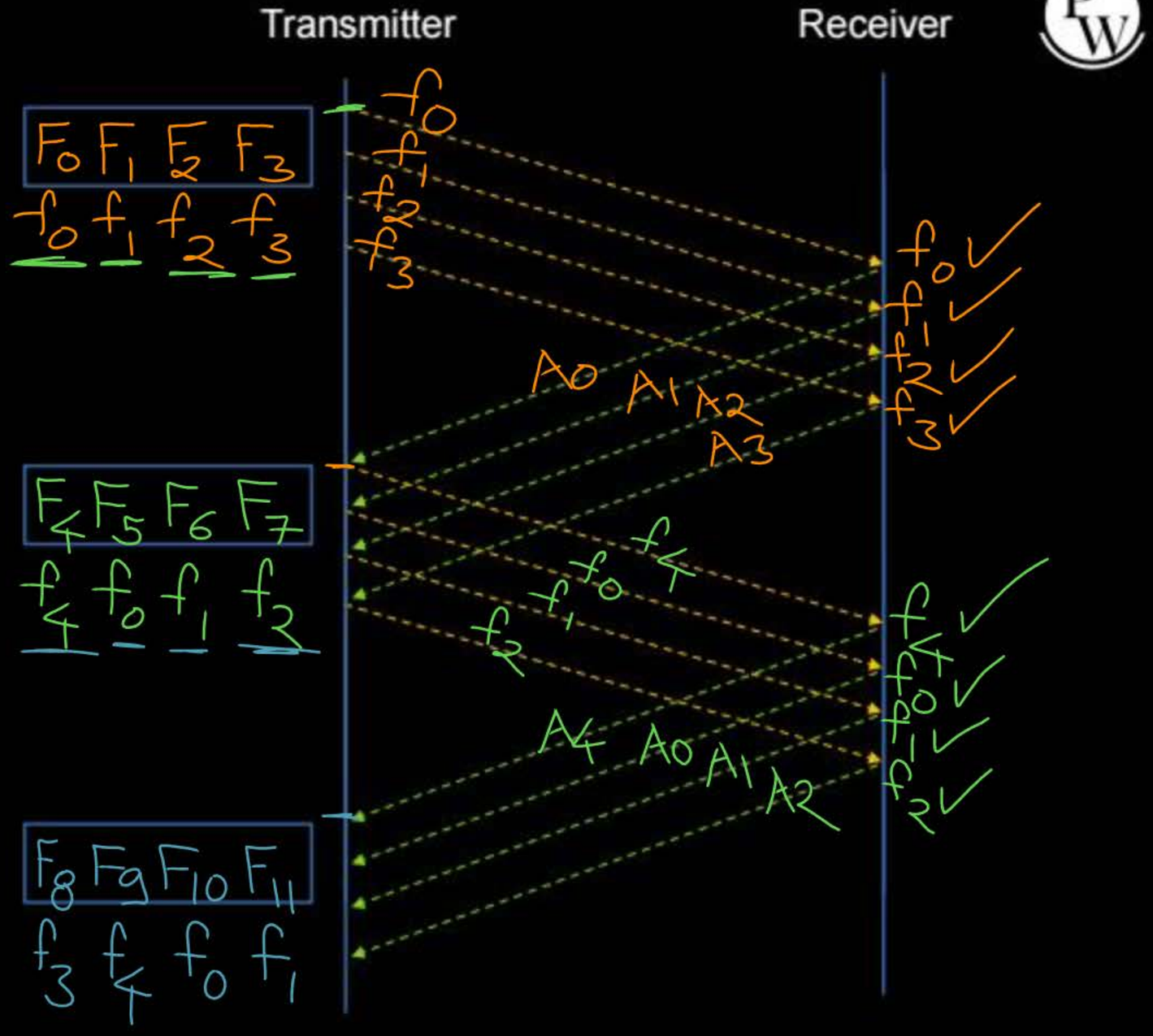
Topic : Go Back N ARQ

CASE I :

Suppose N = 4

Go back 4 ARQ

Sequence Number = 0 to 4



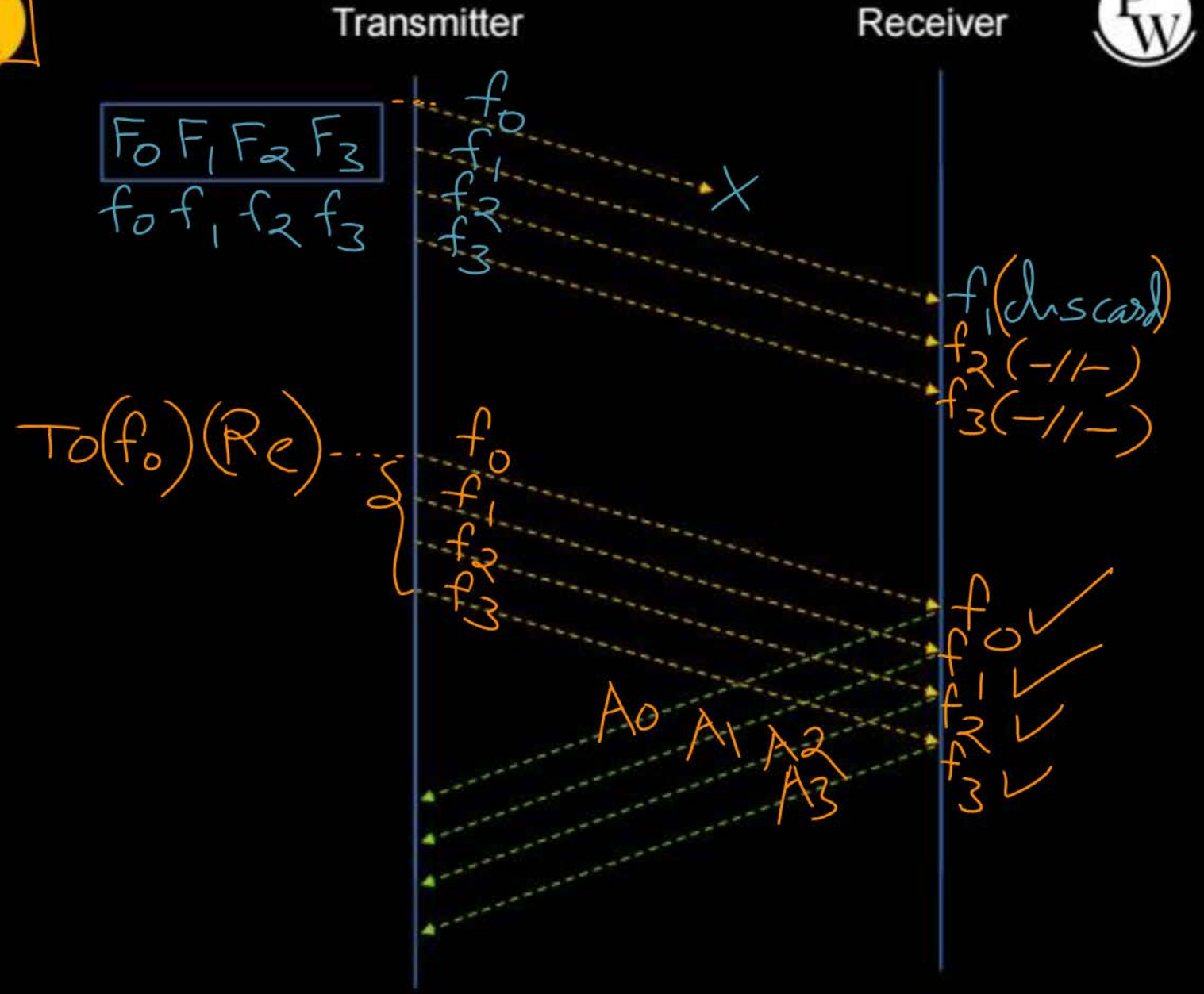
Topic : Go Back N ARQ

CASE II :

Suppose N = 4

Sequence Number = 0 to 4

mod (N+1)

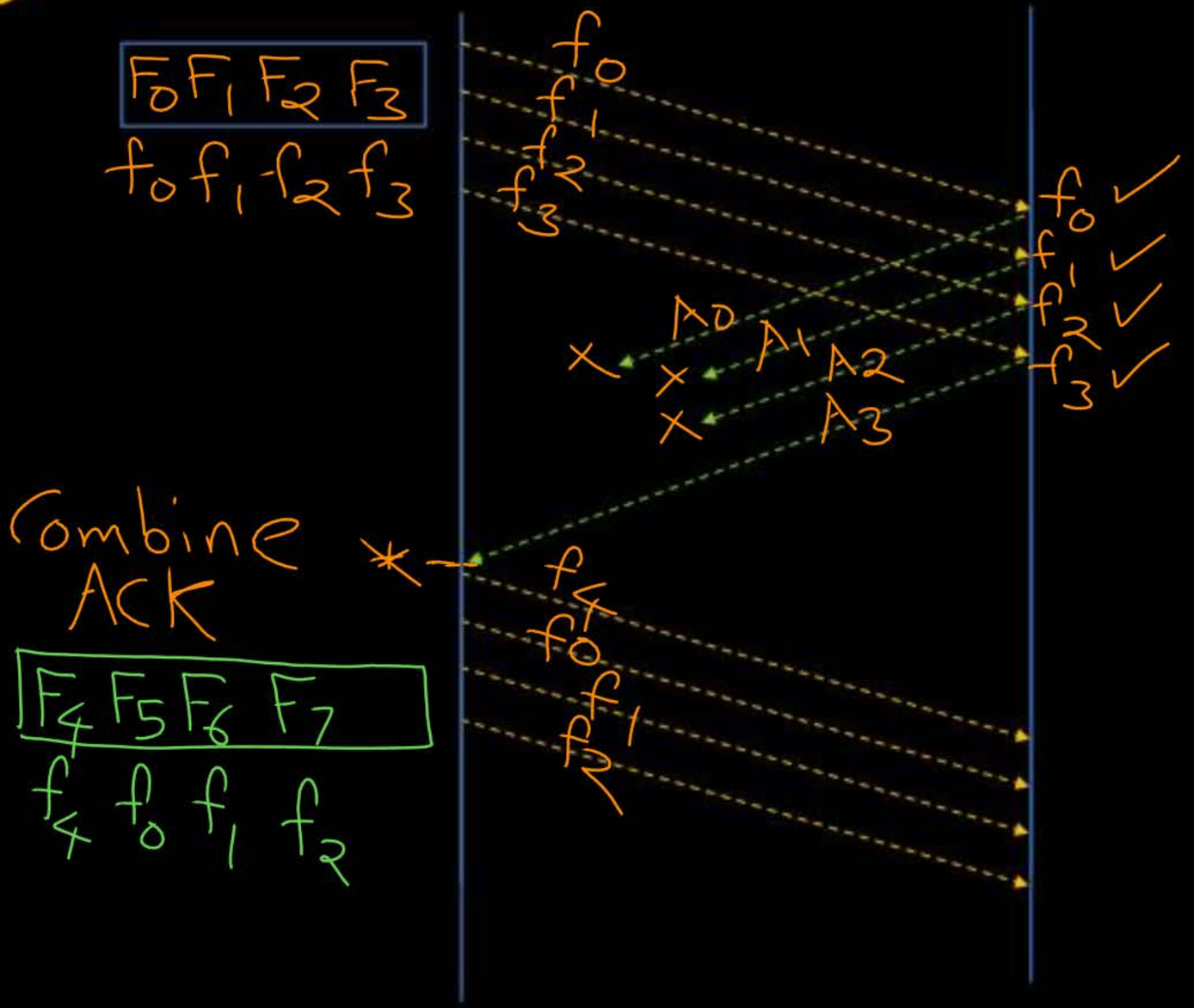


Topic : Go Back N ARQ

CASE III :

Suppose N = 4

Sequence Number = 0 to 3



Topic : Go Back N ARQ

CASE IV :

Suppose N = 4

Sequence Number = 0 to 4

Receiver is able to recognize duplicate Frame.

2 mins Summary

Topic Sliding Window ARQ

Topic Go Back N ARQ

THANK - YOU