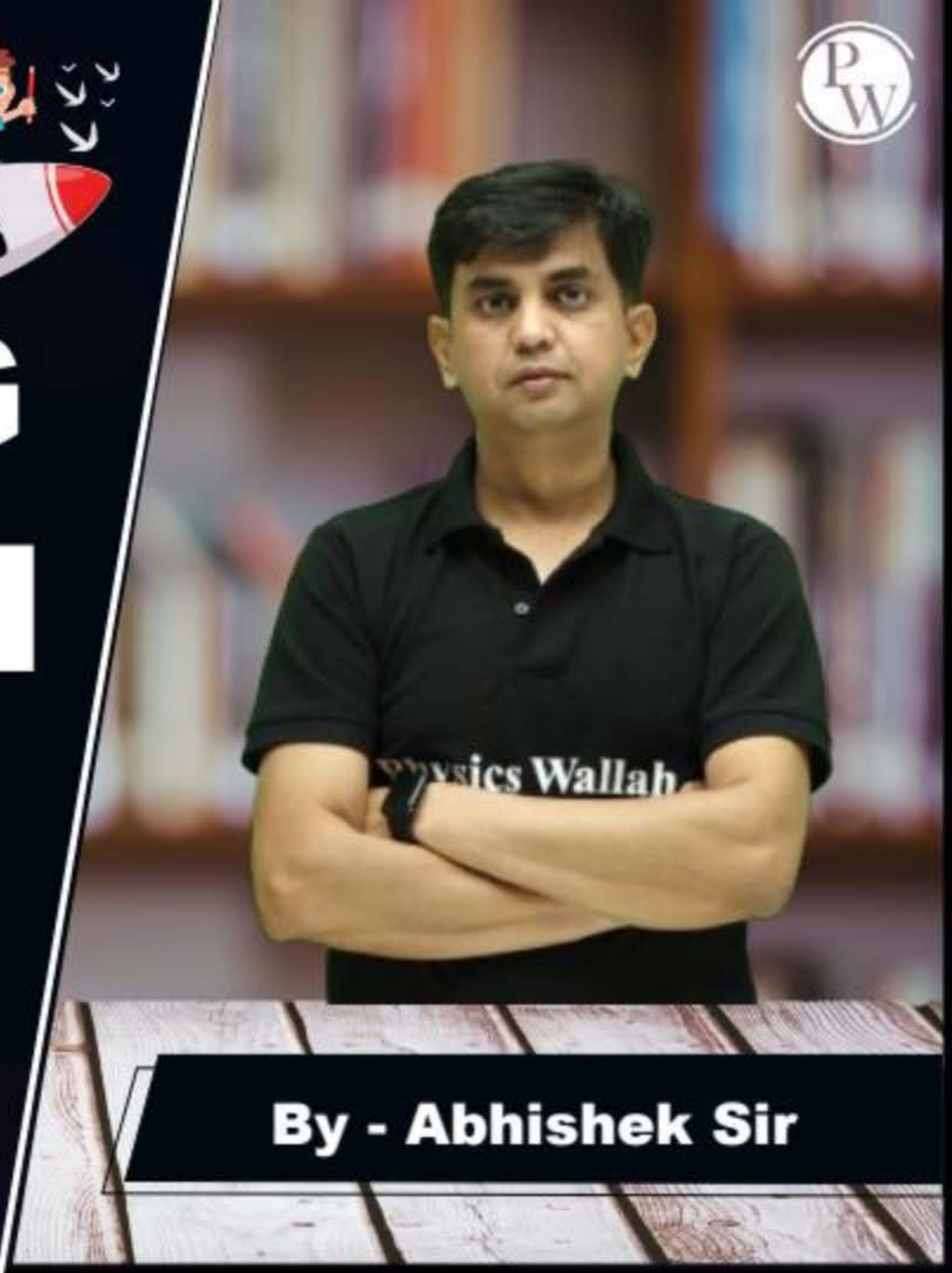
CS & IT ENGINEERING

Computer Network

Flow Control

Lecture No. - 08



By - Abhishek Sir

Recap of Previous Lecture

Topic — Sliding Window ARQ

Topic — Go Back N ARQ

Topics to be Covered

Topic Go Back N ARQ

Topic Sliding Window 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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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.

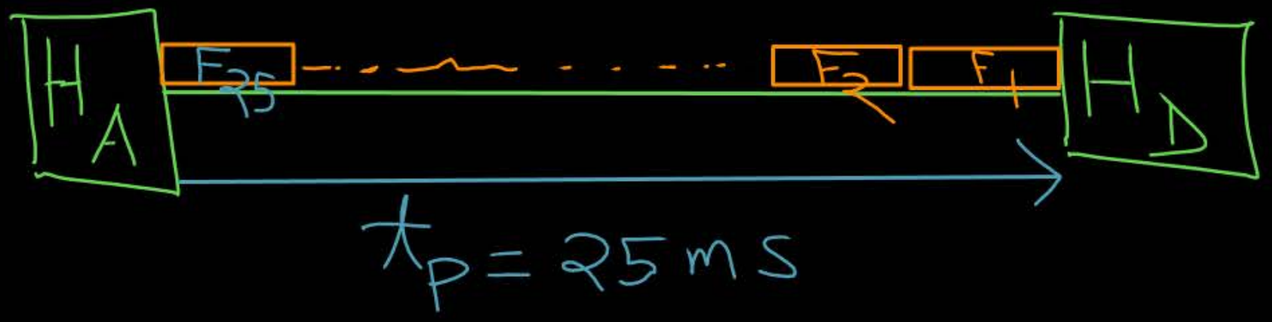
[GATE 2009]

A. l = 2

B. l = 3

C. l = 4

D. l = 5



Ans: D

Solution:-

Packet Size = 1000 bits $= 10^3$ bits

Bandwidth = 10^6 bits / sec

$$t_x = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{10^3 \text{ bits}}{10^6 \text{ bits / sec}} = 1 \text{ ms} = 10^{-3} \text{ sec}$$

$t_p = 25$ ms

Minimum number of frames required to maximally pack them in transit $= \left\lceil \frac{t_p}{t_x} \right\rceil = \left\lceil \frac{25 \text{ ms}}{1 \text{ ms}} \right\rceil = 25$ frames

Transmitter's transmitting window size (N) $\geq$ 25

For Sliding Window ARQ :

Total number of sequences = N

Minimum number of bits required for sequence number field (l)

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

$$l = \lceil \log_2(25) \rceil \text{ bits} = 5 \text{ bits}$$

#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]

A 16 ms

B 18 ms

C 20 ms

D 22 ms

Ans: C

Solution:-

Piggybacking :

→ ACK always present inside packet header

→ Packet header contains :

1. Sequence Number (k bits)
2. ACK Number (k bits)

$$t_{x_A} = t_x$$

Sender Window Size = $2^l = 2^5 = 32$

Cycle Time = $(t_x + t_p) + (t_{xA} + t_p) = (1+25)+(1+25)\,ms$

$= 52\,ms$

minimum time the sender will have to wait = [Cycle Time − $2^l * t_x$]

$= [52ms - (2^5) * 1ms]$

$= 20\,ms$

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]

Total number of sequences =
Transmitter's transmitting window size
+ Receiver's receiving window size

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

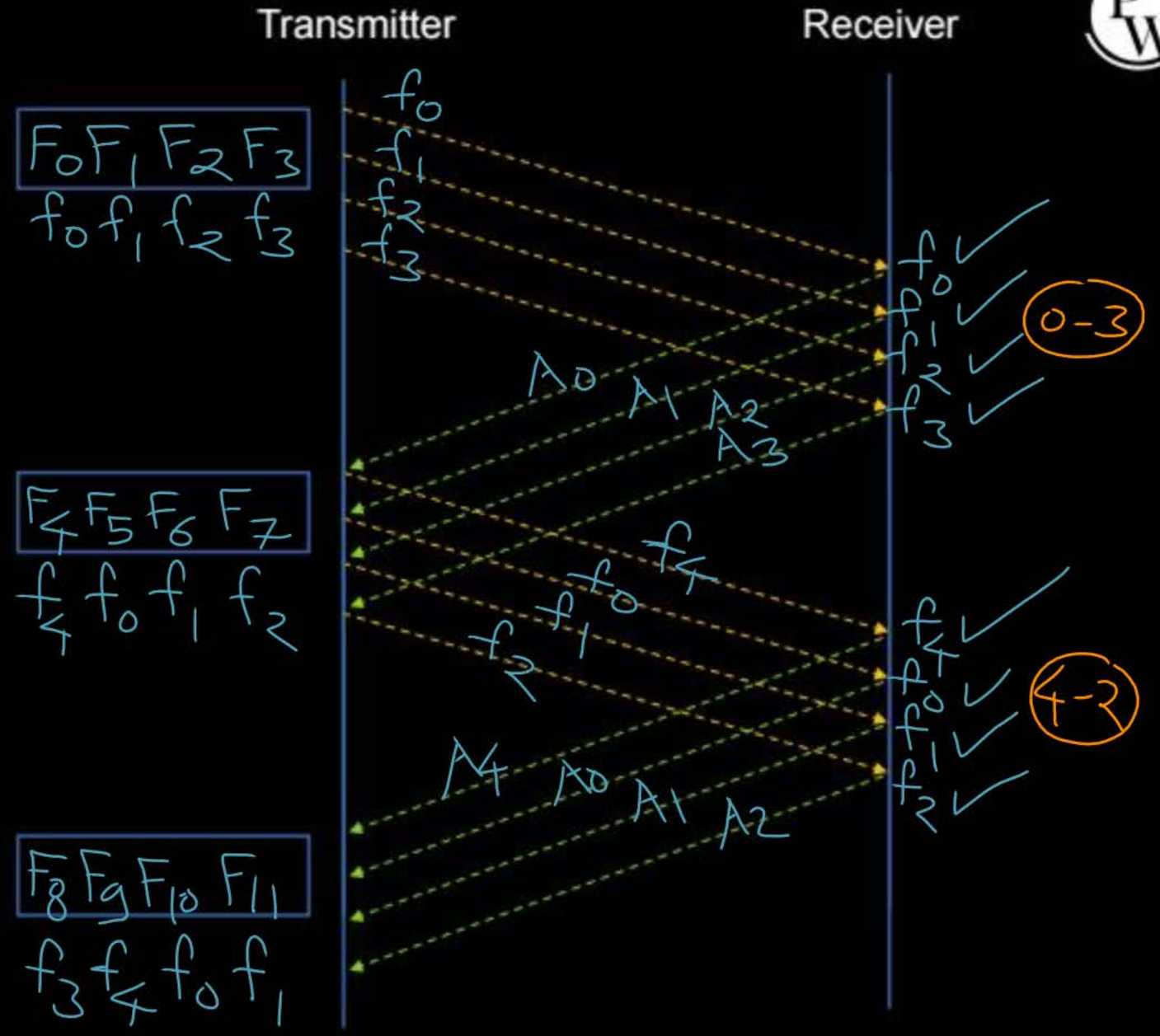
Topic : Go Back N ARQ

CASE I :

Suppose N = 4

Go back 4 ARQ

Sequence Number = 0 to 4

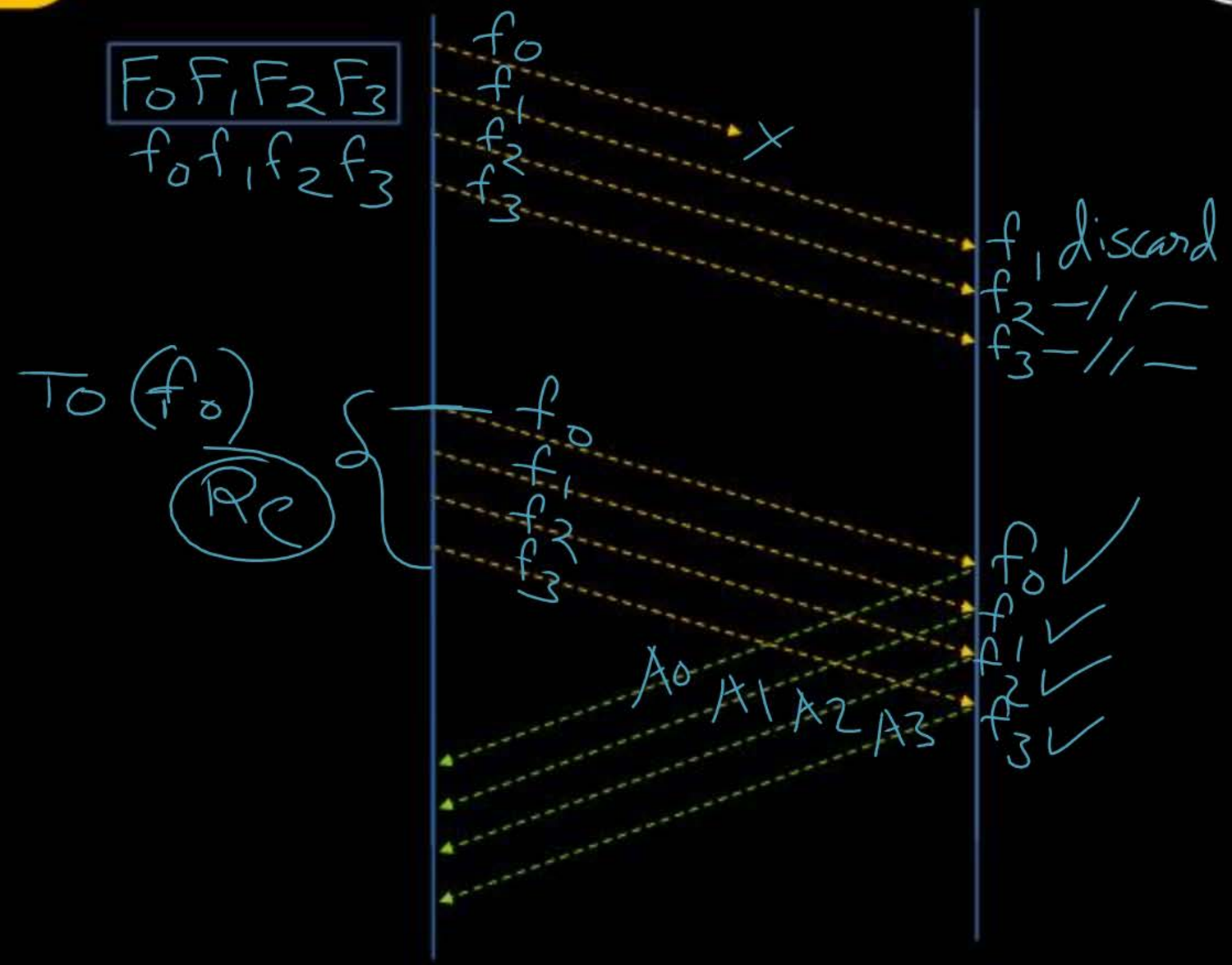


Topic : Go Back N ARQ

CASE II :

Suppose N = 4

Sequence Number = 0 to 4

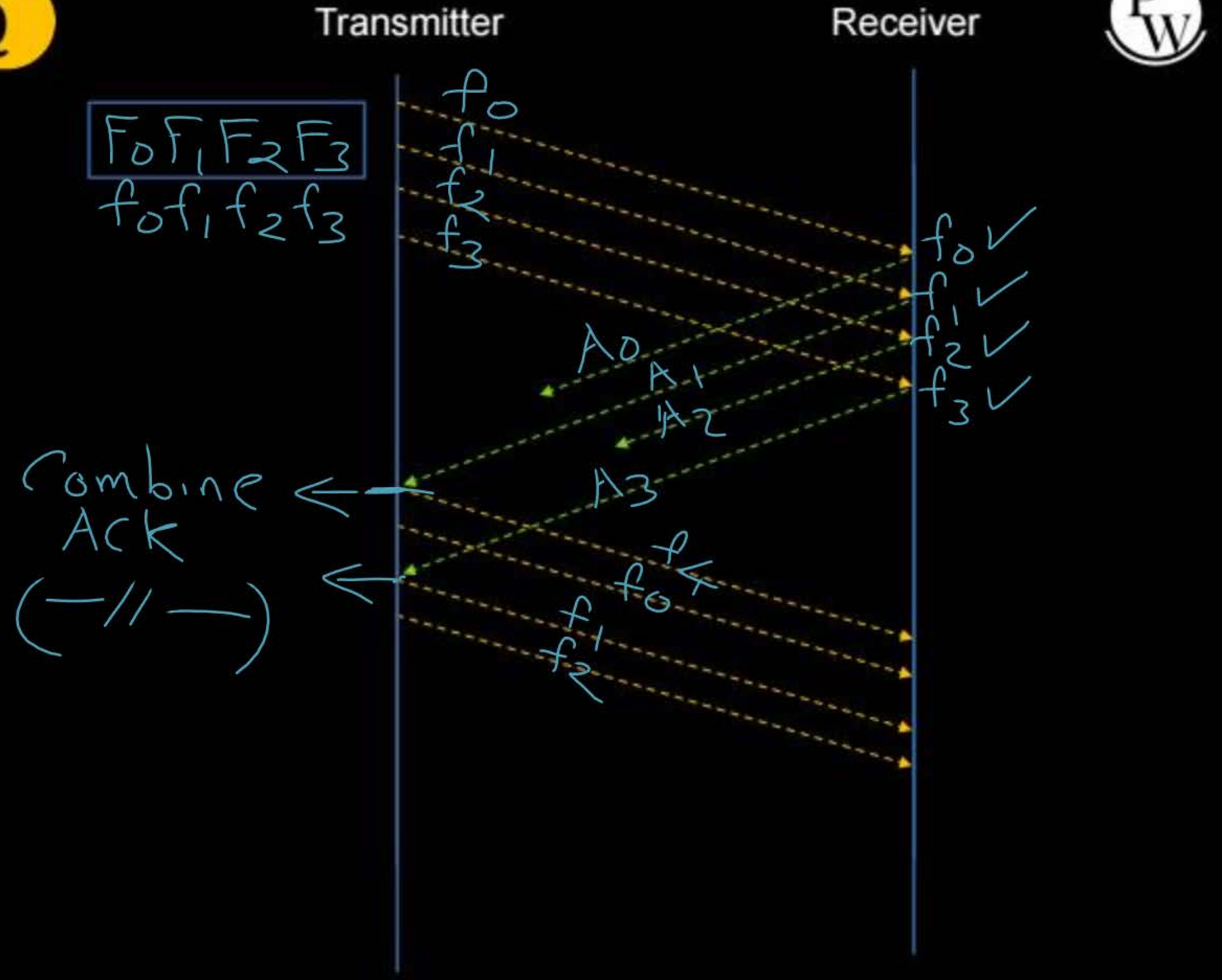


Topic : Go Back N ARQ

CASE III :

Suppose N = 4

Sequence Number = 0 to 4

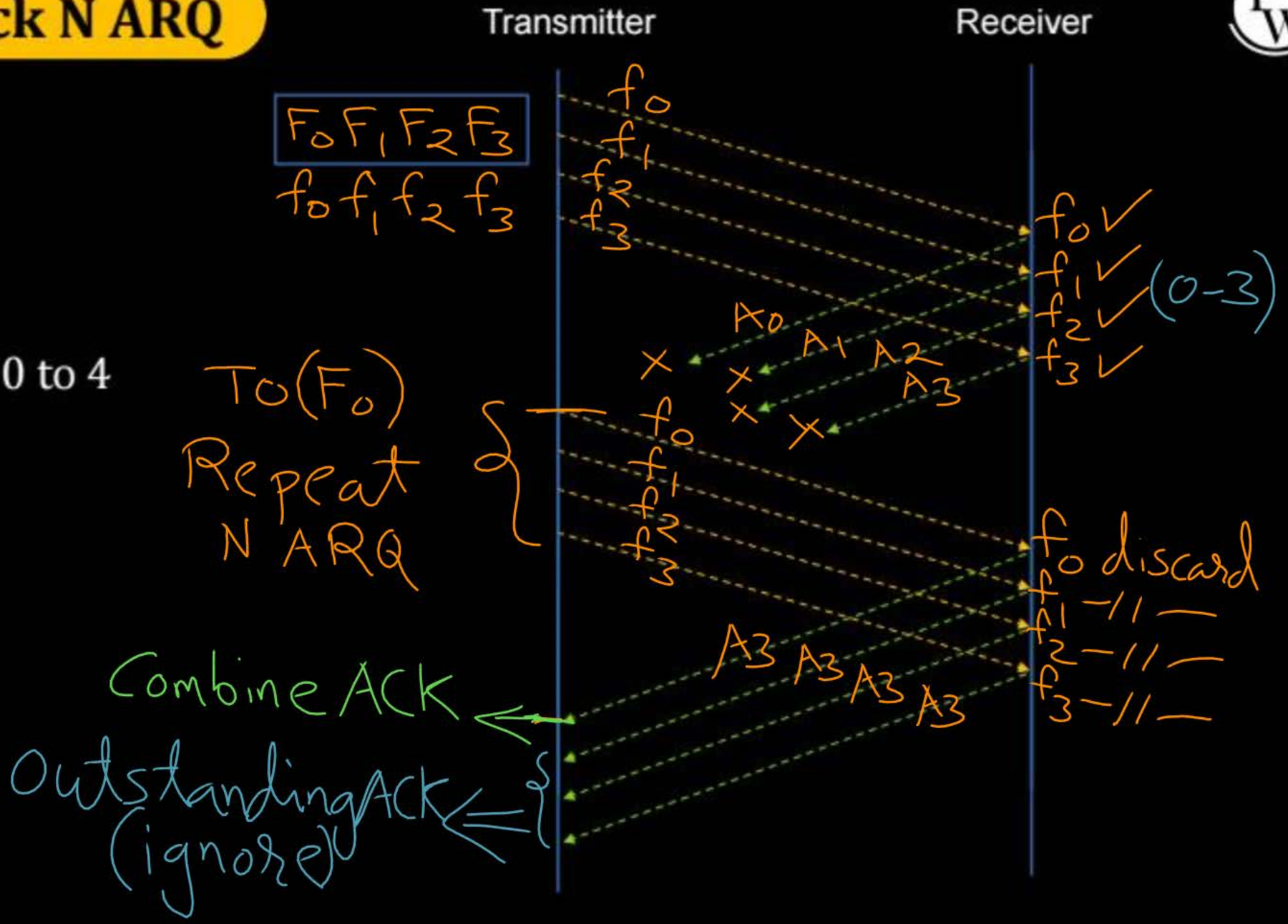


Topic : Go Back N ARQ

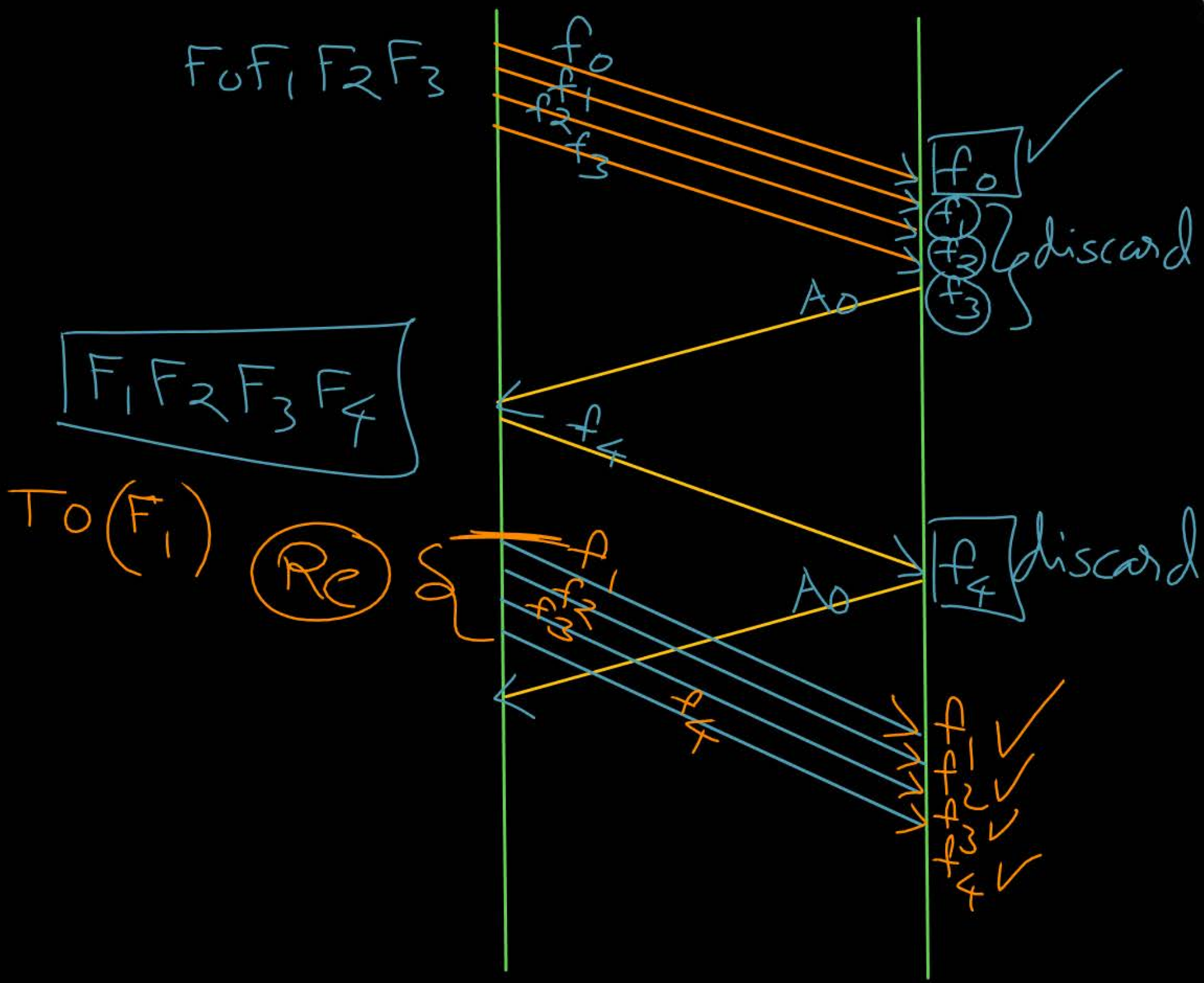
CASE IV :

Suppose N = 4

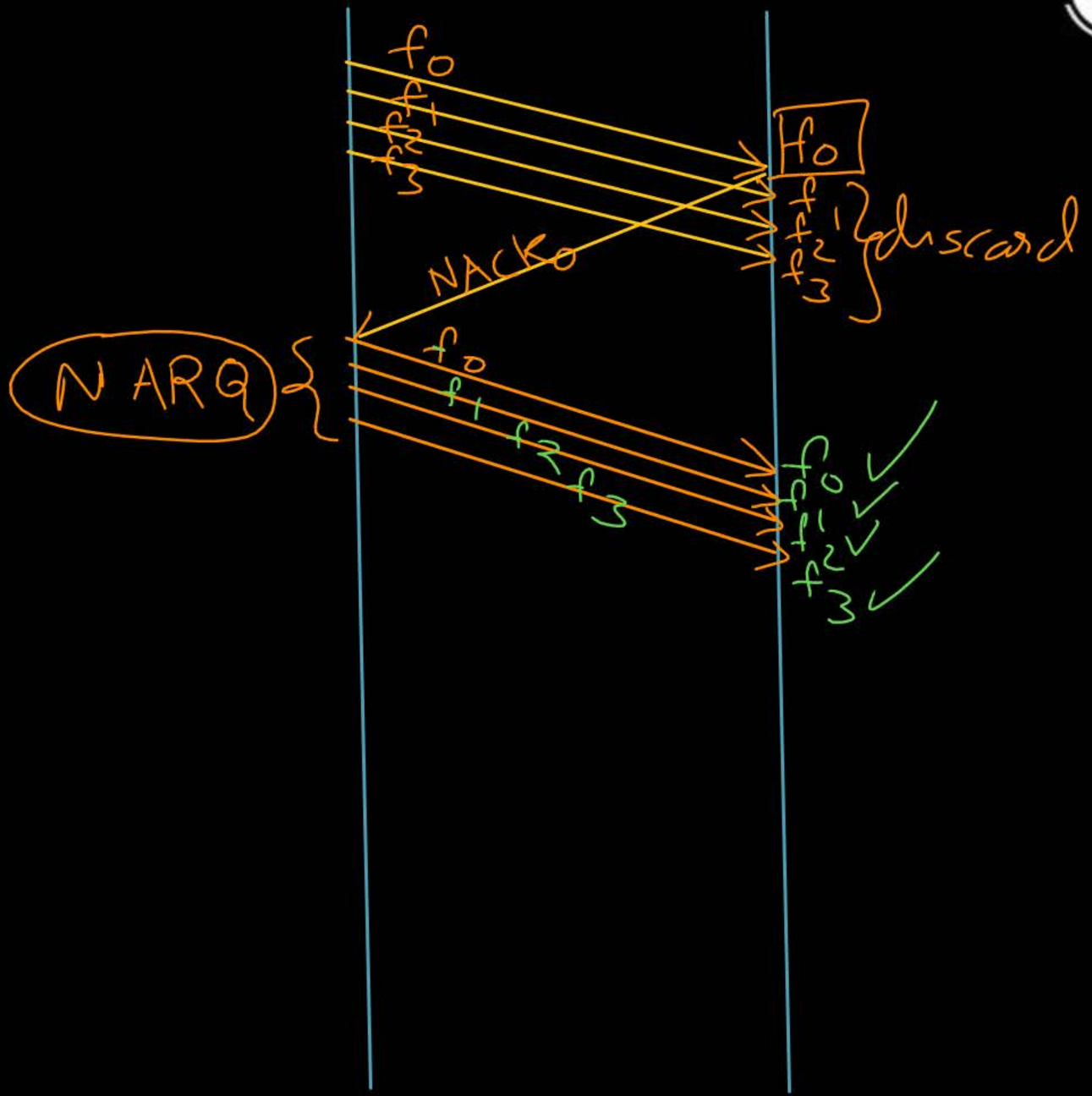
Sequence Number = 0 to 4



CASE - V


F0F1F2F3
f0
f1
f2
f3
f0
f1
f2
f3
discard
A0
F1F2F3F4
f4
T0(F1)
Rc
f1
f2
f3
A0
f4
f4
discard

CASE - VII



Topic : Go Back N ARQ

→ Transmitter transmit N frames without any acknowledgment

→ Receiver transmit "individual acknowledgment"
[for every successfully received frame]

→ "Cumulative (combine) acknowledgment" may exist.
[Acknowledges more than one frame]

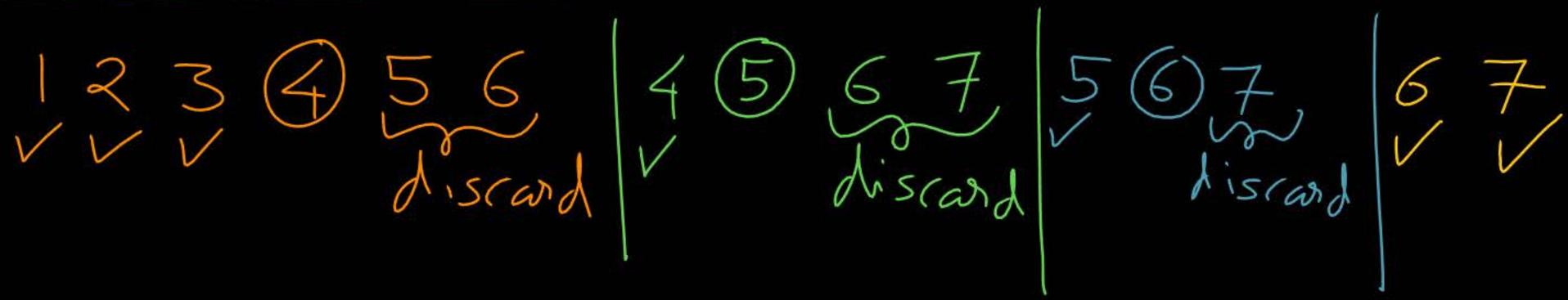
Topic : Go Back N ARQ

→ Whenever transmitter gets time-out or received NACK, it retransmit all N frames [those resides in transmitting window]

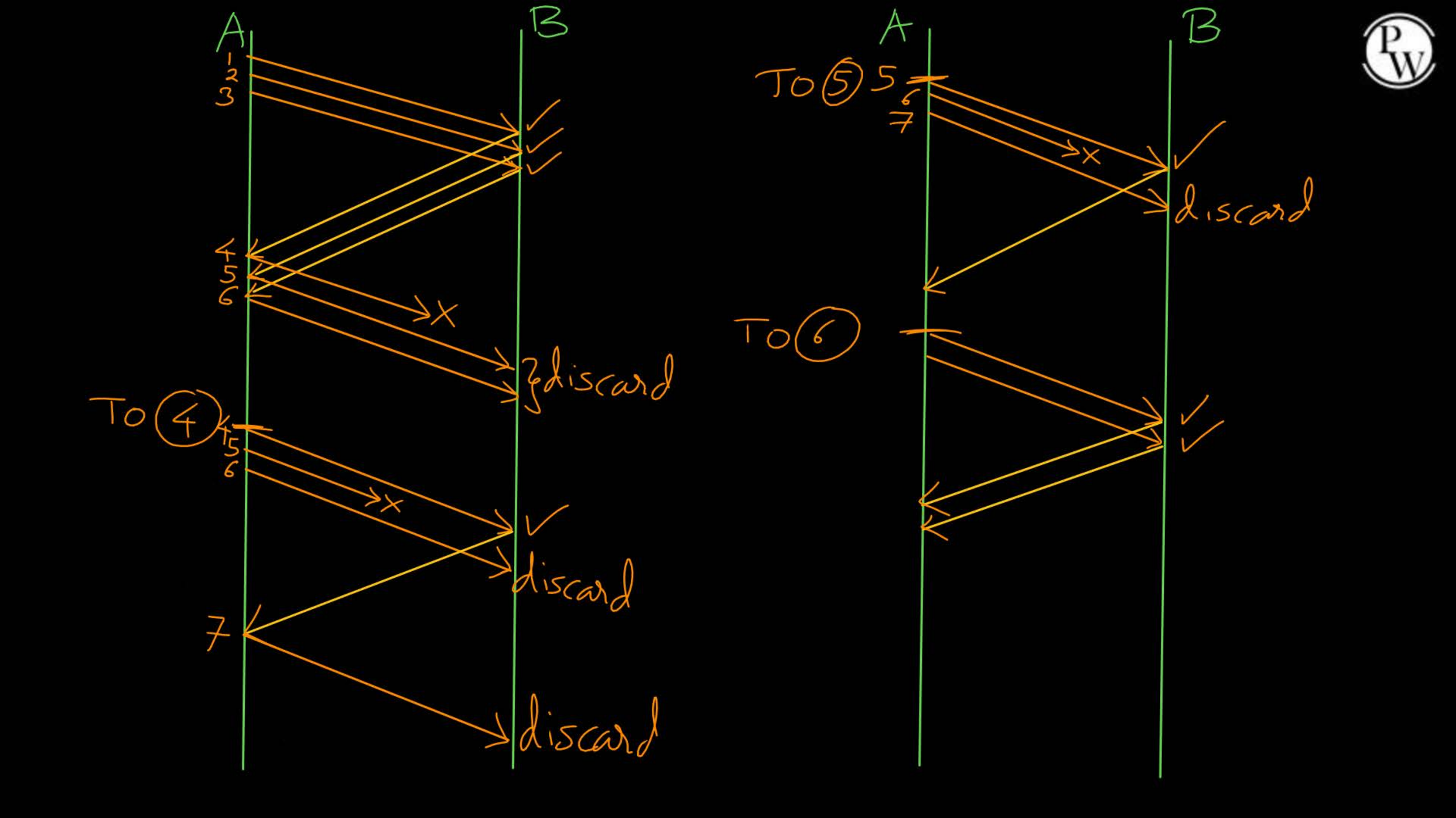
→ Receiver discard the frame which is out of order, and send ACK of the frame which is correctly received recently

Example 10 :-

Host A wants to send a file into 7 packets to Station B using go-back-n (window size 3) flow control strategy. If every 4th packet that A transmits gets lost (but no ACKs from B ever get lost), then what is the number of packets that A will transmit for sending the file to B?



Ans = 15


A
B
1
2
3
4
5
6
discard
To (4)
4
5
6
7
discard
discard
A
B
To (5)
5
6
7
discard
To (6)

#Q. Station A needs to send a message consisting of 9 packets to Station B using a sliding window (window size 3) and go-back-n flow control strategy. All packets are ready and immediately available for transmission. If every 5^{th} packet that A transmits gets lost (but no ACKs from B ever get lost), then what is the number of packets that A will transmit for sending the message to B?

[GATE 2006]

KGP, H.W

A 12

B 14

C 16

D 18

#Q. Consider a network connecting two systems located 8000 kilometers apart. The bandwidth of the network is 500×10^6 bits per second. The propagation speed of the media is 4×10^6 meters per second. It is needed to design a Go-Back-N sliding window protocol for this network. The average packet size is 10^7 bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then, the minimum size in bits of the sequence number field has to be _____.

[GATE 2015]

H.W

#Q. A 20 Kbps satellite link has a propagation delay of 400 ms. The transmitter employs the "go back n ARQ" scheme with n set to 10. Assuming that each frame is 100 bytes long, what is the maximum data rate possible?

[GATE 2004]

H.W

(A) 5Kbps

(B) 10Kbps

(C) 15Kbps

(D) 20Kbps

#Q. A 1Mbps satellite link connects two ground stations. The altitude of the satellite is 36,504 km and speed of the signal is 3×10^8 m/s. What should be the packet size for a channel utilization of 25% for a satellite link using go-back-127 sliding window protocol? Assume that the acknowledgment packets are negligible in size and that there are no errors during communication.

[GATE 2008]

H.W.

(A) 120 bytes

(B) 60 bytes

(C) 240 bytes

(D) 90 bytes

Topic : Selective Repeat ARQ

→ Transmitter's transmitting window size = N

N > 1

→ Receiver's receiving window size = N

→ Total number of sequences = 2N [0 to (2N-1)]

0 . . . . (N-1)
N . . . . (2N-1)

Total number of sequences =
Transmitter's transmitting window size
+ Receiver's receiving window size

Sequence number ← (Frame number) mod (2N)

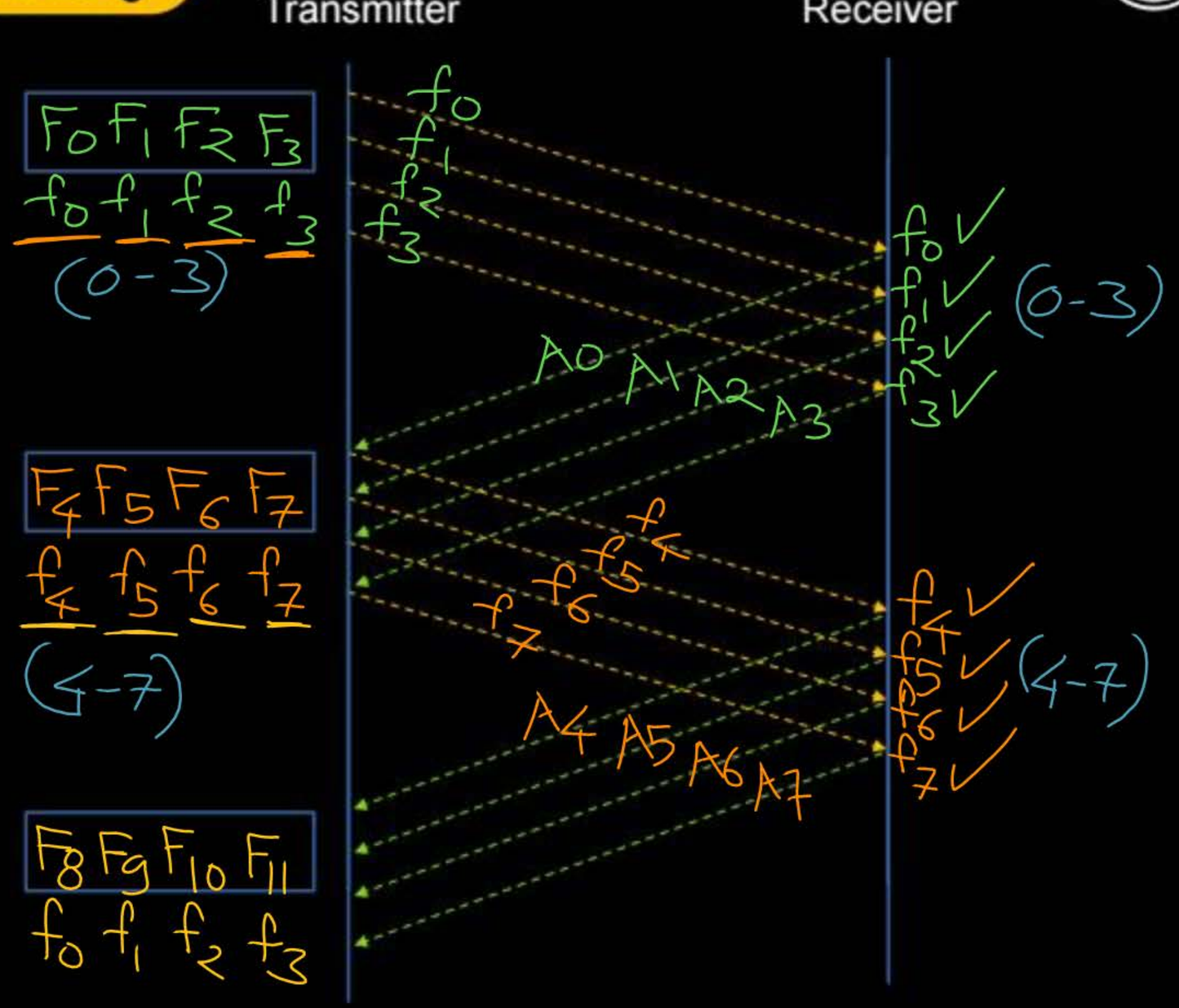
Topic : Selective Repeat ARQ

CASE I :

Suppose N = 4

Sequence Number = 0 to 7

mod (8)

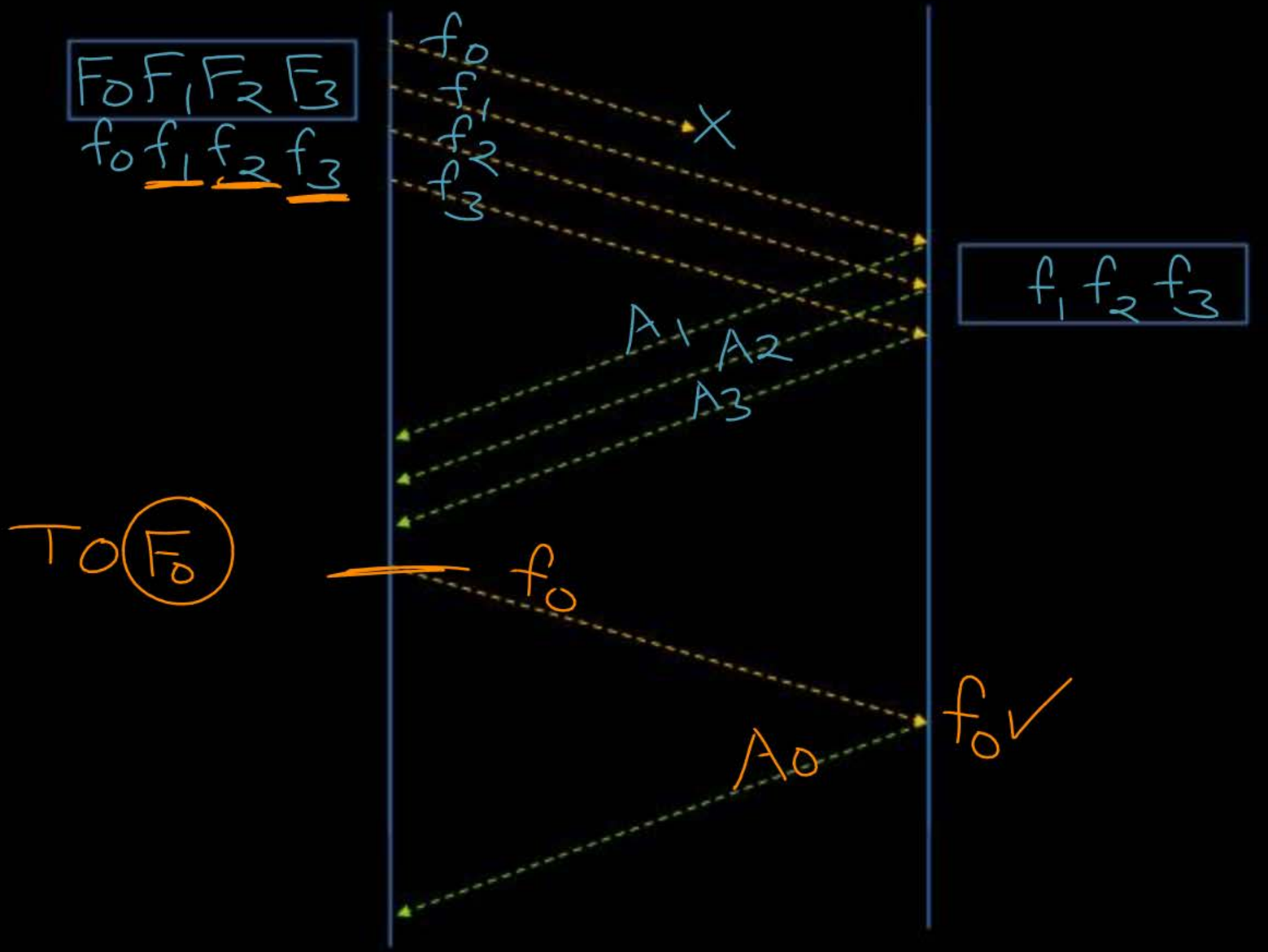


Topic : Selective Repeat ARQ

CASE II :

Suppose N = 4

Sequence Number = 0 to 7

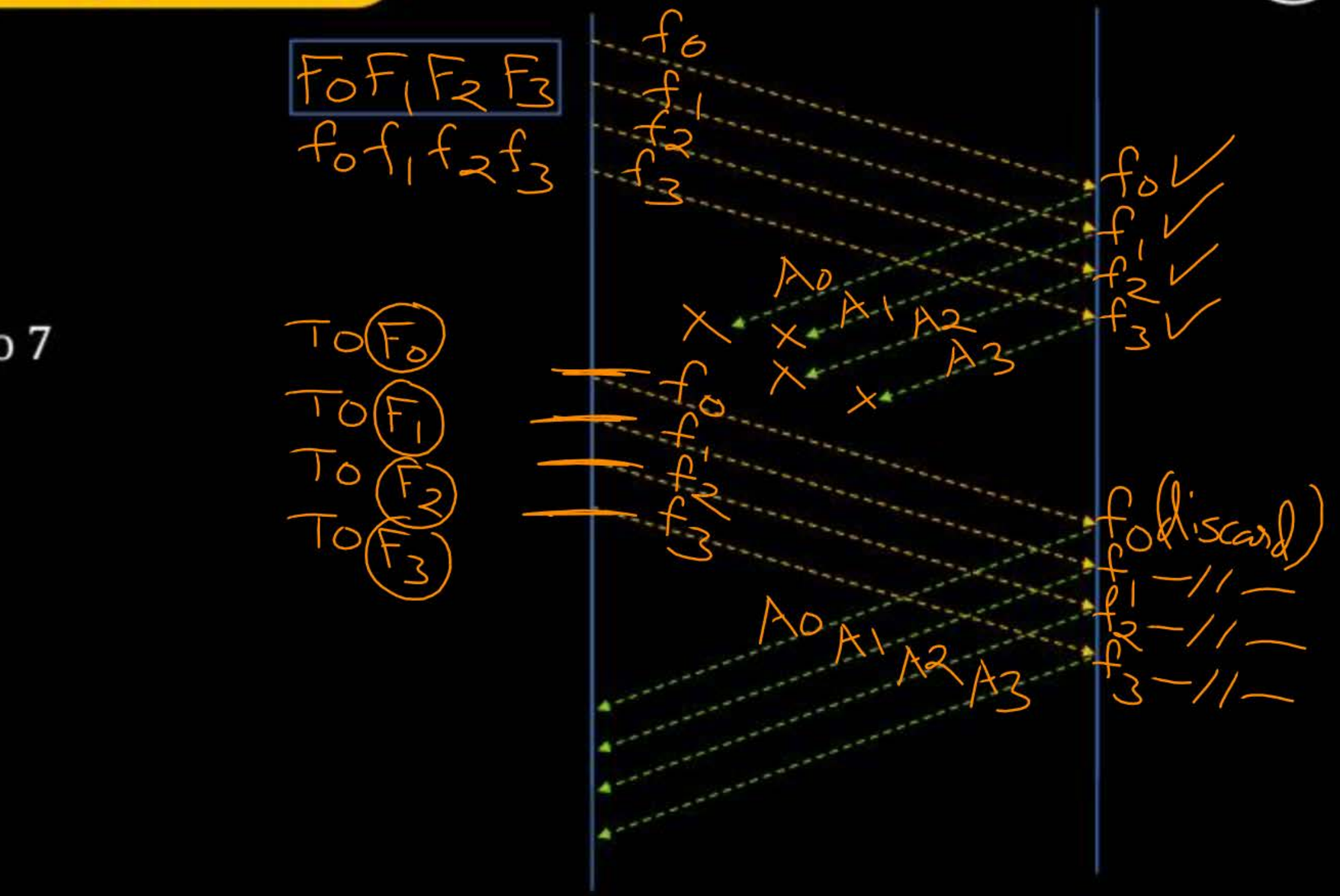


Topic : Selective Repeat ARQ

CASE III :

Suppose N = 4

Sequence Number = 0 to 7



2 mins Summary

Topic Go Back N ARQ

Topic Selective Repeat ARQ

THANK - YOU