CS & IT ENGINEERING

COMPUTER NETWORKS

Flow Control

Lecture No- 08

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TOPICS TO BE COVERED

GB-N ARQ

Q.1

In GB-3, If every 5th packet that is being transmitted is lost and If we have to send 10 packet, then How many transmission are required

Q.2

In GB-4 If every 6^{th} packet that is being transmitted is lost and If we have to send 10 packet then how many total transmission are required.

Q.3

In GB-3, If every 4^{th} packet that is being transmitted is lost and if we have to send 10 packet then how many total transmission are required. Ans: 27

GB-3, 4^{th} lost, 10 Pkt

$\boxed{1\ 2\ 3}\ \boxed{4\ 5\ 6}\ 4\ \boxed{5\ 6\ 7}\ 5\ \boxed{6\ 7\ 8}\ 6\ \boxed{7\ 8\ 9}\ 7\ \boxed{8\ 9\ 10}\ 8\ \boxed{9\ 10\ \ }\ 9\ 10$

x x x x x x

Total transmission = 27

Q.4

Station (A) needs to send a message of 9 packets where send windows = 3. All packets are ready and immediately available for transmission. By using GBN strategy, if every fifth packet gets lost, then what is the number of packets that station (A) will transmit for sending all its message _____.

GATE-2016

$W_s = 3$, 5^{th} lost , 9 Pkt

i.e GB-3

$\boxed{1\ 2\ 3}\ 4\ \boxed{5\ 6\ 7}\ 5\ 6\ \boxed{7\ 8\ 9}\ 7\ 8\ \boxed{9\quad\quad}\ 9$

Total transmission = 16

Q.5

Station A needs to send a message consisting of 15 packets to station 'B' using a sling window (window size 4) and go-back-N error control strategy. All packets are ready and immediately available for transmission. If every 6th packet that 'A' transmits gets lost (but no Acks from 'B' every gets lost), then what is the number of packets that 'A' will transmit for sending the message to 'B' ?

(A) 29

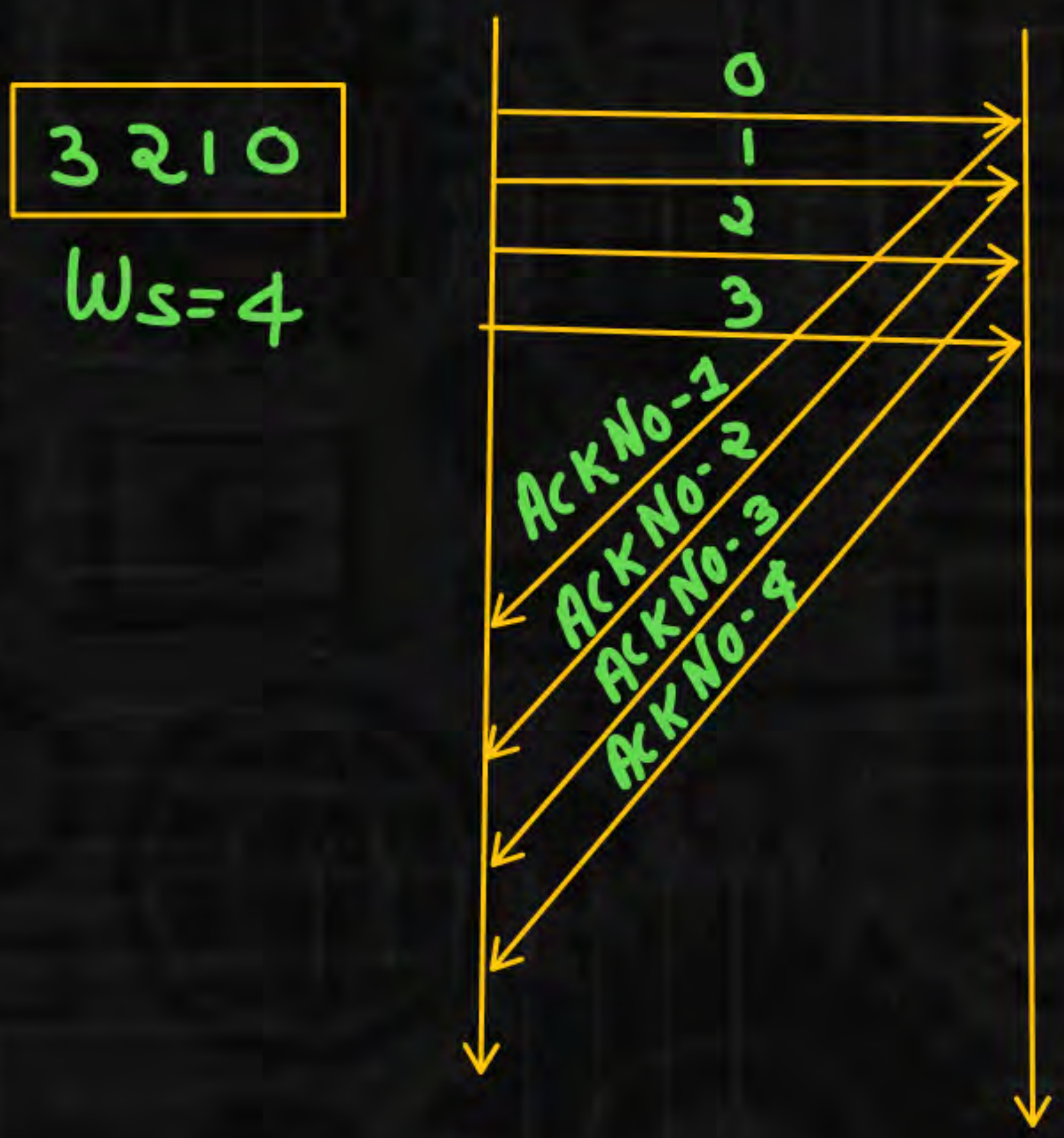
(B) 33

(C) 27

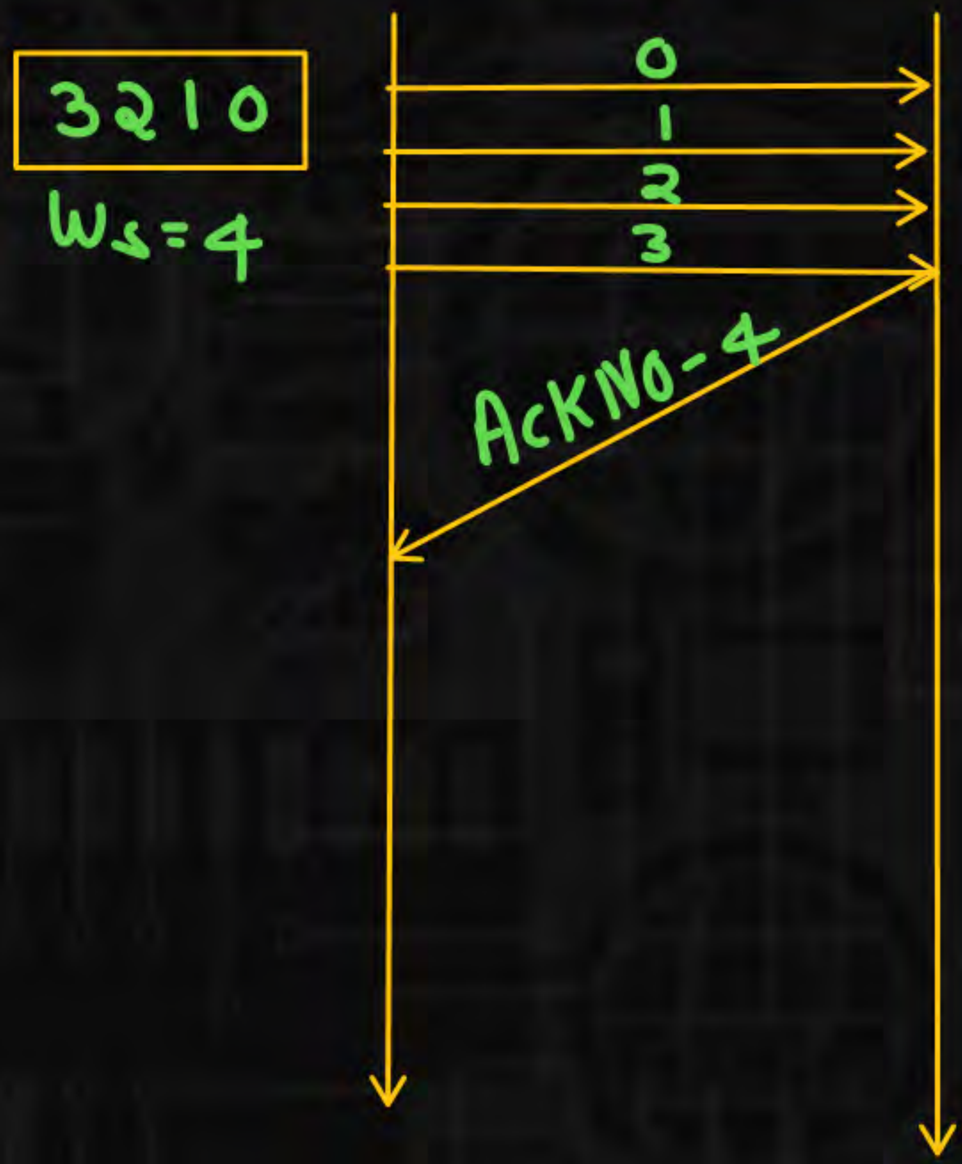
(D) 28

ACK

Independent



Cumulative



Note

① stop and wait Protocal uses Independent Acknowledgement and acknowledgement Number defines the Number of Next expected Frame

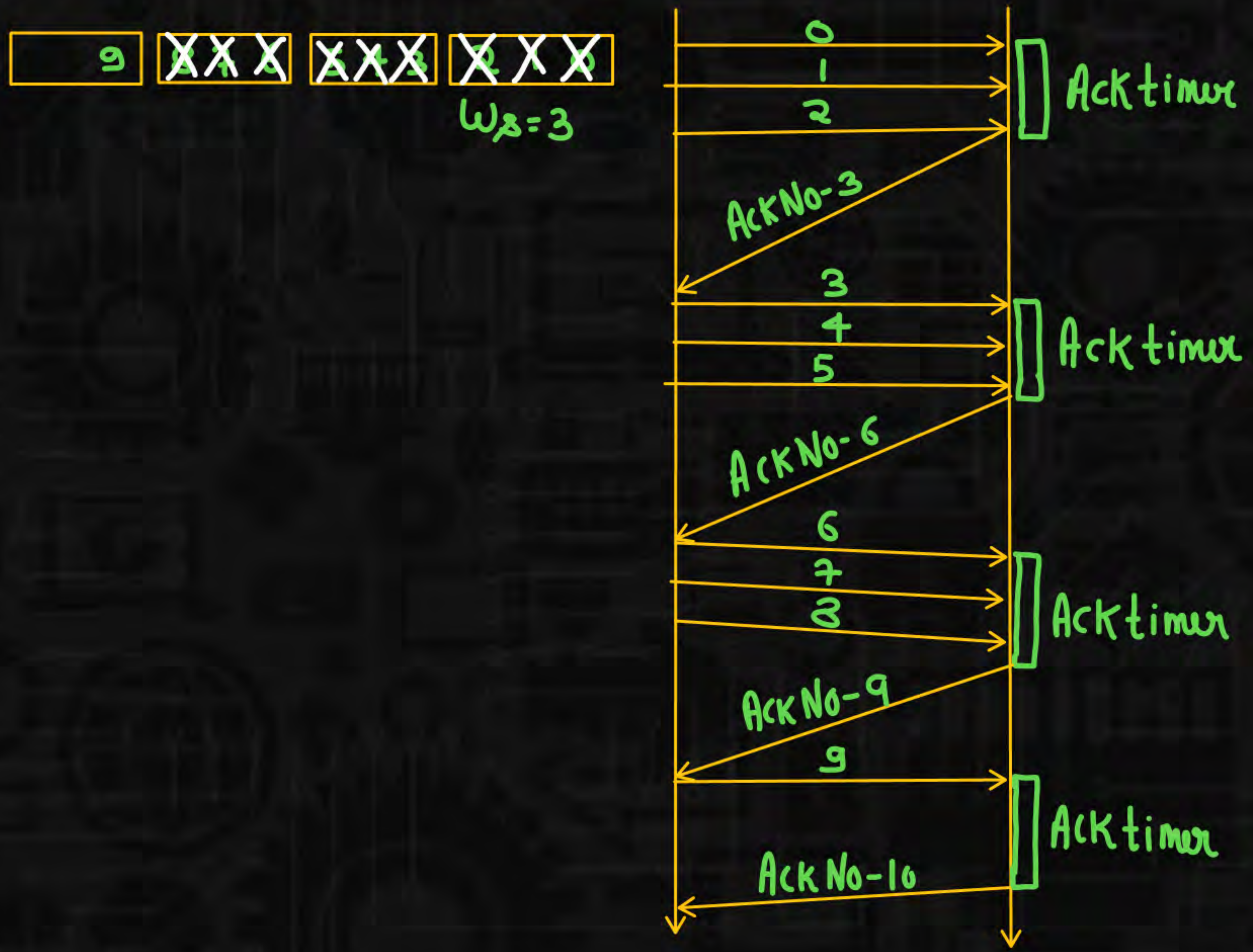
② GB-N uses cumulative Acknowledgement and Acknowledgement Number defines the Number of Next expected Frame

③ $\boxed{\text{ACK time} < \text{Time out Time}}$

OR

$\boxed{\text{Time out timer} > \text{Ack timer}}$

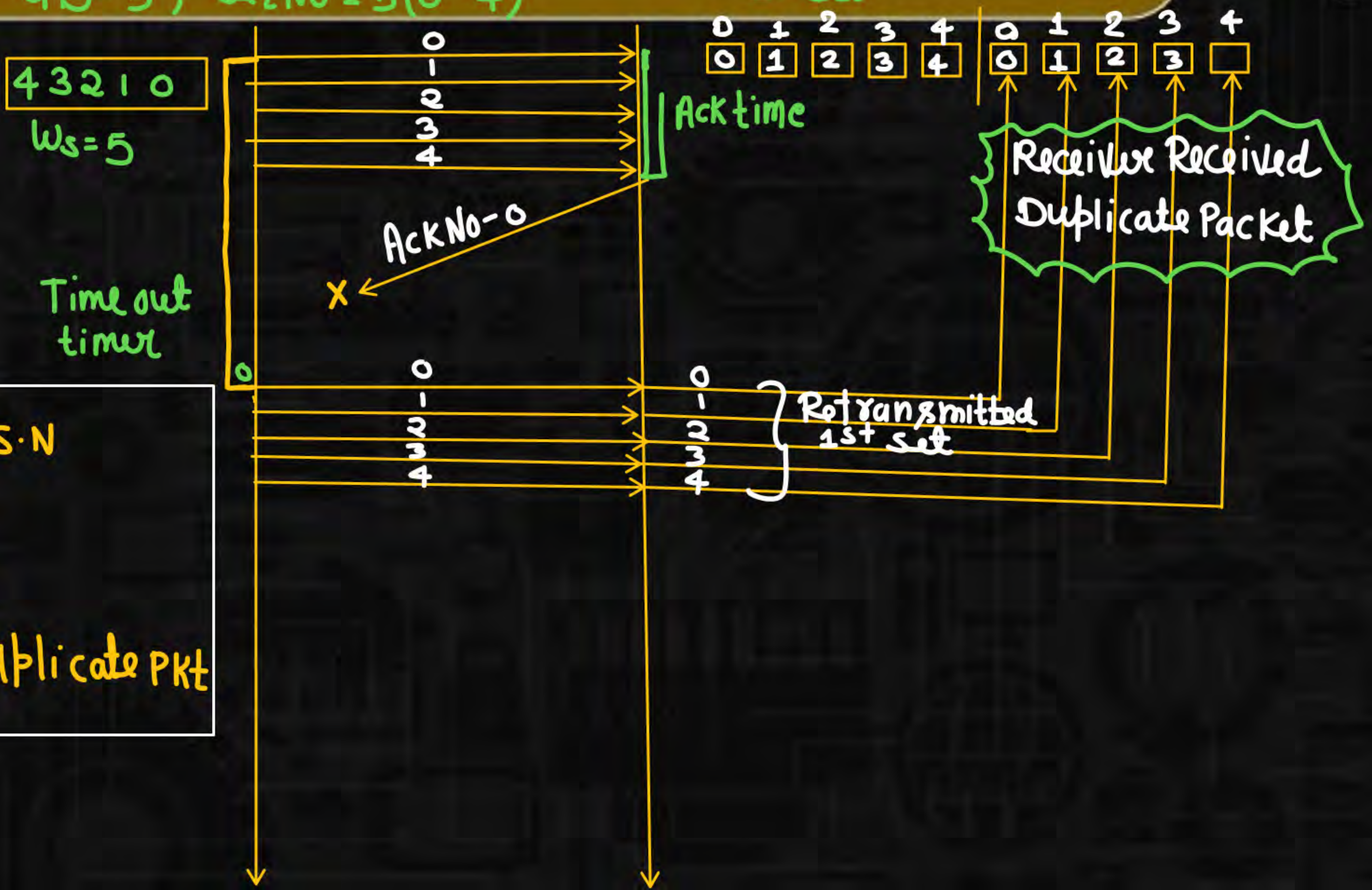
GB-3, 10Pkt



9
Ws=3
0
1
2
Ack timer
AckNo-3
3
4
5
Ack timer
AckNo-6
6
7
8
Ack timer
AckNo-9
9
Ack timer
AckNo-10

Relationship b/w window size & sequence No.

GB-5 , SeqNo = 5(0-4)



$$W_S + W_R \leq A.S.N$$

$$5 + 1 \leq 5$$

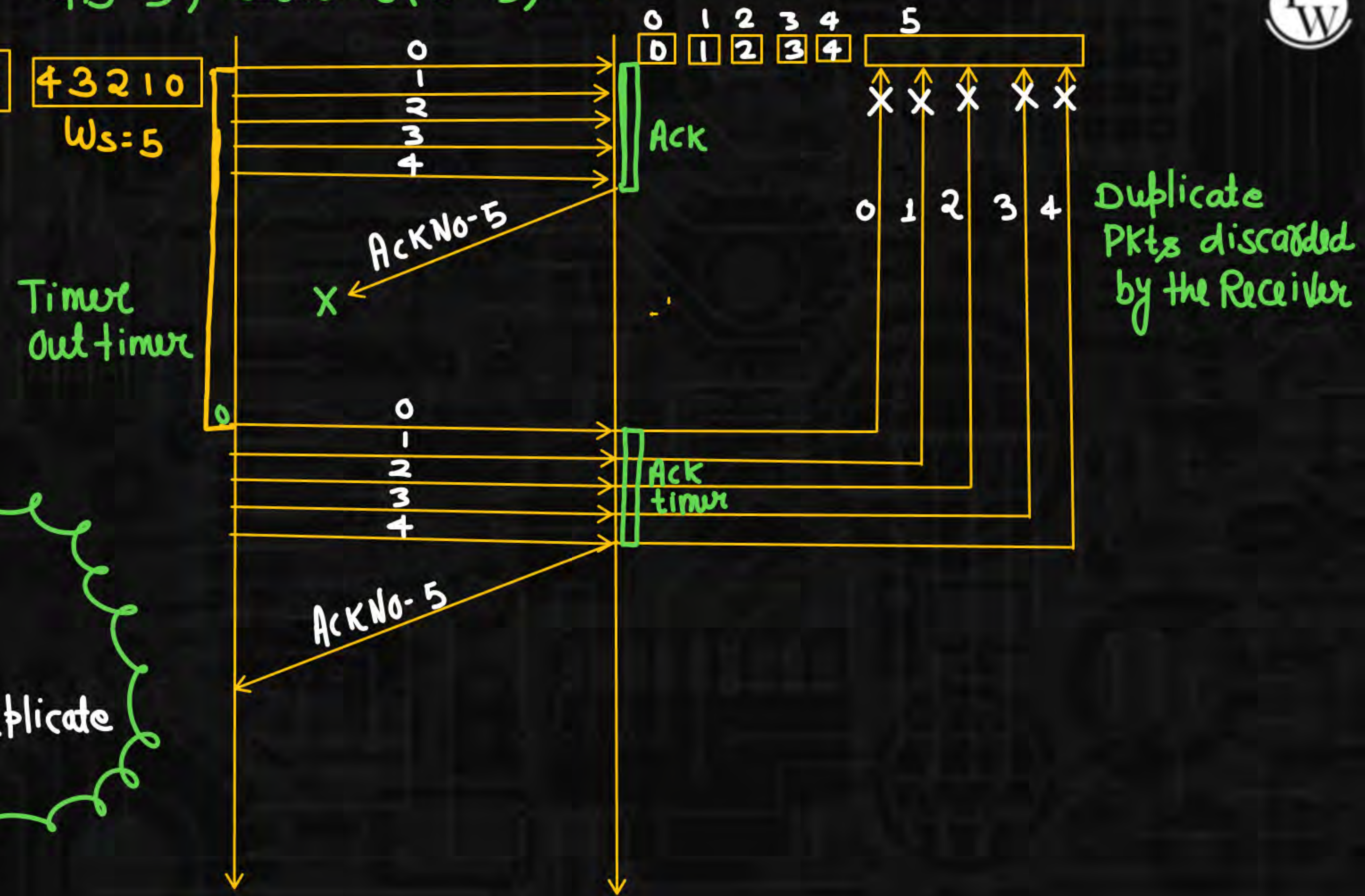
$$6 \leq 5 \text{ (No)}$$

Problem of Duplicate Pkt

GB-5, SeqNo = 6 (0 - 5)

5 4 $\boxed{3\ 2\ 1\ 0\ 5}$ $\boxed{4\ 3\ 2\ 1\ 0}$

$W_s = 5$



$W_s + W_R \leq A.S.N$

$5 + 1 \leq 6$

$6 \leq 6$ (yes)

No Problem OF Duplicate Packet

Note

① Duplicate Packet Problem can be solved by Increasing the sequence Numer or Decreasing the Sender window size

② Duplicate Packet Problem can be solved by using the Following Formula $\boxed{W_S + W_R \leq A.S.N}$ [Available Sequence Number)

W_R size: In the GB-N the window receiver size is equal to one always irrespective of window sender size $\boxed{(W_R=1)}$

W_s size: Window sender size is calculated based on the following formula

$$\boxed{W_S+W_R \leq A.S.N}$$

$$W_S+1 \leq A.S.N$$

$$\boxed{W_S \leq A.S.N-1}$$

$W_s \leq 6-1$ ($A \cdot S \cdot N = 6$ From Last Diagram)

$W_s \leq 5$

$W_s + W_R \leq A \cdot S \cdot N$

$W_s + 1 \leq A \cdot S \cdot N$

$\boxed{W_s \leq A \cdot S \cdot N - 1}$

1. Seq No = 6 (0 - 5)

W_S	W_R
5	1

2. Seq No = 16 (0 - 15)

W_S	W_R
15	1

3. Seq No = N [0 — N-1]

W_S	W_R
N-1	1

4. Seq No = 3bit

Total Seq No = $2^3 = 8(0-7)$

W_S	W_R
$7\,[2^3-1]$	1

5. Seq No = 4 bit

Total sequence No. = $2^4 = 16\,(0-15)$

W_S	W_R
$15\,[2^4-1]$	1

6. Seq No. = K bit

W_S	W_R
2^K-1	1

7.

W_S	W_R	minimum sequence Required
5	1	6
15	1	16
25	1	26
N	1	N+1

$$\boxed{\text{minimum sequence No. required in GB-N} = W_S + W_R}$$

SeqNo = 8 (0 - 7)

W_S	W_R
7	1 ✓
6	1 ✓
5	1 ✓
4	1 ✓
3	1 ✓
2	1 ✓
1	1 ✗ [GB-N (N > 1)] It is stop & wait
2	2 ✗ [In GB-N ($W_R = 1$ Always)]

$$W_S + W_R \le A \cdot S \cdot N$$

$$W_S + 1 \le A \cdot S \cdot N$$

$$W_S \le A \cdot S \cdot N - 1$$

$$W_S \le 8 - 1$$

$$\boxed{W_S \le 7}$$

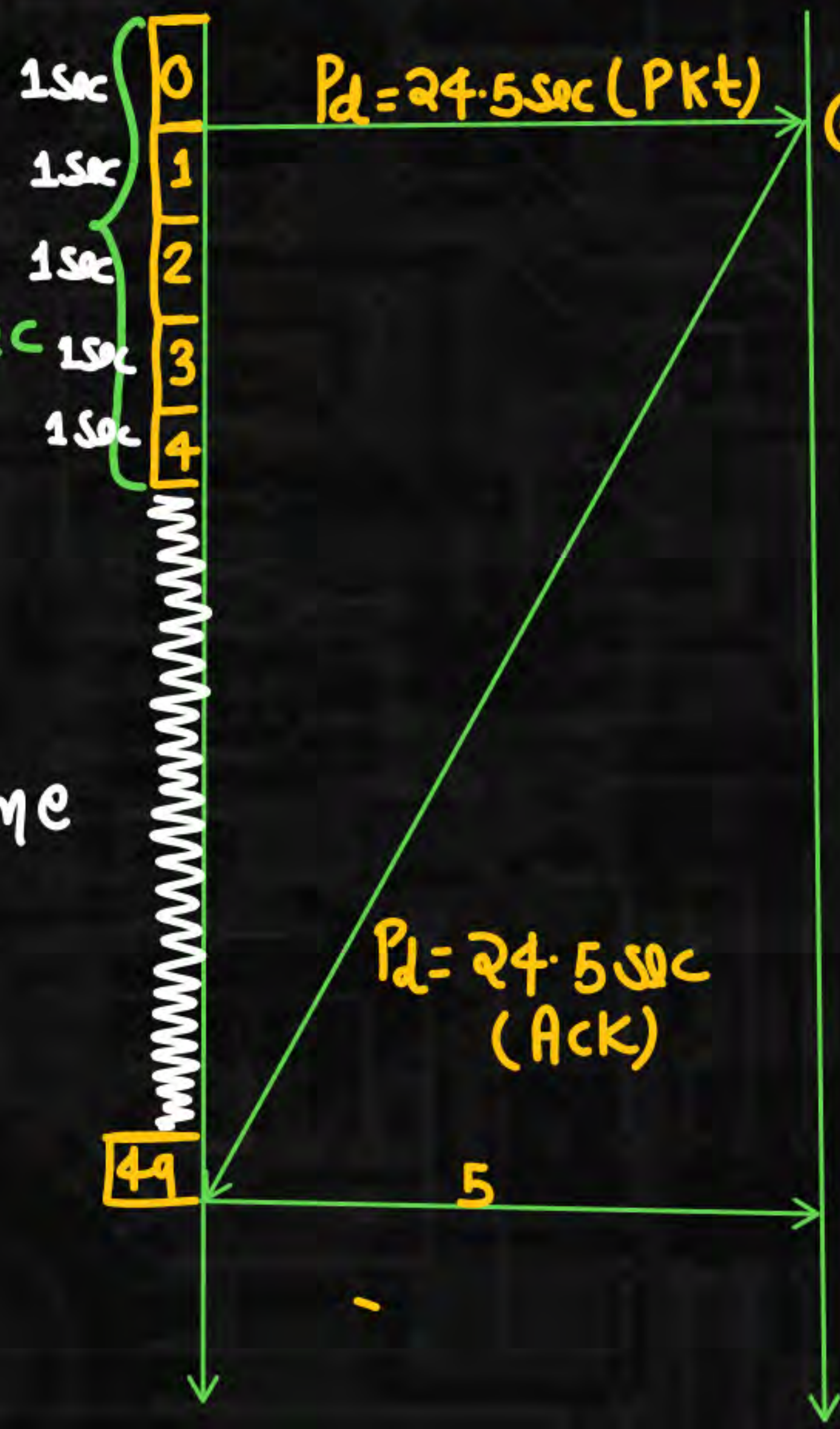
Q: $T_d = 1\,sec$, $P_d = 24.5\,sec$, $Q_d = 0$, $P_{rd} = 0$, $T_d(Ack)$, GB-5, SeqNo = 6(0-5)

5 4 3 2 1 $\cancel{0}$

$W_s = 5$

Useful time $\Rightarrow$ 5 sec

Waiting time = 45 sec



$$\text{efficiency} = \frac{5}{50} = \frac{1}{10} = 10\%$$

$$\text{efficiency} = \frac{\text{useful time}}{\text{total time}}$$

$$= \frac{\text{useful time}}{\text{useful time} + \text{waiting time}}$$

$$= \frac{5\,sec}{5\,sec + 45\,sec} = \frac{5\,\cancel{sec}}{50\,\cancel{sec}}$$

$$\boxed{\text{efficiency} = \frac{1}{10} = 10\%}$$

$$\text{efficiency} = \frac{\text{useful time}}{\text{total time}}$$

$$\boxed{\text{efficiency} = \frac{N * T_d(\text{frame})}{T_d(\text{frame}) + 2 * P_d + Q_d + P_{rd} + T_d(\text{Ack})}}$$

exact Formula

$$\text{efficiency} = \frac{5 * 1\ \text{sec}}{1\ \text{sec} + 2 * 24.5 + 0 + 0 + 0}$$

$$\text{efficiency} = \frac{5\ \text{sec}}{1 + 49\ \text{sec}}$$

$$\text{efficiency} = \frac{\cancel{5}}{\cancel{50}} = \frac{1}{10}$$

$$\boxed{\text{efficiency} = 10\%}$$

$$\eta = \frac{N * T_d}{T_d + 2 * P_d + \cancel{Q_d}^{0} + \cancel{P_{rd}}^{0} + \cancel{T_d(\text{Ack})}^{0}}$$

$$\eta = \frac{N * T_d}{T_d + 2 * P_d}$$

$$\eta = \frac{N * \cancel{T_d}}{\cancel{T_d}\left[1 + 2 * \frac{P_d}{T_d}\right]}$$

Approxim-ate Formul $\Rightarrow$ $\boxed{\eta = \frac{N}{1 + 2a}}$

$$a = \frac{P_d}{T_d}$$

If $N = 1 + 2a$

$$\eta = \frac{1+\cancel{2a}}{1+\cancel{2a}}$$

$$\boxed{\eta = 100\ \%}$$

If $N > (1+2a)$

No Benifit

Q: $\eta = \frac{1}{10}$, Bandwidth = 40 mbps , Throughput = ?

$$\text{Throughput} = \frac{1}{\cancel{10}} * \cancel{40}\,\text{mbps}$$

$$\boxed{\text{Throughput} = 4\ \text{mbps}}$$

$$\boxed{\text{Throughput} = \text{efficiency} * \text{Bandwidth}}$$

OR

$$\boxed{\text{Throughput} = \frac{N * \text{Frame size}}{\text{Total time}}}$$

$$\text{efficiency} = \frac{\text{throughput}}{\text{Bandwidth}}$$

$$= \frac{\cancel{4}\,\text{mb}\cancel{\text{ps}}}{\cancel{40}\,\text{mb}\cancel{\text{ps}}}$$

$$\boxed{\text{efficiency} = \frac{1}{10}}$$

Problem Solving on GB-N Protocol

Q.1 In Go-back-N protocol, if the maximum window size is 512 what is the range of sequence number

(A) 0 to 513

(B) 1 to 513

(C) 0 to 512

(D) 1 to 512

In GB-N sender window size = N
min. sequence No. required in GB-N $= W_S + W_R = N+1$ (0 − N)

Sender window size = 512
min. sequence No. required $= 512+1 = 513$ (0 − 512)

Q.2

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

(A) 5 Kbps

(B) 10 Kbps

(C) 15 Kbps

(D) 20 Kbps

$B = 20\text{ Kbps} = 20 \times 10^3$ bits/sec

$P_d = 400$ msec

GB-10

$N = 10$

Frame size $= 100$ Byte

$= 8 \times 100$ bits

$= 800$ bits

$T_d(\text{frame}) = \dfrac{\text{Frame size}}{\text{Bandwidth}}$

$= \dfrac{800 \text{ bits}}{20 \times 10^3 \text{ bits/sec}}$

$= 40 \times 10^{-3}$ sec $= 40$ msec

Throughput = $\eta * B$

$= 0.4761 * 20 \text{ Kbps}$

$= 9.52 \text{ Kbps}$

$\simeq 10 \text{ Kbps}$

$$\eta = \frac{\text{usefultime}}{\text{totaltime}}$$

$$= \frac{N * T_d(\text{frame})}{T_d(\text{frame}) + 2 * P_d + \cancel{Q_d}^{0} + \cancel{P_{rd}}^{0} + \cancel{T_d(\text{Ack})}^{0}}$$

$$= \frac{10 * 40 \text{ msec}}{40 \text{ msec} + 2 * 400 \text{ msec}}$$

$$= \frac{40\cancel{0} \cancel{\text{msec}}}{84\cancel{0} \cancel{\text{msec}}}$$

$$= 0.4761$$

Q.3 Assume we need to design Go-back-N sliding window protocol for a network in which bandwidth is 1 Mbps and average distance between sender and receiver is 5000 Km. Assume that average packet size is 5000 bits. Propagation speed in the media is 2×10^8 m/sec. In GB-10 If process delay is 0.5 Msec and queuing delay is 2msec then what is the efficiency.

(A) 99%

(B) 57%

(C) 87%

(D) 67%

B = 1 mbps = 10^6 bits/sec

d = 5000 km

Pkt size or Frame size = 5000 bits

$V = 2 * 10^8$ m/sec

$V = 2 * 10^5$ km/sec

GB-10, N = 10

P_{rd} = 0.5 msec

Q_d = 2 msec

$$\text{efficiency} = \frac{\text{useful time}}{\text{total time}}$$

$$= \frac{N * T_d(\text{frame})}{T_d(\text{frame}) + 2 * P_d + Q_d + P_{rd} + \underbrace{\cancel{T_d(\text{Ack})}}_{0}}$$

$$= \frac{10 * 5}{5 + 2 * 25 + 2 + 0.5}$$

$$= \frac{50}{57.5} = 0.8695$$

$$\eta = 86.95\ \%$$

$$\boxed{\eta \cong 87\ \%}$$

$$T_d(\text{frame}) = \frac{\text{Frame size}}{\text{Bandwidth}}$$

$$= \frac{5000\ \cancel{\text{bits}}}{10^6\ \cancel{\text{bits}}/\text{sec}}$$

$$= 5 * 10^{-3}\ \text{sec} = 5\ \text{msec}$$

$$P_d = \frac{d}{v} = \frac{5000\ \cancel{\text{km}}}{2 * 10^5\ \cancel{\text{km}}/\text{sec}}$$

$$= 25 * 10^{-3}\ \text{sec}$$

$$= 25\ \text{msec}$$

Q.4 Assume a sender send 6 packet 0, 1, 2, 3, 4 and 5. The sender receivers an acknowledgement with AckNo = 3. what is the interpretation if the system in using GB-N

(A) It means that packet 3 has been received uncorrupted

(B) It means packet 0, 1, 2 have received uncorrupted and receiver is expected packet 3

H.W

(C) Ack does not say anything about other packet

(D) All the above

Q.5 In a sliding window ARQ scheme, the transmitter's window size is N and the receiver's window size is M. The minimum number of distinct sequence numbers required to ensure correct operation of the ARQ scheme is

GATE-IT-2004

H·W

(A) min (M, N)

(B) max (M, N)

(C) M + N

(D) MN

Q.6

Consider packet size is 1000 bits and distance between two hosts is 5 km, 1 Mbps link with signal speed 2 ms/km (ms per km) is used, the efficiency in percentage if GB-N protocol is used and N is set to 7 _____.

H·W

Q.7

In GB-N Protocol the packet size is 1000 bytes transmission time for one packet is 1ms. If distance between hosts is 10km and signal speed is 5ms per km (5ms/km) and frame sequence number are 6 bit long in frame format then the throughput (in Mbps) is _____ .

H·W

Q.8

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 50μ sec. Acknowledgement packets (sent only from B to A) are very small and require negligible transmission time. The propagation delay over the link is 200 μ sec. What is the maximum achievable throughput in this communication?

HW

GATE

(A) 7.69×10^6 Bps

(B) 11.11×10^6 Bps

(C) 12.33×10^6 Bps

(D) 15.00×10^6 Bps


THANK YOU
GW
SOLDIERS !