CS & IT ENGINEERING

COMPUTER NETWORKS

TCP & UDP

Lecture No-03

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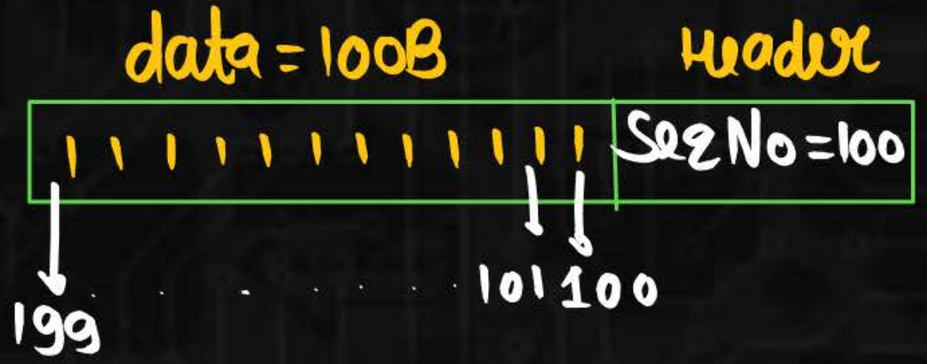
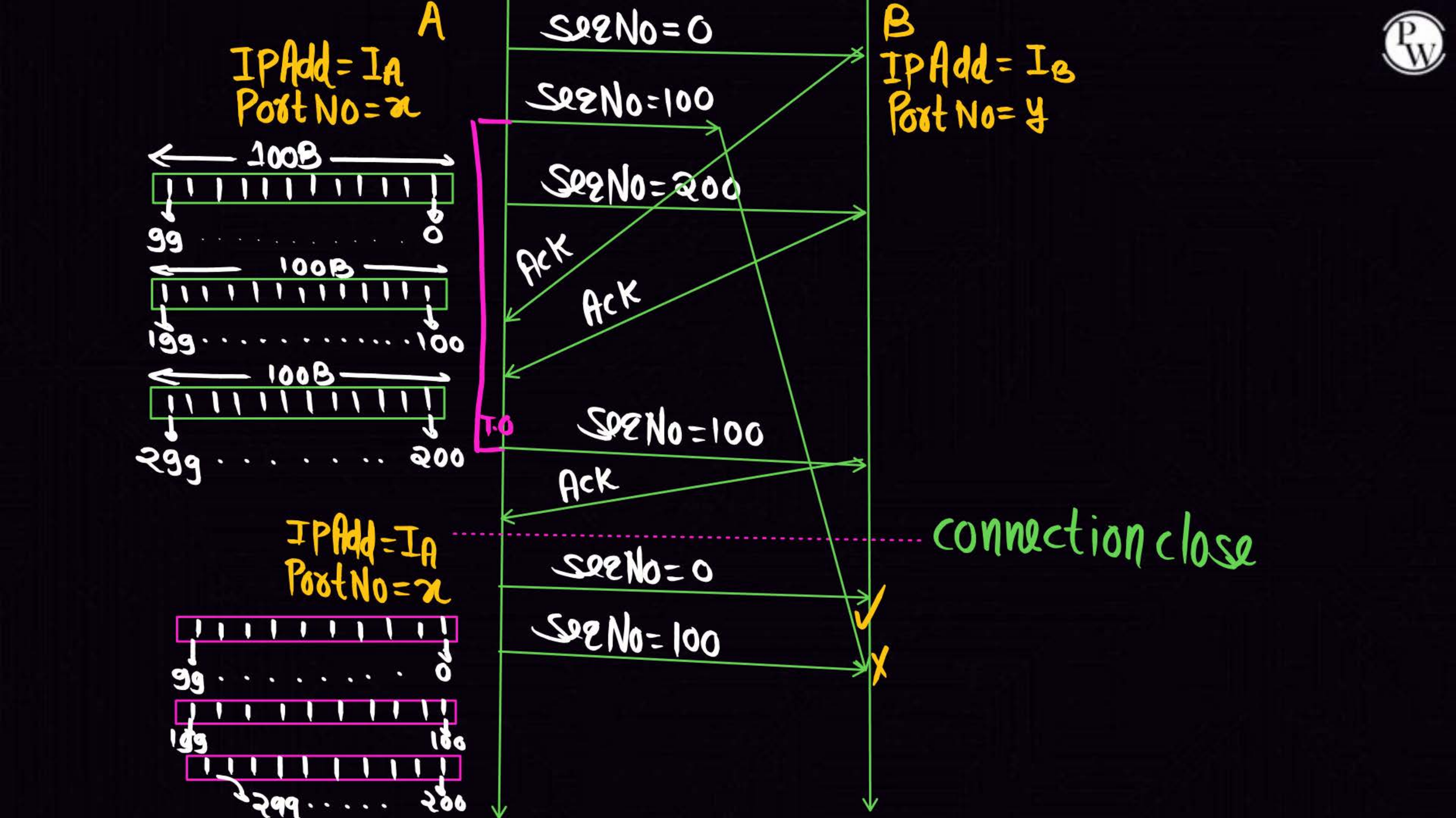
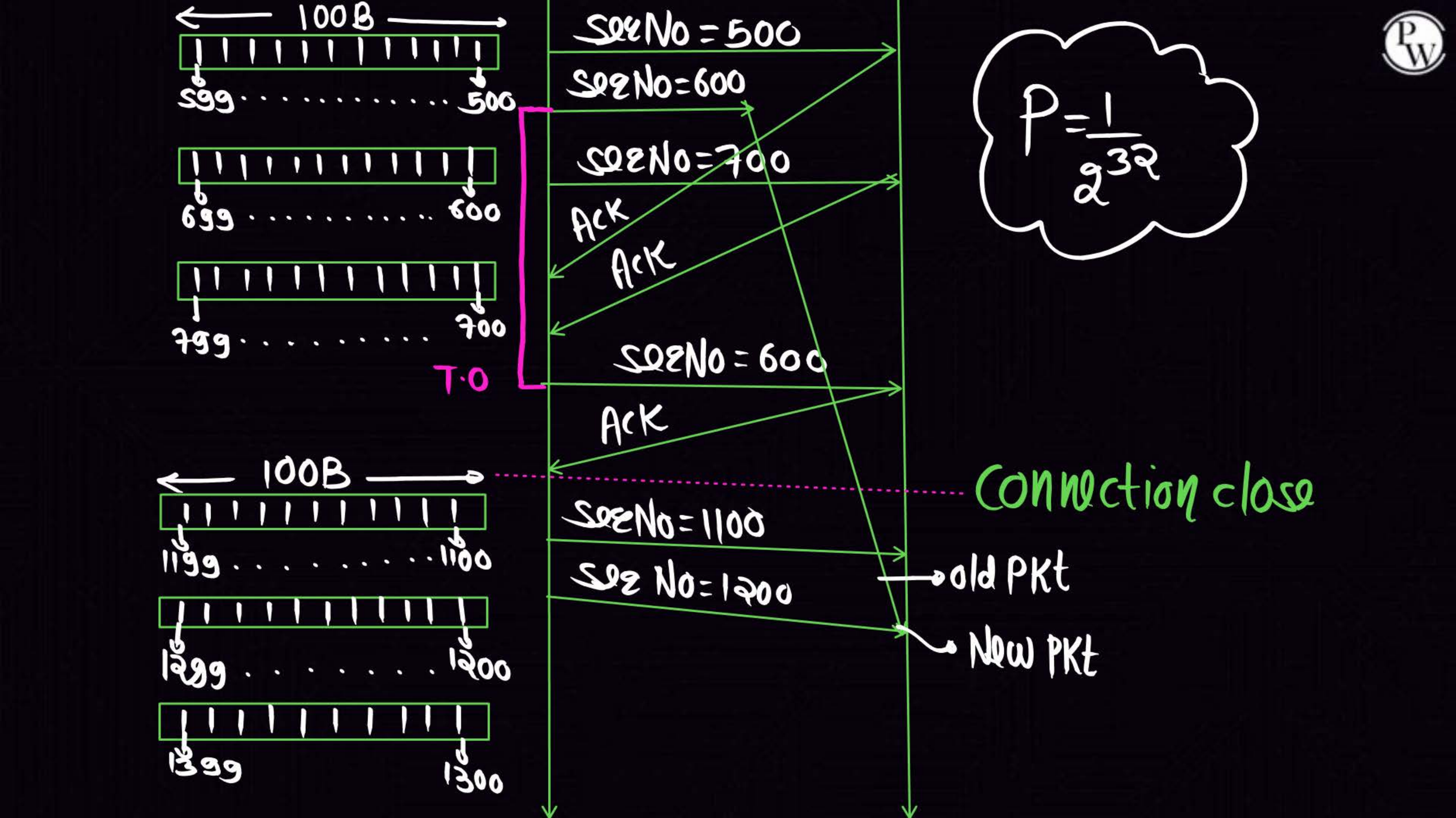
Wrap Around Time


data = 100B
Header
Seq No = 100
199
101
100


Seq No = 100
Ack No = 200


A
IPAdd = IA
Port No = x
B
IPAdd = IB
Port No = y
Seq No = 0
Seq No = 100
Seq No = 200
Ack
Ack
100B
99
0
100B
199
100
100B
299
200
T.O
Seq No = 100
Ack
connection close
IPAdd = IA
Port No = x
Seq No = 0
Seq No = 100
99
0
199
100
299
200


100B
599
500
699
600
799
700
T.O
100B
1199
1100
1299
1200
1399
1300
SeqNo = 500
SeqNo = 600
SeqNo = 700
Ack
Ack
SeqNo = 600
Ack
SeqNo = 1100
Seq No = 1200
old PKt
New PKt
Connection close
P = 1/2^32

Note:

TCP suggest that do not start with the sequence Number 0 Always choose any Random sequence Number initially.

Wrap Around Time

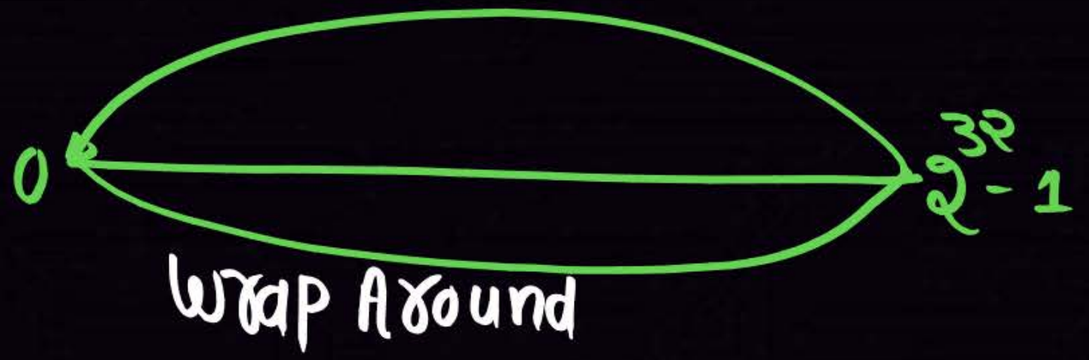
Seq No = 32 bit

Total Sequence Number = $2^{32} = 2^2 * 2^{30}$ = 4G Sequence Number

data size = 4GB

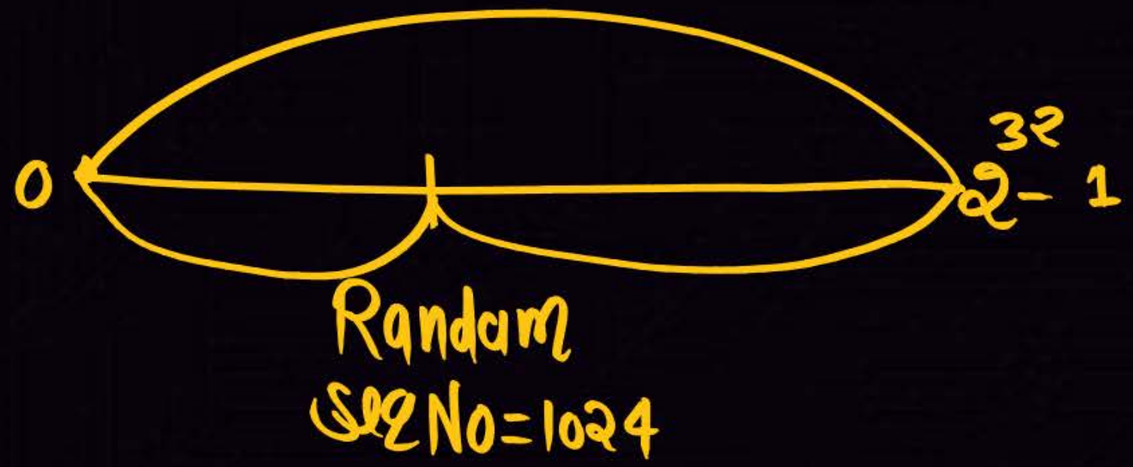
If data size > 4GB

Seq No = 2^{32} (0 to $2^{32} - 1$)



If data size = 4GB + 4GB

0 to $2^{32} - 1$ 0 to $2^{32} - 1$



wrap Around

Wrap Around time: Time taken to wrap Around

Note: wrap Around time (WAT) depends on Bandwidth

① $B = 1MBPS = 10^6 Byte/sec$

$1 sec \longrightarrow 10^6 Byte$

$10^6 Byte \longrightarrow 1 sec$

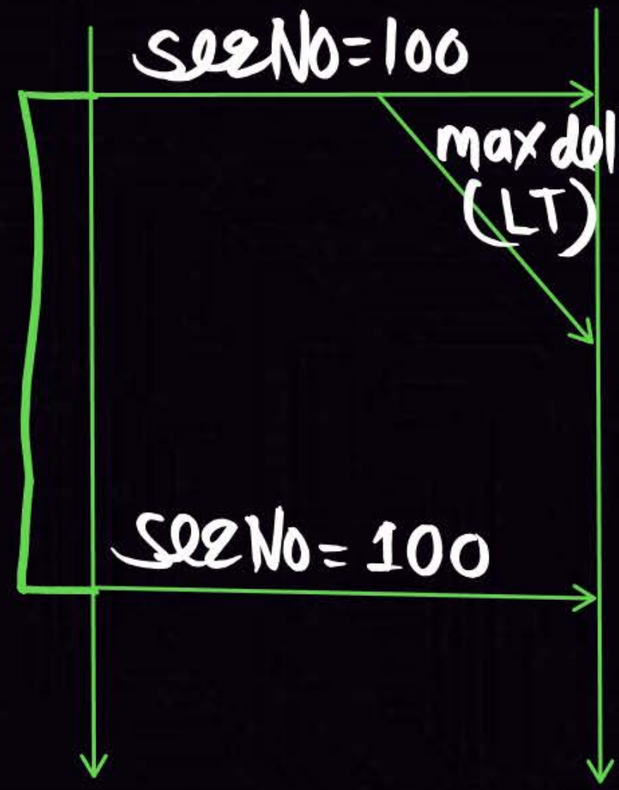
$10^6 seqNo \longrightarrow 1 sec$

$1 seqNo \longrightarrow \frac{1 sec}{10^6}$

$2^{32} seqNo \longrightarrow \frac{2^{32}}{10^6} sec$

4294 sec

$WAT = 4294.96 sec$



WAT > LT

No Problem

$WAT = \frac{\text{total seqNo}}{(\text{Bandwidth}) Byte/sec}$

② $B = 1GBPS = 10^9$ Byte/sec

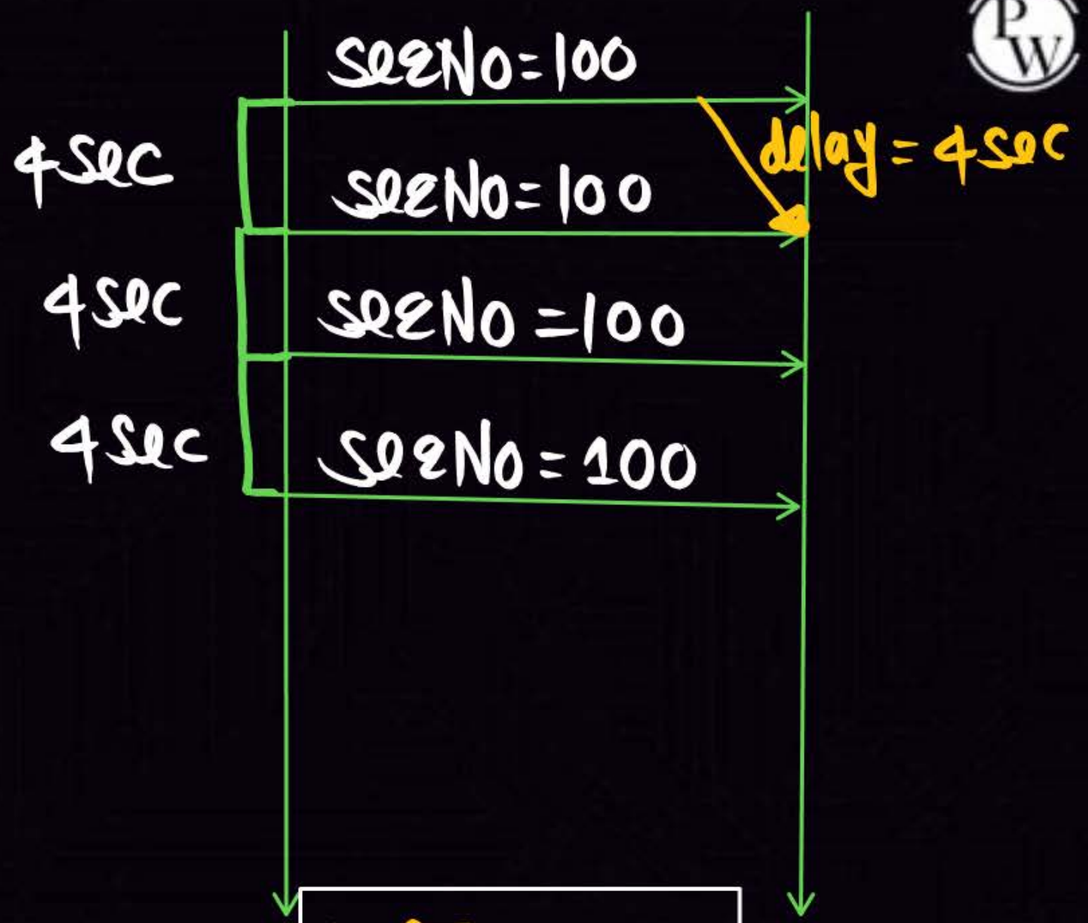
10^9 Byte ⟶ 1 sec

10^9 SeqNo ⟶ 1 sec

1 SeqNo ⟶ $\frac{1}{10^9}$ sec

2^{32} SeqNo ⟶ $\frac{2^{32}}{10^9}$ sec

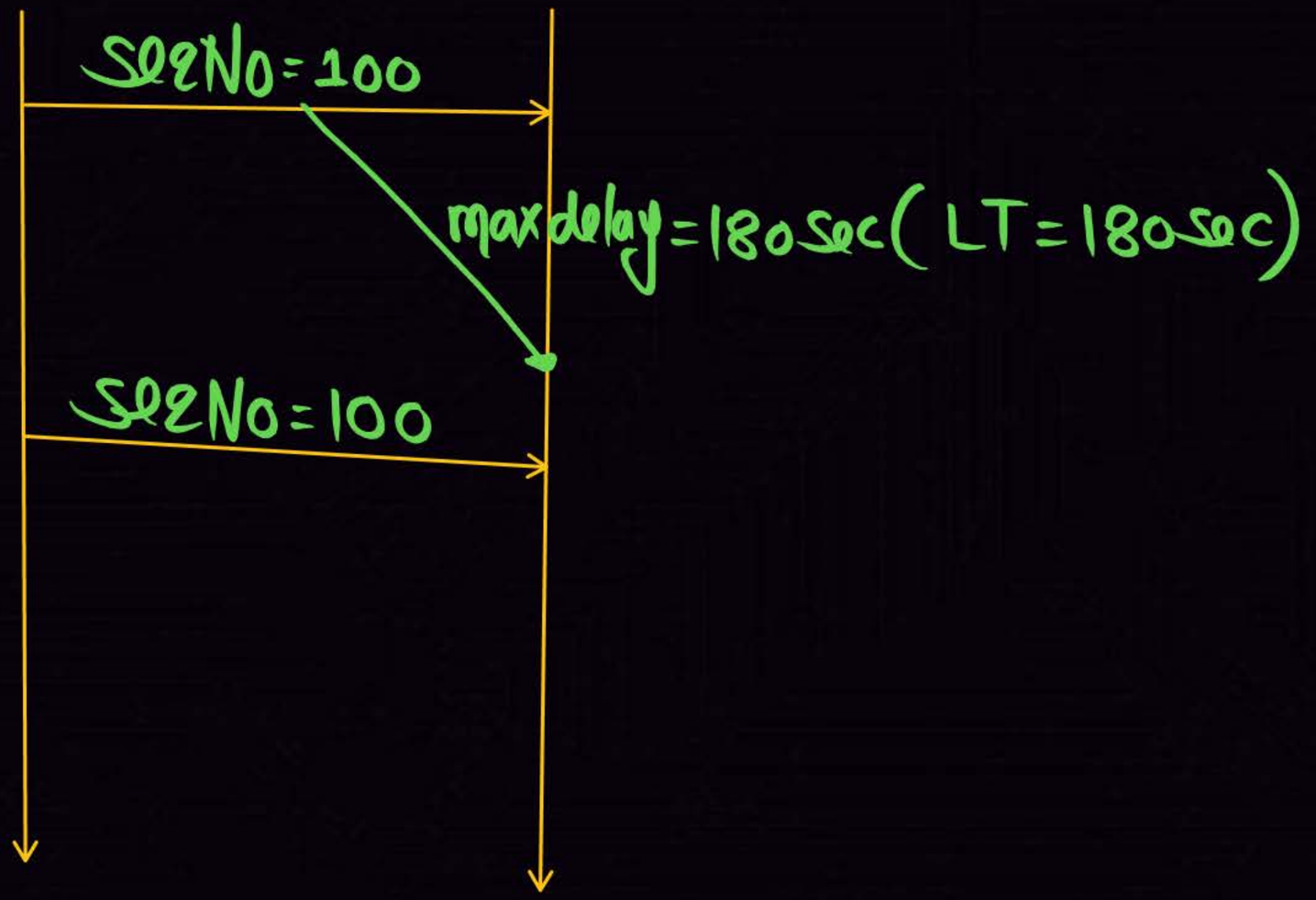
WAT = 4.294 sec



WAT < LT

Problem

(Lifetime = 180sec)


SeqNo = 100
max delay = 180 sec (LT = 180 sec)
SeqNo = 100

$B = 1GBPS = 10^9$ Byte/sec, $LT = 180sec$

$1sec \longrightarrow 10^9$ Byte

$1sec \longrightarrow 10^9$ Seq No

$180sec \longrightarrow 180 * 10^9$ Seq No

minimum Seq No required to Avoid wrap Around with in the Life time $= 180 * 10^9 \approx 2^8 * 2^{30} \approx 2^{38}$

$= LT * B$

minimum Number of bits required in the Seq No field to Avoid wrap Around with in the Life time $= \lceil \log_2 180 * 10^9 \rceil = 38$ bit

$\lceil \log_2 LT * B \rceil$

Note:

① minimum sequence Number required to Avoid wrap Around within the Life time = LT*B

② minimum Number of bits required in the sequence Number field to Avoid wrap Around with in the Life time

$= \lceil \log_2 LT*B \rceil$

③ Bandwidth must be in Byte/sec

Extra bits = 38 - 32 = 6 bit

Timestamp = 6 bits

Range → 0 to $2^6 - 1$

→ 0 to 63

Time stamp = 6 bits

1st set time stamp value = 000000 → 0

2nd set time stamp value = 000001 → 1

3rd set time stamp value = 000010 → 2

4th set time stamp value = 000011 → 3

64th set time stamp value = 111111 → 63

$$\frac{2^{38}\ \text{SetNo}}{2^{32}\ \text{SetNo}} = 2^6 = 64\ \text{Sets}$$

$$2^{32} * 64 = 2^{32} * 2^6 = 2^{38}$$

↓

Sets

2^{38} SetNo

2^{38} Byte

$2^8 * 2^{30}$ B

256GB

SetNo = 32bit

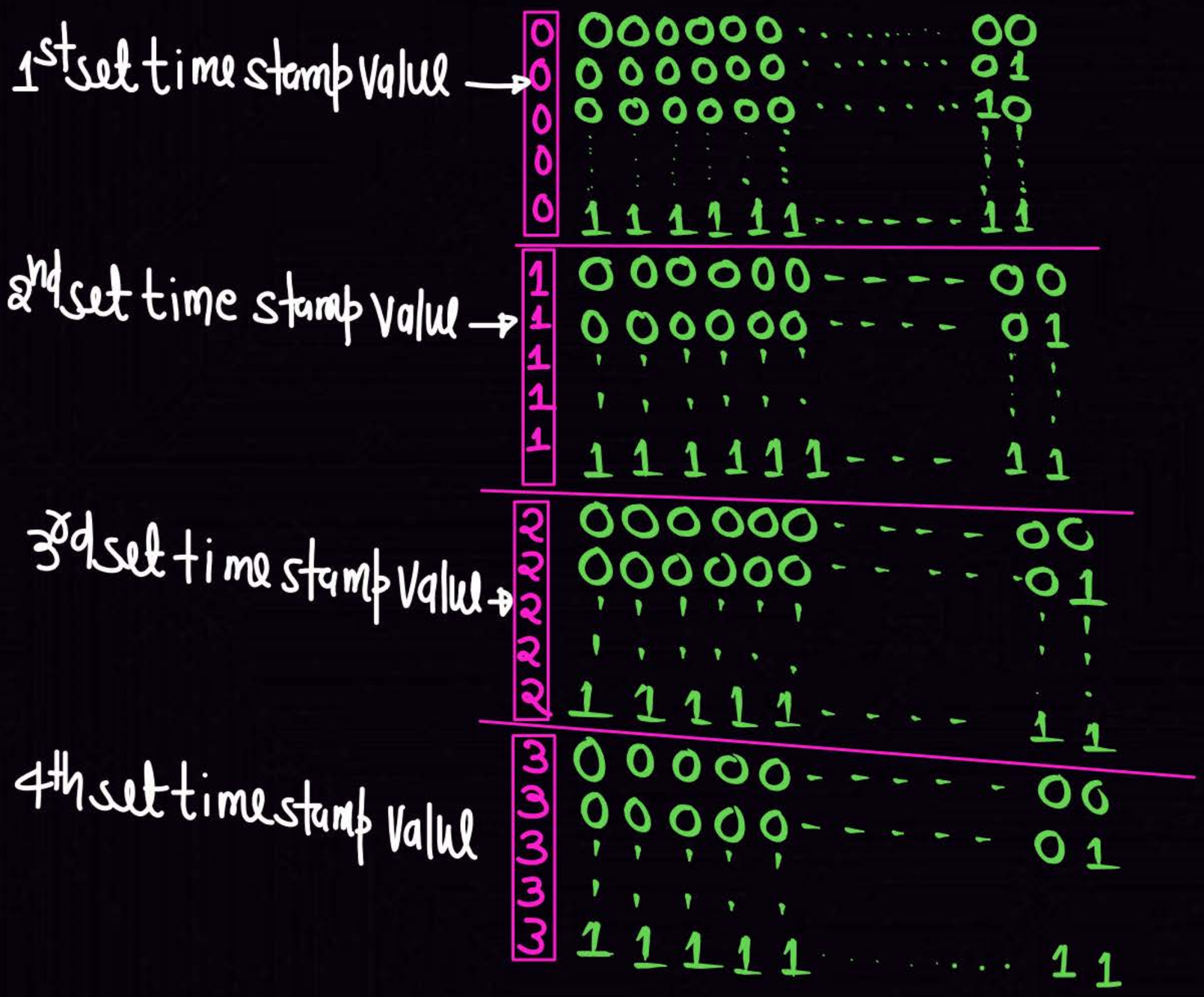
totalSetNo = 2^{32}

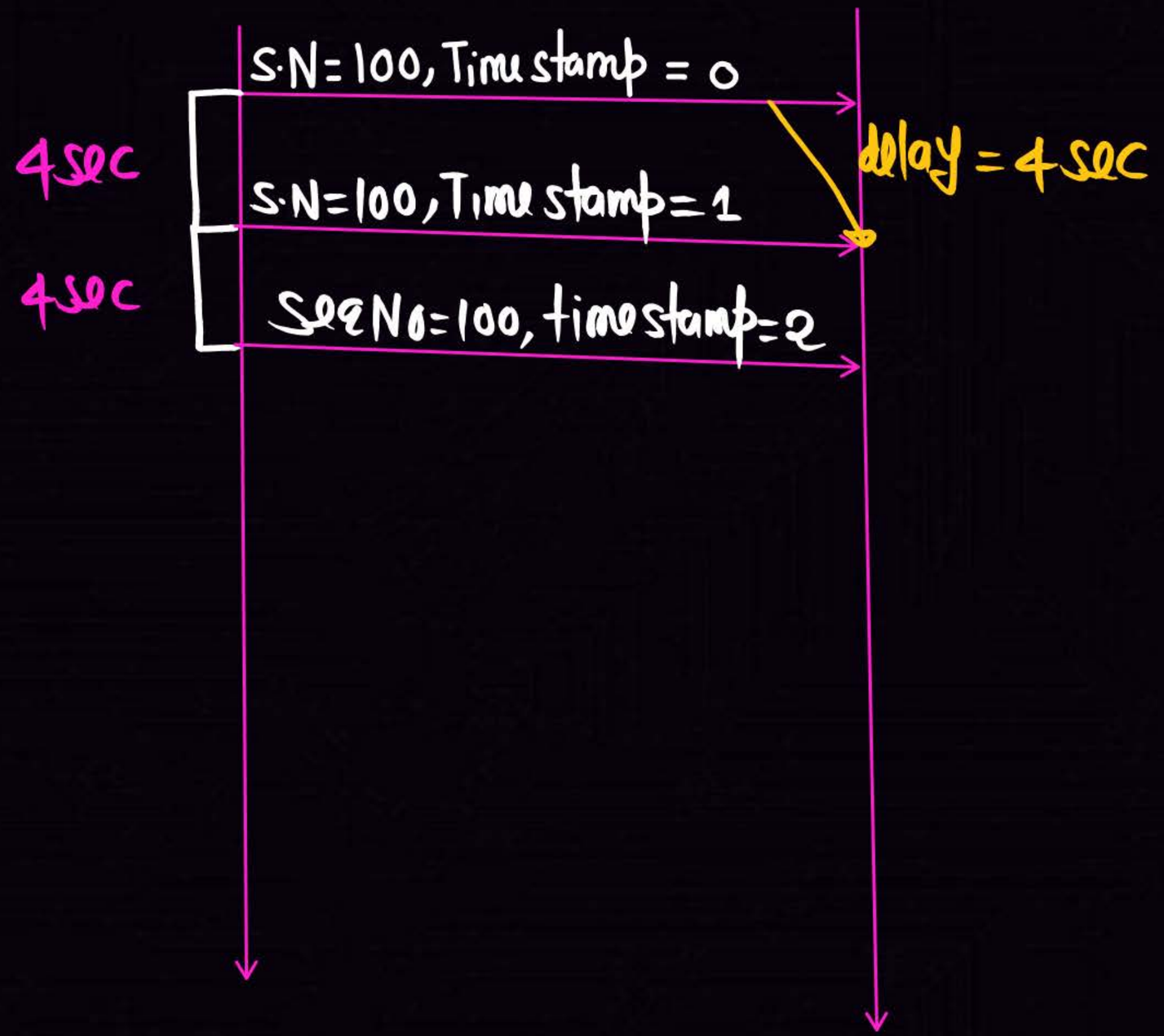
$= 2^{32}$ B

$= 2^2 * 2^{30}$ B

= 4GB

$$\frac{256\text{GB}}{4\text{GB}} = 64\ \text{Sets}$$


1st set time stamp value
2nd set time stamp value
3rd set time stamp value
4th set time stamp value


S.N=100, Timestamp = 0
delay = 4 sec
4 sec
S.N=100, Timestamp=1
4 sec
SeqNo=100, timestamp=2

Q.1 Consider 200 Mbps network with a sequence number field 28 bits. The wraparound time of the sequence number is ____.

$B = 200 Mbps = 200 * 10^6$ bits/sec

$B = \frac{200 * 10^6}{8}$ Byte/sec $= 25 * 10^6$ Byte/sec

$25 * 10^6$ Byte ⟶ 1 sec

$25 * 10^6$ seq No ⟶ 1 sec

1 seq No ⟶ $\frac{1}{25 * 10^6}$ sec

2^{28} seq No ⟶ $\frac{2^{28}}{25 * 10^6}$ sec $= 10.73$

WAT = 10.73 sec

shortcut

$$WAT = \frac{\text{total seq. No}}{[\text{Bandwidth}]\ \text{Byte/sec}}$$

$$WAT = \frac{2^{28}}{25 * 10^6}\ \text{sec}$$

WAT = 10.73 sec

Q.2

Consider a long-lived TCP session with an end-to-end bandwidth of 1 Gbps (= 10^9 bits per second). The session starts with a sequence number of 1234. The minimum time (in seconds, rounded to the closest integer) before this sequence number can be used again is _____ .

[GATE- 2008]

$B = 1\text{Gbps} = 10^9 \text{ bits/sec}$

$$WAT = \frac{\text{total Seq. No}}{(\text{Bandwidth})_{\text{Byte/sec}}}$$

$$= \frac{2^{32}}{\frac{10^9}{8}} = \frac{8 * 2^{32}}{10^9} = 34.35$$

$WAT = 34.35 \text{ sec}$

$WAT = 34 \text{ sec}$

Q.3

Consider the data transfer using TCP over a 1 Gbps link. Assuming that the maximum segment lifetime (MSL) is set to 60 seconds, the minimum number of bits required for the sequence number field of the TCP header, to prevent the sequence number space from wrapping around during the MSL is _____.

[GATE- 2022]

$B = 10^9$ bits/sec , $LT = 60$ sec

$B = \frac{10^9}{8}$ Byte/sec

minimum Number of bits required to Avoid wrap Around with in the Life time $= \lceil \log_2 LT * B \rceil = \lceil \log_2 60 * \frac{10^9}{8} \rceil = \lceil \log_2 7.5 * 10^9 \rceil = \lceil 32.8 \rceil$

$= 33$ bits

OR

$B = \frac{10^9}{8}$ Byte/sec

1 sec ⟶ $\frac{10^9}{8}$ Byte

1 sec ⟶ $\frac{10^9}{8}$ seq No

60 sec ⟶ $60 * \frac{10^9}{8}$ seq No

$= 7.5 * 10^9$ seq No $= 2^3 * 2^{30} = 2^{33} \Rightarrow$ (seq No = 33 bits)

$= \lceil \log_2 7.5 * 10^9 \rceil = \lceil 32.8 \rceil = 33$ bits

Q.5 Suppose you are asked to design a new reliable byte-stream transport protocol like TCP. This protocol, named myTCP, runs over a 100 Mbps network with Round Trip Time of 150 milliseconds and the maximum segment lifetime of 2 minutes. Which of the following is/are valid lengths of the Sequence Number field in the my TCP header?

[MSQ]

[GATE-2023-CN: 2M]

A ✗ 30 bits (< 31 bits)

B ✓ 32 bits (≥ 31 bits)

C ✓ 34 bits (≥ 31 bits)

D ✓ 36 bits (≥ 31 bits)

$B = 100 Mbps = 100 * 10^6$ bits/sec , $LT = 2 min = 120 sec$

$\frac{100 * 10^6}{8}$ Byte/sec $= 12.5 * 10^6$ byte/sec

min seq No required to Avoid wrap Around with in the Life time $=$ $LT * B$

$= 120 * 12.5 * 10^6$

$= 1500 * 10^6 = 15 * 10^8$

minimum No. OF bits required in the seq No field $= \lceil \log_2 * 15 * 10^8 \rceil$

$= \lceil 30.32 \rceil = 31$ bits


THANK YOU
GW
SOLDIERS !