CS & IT ENGINEERING

COMPUTER NETWORKS

TCP & UDP

Lecture No-02

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Wrap Around Time

Wrap Around Time

Sequence Number = 32 bit

Total Seq. No = $2^{32} = 2^2 * 2^{30}$ = 4G Sequence Number

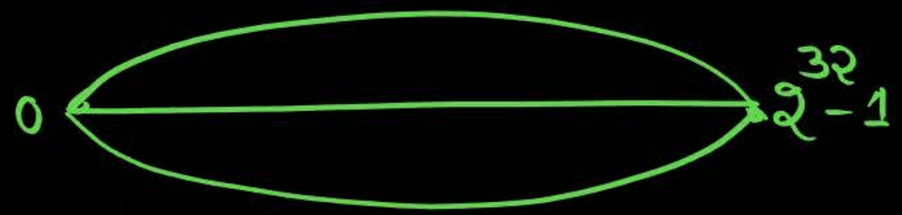
data size = 4GB

If data size > 4GB

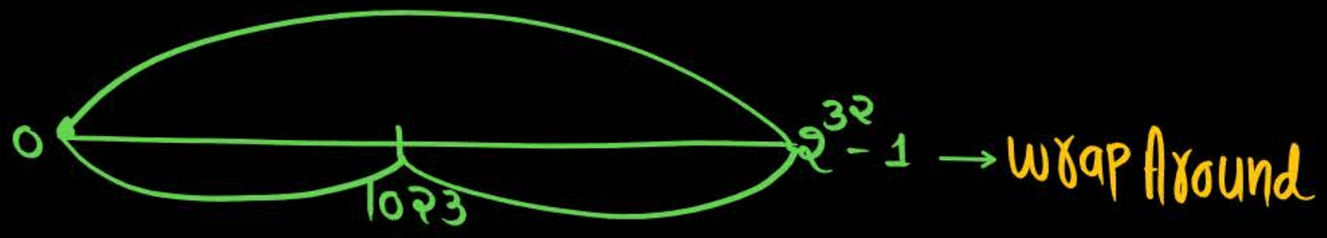
Seq No = 2^{32} (0 to $2^{32} - 1$)

If data size = 4GB + 4GB

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



Wrap Around



→ Wrap Around

↓

Random sequence Number

Wrap Around time (WAT)

Time taken to wrap Around

Note: Wrap Around time depends on the Bandwidth

1. $B = 1\,MBPS = 10^6\ Byte/sec$

$1\ sec \longrightarrow 10^6\ Byte$

$10^6\ Byte \longrightarrow 1\ sec$

$10^6\ seq\ No \longrightarrow 1\ sec$

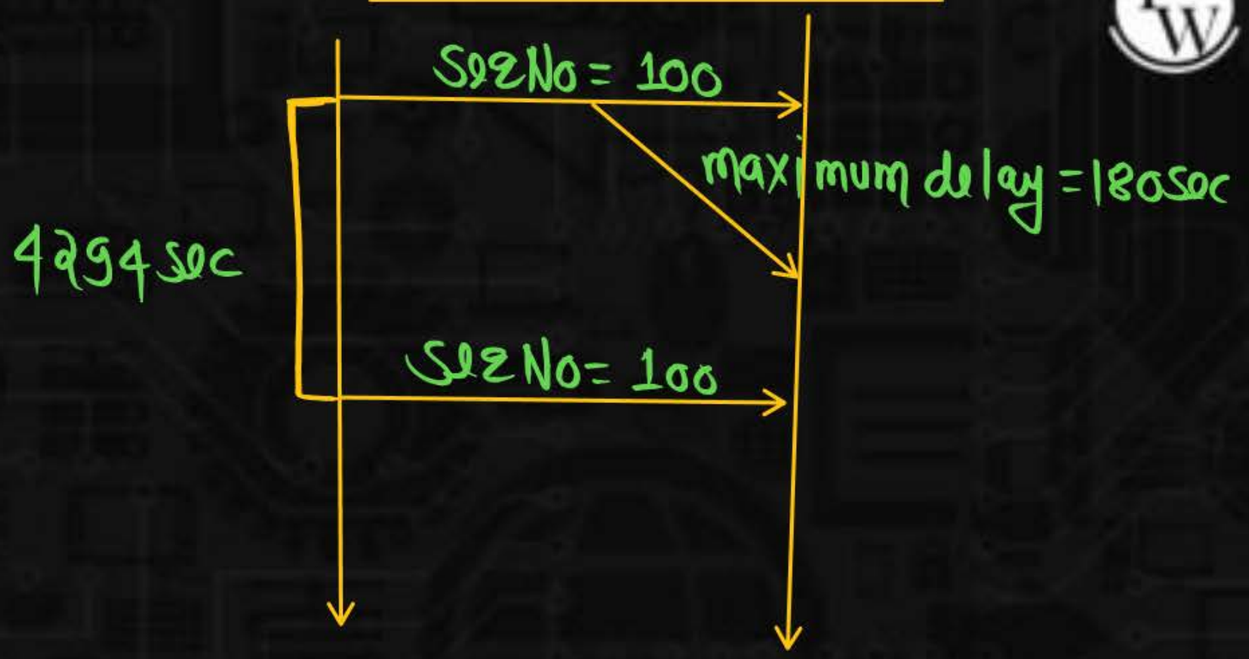
$1\ seq\ No \longrightarrow \frac{1}{10^6}\ sec$

$2^{32}\ seq\ No \longrightarrow \frac{2^{32}}{10^6}\ sec$

$= 4294.96\ sec$

WAT = 4294.96 sec

LT = 3 min = 180 sec



WAT > LT

No Problem

2. $B = 1\,GBPS = 10^9\ Byte/sec$

10^9 Byte ⟶ 1 sec

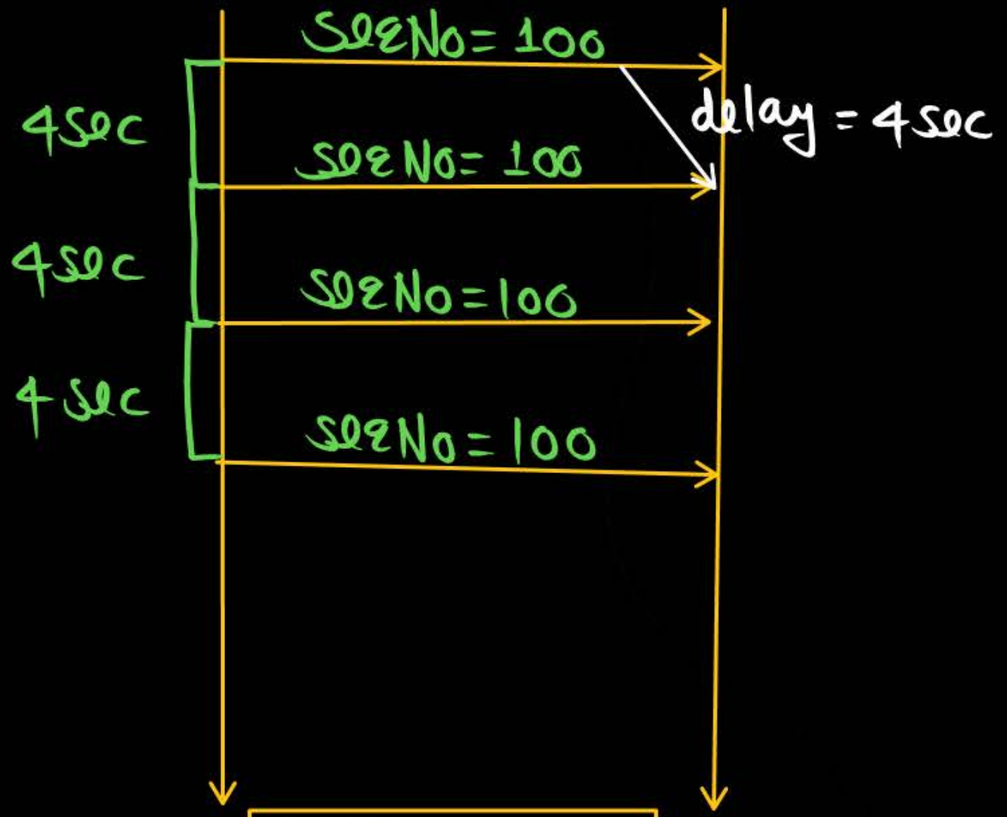
10^9 Seq. No ⟶ 1 sec

1 Seq No ⟶ $\frac{1}{10^9}$ sec

2^{32} Seq No ⟶ $\frac{2^{32}}{10^9}$ sec

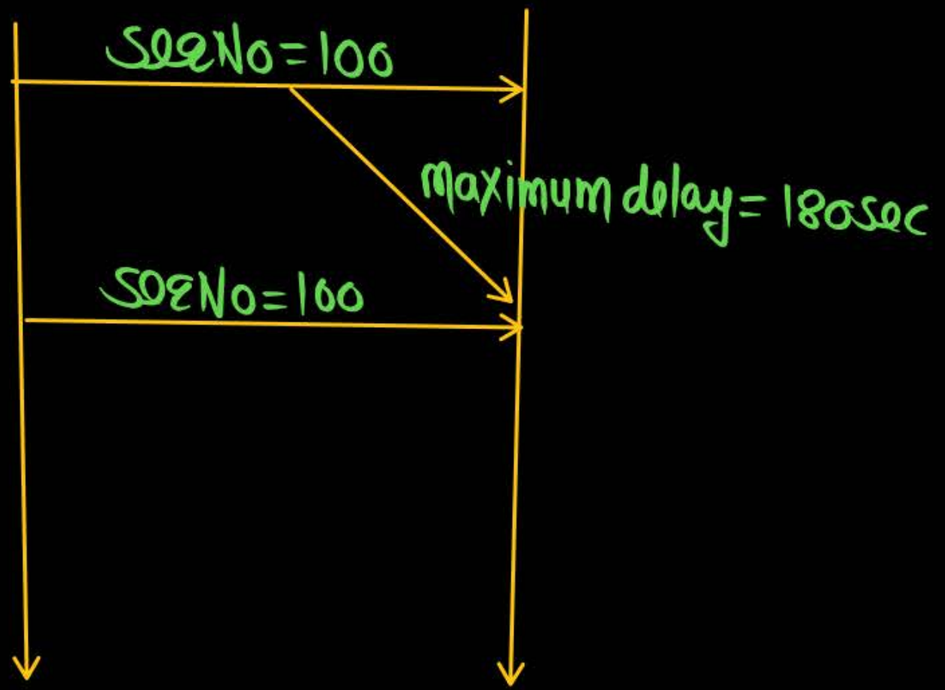
$= 4.294\ sec$

WAT = 4.294 sec



WAT < LT

Problem


SeqNo = 100
maximum delay = 180sec
SeqNo = 100

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

1sec ⟶ 10^9 Byte

1sec ⟶ 10^9 Seq No.

180sec ⟶ $180 * 10^9$ Seq No

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

= LT * B

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

② minimum No. of Bits required in the seq. No 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

↓

option

↓

Time stamp = 6 bit

↓

Range → 0 to $2^6 - 1$

Range → 0 to 63

1st set time stamp value = 000000 → 0

2nd " " " " = 000001 → 1

3rd " " " " = 000010 → 2

4th " " " " = 000011 → 3

.

.

.

64th set time stamp value = 111111 → 63

2^{38} Seq No

2^{38} Byte

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

256 GB

Seq No = 32 bit

2^{32} Seq No

2^{32} Byte

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

4 GB

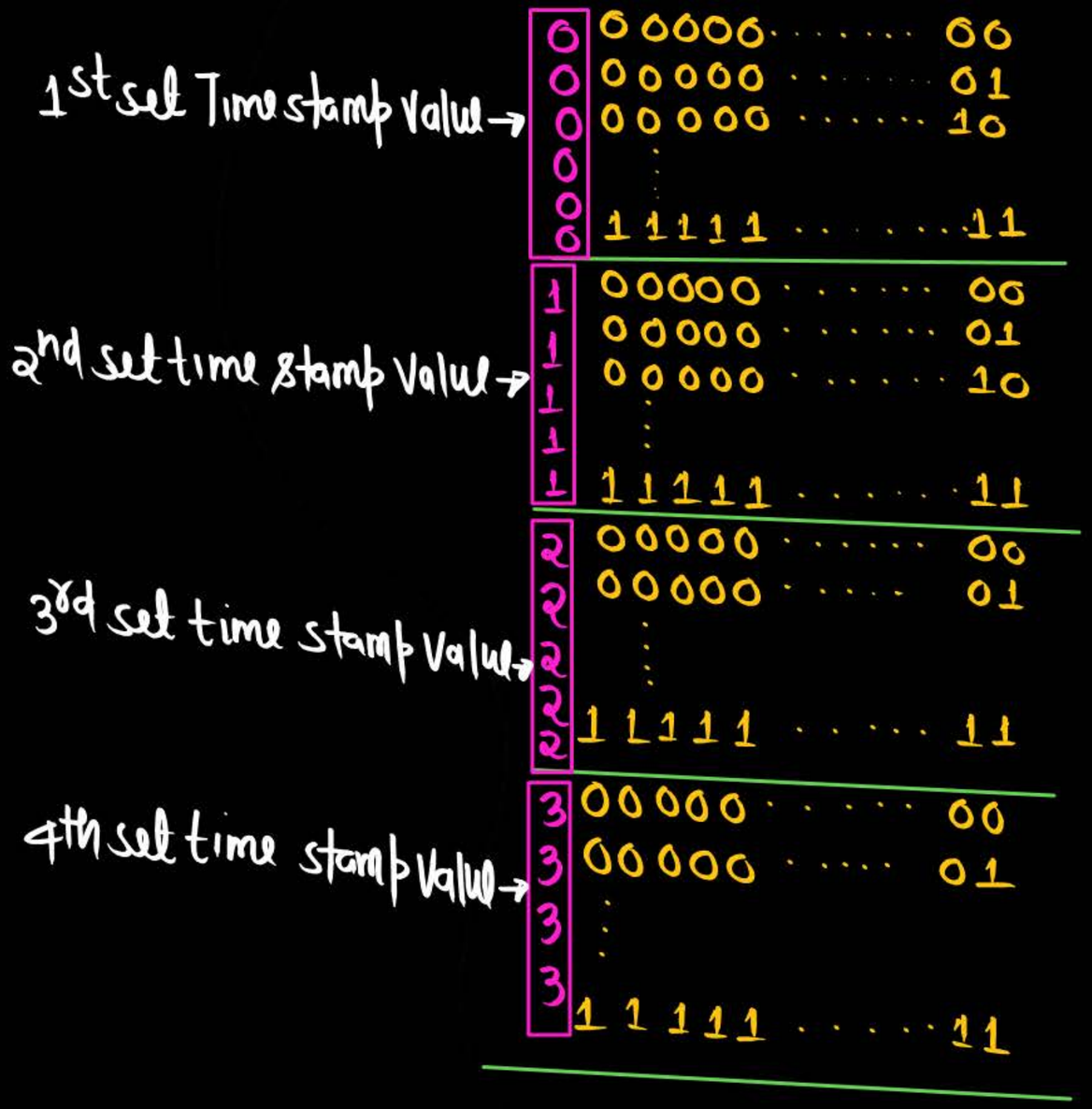
$$\frac{256\,GB}{4\,GB} = 64 \text{ set}$$

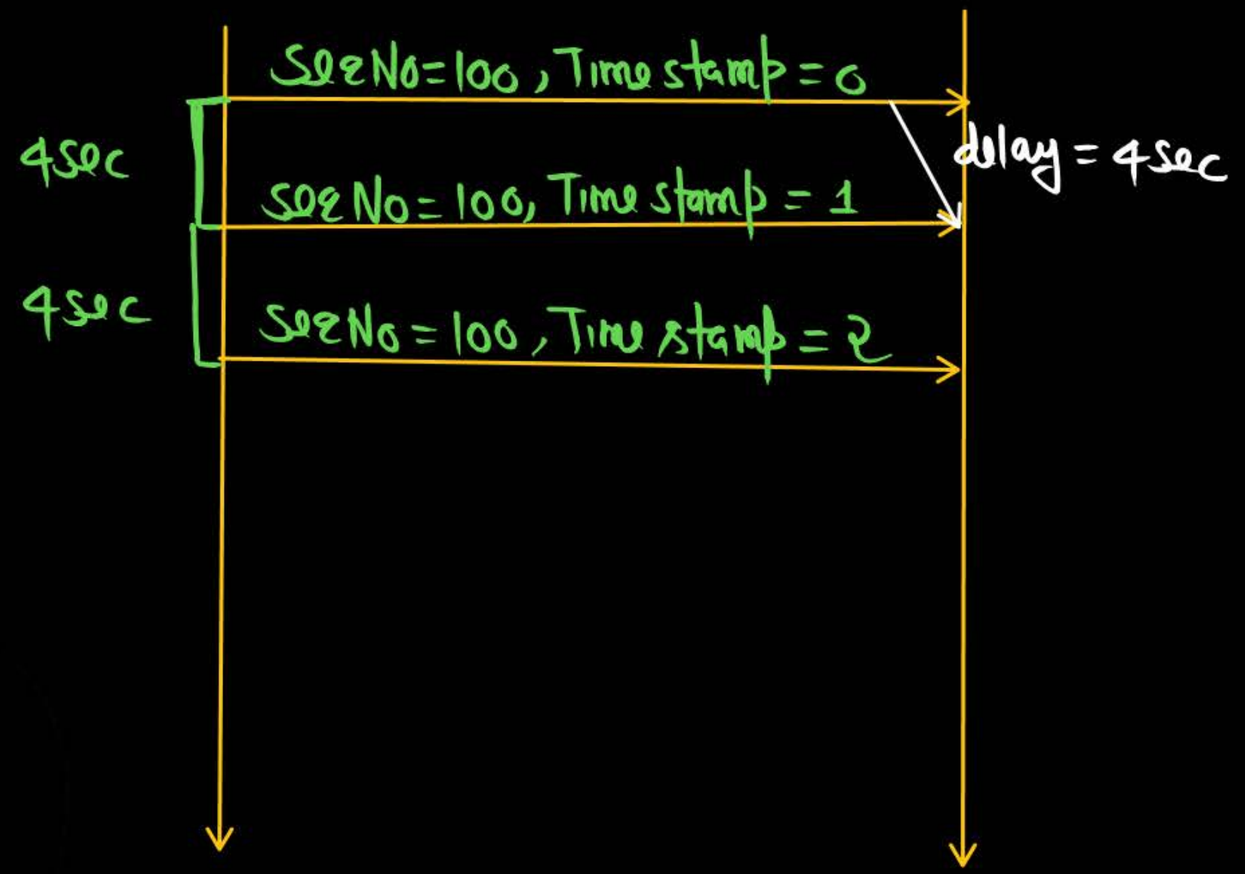
$$\frac{2^{38}\ \text{Seq No}}{2^{32}\ \text{Seq No}} = 2^6 = 64 \text{ sets}$$

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

↓

sets


1st set Time stamp value →
2nd set time stamp value →
3rd set time stamp value →
4th set time stamp value →
0 00000 00
0 00000 01
0 00000 10
0 11111 11
1 00000 00
1 00000 01
1 00000 10
1 11111 11
2 00000 00
2 00000 01
2 11111 11
3 00000 00
3 00000 01
3 11111 11


Seq No = 100, Time stamp = 0
delay = 4sec
4sec
Seq No = 100, Time stamp = 1
4sec
Seq No = 100, Time stamp = 2

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

Soln:

$B = 200 \text{ mbps} = 200 * 10^6 \text{ bits/sec}$

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

$25 * 10^6$ 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 sec

WAT = 10.73 sec

Shortcut

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

$$WAT = \frac{2^{28}}{25 * 10^6} = 10.73 \text{ sec}$$

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]

$B = 10^9$ bits/sec

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

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

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

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

$WAT = 34.35$

$WAT = 34$ 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] (2m)

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

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

minimum No. of bits required in the sequence No. field to Avoid wrap Around with in the Life time $= \lceil \log_2 LT * B \rceil = \lceil \log_2 60 * \frac{10^9}{8} \rceil = \lceil \log_2 7.5 * 10^9 \rceil = \lceil 32.8 \rceil = 33$ bit

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 $\cong 2^3 * 2^{30} \cong 2^{33}$

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

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: 1M]

A 30 bits (≥ 31)

B 32 bits (≥ 31)

C 34 bits (≥ 31)

D 36 bits (≥ 31)

(B, C, D)

$B = 100 mbps = 100 * 10^6$ bits/sec

$B = \frac{100 * 10^6}{8}$ Byte/sec $= 12.5 * 10^6$ Byte/sec , $LT = 2 min = 120 sec$

minimum seq No. required to avoid wrap around within the life time $= LT * B$

$= 120 * 12.5 * 10^6 = 1500 * 10^6 = 15 * 10^8$

min. No. of bits required in the seq No. field $= \lceil \log_2 15 * 10^8 \rceil = \lceil 30.32 \rceil = 31$

No. of bits required in the seq No field ≥ 31

Q.6

Consider the three-way handshake mechanism followed during TCP connection establishment between hosts P and Q. Let X and Y be two random 32-bit starting sequence numbers chosen by P and Q respectively. Suppose P sends a TCP connection request message to Q with a TCP segment having SYN bit = 1, SEQ number = X, and ACK bit = 0. Suppose Q accepts the connection request. Which one of the following choices represents the information present in the TCP segment header that is sent by Q to P?

(A) SYN bit = 1, SEQ number = Y, ACK bit = 1, ACK number = X+1, FIN bit = 0

(B) SYN bit = 0, SEQ number = X+1, ACK bit = 0, ACK number = Y, FIN bit = 1

(C) SYN bit = 1, SEQ number = X+1, ACK bit = 0, ACK number = Y, FIN bit = 0

(D) SYN bit = 1, SEQ number = Y, ACK bit = 1, ACK number = X, FIN bit = 0


4-6pm
6:30 to 8:30pm
THANK YOU
GW
SOLDIERS !