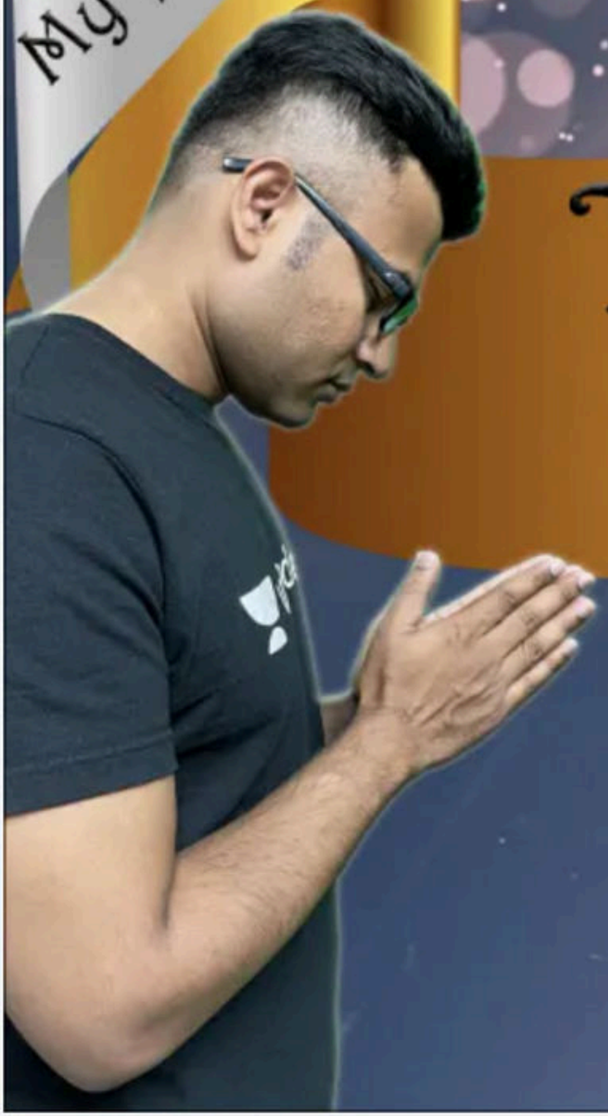
Application Layer, Network Devices and Revision

Complete Course on Computer Networks - Part III

Ravindrababu Ravula • Lesson 21 • Apr 17, 2021

My philosophy



TEACHING IS WORSHIP

STUDENTS ARE GODS

Upcoming live streams

Surprise Educator Launch | Launch Event | Live on 17th...

Scheduled for 4/17/21, 12:00 PM

SET REMINDER

Valid Pair Problem Discussion | Codechef April...

Scheduled for 4/17/21, 1:00 PM

SET REMINDER

World Record Problem Discussion | Codechef April...

Scheduled for 4/17/21, 1:45 PM

SET REMINDER

Strong Language Problem Discussion | Codechef April...

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SET REMINDER

Chef and Dice Problem Discussion | Codechef April...

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Worthy Matrix Problem Discussion | Codechef April...

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Download the Slides | Revision of Algo & Data...

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Download the Slides | Complete Revision of Java |...

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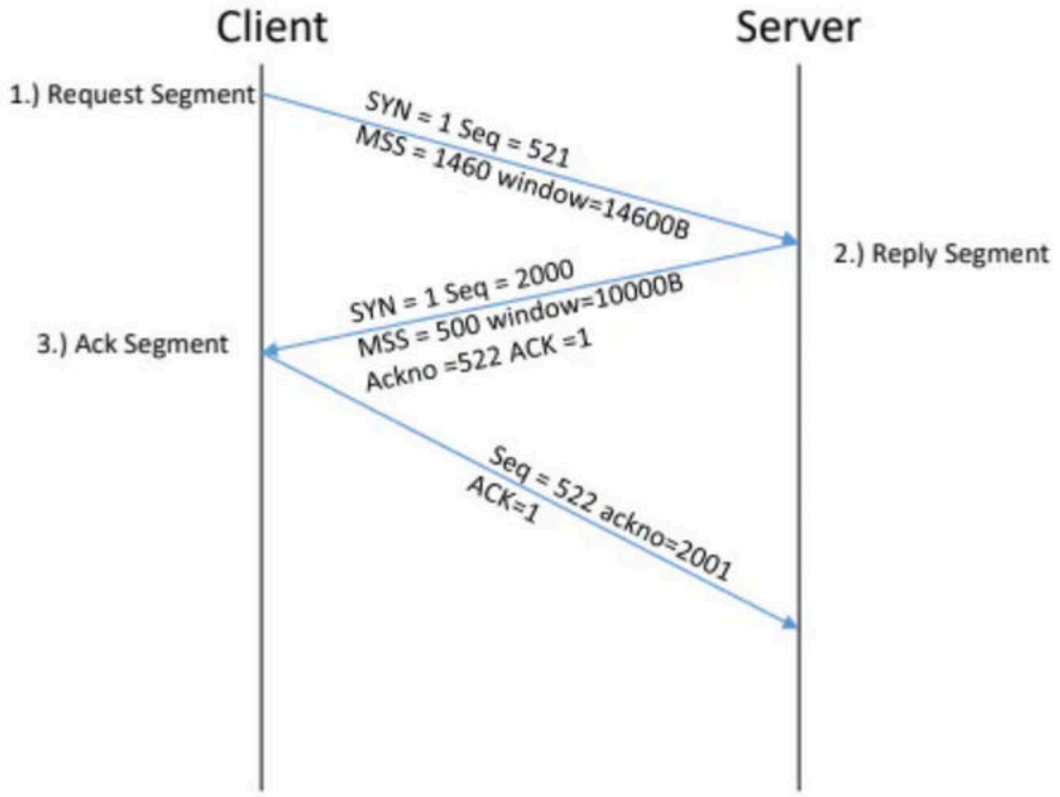
LEARN FROM TOP EDUCATORS

Three Way Handshake is a process used for establishing a TCP connection.



Imagine this scenario for connection Establishment

Step-03: ACK-

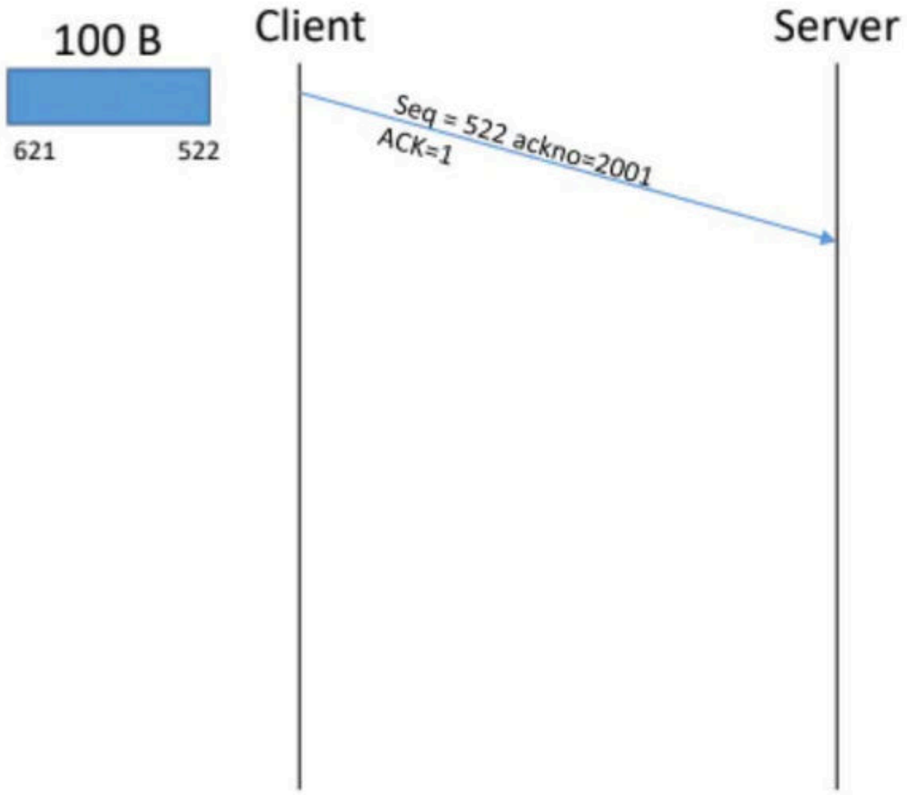
After receiving the reply segment,

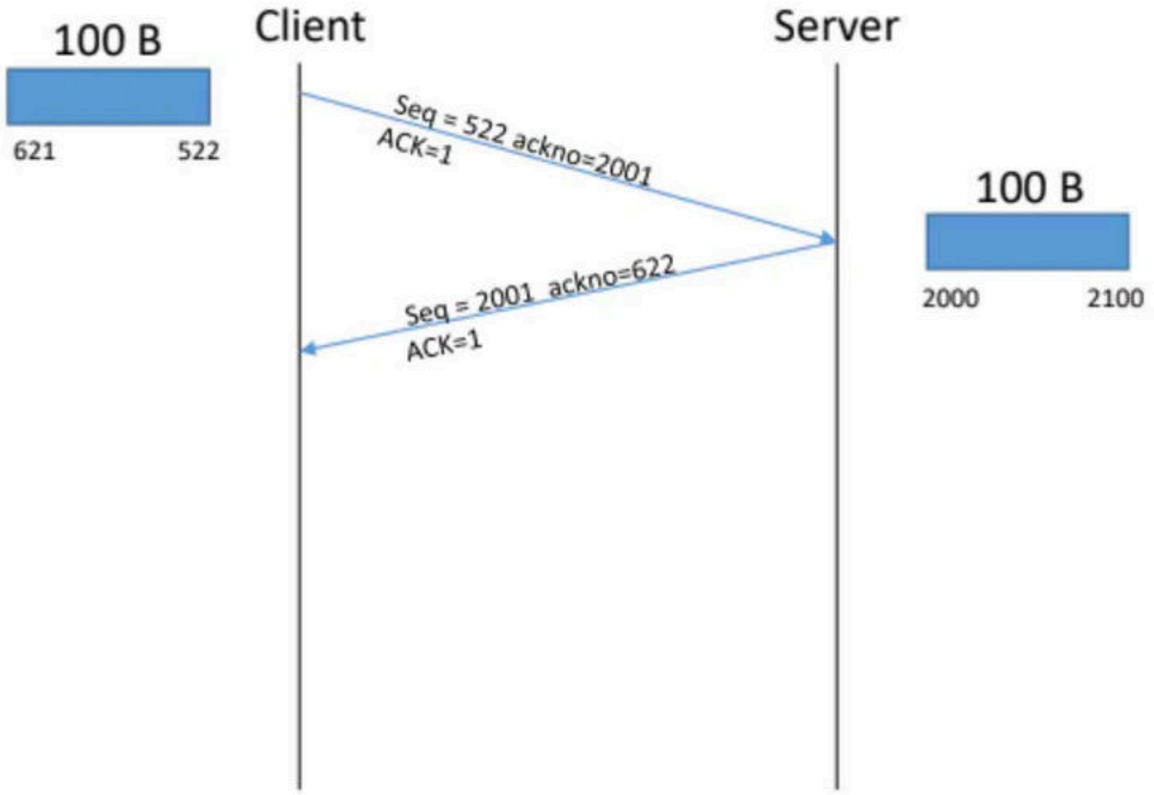
- Client acknowledges the response of server.
- It acknowledges the server by sending a pure acknowledgement.

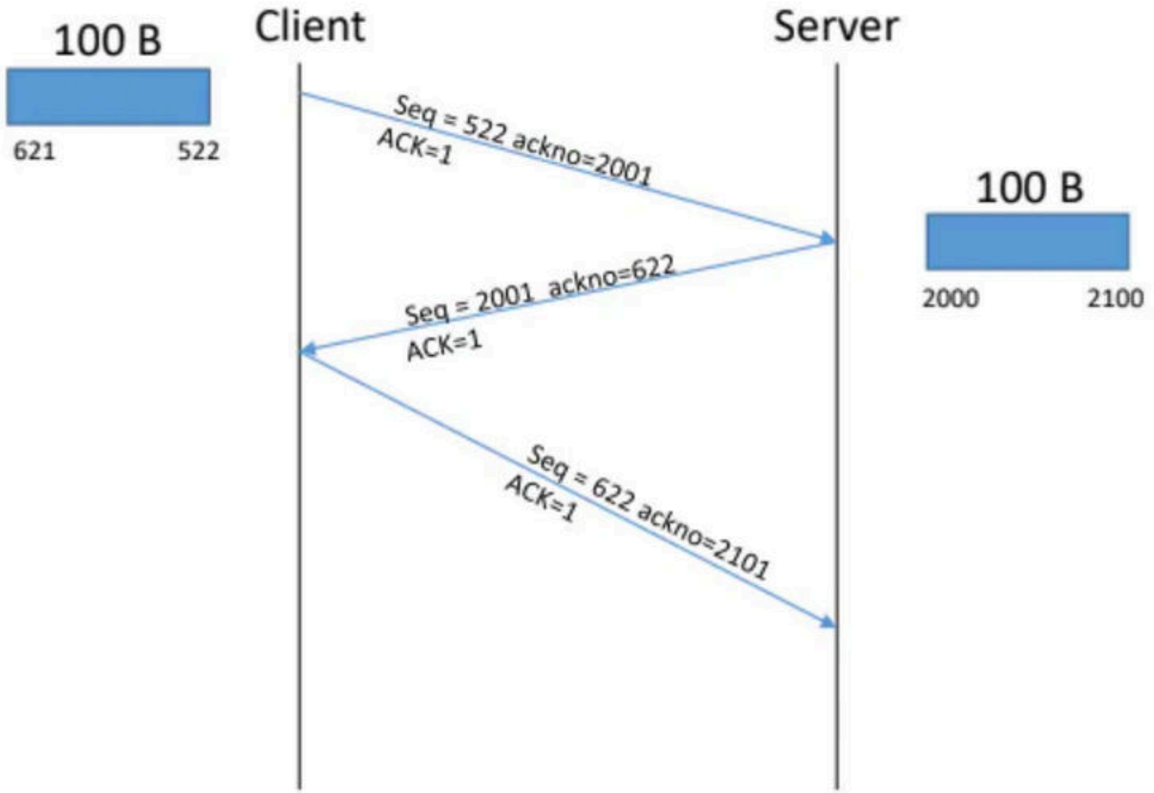
In any TCP segment,

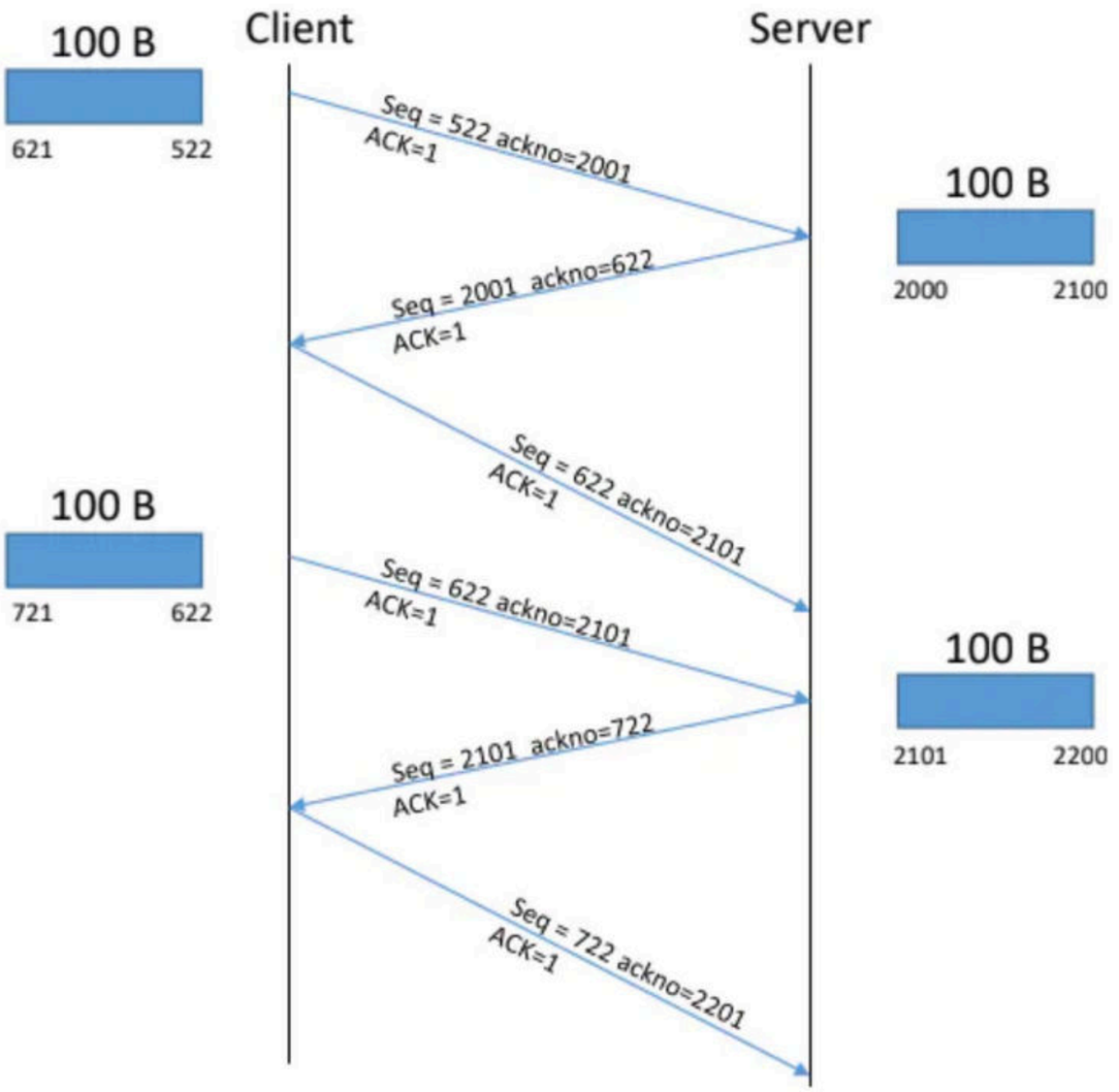
1. If SYN bit = 1 and ACK bit = 0, then it must be the request segment.
2. If SYN bit = 1 and ACK bit = 1, then it must be the reply segment.
3. If SYN bit = 0 and ACK bit = 1, then it can be the pure ACK or segment meant for data transfer.
4. If SYN bit = 0 and ACK bit = 0, then this combination is not possible.

DATA TRANSMISSION

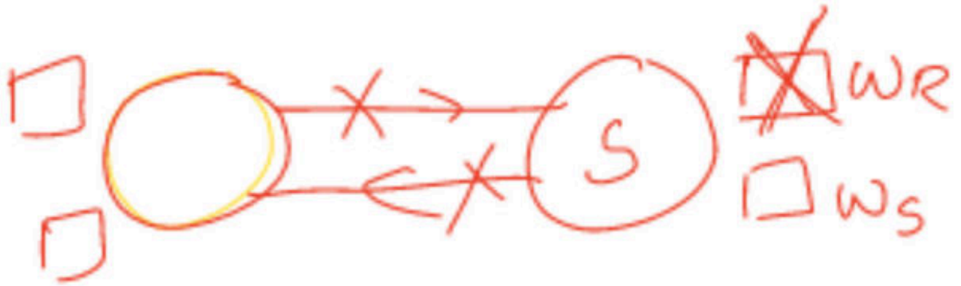



100 B
621
522
Client
Server
Seq = 522 ackno=2001
ACK=1
Seq = 2001 ackno=622
ACK=1
100 B
2000
2100

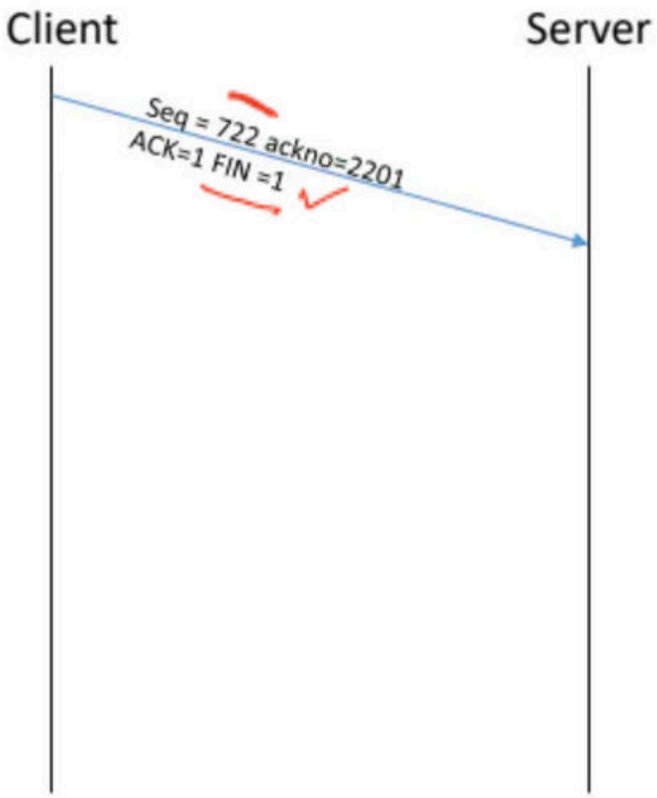

100 B
621
522
Client
Server
Seq = 522 ackno=2001
ACK=1
100 B
2000
2100
Seq = 2001 ackno=622
ACK=1
Seq = 622 ackno=2101
ACK=1


Client
Server
100 B
621
522
Seq = 522 ackno=2001
ACK=1
100 B
2000
2100
Seq = 2001 ackno=622
ACK=1
Seq = 622 ackno=2101
ACK=1
100 B
721
622
Seq = 622 ackno=2101
ACK=1
100 B
2101
2200
Seq = 2101 ackno=722
ACK=1
Seq = 722 ackno=2201
ACK=1

CONNECTION TERMINATION



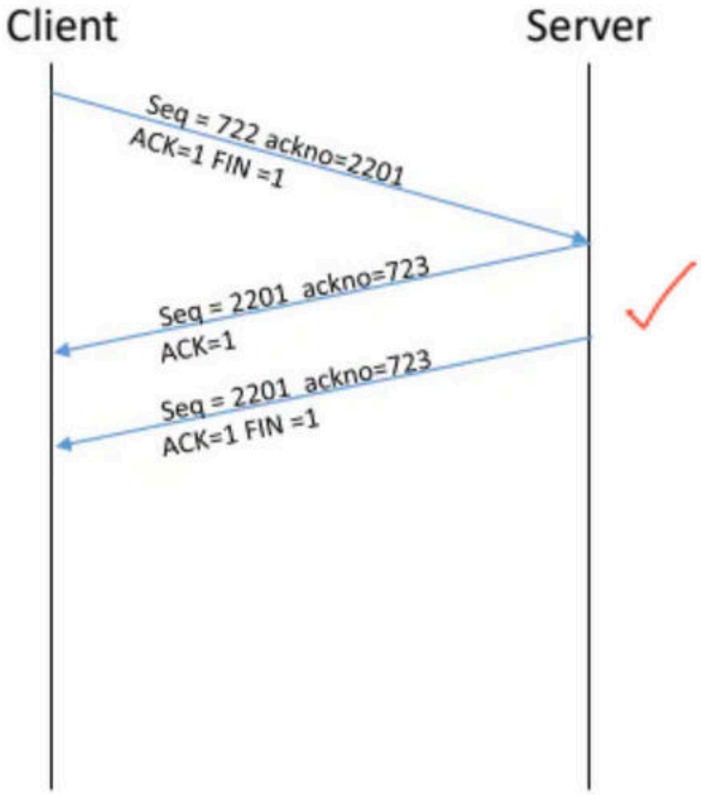
Consider-
There is a well established TCP connection between the client and server.
Client wants to terminate the connection.



Step-01:

For terminating the connection,
- Client sends a FIN segment to the server with FIN bit set to 1.
- Client enters the **FIN_WAIT_1 state**.
- Client waits for an acknowledgement from the server.

CONNECTION TERMINATION



Step-02:

After receiving the FIN segment,
- Server frees up its buffers.
- Server sends an acknowledgement to the client.
- Server enters the CLOSE_WAIT state.

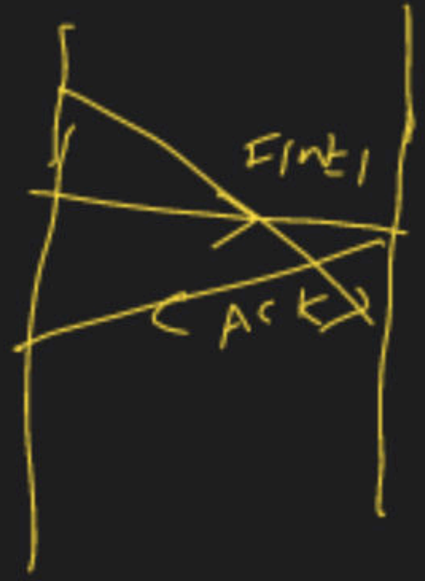
Step-03:

After receiving the acknowledgement, client enters the FIN_WAIT_2 state.

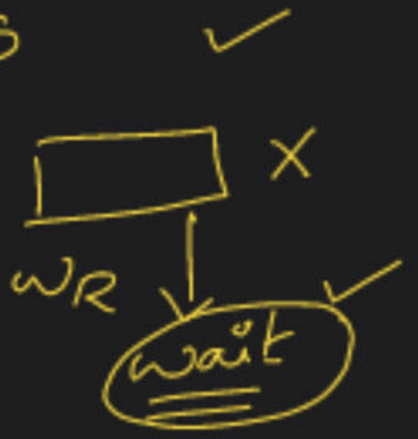
For terminating the connection,
- Server sends a FIN segment to the client with FIN bit set to 1.
- Server waits for an acknowledgement from the client.

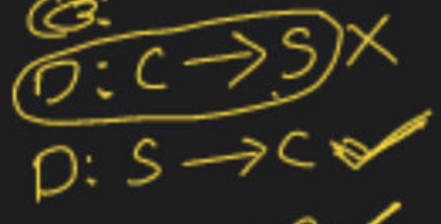
Seq=100...
FIN=1
Seq=101
ACK=1

C
S
WS
WR

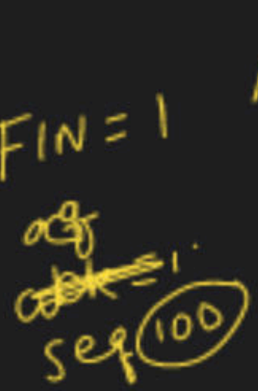

FIN=1
ACK

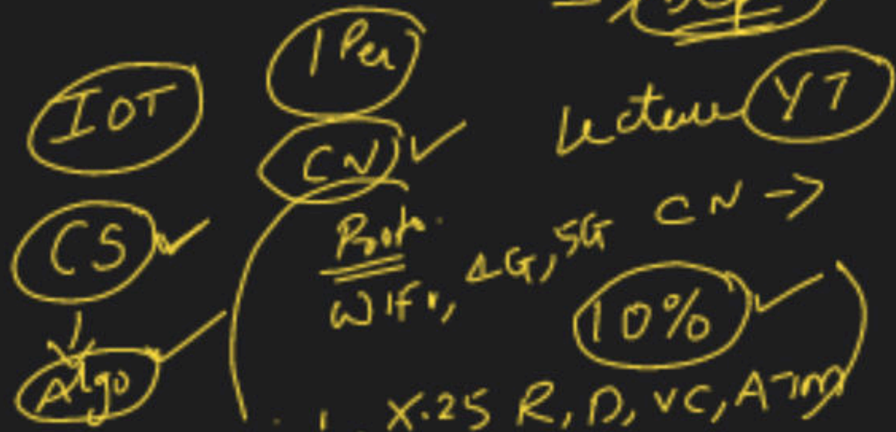
WR
WS

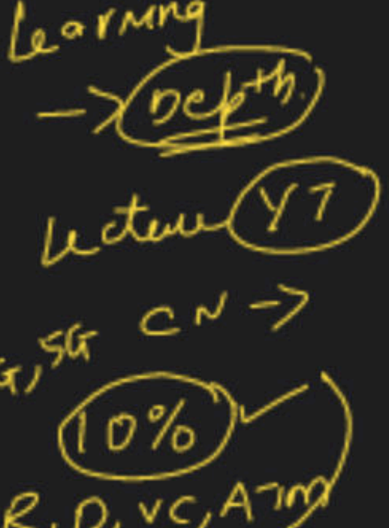

X
WR
wait

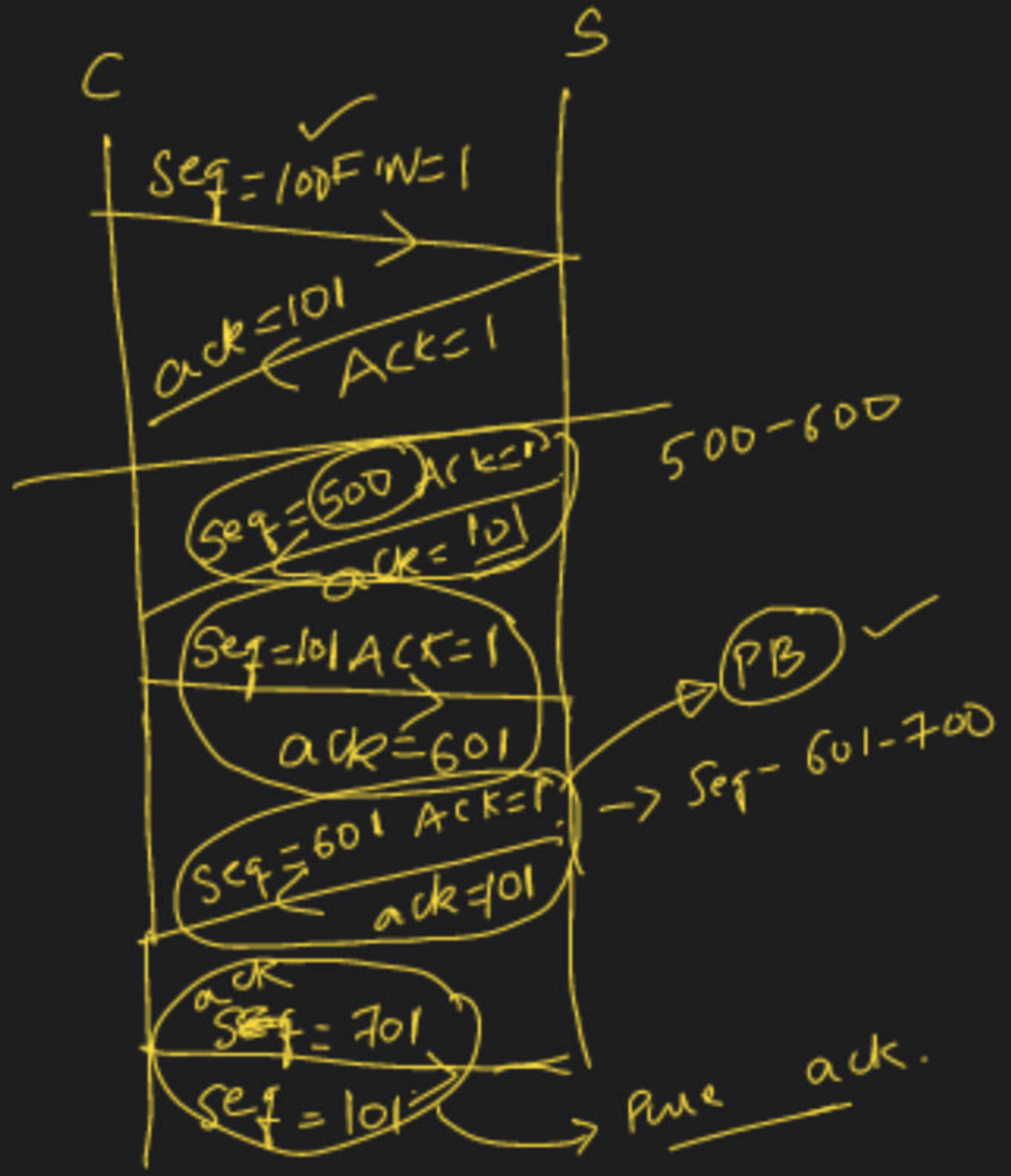

D: C → S
X
D: S → C
A: C → S
Pure
A: S → C

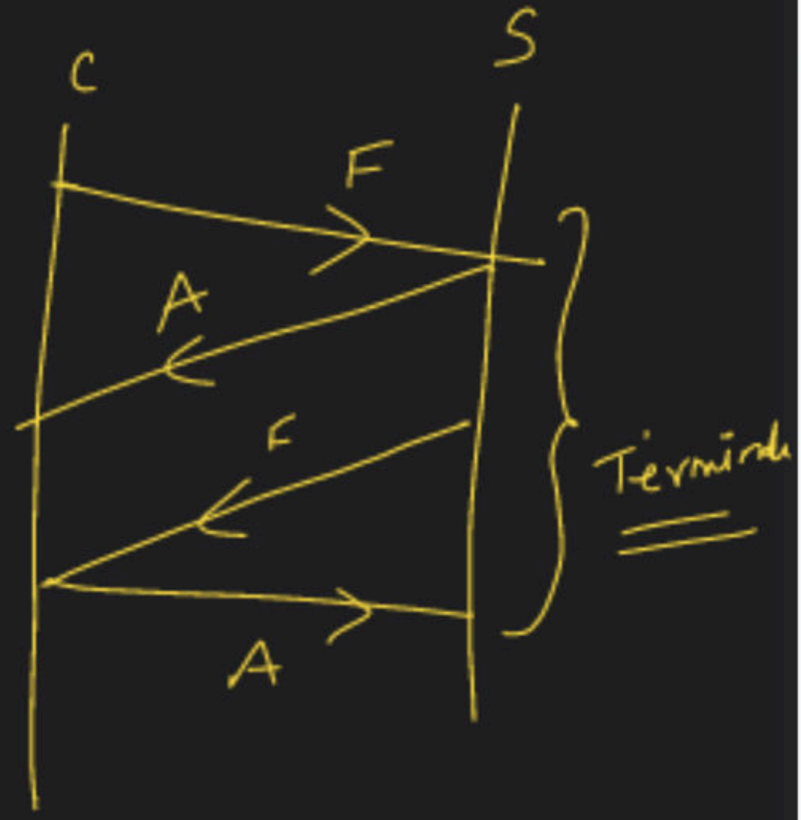
D+A
C
S

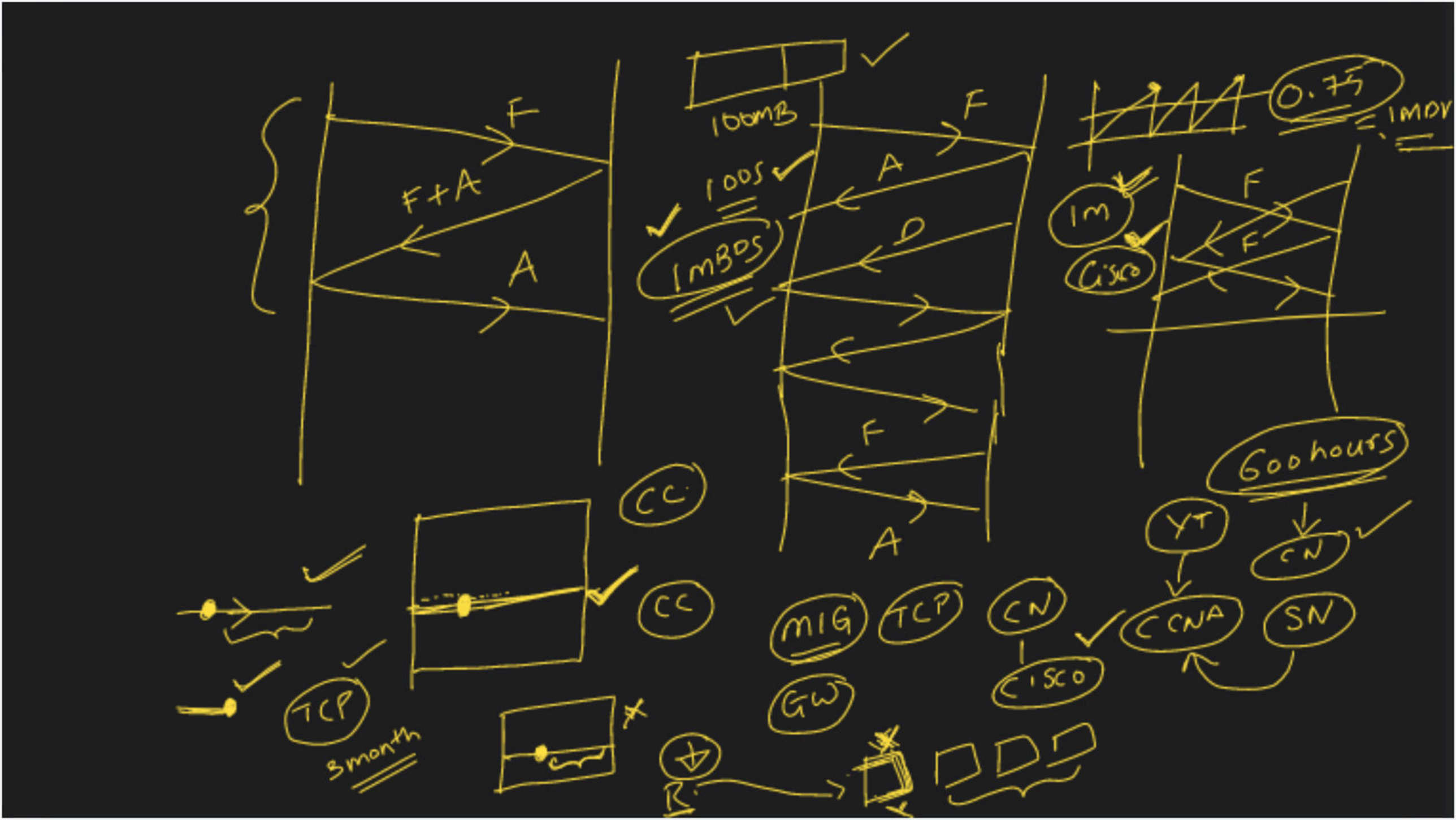

FIN=1
Ack=101
=
seq
seq
100


IOT
CS
Algo
IPv6
CN
Both
WiFi, 4G, 5G
10%
X.25 R, D, VC, ATM

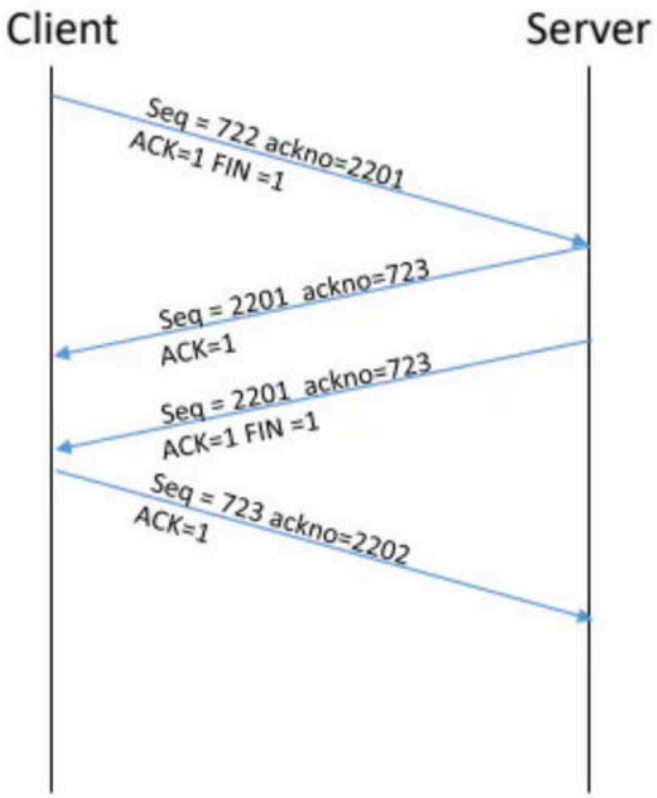

Learning
Depth
Lectures
YT
CN


C
S
Seq = 100 F SYN = 1
ack = 101
ACK = 1
500 - 600
Seq = 500 ACK = 1
ack = 101
Seq = 101 ACK = 1
ack = 601
PB
-> Seq - 601 - 700
Seq = 601 ACK = 1
ack = 101
ack
Seq = 701
Seq = 101
Pure ack.


C
S
F
A
F
A
Termin


F
F+A
A
100MB
100S
1MBPS
F
A
D
F
A
0.75
1MDV
1M
Cisco
F
F
600 hours
YT
CN
CCNA
SN
CC
CC
TCP
3 month
MIG
TCP
CN
Cisco
GW
R

CONNECTION TERMINATION



Step-04:

After receiving the FIN segment,

- Client frees up its buffers.
- Client sends an acknowledgement to the server (not mandatory).
- Client enters the TIME_WAIT state.

Author RBR
Date

Computer Networks

TCP header Part 4

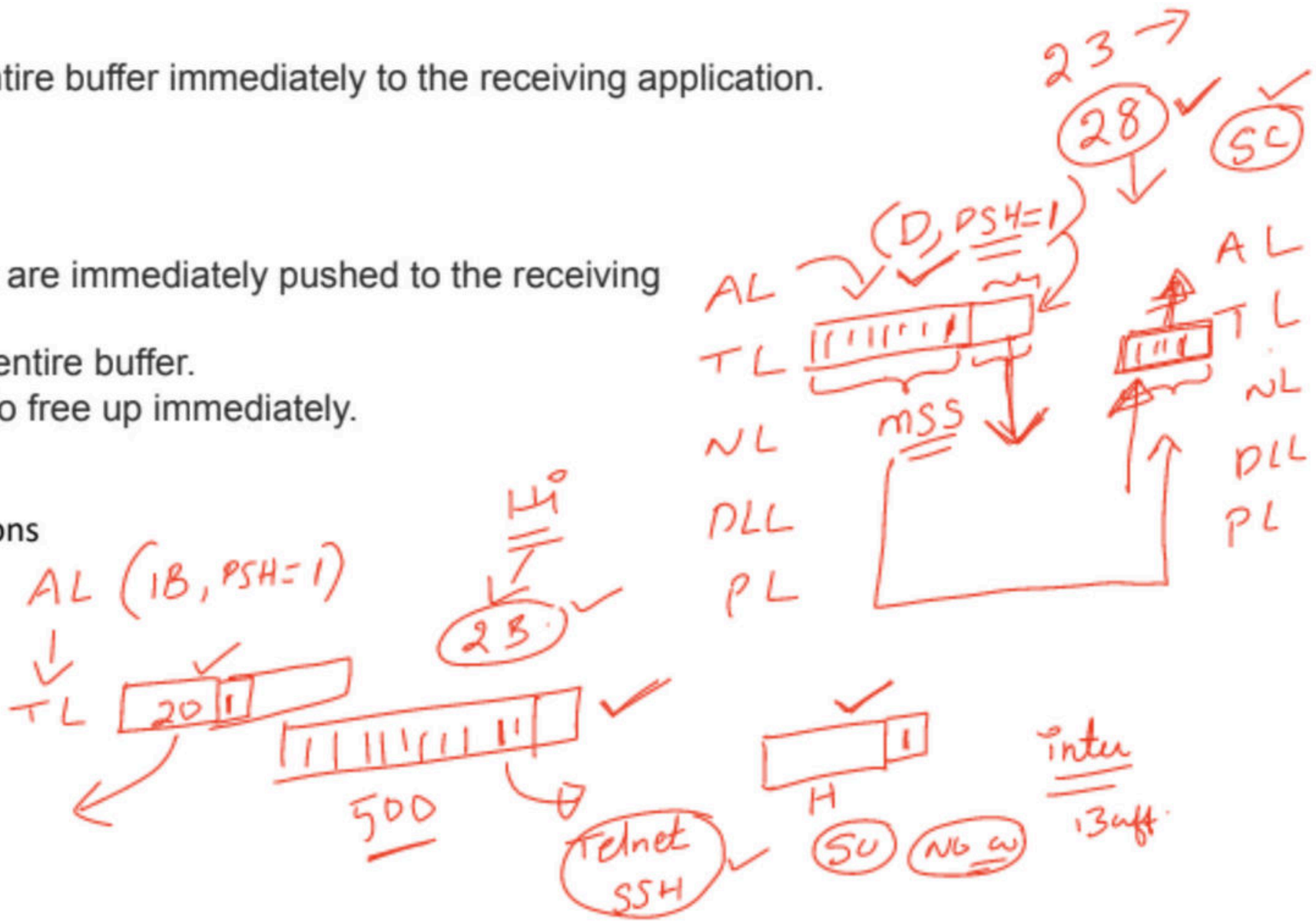
PSH Bit-

PSH bit is used to push the entire buffer immediately to the receiving application.

When PSH bit is set to 1,

- All the segments in the buffer are immediately pushed to the receiving application.
- No wait is done for filling the entire buffer.
- This makes the entire buffer to free up immediately.

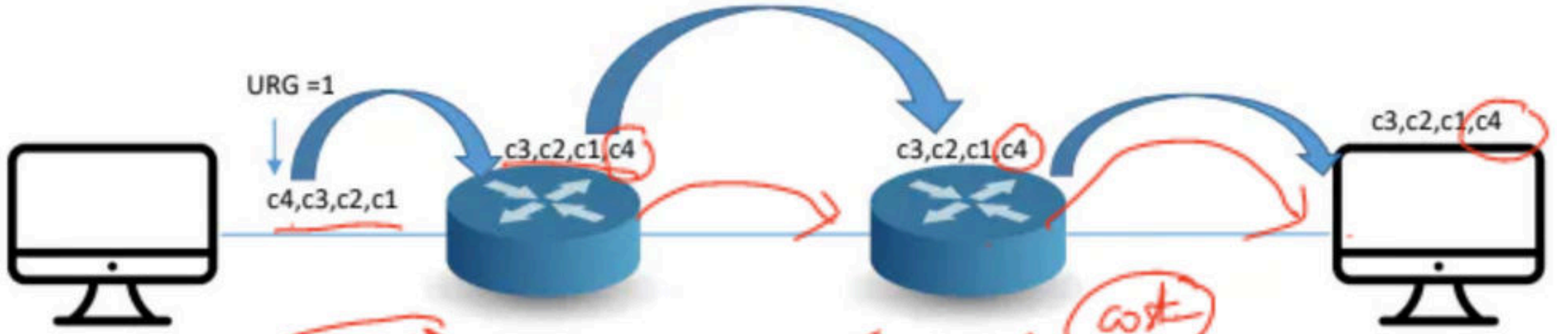
Useful in case of chat applications



URG Bit-

URG bit is used to treat certain data on an urgent basis.

When URG bit is set to 1,
It indicates the receiver that certain amount of data within the current segment is urgent.

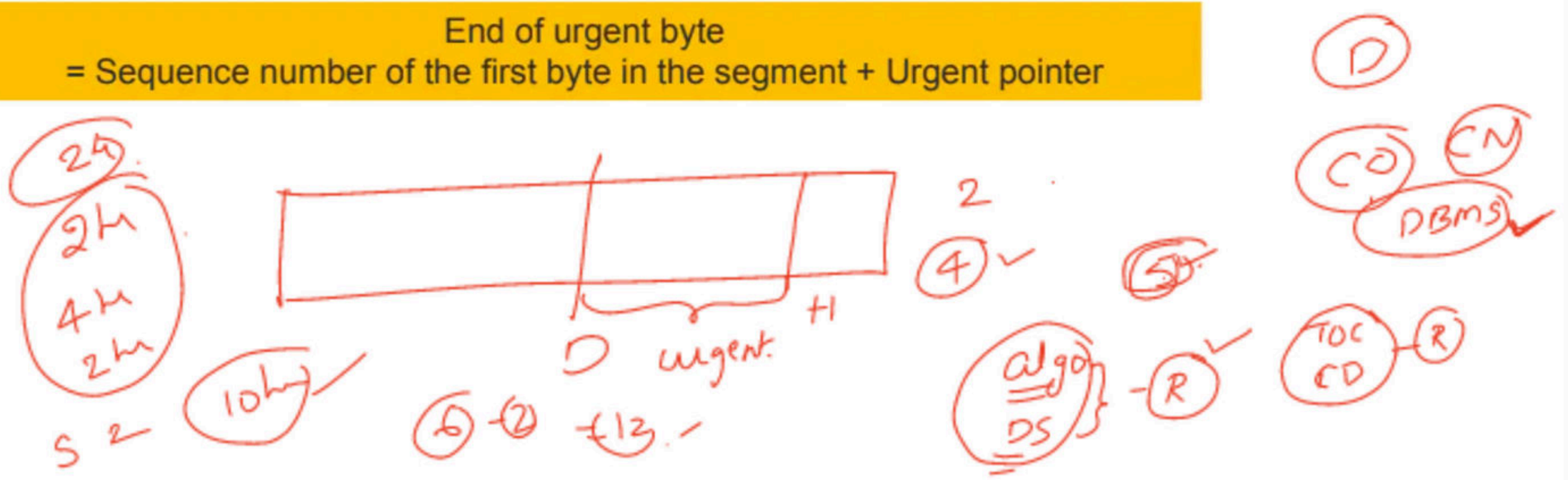


Urgent Pointer-

- Urgent pointer is a 16 bit field.
- It indicates how much data in the current segment counting from the first data byte is urgent.
- Urgent pointer added to the sequence number indicates the end of urgent data byte.
- This field is considered valid and evaluated only if the URG bit is set to 1.

Number of urgent bytes = Urgent pointer + 1

End of urgent byte
= Sequence number of the first byte in the segment + Urgent pointer



RST Bit-

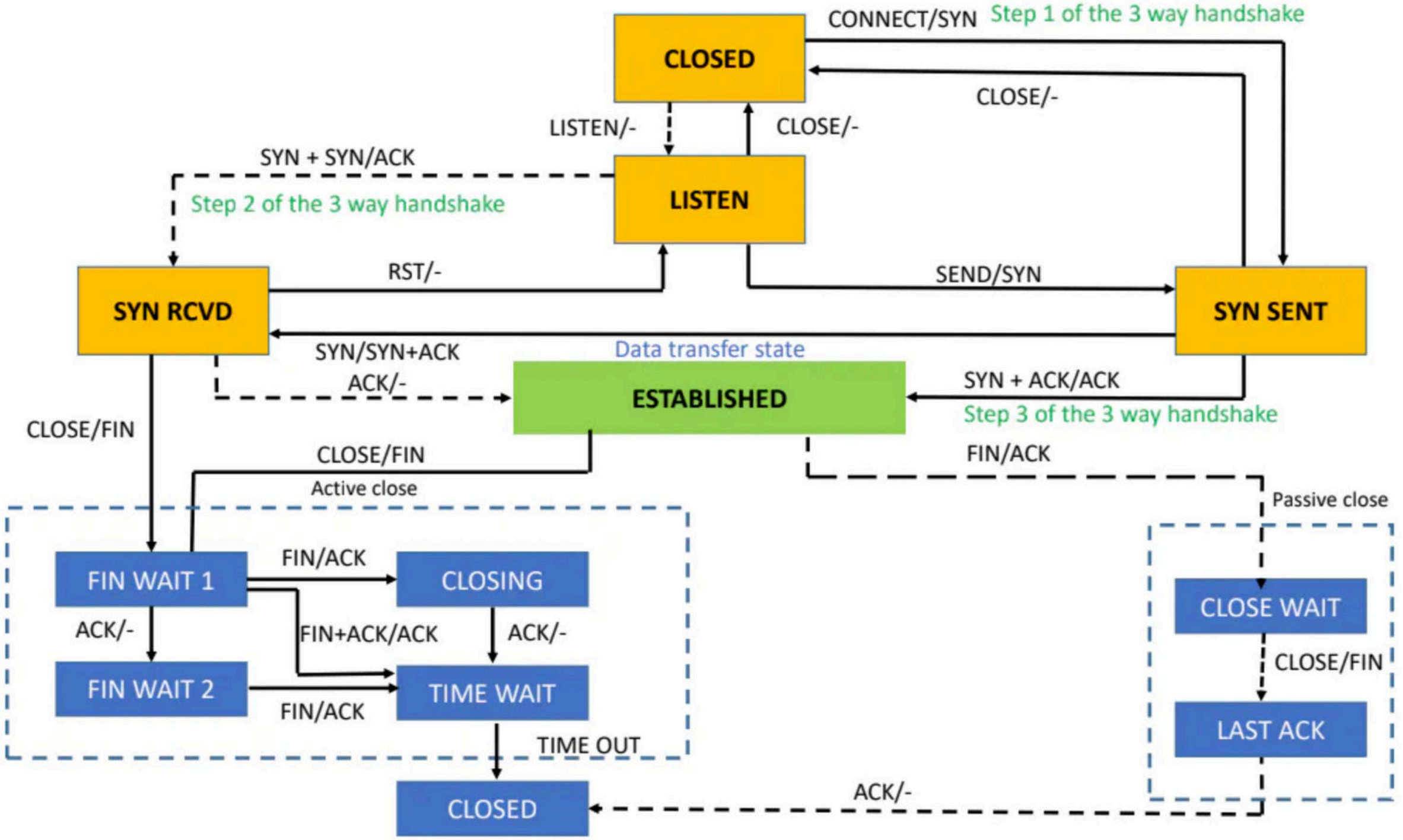
RST bit is used to reset the TCP connection.

When RST bit is set to 1,
- It indicates the receiver to terminate the connection immediately.
- It causes both the sides to release the connection and all its resources abnormally.
- The transfer of data ceases in both the directions.
- It may result in the loss of data that is in transit.

This is used only when-
- There are unrecoverable errors.
- There is no chance of terminating the TCP connection normally.

State	Description
CLOSED	No connection is active or pending
LISTEN	The server is waiting for an incoming call.
SYN RCVD	A connection request has arrived; wait for ACK
SYN SENT	The application has started to open a connection
ESTABLISHED	The normal data transfer state
FIN WAIT 1	The application has said it is finished
FIN WAIT 2	The other side has arranged to release
TIME WAIT	Wait for all packets to die off
CLOSING	Both sides have tried to close simultaneously
CLOSE WAIT	The other side has initiated the release
LAST ACK	Wait for all packets to die

The states used in TCP connection management finite state machine.

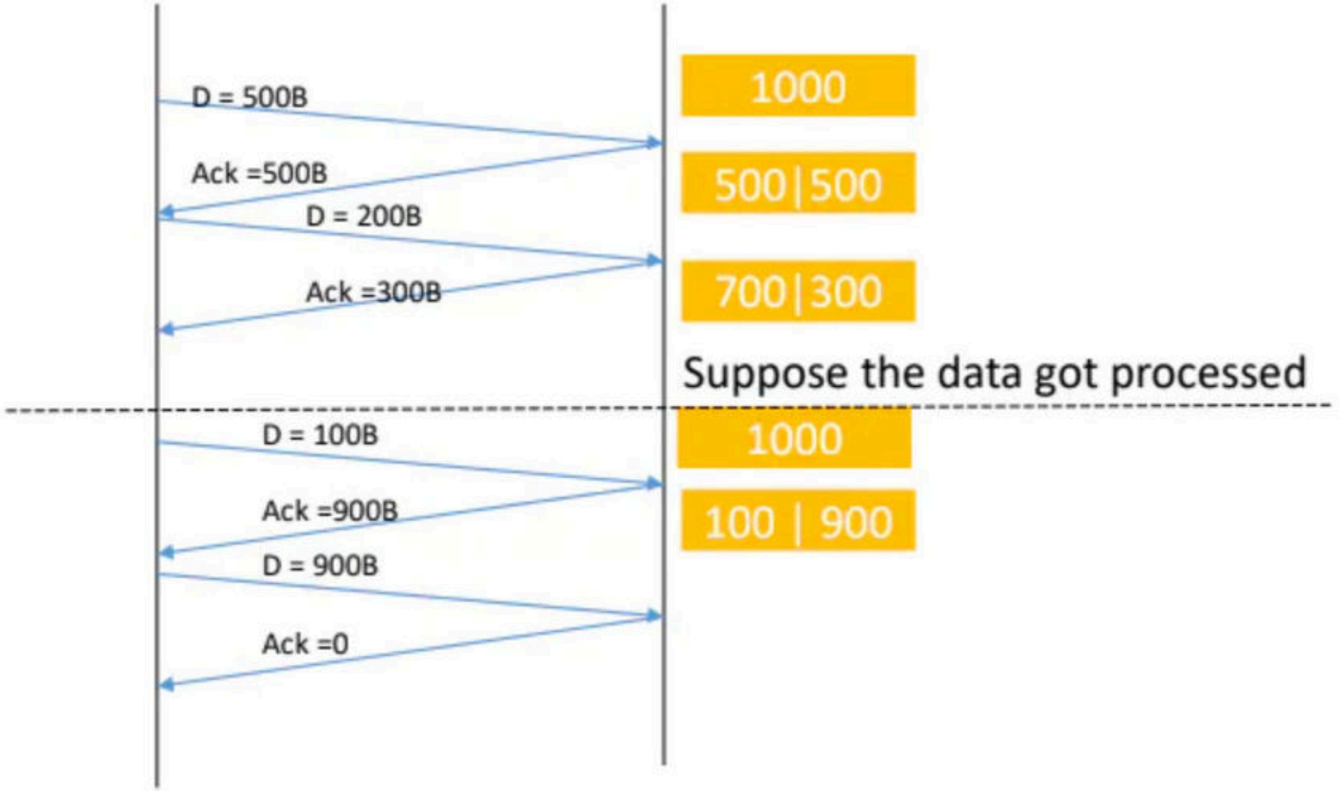

CLOSED
CONNECT/SYN
Step 1 of the 3 way handshake
CLOSE/-
LISTEN/-
CLOSE/-
SYN + SYN/ACK
Step 2 of the 3 way handshake
LISTEN
SYN RCVD
RST/-
SEND/SYN
SYN SENT
SYN/SYN+ACK
ACK/-
Data transfer state
ESTABLISHED
SYN + ACK/ACK
Step 3 of the 3 way handshake
CLOSE/FIN
CLOSE/FIN
Active close
FIN/ACK
Passive close
FIN WAIT 1
FIN/ACK
CLOSING
ACK/-
FIN+ACK/ACK
ACK/-
FIN WAIT 2
TIME WAIT
FIN/ACK
CLOSE WAIT
CLOSE/FIN
LAST ACK
TIME OUT
CLOSED
ACK/-

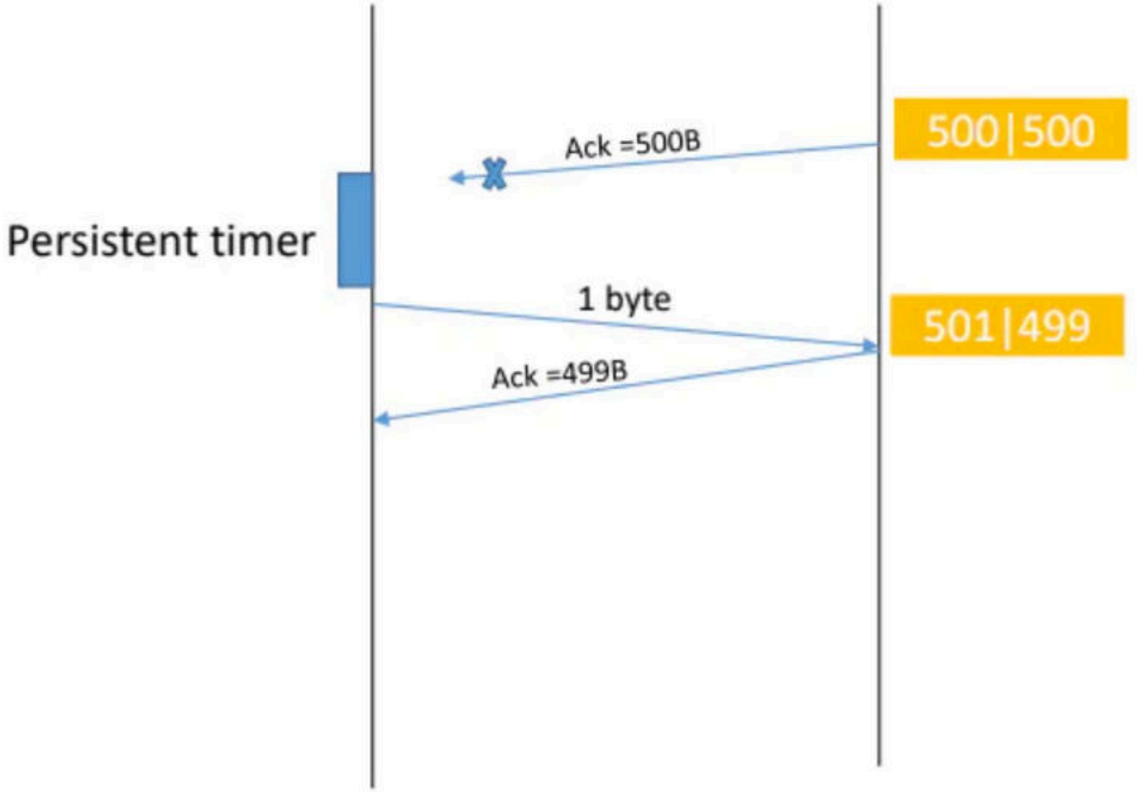
Computer Networks

TCP header part 5

Window Size

- Window size is a 16 bit field.
- It contains the size of the receiving window of the sender.
- It advertises how much data (in bytes) the sender can receive without acknowledgement.
- Thus, window size is used for **Flow Control**.





Consider the following situation-
Sender receives an acknowledgment from the receiver with zero window size.
This indicates the sender to wait.
Later, receiver updates the window size to 500B
and sends the segment with the update to the sender.
This segment gets lost.
Now, both sender and receiver keeps waiting for each other to do something.
To deal with such a situation, TCP uses a persistent timer.

Checksum

Checksum is a 16 bit field used for error control.
It verifies the integrity of data in the TCP payload.
Sender adds CRC checksum to the checksum field before sending the data.
Receiver rejects the data that fails the CRC check.

Understanding with an example

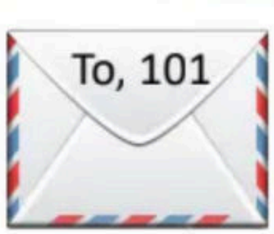
Got damaged
While transporting

Letter delivered to wrong house

Checksum

Checksum is a 16 bit field used for error control.
It verifies the integrity of data in the TCP payload.
Sender adds CRC checksum to the checksum field before sending the data.
Receiver rejects the data that fails the CRC check.

Writing the delivery address
Inside the letter too



Options

Options field is used for several purposes.
The size of options field vary from 0 bytes to 40 bytes.

Options field is generally used for the following purposes-

1. Time stamp
2. Window size extension
3. Parameter negotiation
4. Padding

Time Stamp

When wrap around time is less than life time of a segment,
Multiple segments having the same sequence number may appear at the receiver side.
This makes it difficult for the receiver to identify the correct segment.
If time stamp is used, it marks the age of TCP segments.
Based on the time stamp, receiver can identify the correct segment

Window Size Extension

Options field may be used to represent a window size greater than 16 bits.
Using window size field of TCP header, window size of only 16 bits can be represented.
If the receiver wants to receive more data, it can advertise its greater window size using this field.
The extra bits are then appended in Options field.

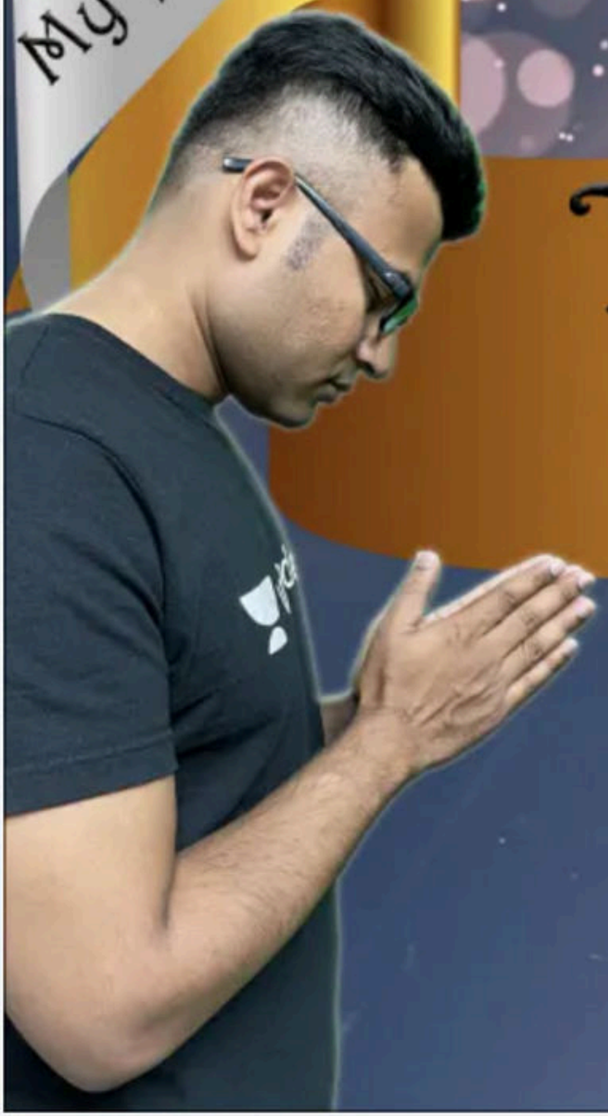
Parameter Negotiation

Options field is used for parameters negotiation.
Example- During connection establishment,
Both sender and receiver have to specify their maximum segment size.
To specify maximum segment size, there is no special field.
So, they specify their maximum segment size using this field and negotiates.

Padding

Addition of dummy data to fill up unused space in the transmission unit and make it conform to the standard size is called as padding.
Options field is used for padding.

My philosophy



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