Intro

TCP (Transmission Control Protocol) - Transport layer protocol. It is a reliable, byte stream based protocol.

It is connection oriented - it has official “start” (3-way handshake) and “end” (4-way handshake).

It is reliable - has confirmation of data delivery (ACK packets). Data bytes arrive in order they were sent. TCP also has packet retransmission.

It has flow control - TCP adjusts transmission rate (receiver can tell sender to slow down sending data or to speed up)

Sequence and Acknowledgement numbers

In short, sequence numbers (SEQ) track what has been sent and acknowledgement numbers (ACK) track what has been received. Sequence/Acknowledgement numbers are a measure of **bytes** sent/received.

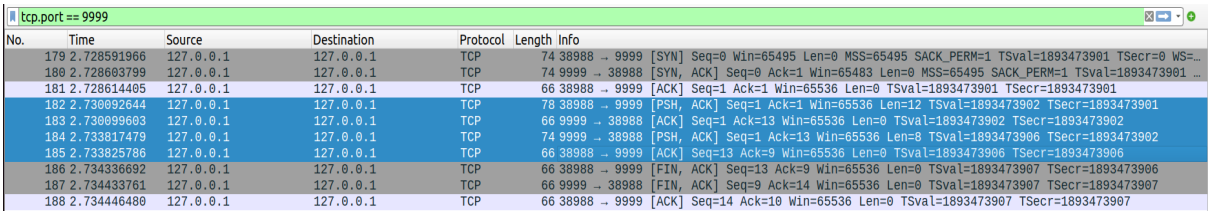
Initially, SEQ numbers are chosen semi-randomly.

$$ACK(n) = SEQ(n) + L(n)$$
$$SEQ(n+1) = ACK(n)$$

Here n is the n-th sent packet number. L(n) is the length of n-th sent TCP packet

These rules are true during the data transmission stage, when the connection was successfully established and before connection is terminated.

SEQ number is also a label/number of the first byte in current packet’s payload and ACK is a label of the first byte in next packet’s payload (Which means ACK - 1 is the label of the last byte inside current payload).



An example of TCP communication (fig. 1)

In fig.1 There are actual examples of both TCP communication “start” and “end” as well as data transmission (blue lines). Port 38988 is a client that has sent 12 bytes of data and port 9999 is a server that received the 12 bytes and responded with sending 8 bytes of data back to the client.

Q: What's the point of [PSH,ACK] ?
Q: Why is ACK always set?

References:

- https://networkengineering.stackexchange.com/questions/29823/why-is-tcp-acknowledging-all-the-time#:~:text=The%20ACK%20bit%20is%20continuously,is%20used%20to%20do%20so.
- https://serverfault.com/questions/928642/all-tcp-packets-have-the-psh-flag-set-who-what-would-be-responsible-for-that
- https://serverfault.com/questions/124517/what-is-the-difference-between-unix-sockets-and-tcp-ip-sockets?rq=1