

CS 725/825 & IT 725

Lecture 15

Transport Layer

October 22, 2025

TCP

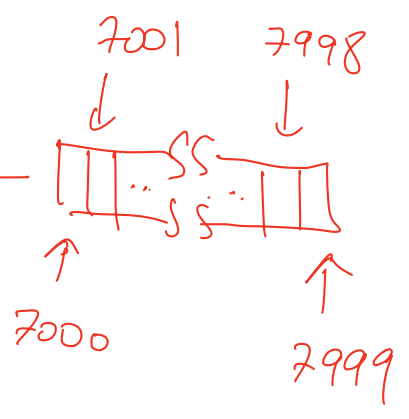
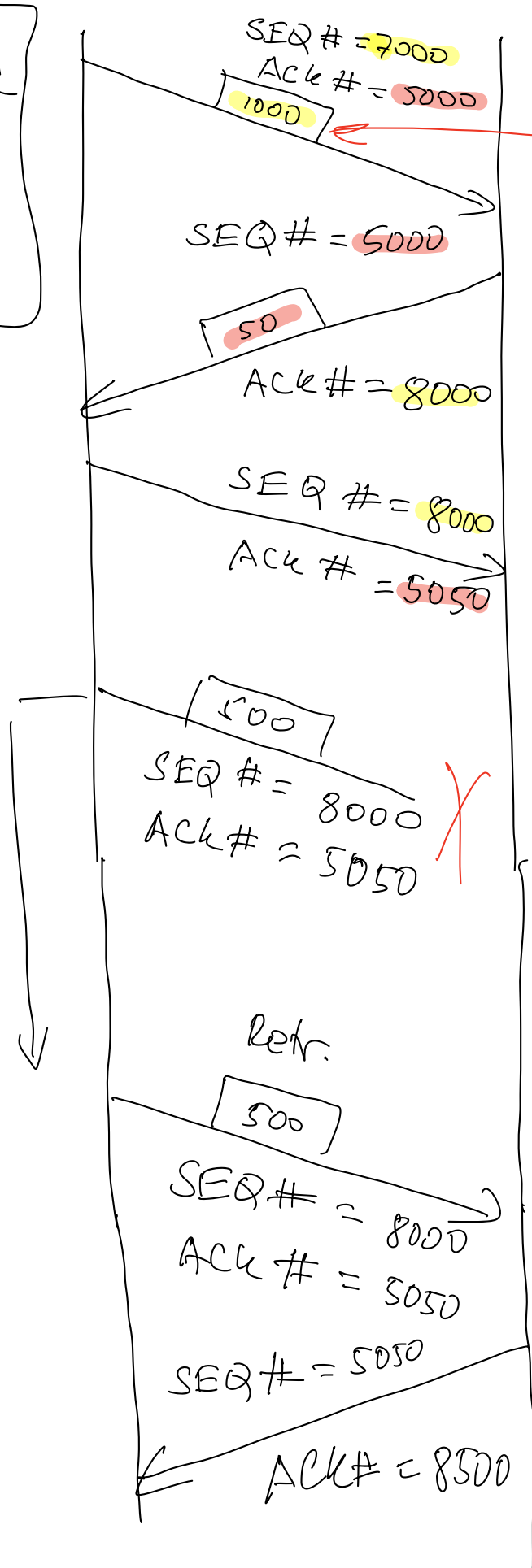
- ▶ Transport Control Protocol
- ▶ Provides bidirectional transparent connection-oriented reliable service
- ▶ Design parameters and objectives
 - used by most popular applications, majority of Internet traffic is transported over TCP
 - significant impact on congestion behavior of the Internet
 - must operate over networks with widely-varying characteristics
 - must be robust and (relatively) simple to implement

TCP Header

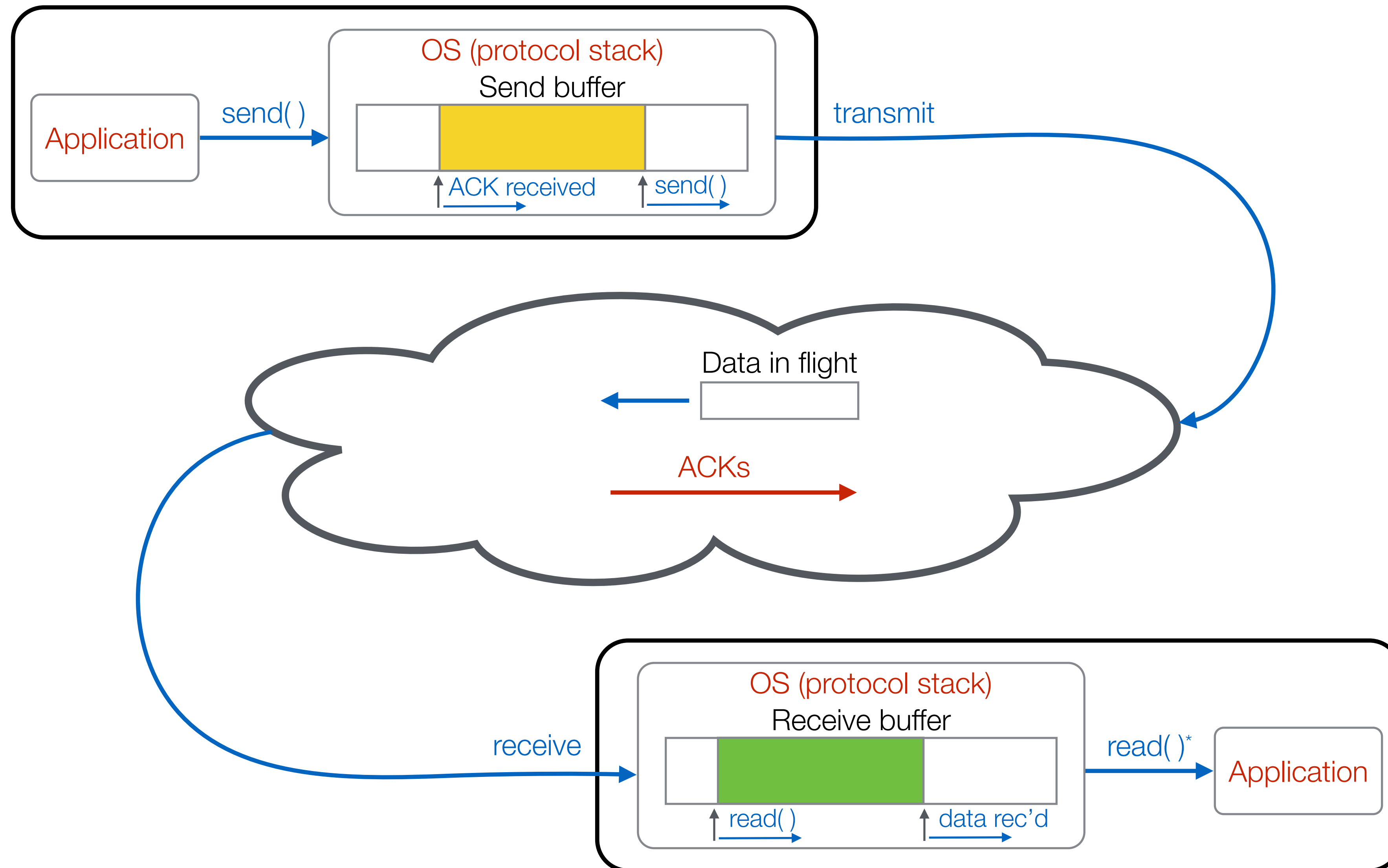
TCP Header																																	
Offsets Octet		0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Source port																Destination port															
4	32	Sequence number																															
8	64	Acknowledgment number (if ACK set)																															
12	96	Data offset	Reserved 0 0 0			N S	C W R	E C E	U R G	A C K	P S H	R S T	S S Y N	F I N	Window Size																		
16	128	Checksum																Urgent pointer (if URG set)															
20	160	Options (if Data Offset > 5, padded at the end with "0" bytes if necessary)																															
...	...	...																															

Another image appropriated from Wikipedia...

TCP SEQ &
ACK #
EXAMPLE

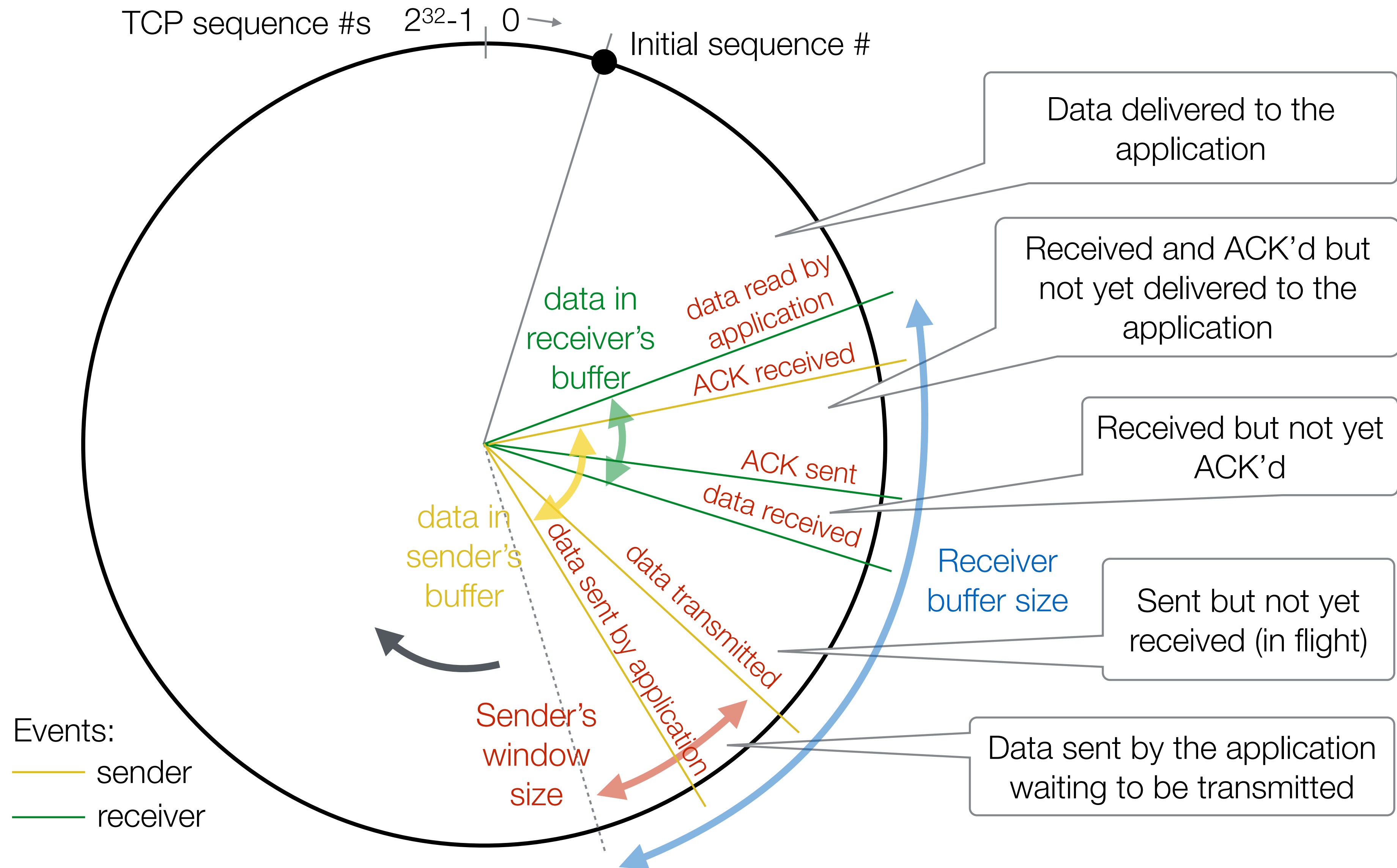


TCP buffering and data flow

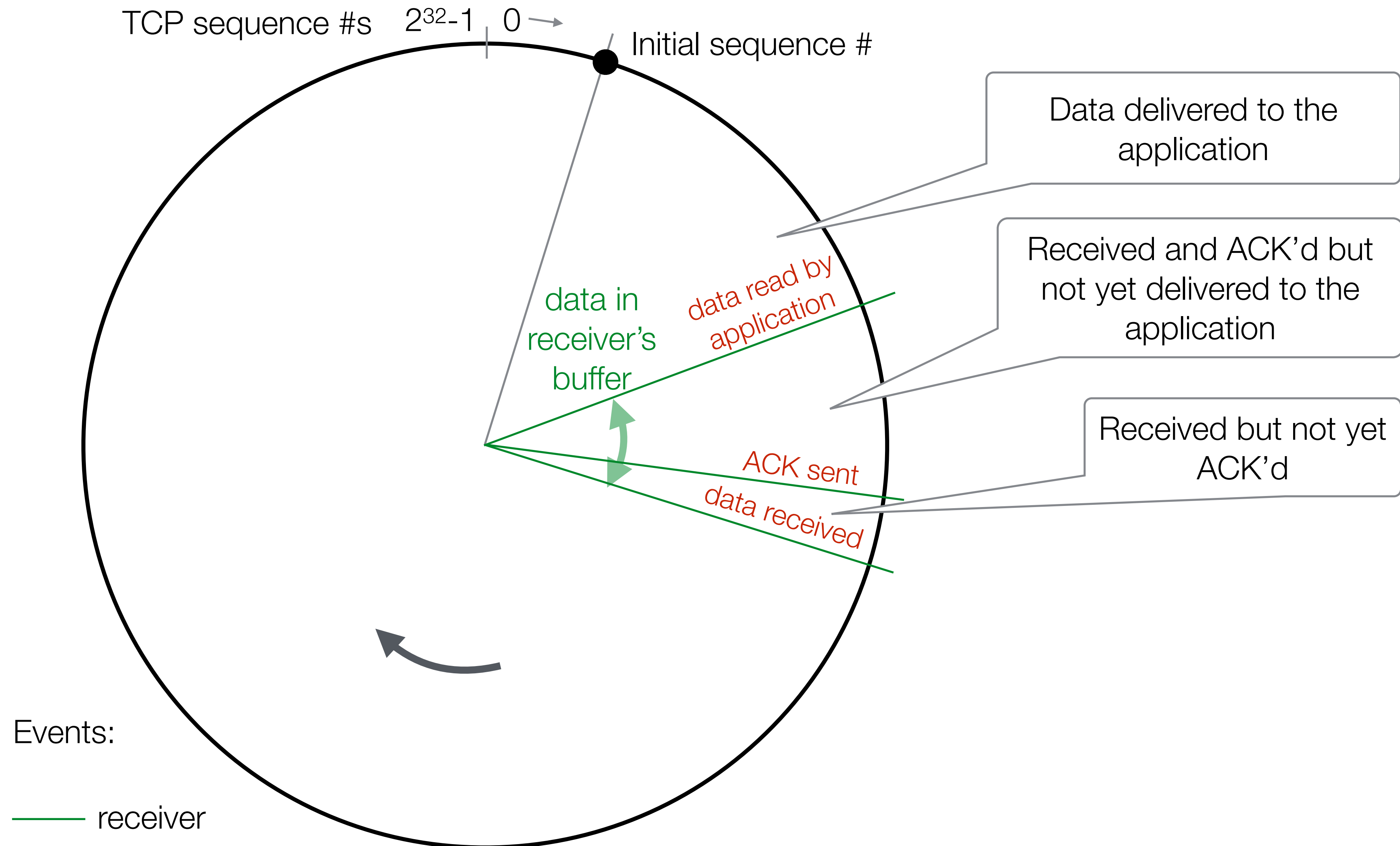


(*) many APIs call the `read()` operation "receive" (eg: `recv()`), `read` is used here to avoid confusion with receiving data on an interface

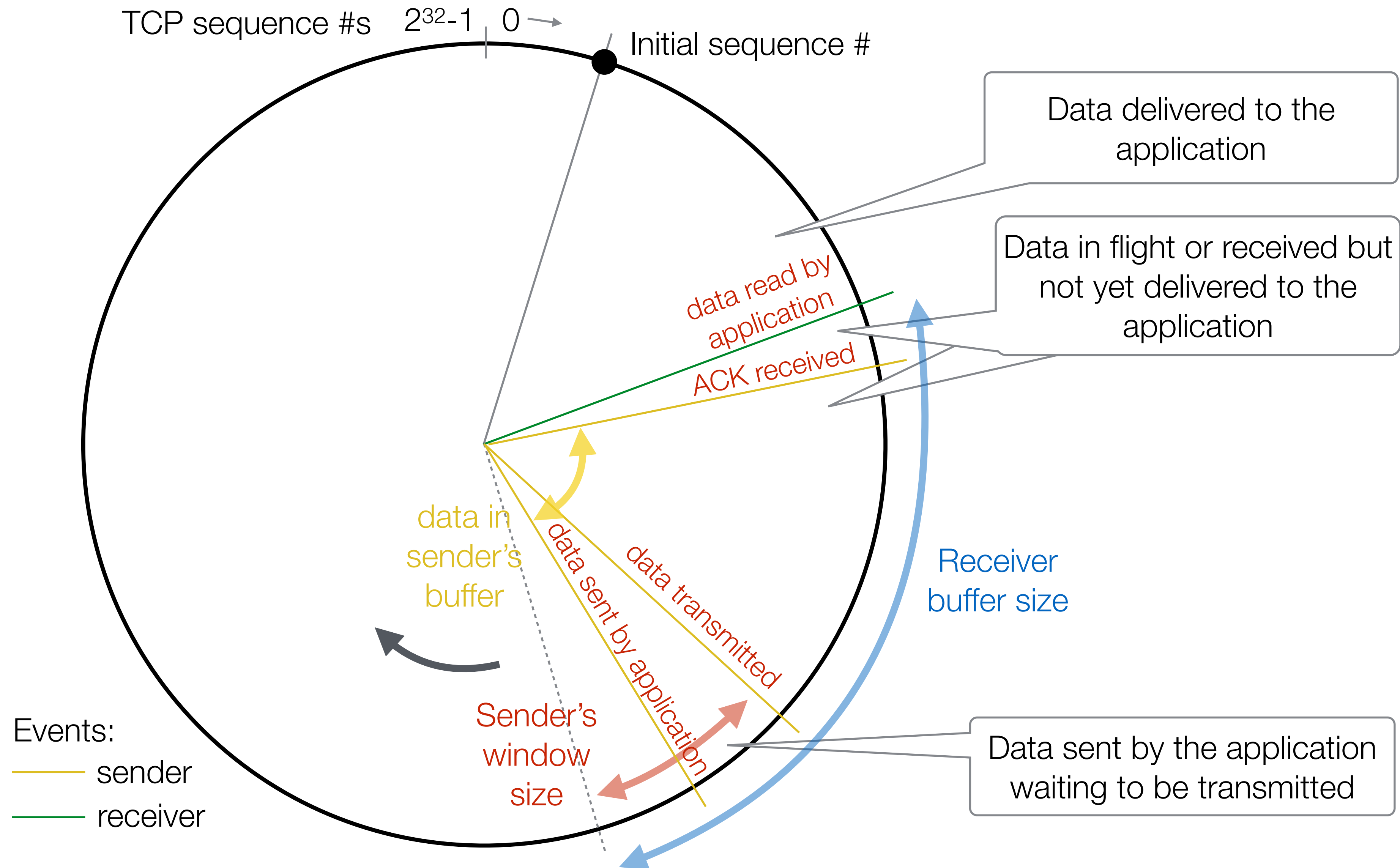
TCP Sliding Window



TCP Sliding Window



TCP Sliding Window



TCP session management

TCP Flags

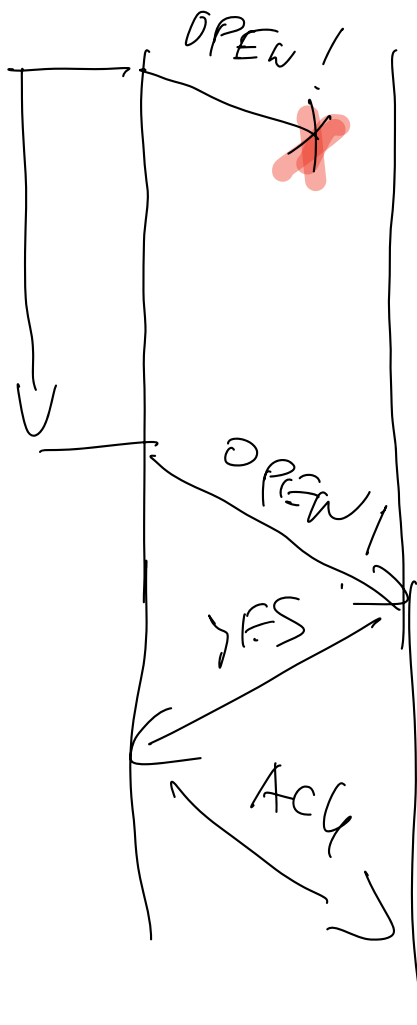
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...	...	...																															

Another image appropriated from Wikipedia...

CONNECTION OPEN CONCEPTS



TO



3-WAY HANDSHAKE

CONNECTION REJECTED

