CS 725/825 & IT 725

Lecture 15

Transport Layer

October 28, 2026

TCP

- Transport Control Protocol
- Provides bidirectional transparent connection-oriented reliable stream 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

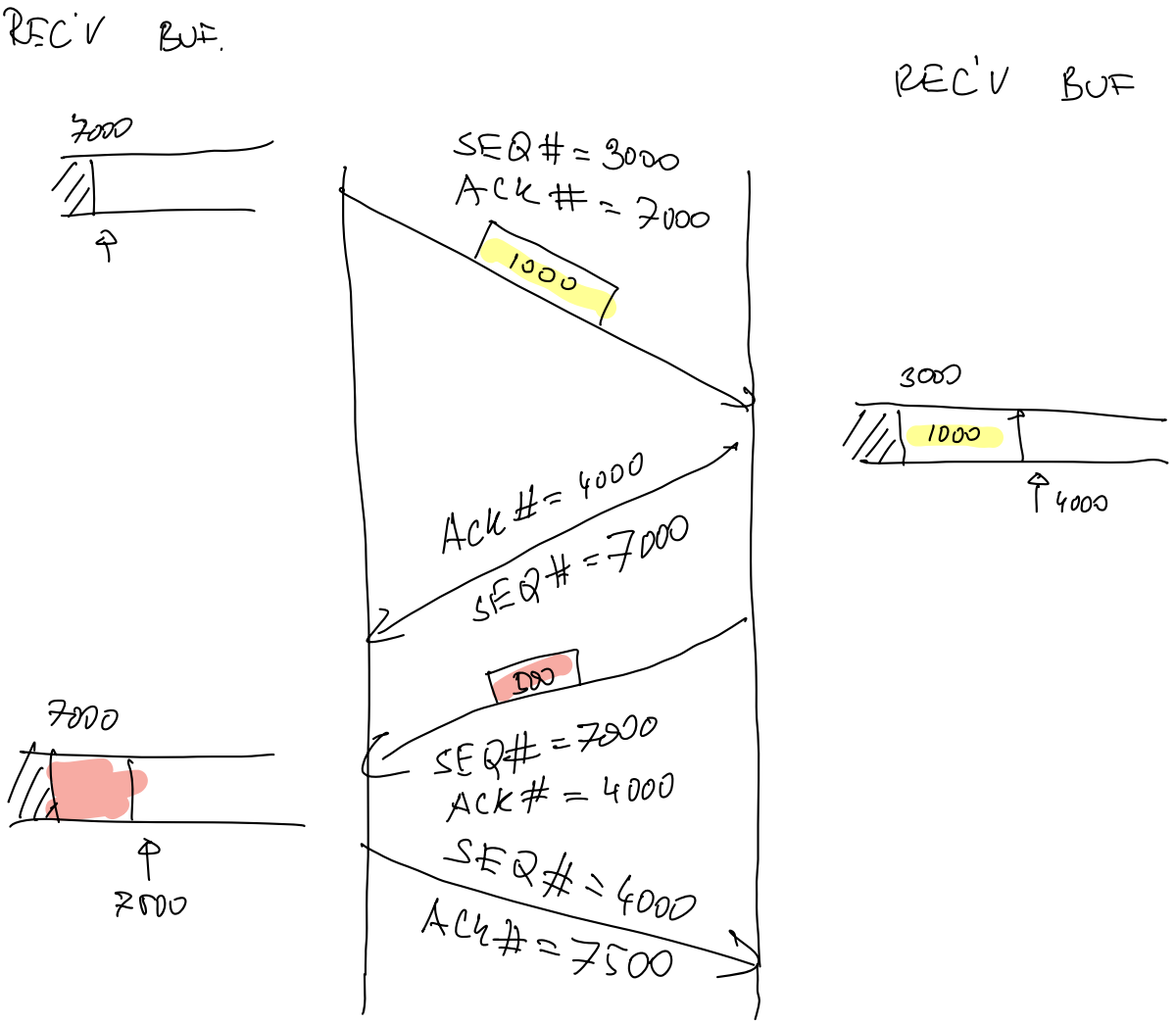
TCP Header

TCP Header

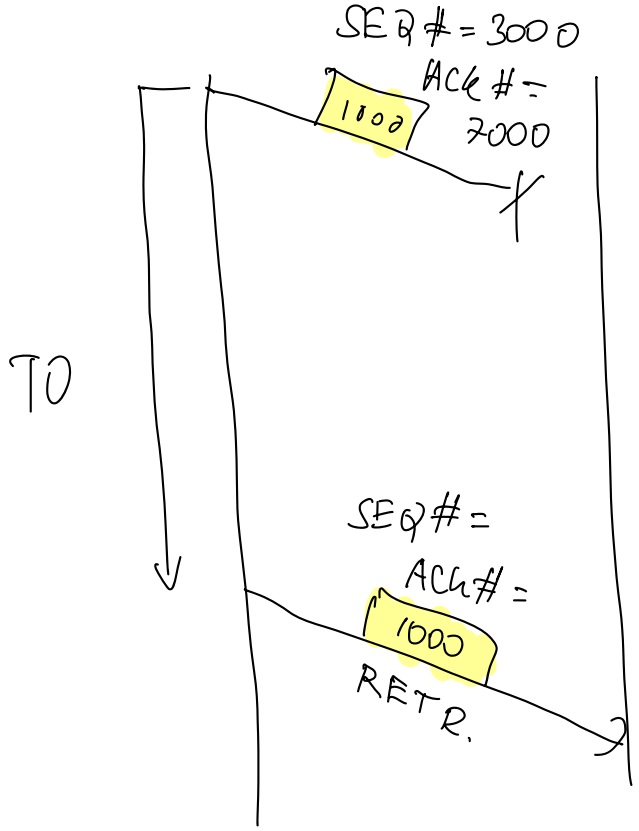
Offsets Octet		0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Source port																Destination port														
4	32	Sequence number																														
8	64	Acknowledgment number (if ACK set)																														
12	96	Data offset				Reserved 0 0 0				NS	CWR	ECE	URG	ACK	PSH	RST	SYN	FIN	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...

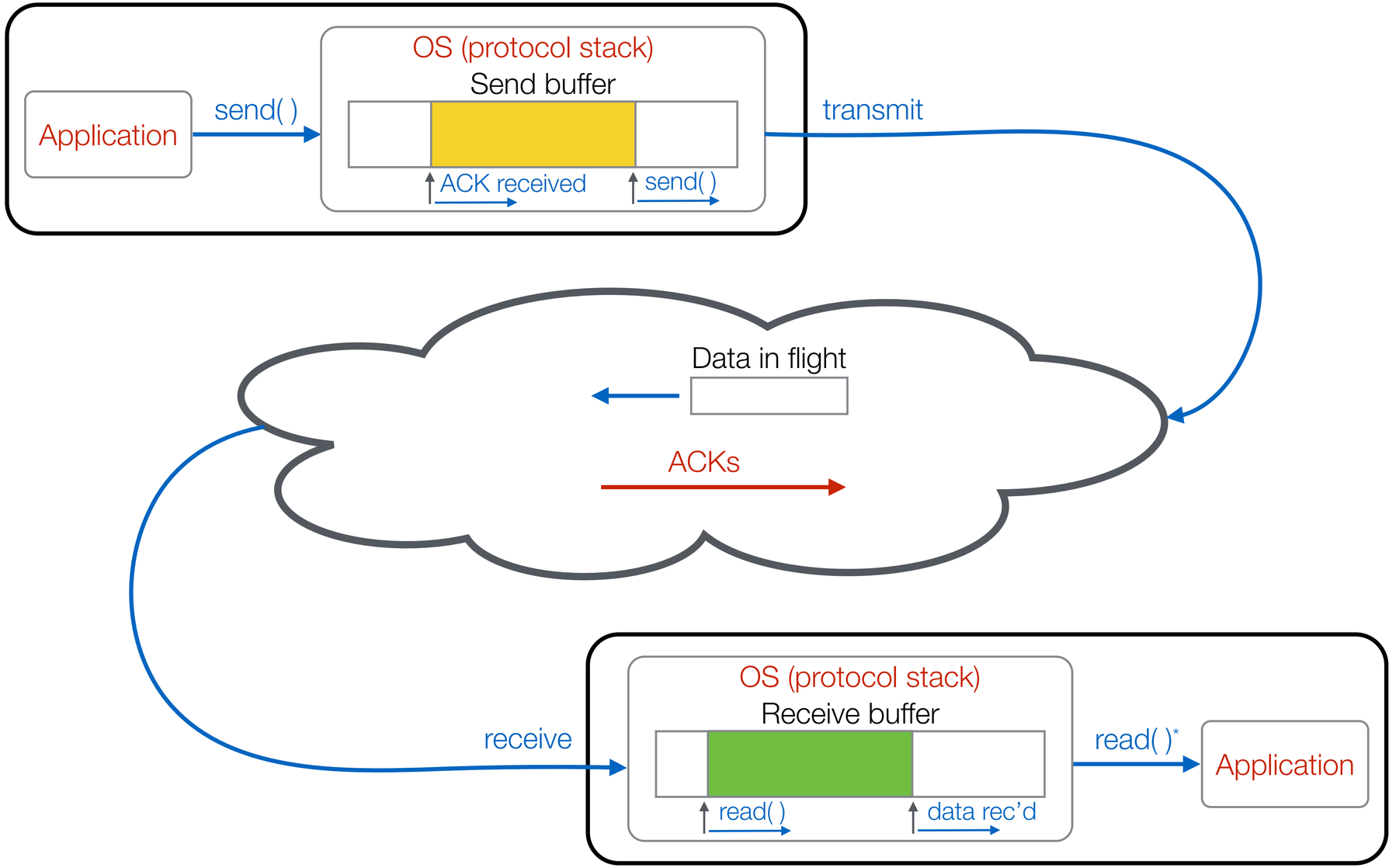
TCP SEQ & ACK NUMBERS



RETRANSMISSION

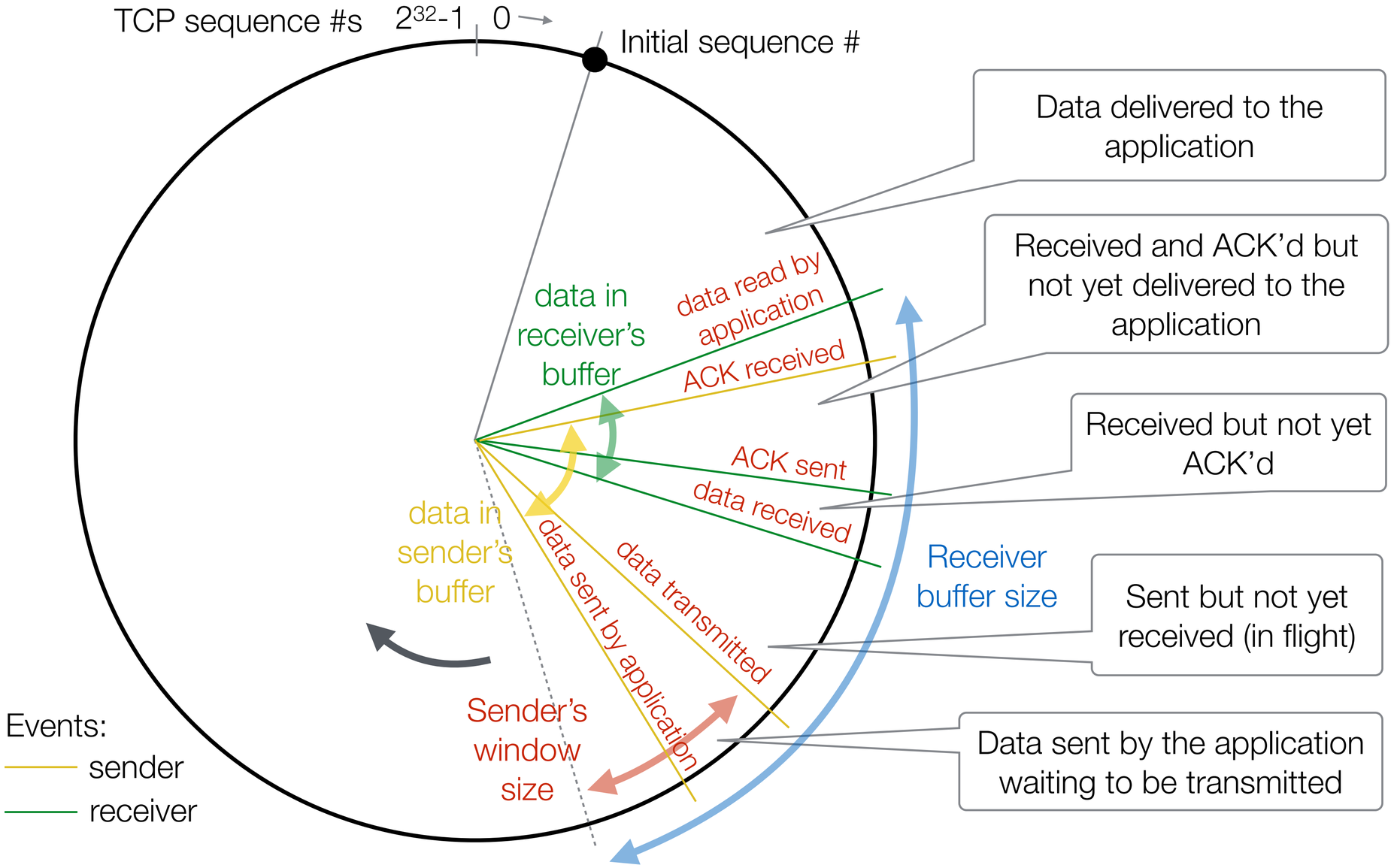


TCP buffering and data flow

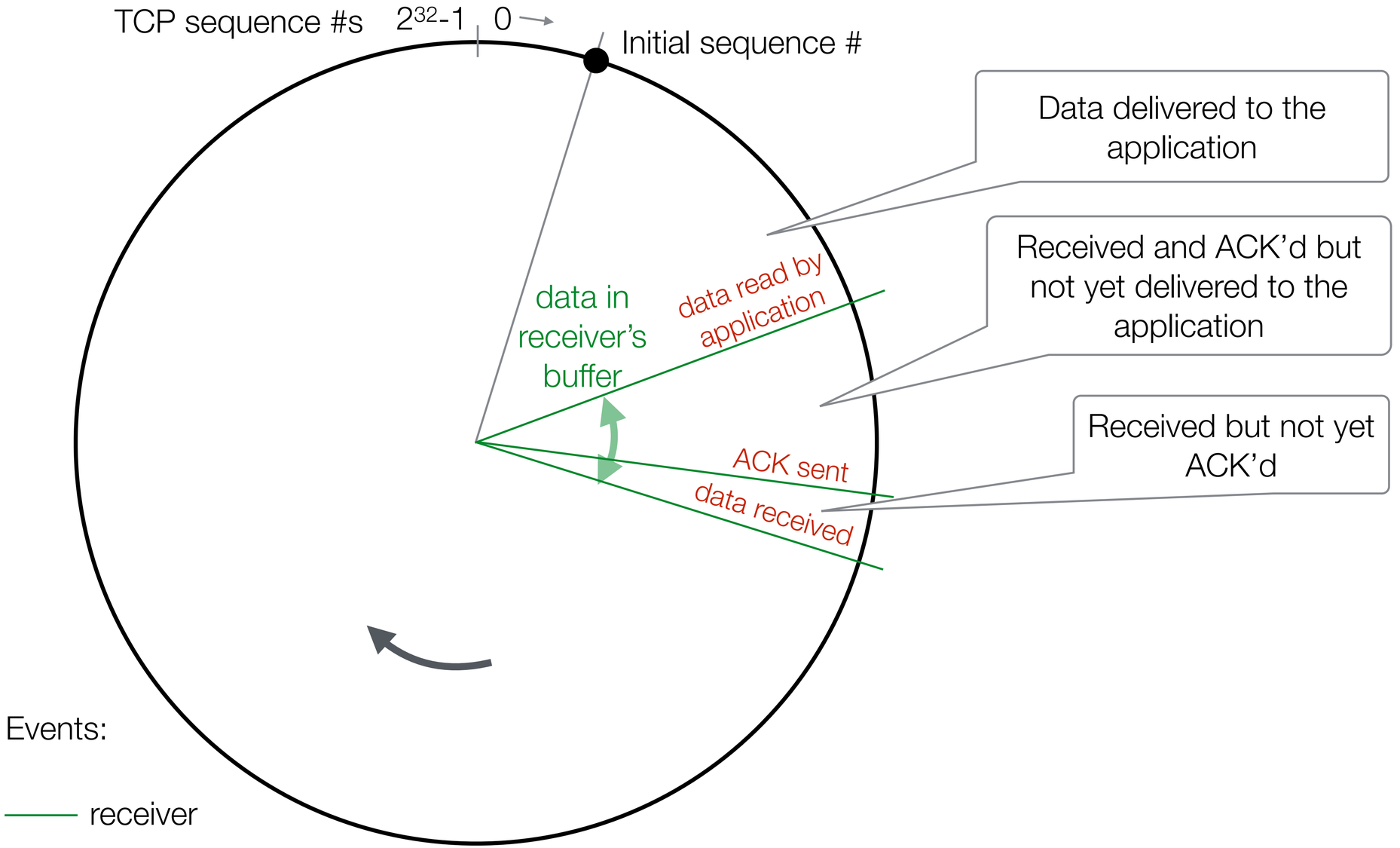


(*) many APIs call the read() operation "receive" (eg: recv()), read is used here to avoid confusion with receiving data on an interface

TCP Sliding Window



TCP Sliding Window



TCP Sliding Window

