CSE/EE 461 – Lecture 13/14+

E2E and Flow Control

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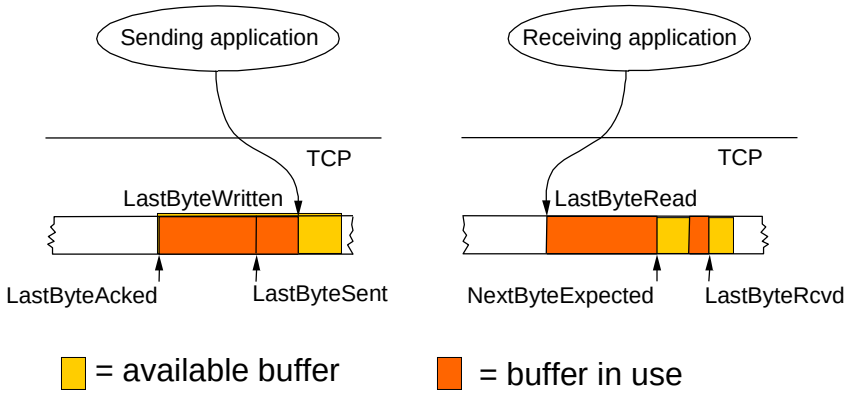
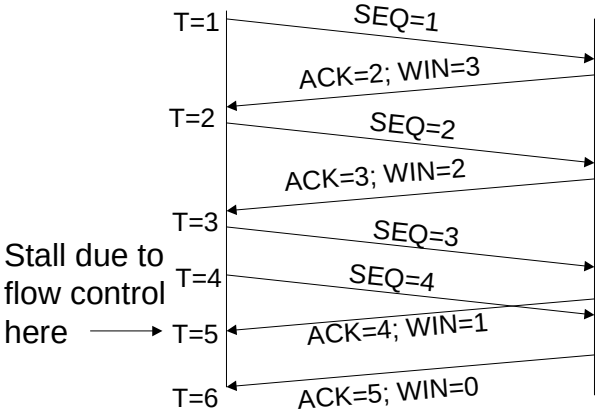
Flow Control

- Sender must transmit data no faster than it can be consumed by the receiver
  - Receiver might be a slow machine
  - App might consume data slowly
- Implement by adjusting the size of the sliding window used at the sender based on receiver feedback about available buffer space
  - This is the purpose of the Advertised Window field

Sender and Receiver Buffering



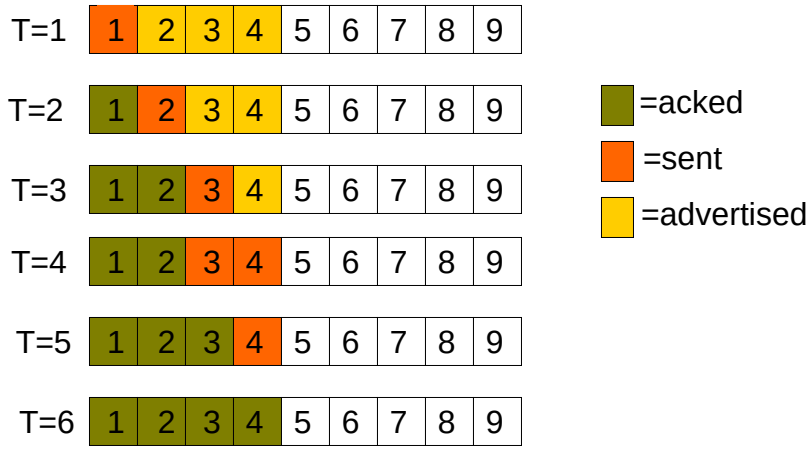
Example – Exchange of Packets



Stall due to flow control here →

Receiver has buffer of size 4 and application doesn't read

Example – Buffer at Sender



Which layer provides Reliability?

- We've been talking about the Transport layer but …
- ARQ is used by some link layers
  - Acknowledgements in 802.11
- Error detection/correction codes boost reliability
  - Ethernet CRC, IP header checksum, etc.
- Where is the "right" place in the protocol stack?

End-to-End Argument

- Key design principle applied in the Internet
- Reliability is needed end-to-end and can't be replaced by lower layer mechanisms. So put it end-to-end; use lower mechanisms to improve performance as needed.

- TCP provides reliable delivery
  - Checksums packet data as well
- Lower layers keep their residual error rate is low
  - CRC enough for Ethernet; wireless links more problematic