

CSc 450/550

Computer Networks

TCP Flow Control

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Summer 2006

6/8/06

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1

Review: TCP basics

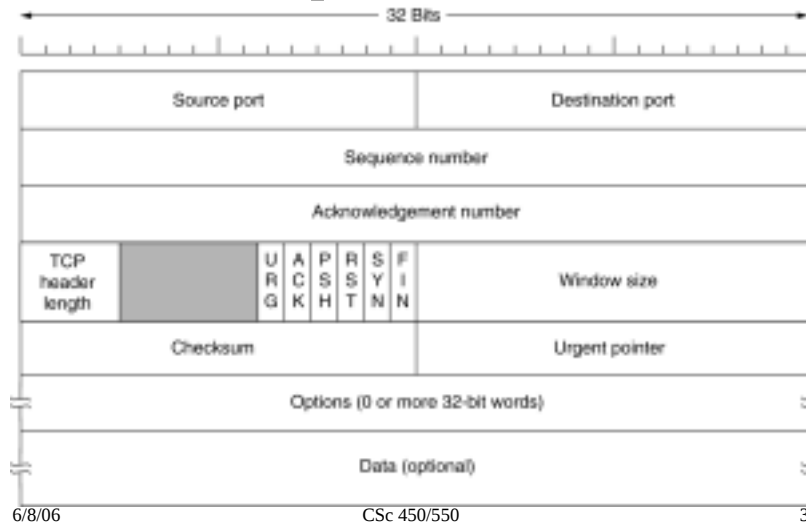
- Services offered by TCP
 - use services offered by IP
 - TCP protocol mechanisms
 - to fill the gap
- TCP connection management
 - TCP connection establishment
 - TCP connection release
 - TCP state machine

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2

TCP packet header



TCP flow control

- **Purpose**
 - avoid a fast sender to overflow a slow receiver
 - overflow: exceed receiver's available buffer space
- **Approach**
 - let the receiver tell
 - how much available space I have
 - receiver window size (16-bit) in TCP header
 - advertised window size
 - in bytes!

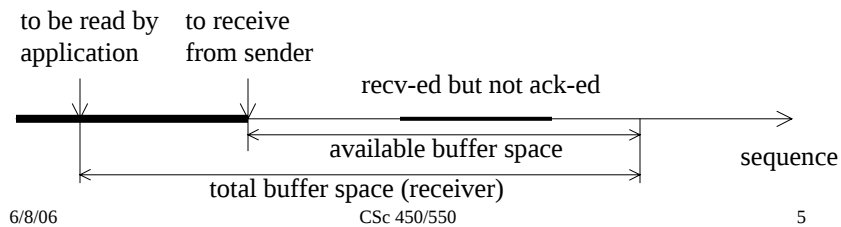
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4

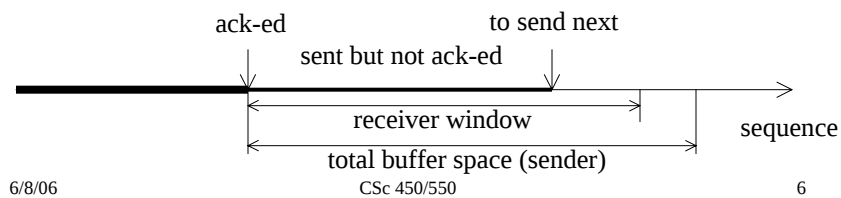
TCP receiver's view

- Sequence space
 - acknowledgment number
 - the next *continuous* byte to receive from the sender
 - receiver window
 - available buffer space at receiver



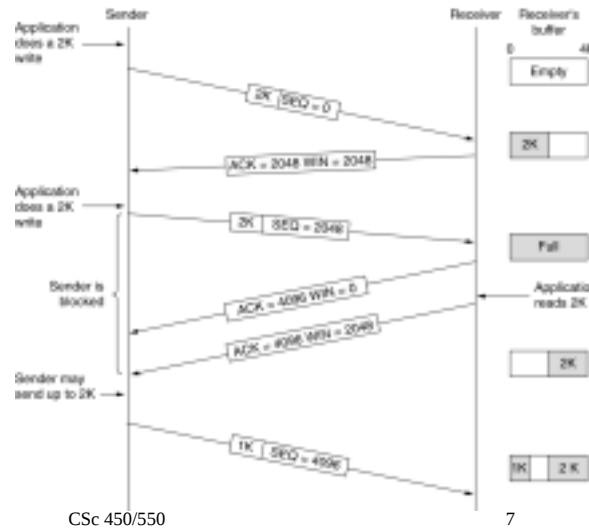
TCP sender's view

- Sequence space
 - sequence number
 - the first byte in the payload
 - sender window
 - $\min \{\text{receiver window, total buffer space}\}$



Between sender and receiver

- Window control
 - sliding window
 - acknowledgment
 - variable window
 - window size



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7

Window and sequence space

- Window space (16-bit)
 - maximum window size $2^{16}-1$: ~64K bytes!
 - achievable throughput limit: win/rtt
- Sequence space (32-bit)
 - t_1 : time to consume the sequence space
 - t_2 : time a packet can “live” in the network
 - $t_1 < t_2$: no reuse; $t_1 < t_2/2$: always ordered
- Explore further: TCP large window

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8

This lecture

- TCP flow control
 - purpose
 - mechanism
 - sliding variable window: seqno, ackno, win
- Explore further
 - TCP large window
 - in tcpdump (or Ethereal)
 - time sip:spt > dip:dpt: P **144**:192 (48) **ack** 321 **win** 16022

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9

Next lecture

- TCP error control
 - read CN Chapter 6

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10