Chapter 3: Transport Layer

- Transport layer services:
  - Multiplexing/demultiplexing
  - Connection management
  - Reliable data transfer
  - Congestion control
  - Flow control

TCP: SEQ and ACK numbers

Host A

ACK=100

Seq=100, 20 bytes data

Seq=92, 8 bytes data

ACK=120

SendBase = 100

SendBase = 120

time

Host B

TCP: retransmission scenarios

What happens next?
We’ll look at ACK & SEQ #s and come back to this.

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TCP segment structure

TCP possible sender events:

1. data received from application:
   - SEQ # is byte-stream number of first data byte in segment
   - Timer for the oldest un-acked segment
   - Expiration interval: TimeOutInterval

2. timeout:
   - Retransmit segment that caused the timeout
   - Restart the timer

3. ACK received:
   - For previously unacked segments
   - Update what is known to be acked
   - Start timer if there are outstanding segments

TCP retransmission scenarios

TCP retransmission scenarios (more)

1) What is/was ‘A’s next step?
2) What does ‘B’ then do?
**Discussion Question 1**

- Suppose Host A sends two TCP segments back to back to Host B over a TCP connection.
  - What might be the first sequence number?
  - If 20 bytes are sent, what is the second sequence number?
  - Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

b) The random initial number, plus 20 bytes  
c) ACK number = initial sequence number - *i.e., “still waiting for the first segment”*  

**Summary**

- TCP (and UDP) Services  
- Define & implement a reliable transport service  
- Previous class  
  - Connection management  
  - Checksum  
- Detect packet loss and retransmit  
- Detect out-of-order packets and retransmit  
- Congestion control - next class  
- Flow Control