EECS 489 - Winter 2024

Discussion 6

Assignment 2 is due this week!

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- **Due Date: Friday, February 23rd @ 11:59 pm EST**
- 3 late days across Assignments 2-4
- Midterm: **Wednesday, March 6th @ 10:30 am - 12:00 pm EST**
  - Done during class time
  - Will be released on Canvas, open note but NO resources beyond class materials
  - Content will be **everything** up to the last lecture before the Midterm
- No discussions during the week of the exam
  - Next one in 3 weeks!
- OH will still being held

Today

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- TCP Practice Questions

TCP - Transmission Control Protocol

Transmission Control Protocol (TCP) Header
20-60 bytes

source port number 2 bytes		destination port number 2 bytes	
sequence number 4 bytes			
acknowledgement number 4 bytes			
data offset 4 bits / reserved 3 bits / control flags 9 bits		window size 2 bytes	
checksum 2 bytes		urgent pointer 2 bytes	
optional data 0-40 bytes			

Q1: TCP File Transfer

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- Consider transferring an enormous file of L bytes from host A to host B.
- What is the maximum value of L such that we don't run out of TCP sequence numbers?
  - Note: TCP sequence number is 4 bytes in the header

Q1: TCP File Transfer

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- Consider transferring an enormous file of L bytes from host A to host B.
- What is the maximum value of L such that we don't run out of TCP sequence numbers?
  - Note: TCP sequence number is 4 bytes in the header
- 2^{32} bytes
  - 4 bytes = 4*8 bits = 32 bits, so we need 2^{32} bytes for sequence numbers before we run out

Q1: TCP File Transfer

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- Consider transferring an enormous file of L bytes from host A to host B.
- Given L = 2^32 bytes, find how long it takes to transmit the file Assume:
  - MSS (max segment size) = 1460 Bytes
  - MTU (max transmission unit) = 1500 Bytes
  - 128 Mbps link from A to B
  - Ignore flow and congestion control, assume A sends as fast as possible contiguously.

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  - 128 Mbps link from A to B
  - Ignore flow and congestion control, assume A sends as fast as possible contiguously.
- ~276 seconds
  - Amount of Data / Bandwidth -> ((2^32 / 1460) * 1500) / (128 * 10^6 / 8)

Q2: TCP Segment Metadata

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- Host A (sender) and B (receiver) are communicating over a TCP connection.
- Assume the following events happen in order:
  - B has received the first 127 bytes of the flow from A, this consumes seq num 0-126
  - A then sends two segments, S1 (80 bytes of data), S2 (40 bytes of data)
  - S1 has sequence num 127, source port 30302, destination port 80
  - B sends ACK1 and ACK2 to A when it receives the first / second segment respectively
  - Assume S1 and S2 arrive in order
- For S2, what are the sequence num, source port and destination port?

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  - Seq num: 207, Source port: 30302, Destination port: 80

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- **Now assume S1 and S2 come out of order**, For ACK1, what are the ack num, source port and destination port?

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- **Now assume S1 and S2 come out of order**, For ACK1, what are the ack num, source port and destination port?
  - Ack num: 127, Source port: 80, Destination port: 30302

Q3: TCP CWND

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- Consider sending a large file over a lossless TCP connection
- Assume:
  - TCP uses AIMD for congestion control with slow start
  - ssthres = 16 MSS
  - Approximately constant RTT
  - CWND starts at 1 MSS
- How long does it take for CWND to increase from 1 MSS to 20 MSS?

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- How long does it take for CWND to increase from 1 MSS to 20 MSS?
  - 8 RTT
  - CWND: 1, 2, 4, 8, 16, 17, 18, 19, 20 (between each two numbers is one RTT, we start exponentially then go to linear/additive)

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- What is the average throughput (in terms of MSS and RTT) of the above process?

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  - ssthres = 16 MSS
  - Approximately constant RTT
  - CWND starts at 1 MSS
- What is the average throughput (in terms of MSS and RTT) of the above process?
  - 85 MSS / 8 RTT
  - Add up the first 8: (since those are the ones we go through before we get to 20 MSS) (1 + 2 + 4 + 8 + 16 + 17 + 18 + 19) MSS / 8 RTT

Wrap-Up

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- Thanks for coming!
- Assignment 2 due this week!
- Midterm is the Wednesday after Spring Break!
- Have a wonderful break!