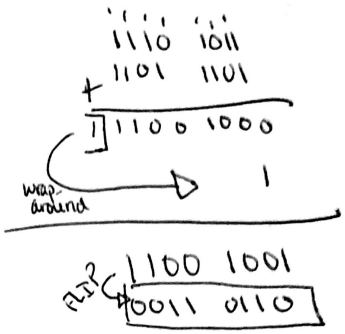
CIS 430/530 Bradley University Dept. of Computer Science &
Information Technology Infrastructure Fall 2020 Information Systems

Name: Gavin Forsberg **Final Exam**

Exam time: 2:30 pm – 4:30 pm, Dec. 11, 2020.
Late submission will result in either 0 pt or late penalty.
Total: 76 pts, extra credit (feedback): 4 pts

1. *List at least four features introduced in the RDT protocols which are used also in the TCP protocol. (4 pts)*
   Reliable transfer, error detection, sequence number, ACK, timeout.

2. *Calculate the checksum (as in UDP) of the following two 8-bit integers(1110 1011) and (1101 1101). (6pts)*



3. Go-back-N vs. Selective Repeat: (1) Which one sends individual ACKs for all packets? (2) Which one's receiver buffers out-of- order packets? (3) Which one maintains timers for only the oldest unACKed packet? (2 pts/each)

1) Selective repeat sends individual ACKs for all packets.

2) Selective repeat does have a receiving buffer for out of order packets.

3) Go-back-N has a timer for the oldest unACKed packet.

4. How does TCP handle out-of-order segments? (2 pts)

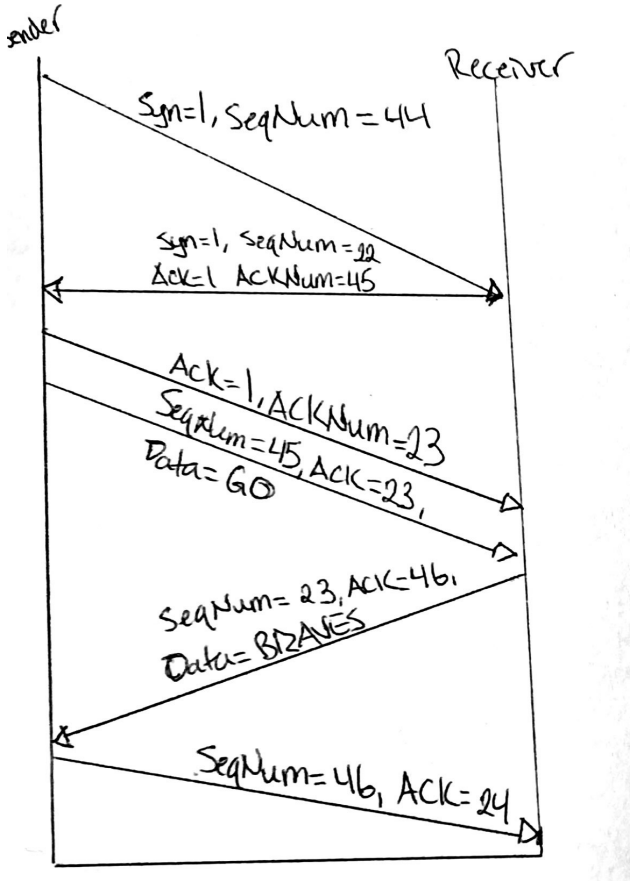
TCP uses sliding window protocol to reorder the packets, if they're out of order, according to the sequence numbers. This puts them in the right order and gets rid of duplicates. With Selective Repeat, the receiver would buffer the packets. With GBN, the receiver would discard the packet and reACK it, with the highest in-order seqNum.

5. Given the following SampleRTTs where R_0 is also the initial Esti- mated RTT). The EstimatedRTT formula has the ratio $\alpha = 0.25$. (a) Calculate all EstimatedRTT values. (6 pts) (b) Would you choose a larger or smaller α value if you want to further reduce the effect of the new Sample RTT to the Estimated RTT? (2 pts)

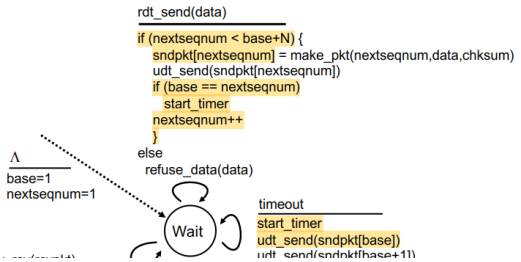
$r_0: (1-.25)*8 + (.25*8) = 8$
$r_1: (1-.25)*8 + (.25*32) = 14$
$r_2: (1-.25)*14 + (.25*52) = 23.5$
$r_3: (1-.25)*23.5 + (.25*4) = 18.625$

Sample RTT	r_0	r_1	r_2	r_3
Sample RTT value	8	32	52	4
Estimated RTT	8	14	23.5	18.625

6. (TCP) Draw the diagram showing the SYN/ACK bits and the sequence/acknowledge numbers for the following communications. (1) The sender has an initial sequence number 44. (2) The re- ceiver has an initial sequence number 22. (3) After handshaking, the sender sends out a message "GO" to the receiver. (4) Af- ter receiving the message "GO", the receiver sends out a message "BRAVES". (10 pts) Note: show all the messages – including the handshaking part and the message exchange part after handshaking for full credit.



7. Given the following (partial) finite state machine of the sender implementing Go-back-N. (1) Why it refuses the data if the nextseqnum is not less than base + N? (2) Why the timer is started when (base == nextseqsum)? (2 pts/each)



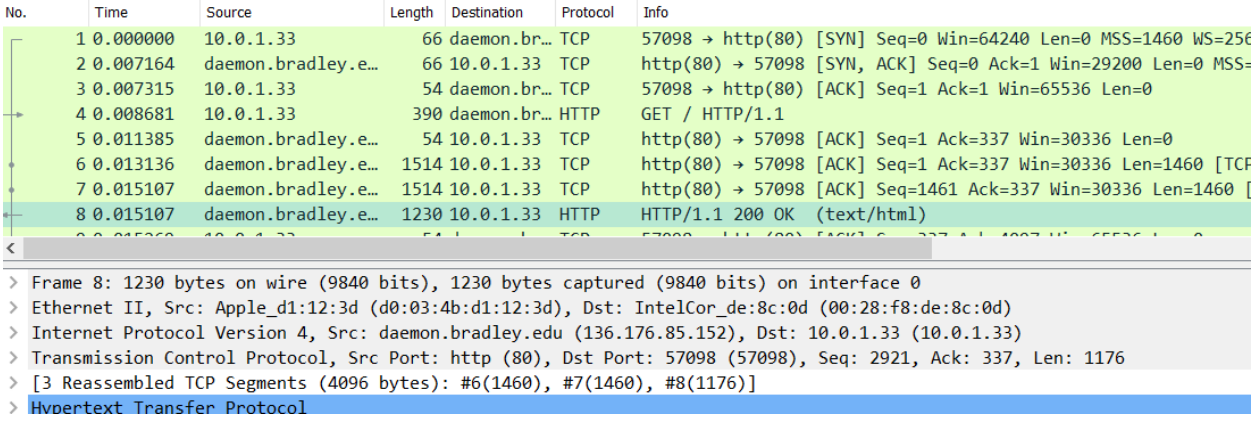
8. (IPv4) In classful addressing, what are the classes for the following addresses?

(a) 140.113.33.44: Class B, public address

(b) 12.8.56.11.: Class A, public address

(c) 193.168.257.1: Class C, public address

9. A maximum transmission unit (MTU) is the largest packet or frame size, specified in octets (eight-bit bytes) that can be sent in a packet- or frame-based network such as the Internet. TCP uses the MTU to determine the maximum size of each packet in any transmission. MTU is usually associated with the Ethernet protocol, where a 1500-byte packet is the largest allowed in it (and hence over most of the Internet). In the following Wireshark capture for the HTTP request (GET / HTTP/1.1), it shows that in order to download the index.html page (size: 4096 bytes) from the HTTP server, the content of the page is divided into three TCP segments (#6, #7, #8) which carry 1460, 1460, and 1176 bytes, respectively. What are occupying the remaining 40 bytes? (4 pts)



The TCP overhead is 20 bytes and the IP overhead is 20 bytes. The segment size for the payload of the packet is 1460 maximum.

10. If you are to divide the 20.20.20.0/23 network into four equal-size subnets, what are the four subnetworks'
(1) network addresses represented by the slash notation:

20.20.20.0./24 20.20.20.64/24 20.20.20.128/24 20.20.20.192./24

(2) range of valid IP addresses:

20.20.20.1 - 20.20.20.254

(3) subnet mask? (4 pts/each for the first two, 2 pts for the third).

255.255.255.0 = 24

11. Assume that you are the network operator at Bradley University overlooking a network 136.176.0.0/16, and you are now planning to allocate consecutive IPv4 addresses for three new student service offices which require at least 100, 50, and 30 IP address, respec- tively. Do your job wisely as (1) the blocks of IP addresses should not overlap, and (2) the IP addresses should be continuous. (8 pts)

100 Addresses 7 bits

136.176.0.0/23 - Gives addresses from 136.176.0.0 to 136.176.0.127

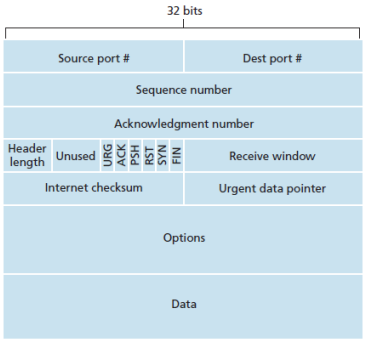
50 Addresses 6 bits

136.176.0.128/24 - Gives addresses from 136.176.0.128 to 136.176.0.192

30 Addresses 5 bits

136.176.0.192/25 - Gives addresses from 136.176.0.192 to 136.176.0.223

12. (TCP) Given the TCP segment structure below, where the header length is 4-bit. What should be these four bits when we sent out a TCP segment with 23 bits in the "Options" field. (3 pts)



The header length field states the length of the TCP header in 32-bit words. It usually is 20 bytes but if there are 23 bits in the options field it should be that 23.

13. Given cwnd = 12 MSS, ssthresh = 14 MSS, dupACKcount=2 in TCP Reno. Assuming that it is now under the congestion avoidance state. (1) If the incoming packet is a duplicated ACK, what would be the ssthresh and cwnd values? (2) If we encounter timeout after receiving the previous packet, what would be the ssthresh value? (4 pts).

1) Ssthresh: 14 cwnd: 12

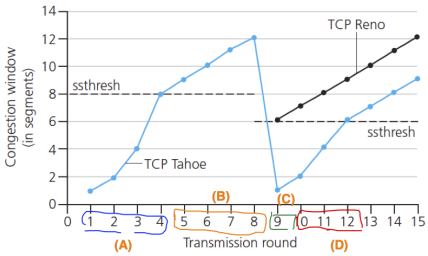
2) Ssthresh: 0

14. In TCP, congestion control has three states: slow start, congestion avoidance, and fast recovery. (1) Which period is in slow start? (2) Which period is in congestion avoidance? Answer the questions using (A) – (D). (4 pts)

1) Period A, Period D

2) Period B (12 - 15 also)

A: Slow start B: Congestion avoidance C: Fast Recovery? D: Slow start



Feedback: (1) Is there any materials introduces in class that you think should be improved? (2) Which part of the materials you would prefer the instructor to spend more time on? (3) Which part of the assignments should be improved? How? (4) Anything else you would like to communicate with the instructor? (4 pts/extra credit) Your comments will be taken seriously to further improve the future classes. Thank you.

I can't think of any specific material that should be improved, however to do with socket programming and the project we just completed, I think that would have been very cool if there was more time for it. Projects like that across the semester would have been cool and absolutely would help with some of the 'dryer' topics throughout the semester. The assignments that are in this format are also kind of dry, not very interactive or fun to do. If there was a way to get some of these points across via projects instead of just answering questions, or maybe a combination of less questions along with a project, the assignments would have been more engaging and fun, in my opinion. Overall, nothing was really terrible. My main takeaway is that more projects could improve the class.