Computer Networks Homework #4
Transport Layer

Name: Blake Williams
ID: 010974718

27 points
7 questions, some with multiple parts

Instructions

- Type your work, print it to a **single** PDF, and upload it to Blackboard before the due date and time. It is strongly suggested that you use the given document.
- Show all of your work. Correct answers alone may not carry full credit without proper justification and details of steps.
- -2 points if you do not insert your name and ID at the top of the document.
- -5 points if it is not typed.
- -5 points if it is not a PDF file.
- -5 points if it is not a single PDF file. Submit one PDF file. Do not submit zip files containing one or more files.
- -5 points if you present the worked problems out of order. In other words, please present the problems in the order assigned, 1, 2, 3, …

1. Suppose a user without administrative privileges on client A initiates an HTTPS session with server S. At the same time, a user without administrative privileges on client B also initiates an HTTPS session with server S. Suppose server S uses port number 443.

   a. (1 pt.) What is the destination port number of the segments from A to S?
   i. 443

   b. (1 pt.) If A and B are on different hosts, is it possible that the source port number in the segments from A to S is the same as that from B to S?
   i. Yes, when client A and B are on different hosts, they are assigned independent port numbers. Therefore there is a case in which both A and B share the same port number to S.

   c. (1 pt.) If A and B are on the same host, is it possible that the source port number in the segments from A to S is the same as that from B to S?
   i. No, each TCP port (when on the same host) is uniquely identified with a port number. Therefore A cannot share the same port as B when on the same host.

2. UDP and TCP use 1's complement for their checksums. Suppose you have the following two 16-bit words: 0101 0101 0101 0101 and 1010 1010 1010 1011.

   a. (2 pts.) What is the 1's complement of the sum of these words? Show all work.
   0101 0101 0101 0101 + 1010 1010 1010 1011 = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 with a 1 carry left most bit
   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 + 1 = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 = final sum
   1s complement = inverse of sum = 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
   b. (2 pts.) With the 1's complement scheme, how does the receiver detect errors?
   The receiver detects errors by verifying that the 1's complement sum of all received words equals **all ones**. Any deviation from this value signals the presence of errors.

   c. (2 pts.) Is it possible that a 4-bit error will go undetected? If so, provide an example.
   Yes, Lets say you have 2 words. Word one is 1111 0000 1111 0000 and word two is 0000 1111 0000 1111. The checksum would be 1111 1111 1111 1111 and the 1s complement would be 0000 0000 0000 0000 . Lets say if in Word one the last four bits were flipped and for word two the last 4 were also flipped. The new words being 1111 0000 1111 1111 and 0000 1111 0000 0000. The new sum would be the same as the original sum,

and the 1s complement would also be the same as the original sum. Therefore the receiver would not detect an error

d. (2 pts.) Is it possible that a 1-bit error will go undetected? If so, provide an example.
No, a single bit flip will always be caught by the 1's complement checksum as the calculated 1s complement will always be different than the original.

3. (5 pts.) Name all FIVE necessary mechanisms used in TCP to implement reliable communication over an unreliable channel. Although important, do NOT list congestion control or flow control.

a. Error Detection (checksums)
b. Acknowledgements (sending acknowledgements to confirm receipt of packets)
c. Retransmission
d. Sequential Numbering
e. Timers for detecting lost segments

4. Consider transferring an enormous file of *L* bytes from host A to host B. Assume an MSS of 1,460 bytes.

a. (3 pts.) What is the maximum value of *L* such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has four bytes.
TCP sequence numbers are 32 bits long making the maximum sequence number 2 ^32 or 4,294,967,296 which is also the maximum L value.

b. (3 pts.) For the *L* you obtain in part (a), find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 5 Gbps link. Ignore flow control and congestion control so A can send the segments back-to-back continuously.
L = 4,294,967,296
MSS is 1460 bytes
Total header size is 66 bytes
Packet size = 1460 + 66 = 1526
Link Capacity = 5gbps or 5 x 10 ^ 9
Number of packets = L / MSS = 2941758
Total Transmitted size = Num packets * Total packet size
Total Transmitted size = 2941758* 1526 = 4489122708bytes
4, 488, 251, 456 bytes to bits = 35912981664 bits
Transmission time = 35912981664 bits / 5 x 10 ^ 9 = 7.183 seconds

5. (2 pts.) Provide the equation for the *EstimatedRTT* of a TCP connection.
a. (1- a)*EstimatedRTT + a*SampleRTT

6. For TCP sequence numbers,

7.a. (1 pt.) What is being numbered?
Numbering individual bytes.

7.b. (1 pt.) What does the sequence number in an ACK mean?
The sequence number in an ACK represents the next byte that the receiver is expecting to receive.

7. (1 pt.) What TCP segment header value is being manipulated in TCP flow control?
Receive window