
[CS-335a] ASSIGNMENT 3

To TCP or to UDP: that is the question

Deadline: 28/11/2021

Professor: Maria Papadopouli

TA: Stathis Kyriazis

TAs mailing list: hy335a@csd.uoc.gr TA: skyriazis@csd.uoc.gr

Part 1: Theory (35 points)

Question 1 [20 points]: Below, there are some statements concerning UDP and TCP. Comment on their validity. Provide a precise, clear and brief justification of your answers [2 points each]

- 1) The **checksum** on the header of a UDP packet ensures the reliable transformation of the packet to its destination.
- 2) Consider the **congestion control of TCP**. When the timer of the sender expires, the value of **ssthresh** is set to the half of its previous value.
- 3) During the slow start phase of TCP, the sending rate is increasing exponentially every RTT.
- 4) A **triple duplicate ACK** event indicates a possibly high congestion in the network.
- 5) When the **cwnd** value reaches the ssthresh, TCP jumps from the slow start phase to the congestion avoidance phase.
- 6) During a TCP session, it is possible that a host sends segments to multiple receivers.
- 7) Consider a TCP session between a Host A and a Host B. If the receive buffer of A is full, A can not send any data to B due to the **TCP's flow control**.
- 8) TCP's flow control would be useless, if the reading rate of the application at the receiver is always faster than the sender's sending rate.
- 9) Can you think of systems/applications that use both UDP and TCP protocols in their operation?

10) When an app uses UDP as a transport layer protocol, it is impossible to provide guarantees for the data delivery. (Be careful here!)

Question 2 [15 points]: Provide brief and clear answers to the following questions:

- 1) Discuss two important differences between the flow control vs. congestion control of TCP. [5 points]
- 2) Describe why a programmer would choose to run an application over UDP instead of TCP. [5 points]
- 3) Do you consider that the fast retransmit (on 3 duplicate ACKs) acts “complementary” to the timer timeout on TCP? [5 points]

Part 2: Problems on TCP (55 points)

Question 1 [25 points]: Assume two hosts A and B that communicate over a TCP connection. Host B has received all the bytes from Host A until the 227 byte. Afterwards, Host A sends two segments to Host B one after another. The first segment contains a payload of 30 bytes, while the second one contains 60 bytes. The source port from Host's A side is 306 and the destination port is 80. Host B sends an acknowledgment each it receives a TCP segment.

- 1) Draw the TCP flow diagram between Host A and Host B, assuming that the two segments arrive in the correct order, without any packet lost. You can ignore Host's B sequence number as no relevant information is given. What is the sequence number of the second segment? Explain. [3 points]
- 2) What are the source and destination port numbers of the acknowledge segments sent from Host B to Host A? [2 points]
- 3) Assume that the second segment reaches Host B before the first segment. What is the acknowledgement number returned by Host B as a response to the arrival of the second segment? Explain. [5 points]
- 4) Assume that the two segments arrive at Host B in the correct order but both of the responses of Host B are lost. Draw the TCP flow diagram between Host A and Host B, and include the retransmission that will happen in the diagram. Which TCP mechanism will trigger the retransmission? Can Host A be certain about what actually happened? [7.5 points]

- 5) Assume that the two segments arrive in order at Host B. However, the first acknowledgment is lost, while the second one arrives at Host A, after the timer of the first packet has expired. Draw the TCP flow diagram between Host A and Host B. Does Host A retransmit a packet? Is a retransmission actually necessary? Explain. [7.5 points]

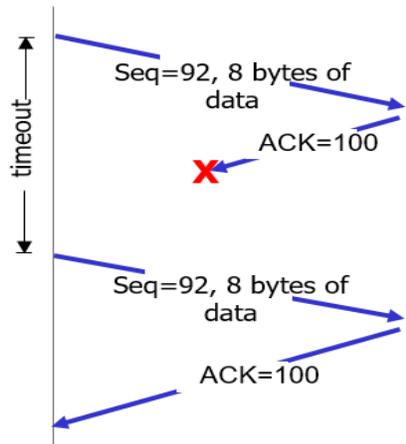
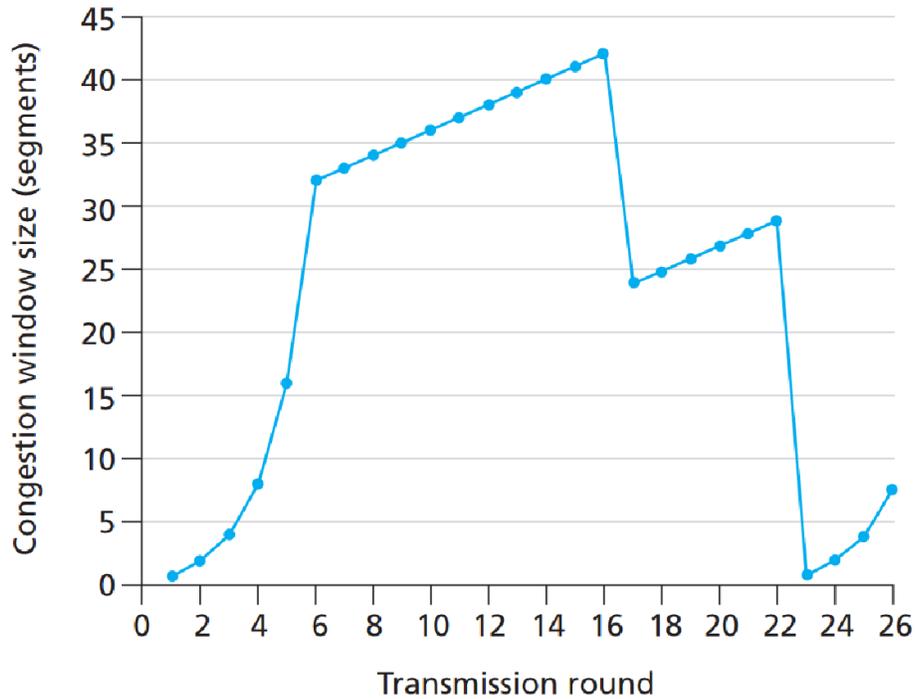


Figure 1 An example of how a TCP flow diagram should look like

Question 2 [30 points]: The diagram below demonstrates an example of the behavior of a specific TCP flow over time. Answer the following questions, with sufficient justification.



- 1) Identify the time intervals when TCP slow start operates. How can we understand that? [2 points]
- 2) Identify the time intervals when TCP congestion avoidance operates. How can we understand that? [3 points]
- 3) After the 16th transmission round, a sudden drop to the size of congestion window is observed. What could have caused that? Speculate about the traffic in the network at this time period? [5 points]
- 4) After the 22nd transmission round, a more severe drop of the size of the congestion window is observed. What could have caused that? Speculate about the traffic on the Internet at this time period? [5 points]
- 5) At which transmission round the 89th segment is sent? How did you estimate it? [5 points]
- 6) What is the value of cwnd during the 17th transmission round? Justify your answer. [5 points]
- 7) What is the value of ssthresh during the 24th transmission round? Explain. [5 points]

Part 3: Hands-on Exercise – Measurements & Analysis (10 points + 10 bonus)

Question 1 [20 points]: Here you need to employ Wireshark. Import the following trace file (<https://kevincurran.org/com320/labs/wireshark/trace-tcp.pcap>) which contains a trace of a TCP flow between a host and a server. Answer the following questions by explaining your answers and providing screenshots from Wireshark.

- 1) What is the IP address of the host initiating the TCP connection? Which are the source and destination port numbers that this host uses on its TCP segments? Provide screenshots to back up your answer. [5 points]
- 2) Identify the TCP segments that correspond to the 3-way handshake. Indicate the flags and their values in the header of these segments? Provide screenshots to back up your answer. Do the flags set on these packets agree with what you have learned in theory? [5 points]
- 3) Select a random TCP segment. Indicate the sequence number, the acknowledge number, and its payload size. Provide screenshots to back up your answer. What is the expected acknowledge number from the other side as a response to this segment? Does it agree with the corresponding response ACK shown in Wireshark? [5 points]
- 4) Determine the length (in bytes) of each of the TCP header fields by examining a random TCP segment. Provide screenshots to back up your answer. [5 points]