GLASGOW COLLEGE UESTC

Exam paper

Communication Networks (UESTC 2018)

Date: 4th September 2020
Time: 14:00-16:00pm

Attempt all PARTS. Total 100 marks

Use one answer sheet for each of the questions in this exam.
Show all work on the answer sheet.

Make sure that your University of Glasgow and UESTC Student Identification Numbers are on all answer sheets.

An electronic calculator may be used provided that it does not allow text storage or display, or graphical display.

All graphs should be clearly labelled and sufficiently large so that all elements are easy to read.

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

Continued overleaf

Q1: This question is regarding network architecture and foundamentals of computer networks. [25 marks]

(1) Explain what is network protocol and give some examples. [4]

(2) Briefly describe the role of the transport layer and network layer respectively. What is the main difference between the two layer? [4]

(3) Which two main pieces of information are required by a process to "identify" the other process with which it wants to communicate? Explain why they are important. [5]

(4) Figure 1 shows a network path connecting a server to a client.

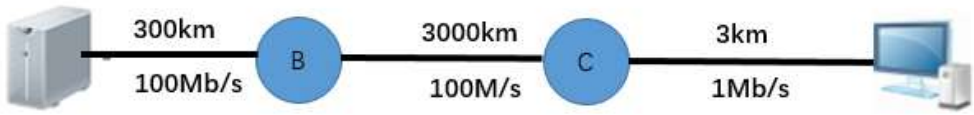

Figure 1 Network path for Question 1

(a) What is the propagation delay for a packet going from the server to the client (you may assume that the speed of signal propagation is 300,000 km/s)? [4]
(b) What is the total transmission delay of a 10,00-bit packet on all of the links? [4]
(c) If the processing delay of the router is 100us, what is the total delay of a 10,00-bit packet going from the server to the client. [4]

Q2: This question is regarding transport servces of computer networks. [25 marks]

(1) Explain the process in which a TCP host establishes connections. [7]

(2) The behavior of TCP congestion control can be represented as a graph in which the x-axis indicates the time, and the y-axis indicates congestion window size. Please use the graph shown in Figure 2 to the answer the following questions. Note that the graph does not explicitly show timeouts, but you should be able to figure out when timeouts happened based on the events shown.

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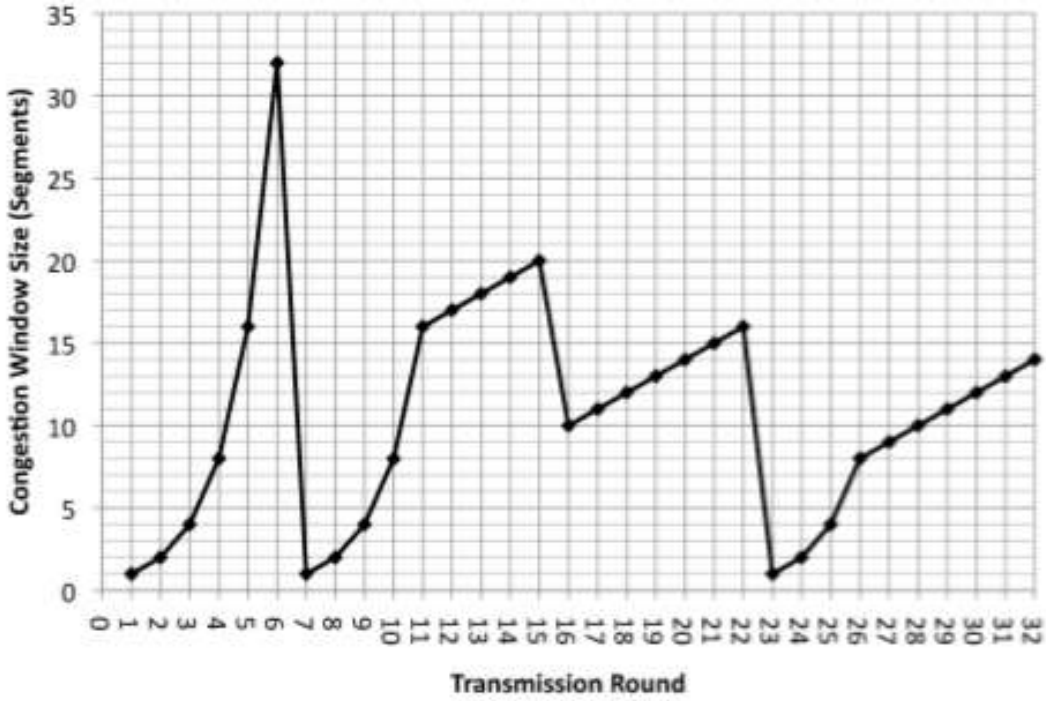

Figure 2. Variation of congestion window size in TCP

(a) Identify the intervals of time when TCP slow start, congestion avoidance is operating respectively. Explain the events happening at transmission rounds 6, 15, and 22, respectively. [6]

(b) State the reasons why slow start is used, and explain why it does a better job than congestion avoidance for that function. (3 marks) Why should congestion avoidance be used instead of slow start during these intervals? (3 marks) [6]

(c) Identify the intervals of time when TCP fast retransmission and fast recovery are used respectively. Please explain what fast retransmission does and how it is triggered. Explain why is fast recovery beneficial. [6]

Q3: This question is regarding network layer services of computer networks. [25 marks]

(1) State the reasons for adopting different Intra-Autonomous System (AS) and Inter-AS routing in the Internet. [5]

(2) Briefly discuss the main motivations and concerns respectively to implement Network Address Translation (NAT) technology in the Internet. [5]

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(3) Consider the network toplogy shown in Figure 3. The number next to a link indicates the link cost. Assume node A has collected all link state information in the network, run Dijkstra's shortest-path algorithm to compute the shortest paths from A to all network nodes. Show your working by adding rows to the following table. (Step 0-Step3: 3 marks each, Step 4-Step 6: 1 mark each) [15]

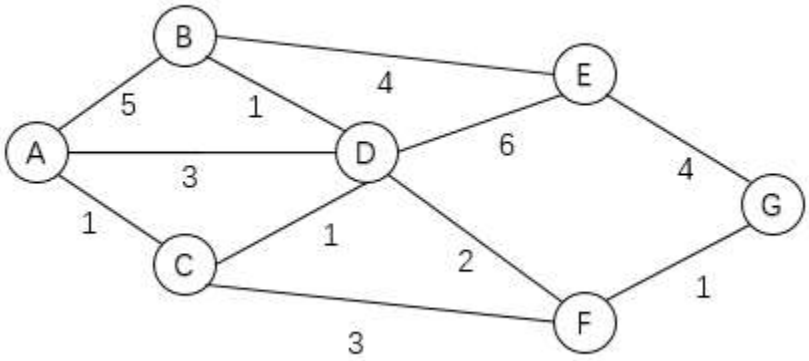

Figure 3 Network topology for Question 4

step	N	D(B),p(B)	D(C),p(C)	D(D),p(D)	D(E),p(E)	D(F),p(F)	D(G),p(G)
0	A						
1							
2							
3							
4							
5							
6							

Q4: This question is regarding Dada link layer and MAC. [25 marks]

(1) A local area network (LAN) such as Ethernet is deployed in an office to support a number of users to access the Internet. How does a host determine the MAC address of another host in the LAN when knowing its IP address? [3]

Continued overleaf

(2) CSMA/CD and CSMA/CA MAC protocols are designed for wired LAN and wireless LAN respectively. Why CSMA/CD cannot be applicable in wireless LAN? State the reason why the link utilization of CSMA/CD is generally higher than that of CSMA/CA. [4]

(3) What are the back off strategies after the CSMA/CD protocol detects a conflict? Briefly describe their advantages and disadvantages, regarding channel utilization and probability of collision. [3]

(4) Consider a Local Area Network (LAN) running CSMA/CD at 200Mbps over 5km shared-medium cable with no repeater. The signal propagation speed in the cable is 200,000 km/sec. If the protocol needs to work properly, what is the minimum frame size of packets? Given your answer and explain why. [6]

(5) Consider a point-to-point link between nodes A and B with the following measured values: Link length = 2000 kilometers; Propagation speed = 5 meters/nanosecond; Link capacity = 1 Mbps; ACK processing time at node A = 10 milliseconds; Packet processing time at node B = 20 milliseconds; Packet size = 1500 bytes; ACK size = 64 bytes. Assume node A is sending to node B. Compute the utilization for the following cases:

(a) Stop-and-Wait with Prob[bit error] = 0 [3]
(b) Sliding Window with Prob[bit error] = 0 and W = 10 (W is window size) [3]
(c) Stop-and-Wait with Prob[bit error] = 0.0001 [3]

End of question paper