GLASGOW COLLEGE UESTC

Exam paper

Communication Networks (UESTC 2018)

Date:28th, June, 2021
Time: 14:30-16:30

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.
For Multiple Choice Questions, use the dedicated answer sheet provided.

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: Computer networks rely on an infrustrature with a comprehensive stack of protocols for supporting data communication and network applications. Either circuit-swtching or packet-switching model can be used for data transmission inside a network. Answer the following questions:

(1) State the similarity and differences of the services provided by data link layer and transport layer respectively. [5 marks]

(2) When an application which transmits data at a steady rate and may stay on for relatively long period of time, such as video-on-demand, would a packet-switched network or a circuit-switched network be more appropriate for this application? Why? [5 marks]

(3) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described in (2). Furthermore, assume that the sum of the application data rates is less than the capacity of each and every link. Is some form of congestion control needed? Why? [5 marks]

(4) Consider sending a file of F = M *L bits over a path of Q links. Each link transmits at R bps. The network is lightly loaded so that there are no queueing delays. When a form of packet switching is used, the M * L bits are broken up into M packets, each packet with L bits. Propagation delay is negligible.

(a) Suppose the network is a packet-switched datagram network, and a connectionless service is used. Now suppose each packet has 2h bits of header. How long does it take to send the file? [5 marks]

(b) Finally, suppose that the network is a circuit switched network. Further suppose that the transmission rate of the circuit between source and destination is R bps. Assuming Ts set-up time and h bits of header appended to the entire file, how long does it take to send the file? [5 marks]

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Q2: The transport layer of computer networks provides logical communication between appliation's processes running on different hosts. Answer the following questions that are related to the transport layer.

(1) In addition to IP address, the transport layer also needs transport addresses. State the name of transport address and explain why multiple transport addresses are needed. [5 marks]

(2) Realibility control can exist in both the transport layer and the data link layer. Explain the reason for this design and state the fundamental difference between them. [5 marks]

(3) The timer timeout plays an important role in Transport Control Protocol (TCP). How is the timeout value specified in TCP (Reno)? What are the consequences if the timeout value is too long or too short? [6 marks]

(4) TCP has two phases: "Slow start" and "Congestion avoidance" for adjusting the window size.

(a) Briefly state the benefits of this design. [4 marks]

(b) A TCP sender establishes a connection and uses slow start. Approximately how many round-trip times (RTTs) are needed before TCP can send N segments? [5 marks]

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Q3: The role of the network layer is to move packets from a sending host to a receiving host. Answer the following questions regarding the network layer.

(1) Discuss how a hierarchical organization of the Internet can make it possible to scale to millions of users. Is it necessary that every autonomous system (AS) uses the same intra-AS routing algorithm? Why or why not? [4 marks]

(2) Consider the network fragment shown in Figure 1. x has only two attached neighbors, w and y, w has a minimum cost path to destination u (not shown) of 5, and y has a minimum-cost path to u of 6. The complete paths from w and y to u (and between w and y) are not shown. All link costs in the network have strictly positive integer values.

(a) Give x's distance vector for destinations w y, and u. [3 marks]

(b) Give a link-cost change for either c(x,w) or c(x,y) such that x will not inform its neighbors of a new minimum-cost path to u as a result of executing the distance vector algorithm. [3 marks]

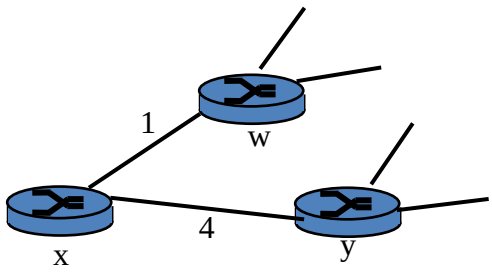

Figure 1 A network fragment for Q3 (2)

(3) Two institutes, A and B, both connect to the same ISP. Company A is assigned the prefix 121.77.80/26 and Company B is assigned the prefix 121.77.64/18. The ISP has a single 3-port router: port 1 connects to Company A, port 2 connects to Company B, and port 3 connects to the rest of the Internet.

(a) Draw and complete (as best you can) the contents of the forwarding table in the ISP's router. [5 marks]

(b) What aggregated prefix does the router advertize to the rest of the Internet so that packets can reach Company A and Company B? [5 marks]

(c) Suppose there are three routers between a source host in X and a sever in the Internet. Ignoring fragmentation, an IP datagram sent from the source host to the destination host will travel over how many interfaces? How many forwarding tables will be indexed to move the datagram from the source to the destination?

[5 marks]

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Q4. The basic service of the data link layer is to move a network-layer datagram from one node to an adjacent node. The data link layer also addresses the issue of mitlple access control. Answer the following questions regarding the dala link layer services.

(1) If all the links in a network were reliable and there is thus no transmission error , would the reliable delivery service at the transport layer be redundant? Why or why not? [4 marks]

(2) Suppose nodes A, B, and C each attach to the same broadcast LAN through their adapters. If A sends many IP datagrams to B with each encapsulating frame addressed to the MAC address of B, will C's adapter process these frames? If so, will C's adapter pass the IP datagrams in these frames to the network layer C? if A sends frames with the MAC broadcast address, answer the above questions again. [5 marks]

(3) CRC can be used at data link layer for detecting possible transmission error. Assume Generator Polynomial G(x)=x4+x+1 is used to compute the check sum of the frame.

(a) Given the data 10000000, what is the checksum? What is the codeword to be sent? Show your work. [5 marks]

(b) The receiver receives 111111000100. Is this a good frame? Show you work. [5 marks]

(4) In CDMA/CD protocol for Ethernet Local Area Networks, the algorithm "Truncated Binary Exponential Backoff Algorithm is used for access control. Briefly describe the idea of the algorithm. Assume that only two stations are competing in an Ethernet segment using "Truncated Binary Exponential Backoff Algorithm. If the first attempt fails, what is the probability that a station successfully sends data in the next attempt? [6 marks]

End of question paper