IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2016

BEng Honours Degree in Computing Part II
MEng Honours Degrees in Computing Part II
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute

PAPER C212

NETWORKS AND COMMUNICATIONS

Tuesday 10 May 2016, 10:00
Duration: 90 minutes

Answer ALL TWO questions

Paper contains 2 questions
Calculators required

Section A (Use a separate answer book for this Section)

1 a A congestion control protocol is said to be *fair* if K applications sharing a bottleneck with capacity R each get R/K of the available bandwidth. In this context, discuss whether TCP's Additive-Increase Multiplicative-Decrease (AIMD) is fair. Please explain your reasoning.

b Is the *Domain Name System (DNS)* really needed for the World Wide Web to function? Please explain.

c Briefly describe each of the following terms:

i) Packet filtering router

ii) Circuit level gateway

iii) Application level gateway

d Assuming a typical client-server interaction (e.g., fetching a page from a web-server) consisting only of one client request and one server reply, explain how many packets respectively are sent if (i) TCP is used, (ii) UDP is used.

e List the pros and cons of using UDP as the transport-layer protocol for HTTP.

f Consider transmitting a large file of L bytes from Host A to Host B. Assume a Maximum Segment Size (MSS) of 536 bytes and the throughput of the link to be 50 Mbps. Please answer the following questions based on the information provided and justify your answers. Clearly state your assumptions, if any.

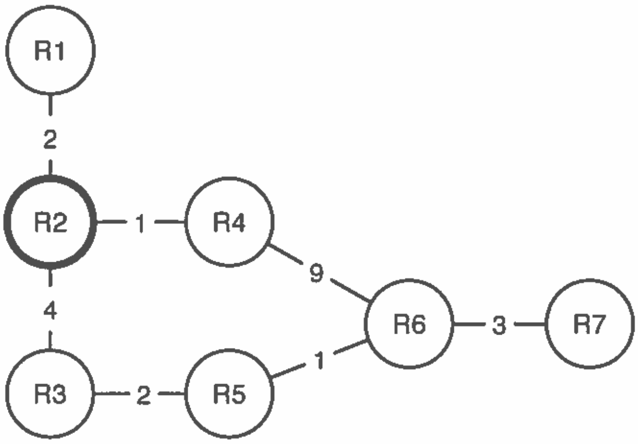
i) What is the maximum value of L such that TCP sequence numbers are not exhausted? (*Hint*: the TCP sequence number field takes up four bytes)

ii) For the L obtained above, find how long it takes to transmit the file. Assume that a total of 64 bytes of transport, network, and data-link layer headers are added to each segment before the resulting packet is sent out. Ignore flow control and congestion control so A can transmit the segments back to back and continuously.

The six parts carry, respectively, 10%, 15%, 15%, 15%, 20%, and 25% of the marks.

Section B (Use a separate answer book for this section.)

2 A network with seven routers, R1–R7, is interconnected with the topology shown below. The edge weights indicate the link costs.



The distance-vector of router R2 is as follows:

$$\{(\mathrm{R1}, \mathrm{R1}, 2), (\mathrm{R2}, \mathrm{R2}, 0), (\mathrm{R3}, \mathrm{R3}, 4), (\mathrm{R4}, \mathrm{R3}, 1), (\mathrm{R5}, \mathrm{R3}, 7), (\mathrm{R6}, \mathrm{R4}, 10), (\mathrm{R7}, \emptyset, \infty)\}$$

a Briefly explain the operation of distance-vector routing.

b State (i) **two** benefits and (ii) **two** drawbacks of distance-vector routing.

c Describe the **two** errors in the distance-vector of R2 based on the topology shown above, and write down the corrected distance-vector.

d How many distance-vector rounds did R2 execute in order to obtain the corrected distance-vector from (c)? Explain your reasoning.

e Taking the corrected distance-vector from (c), write down the distance-vector that R2 will have in the next round.

f Assuming that router R6 is malicious, explain (i) how it can interfere with R2's routing information, and (ii) how R2 could protect against this interference.

The six parts carry, respectively, 20% 10%, 20%, 10%, 20%, and 20% of the marks.