UNIVERSITY OF DUBLIN

TRINITY COLLEGE

Faculty of Engineering, Mathematics & Science

School of Computer Science and Statistics

Integrated Computer Science Programme — Trinity Term 2014

BA (Mod) Business and Computing

Annual Examination

CS2031: Telecommunications II

Wednesday 14th May, 2014 — Sports Centre — 14:00 – 16:00

Stefan Weber

Instructions to Candidates:

Answer 2 questions.

All questions carry equal marks (25 marks).

Answer each question in a separate answer book.

Materials permitted for this examination:
Calculator (non-programmable)

Materials omitted from the front page of an examination paper may not be used or consulted during an examination.

SECTION A

Question 1

(1a) Table 1 lists the distribution of letters from a text.

I) Give the binary tree for Huffman encoding.

E	3
G	3
O	1
S	4
T	5
H	2

Table 1: Distribution of letters

II) Using the binary tree developed in I) write down the code for the following sequence of letters: "testghost".

(10 marks)

(1b) The High-Level Data Link Control (HDLC) protocol defines a number of types of frames shown in figure 1). Explain I) the general layout of HDLC frames, II) the use of the frame types to implement flow control concepts such as Stop-and-Wait ARQ and Selective Repeat ARQ, and III) the terms piggybacking and bit stuffing.

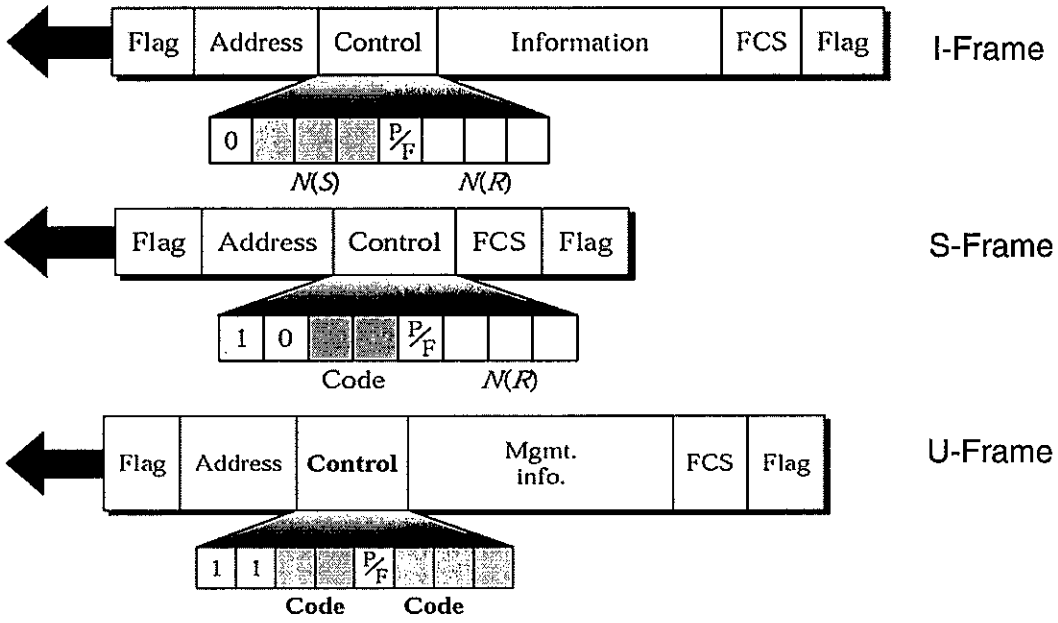

Figure 1: Types of HDLC frames

(15 marks)

(Total 25 marks)

Question 2

(2a) 802.11 defines two modes: the Point Coordination Function (PCF) and the Distributed Coordination Function (DCF). I) Describe the two modes in your own words and explain how they are used to coordinate access to the medium for a number of devices.

II) Explain the terms "hidden terminal problem" and "exposed terminal problem". The explanations should be accompanied by diagrams that visualise the terms.

(10 marks)

(2b) Assume that four stations use a wired medium to communicate. All stations may intend to transmit data at the same time as all other stations. The access to the medium is controlled by a Carrier Sense Multiple Access (CSMA) scheme with Collision Detection (CD) or a Time Division Multiple Access (TDMA) scheme with a reservation protocol. For the CSMA/CD approach, assume times as you see fit. For the TDMA approach, assume that every reservation slot is 1ms long and every contention free slot is 150ms. Contrast the two access control schemes with each other considering 2 scenarios:

I. High network load i.e. every station would like to send data at any given time.
II. Low network load i.e. stations only have data to be transmitted every few seconds.

Your analysis should be accompanied by diagrams that visualise the behaviour of the two schemes in each of the scenarios.

(15 marks)

(Total 25 marks)

Question 3

(3a) The Transmission Control Protocol (TCP) provides management of connections between two endpoints.

I) Explain the life cycle of a TCP connection and the handling of failure of delivery segments and acknowledgements.

II) Explain the term "congestion control" and the use of acknowledgements in congestion control approaches such as Additive-Increase/Multiplicative-Decrease and Slow Start.

(15 marks)

(3b) A TCP connection uses Additive Increase/Multiplicative Decrease (AIMD) for congestion control. The link over which the connection is established has a roundtrip time of 20msec and no congestion at the beginning.

Note that in the following: Each graph should be accompanied by a description that gives an analysis of the respective congestion control algorithm.

I) Draw a graph that shows the progression of the AIMD algorithm from 0 to 500msec with timeouts for packets occurring at 200msec, 300msec, and 440msec. Discuss the graph and the advantages and disadvantages of the approach.

II) Consider the TCP slow start algorithm for the connection described above and draw a graph for the progress of this algorithm from 0 to 500msec with timeouts for packets occurring at 100msec, 200msec, 300msec, 380msec and 460msec. Discuss the graph and the advantages and disadvantages of the approach.

(10 marks)

(Total 25 marks)

Question 4

(4a) I) Describe the concept of distance vector routing on the example of the computer network in Trinity College. Assume that the 10-20 schools of TCD, such as "Computer Science and Statistics (CSS)", "Electronic Engineering (EE)", "Genetics (G)", "Chemistry (C)", etc have individual routers and that these routers are partially connected to one another e.g. the router from CSS may be connected to the router from EE but not to the router from G. The description should include diagrams that visualise the process that the concept follows to establish routing tables.

II) Explain the problem of "Count to Infinity" on the network described in I)

(15 marks)

(4b) An Internet Service Provider (ISP) has bought the right to use the IP addresses in the range from 213.49.0.0 to 214.57.255.255. It uses Classless Inter-Domain Routing (CIDR) to route traffic to these addresses. It receives a number of requests from companies. First company A buys a block of 10,000 addresses, then company B requests 7,000, followed by company C with 550 addresses and company D requests 150 addresses. The ISP processes these requests in the order it receives them.

I) What is the address range allocated for each client? Give the first and last address of the range, the number of significant bits and the subnet mask.

II) If CIDR wasn't used, what classes of network addresses would be allocated to each client? How many addresses would be allocated in total? What would be the fraction of addresses actually used by each client? Compare this to the use of CIDR.

(10 marks)

(Total 25 marks)