Professional Engineers of Ontario

Annual Examinations – May 2010

07-Elec-B4
Information Technology Networks

3 Hours Duration

Notes:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.
2. This is a Closed Book exam. Candidates may use one of two calculators, a Casio or Sharp approved models.
3. There are **5 questions** on this exam. **Any 4 questions constitute a complete paper.** If you attempt more than 4 questions, clearly indicate which ones are to be graded; otherwise, only the first 4 questions as they appear in your answer book will be marked.
4. Marks allocated to each question are noted in the left margin. A complete paper is worth 100 marks.

25 marks **Question 1.** This question concerns medium access control protocols.

10 marks a. Briefly discuss the operation of CSMA/CD in Ethernet, making specific reference to collisions, and recovery from collisions.

3 marks b. Using CSMA/CD in Ethernet, what is the longest period of time that could pass before a collision is detected?

3 marks c. Explain how collisions are avoided in "token ring" networks.

6 marks d. Explain the network's response to a collision in an ALOHA network. When might ALOHA be preferable to CSMA/CD?

3 marks e. Give one advantage and one disadvantage of using a channelized medium access control method, such as FDMA, instead of either Ethernet or Token Ring.

25 marks **Question 2.** This question concerns transport layer protocols.

5 marks a. TCP and UDP are the two most prominent transport layer protocols in use. Briefly explain the major differences between these protocols.

10 marks b. Briefly discuss the operation of congestion control in the TCP protocol, making specific reference to the congestion window, slow start, fast retransmit, and fast recovery.

10 marks c. Using TCP, suppose the initial window size is 1, and the congestion threshold is 16. Assuming all packets are acknowledged, give an example showing how the window size evolves up to and beyond the threshold.

25 marks **Question 3.** This question concerns data link layer and peer-to-peer protocols.

7 marks a. Briefly describe how cyclic redundancy checks (CRCs) detect whether a packet contains an error.

3 marks b. An error correcting code has a minimum Hamming distance of 5. How many errors can it detect? How many errors can it correct?

10 marks c. Using an example, explain the encoding and decoding process of a (7,4) Hamming code. In the example, show how a single error may be corrected, and explain why two or more errors are not correctable.

5 marks d. Briefly describe the operation of ARQ, specifically describing stop-and-wait ARQ as well as go-back-n ARQ.

25 marks **Question 4.** This question concerns cellular telephony.

5 marks a. Explain, giving an example, why dividing space into "cells" increases the number of users who can simultaneously use a given wireless bandwidth.

5 marks b. Compare the operation of CDMA, FDMA, and TDMA.

5 marks c. What is duplexing? Give examples of time-division duplexing and frequency-division duplexing.

5 marks d. Explain the difference between hard handoff and soft handoff.

5 marks e. A city is to be covered by a digital cellular phone network. The spectrum re-use cluster size is 7 cells. Suppose the system bandwidth is 63 MHz. If the system must support 360 users per cell, and ignoring guard bands, how much bandwidth can be allocated to each user?

25 marks **Question 5.** This question concerns the Internet Protocol (IP), versions 4 and 6.

8 marks a. Consider the following IPv4 routing table.

Destination	Mask	Next Hop
127.0.0.1	255.255.255.255	127.0.0.1
129.97.48.0	255.255.255.0	129.97.48.1
129.97.152.0	255.255.255.128	129.97.152.1
129.97.152.128	255.255.255.128	129.97.152.183
default	0.0.0.0	129.97.152.183

Identify the next hop for the following IP address destinations:

i. 129.97.56.254
ii. 129.97.152.254
iii. 129.128.0.1
iv. 129.97.152.1

5 marks b. The table in part a is for a router among which valid IP subnets? Of those subnets, which has its own path to the Internet?

6 marks c. Give any three address ranges that are reserved in IPv4, and their purpose (if any).

6 marks d. Give (and explain) three advantages of IPv6 over IPv4.