Professional Engineers of Ontario

Annual Examinations – May 2011

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. A Casio or Sharp approved calculator is permitted.
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 layered architecture.

20 marks   a.   Name, and describe in one sentence, each layer of the OSI seven-layer model.

5 marks   b.   Of these layers, name the layer where the following are found.
    i.   The UDP protocol.
    ii.   Error-control coding and ARQ.
    iii.   The IP protocol.
    iv.   The HTTP protocol.
    v.   Modulation and detection.

25 marks   **Question 2.** 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.   Some implementations of LTE cellular technology include orthogonal frequency division multiplexing (OFDM) and multiple-input, multiple-output (MIMO) transmission. Briefly explain both terms.

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

5 marks   d.   Consider a cellular system with total available bandwidth of 35 MHz. If the system contains 63 cells, and if the frequency reuse cluster size is 7, how much bandwidth is allocated to each cell?

5 marks   e.   For the same system as in part d, say FDMA is used, and each user requires 40 kHz. How many users can be accommodated in the entire system?

25 marks   **Question 3.** This question concerns medium access control.

5 marks   a.   Briefly explain the medium access control method in Ethernet, making specific reference to collisions and recovery from collisions.

5 marks   b.   In an Ethernet network, what is the longest possible amount of time that can elapse before a collision is detected?

5 marks   c.   In a wireless local area network, explain the hidden terminal problem.

5 marks   d.   Briefly explain the operation of a token ring network. Are collisions possible in a token ring network?

5 marks   e.   Give one advantage, and one disadvantage, of a channelized medium access control method (like FDMA), as compared to Ethernet.

25 marks   **Question 4.** This question concerns the TCP protocol.

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

10 marks   b.   Using TCP, suppose the initial window size is 1, and the congestion threshold is 32. Assuming all packets are acknowledged, give an example showing how the window size evolves up to and beyond the threshold.

5 marks   c.   Using an example, briefly explain why end-to-end congestion control is necessary in large wired networks.

25 marks   **Question 5.** This question concerns Internet Protocol 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
130.15.85.0	255.255.255.128	130.15.85.14
130.15.85.128	255.255.255.128	130.15.85.152
130.15.0.0	255.255.0.0	130.15.1.1
default	0.0.0.0	130.15.1.1

Identify the next hop for the following IPv4 address destinations:
  i.   130.15.85.127
  ii.   130.15.85.129
  iii.   130.15.86.127
  iv.   130.16.85.127

4 marks   b.   The table in part a is for a router among which valid IPv4 subnets?

2 marks   c.   Consider a computer with IPv4 address 130.15.85.192. Assuming the above routing table represents the only router in its subnet, what IPv4 address would that computer have as its gateway?

2 marks   d.   What computer is at the address 127.0.0.1?

9 marks   e.   Give (and explain) three advantages of IPv6 over IPv4.