| PAPER CODE NO. | EXAMINER : Peter McBurney |
| COMP211 | DEPARTMENT : Computer Science   TEL. NO. 794 6760 |

THE UNIVERSITY
of LIVERPOOL

JANUARY 2005 EXAMINATIONS

Bachelor of Science : Year 1
Bachelor of Science : Year 2
No qualification aimed for : Year 1

INTERNET PRINCIPLES

TIME ALLOWED: Two Hours

INSTRUCTIONS TO CANDIDATES

Answer any four questions.

Each question is worth 25 marks.

If you attempt to answer more than the required number of questions, the marks awarded for
the excess questions will be discarded (starting with your lowest mark).

Electronic calculators are neither necessary nor permitted.

THE UNIVERSITY
of LIVERPOOL

QUESTION 1

(a) Draw a diagram to show the standard 5-layer (*"North American"*) model of distributed communication.

3 marks

(b) Briefly describe the function of each layer in the 5-layer model. **2 marks each**

(c) Which layers have protocols found in machines at the network edge? **2 marks**

(d) Which layers have protocols typically found in the machines in the network core? **2 marks**

(e) What are the major differences between the structure of the Internet and the structure of public voice telecommunications networks? What implications do these differences have for the design of communications protocols and standards? Illustrate your answer with examples.

8 marks

QUESTION 2

(a) What information is contained in a TCP/IP socket? **2 marks**

(b) What does an Application-Layer protocol provide to protocols in the layer beneath? **3 marks**

(c) What is the difference between a "push" protocol and a "pull" protocol? Give an example of each type, and explain why each example can be described as such. **6 marks**

(d) Draw a diagram to show the standard protocol or protocols used for sending email messages. On the diagram, label each entity involved, and the protocol connecting them. **6 marks**

(e) Explain the differences between *client-server* and *peer-to-peer (P2P)* models of distributed computing. Illustrate your answer with a diagram, and describe a typical application for each model. **8 marks**

THE UNIVERSITY
of LIVERPOOL

QUESTION 3

(a) A message is 5200 bytes long, and is broken into segments of 800 bytes each. The Sender chooses a random start value of 4500.

    (i) How many segments will the message be broken into?   **1 mark**

    (ii) Give the start and end bytes of each segment.   **2 marks**

    (iii) Give the ACK numbers which the Receiver will use to indicate that each segment was received uncorrupted.   **2 marks**

    (iv) Suppose the Receiver chooses a random start of 126 for its sequence numbers, and suppose that the Receiver sends only headers (and no data) back to the Sender. What will be the ACK numbers used by the Sender?   **2 marks**

    (v) Draw a brief Message Sequence Chart for the interaction.   **3 marks**

(b) What characteristics of the Internet lead it to being described as an *"unreliable"* communications medium?   **3 marks**

(c) Explain how the main features of the TCP protocol were designed to address the characteristics you listed in Question 3(c) above.   **7 marks**

(d) How does TCP respond to network congestion?   **5 marks**

QUESTION 4

(a) Protocols at the Transport Layer create segments which are then given to the layer below. What do these segments contain?   **2 marks**

(b) Protocols at the Network Layer create datagrams which are given to the layer below. What do these datagrams contain?   **2 marks**

(c) How does TCP differ from UDP?   **2 marks**

(d) Do datagram networks used on the Internet require call set-up and tear-down? Why or why not?   **3 marks**

(e) Suppose you have 7 host machines and 1 router all connected together, with the following IPv4 addresses:

- Three hosts have addresses in the network 223.1.1.0/24.
- Two hosts have addresses in the network 223.2.0.0/16.
- Two hosts have addresses in the network 223.1.3.0/30.
- The router has addresses 223.1.1.40, 223.2.0.9 and 223.1.3.85.

    (i) Draw a diagram to represent this configuration.   **5 marks**

    (ii) Draw a forwarding table for the host machine with IP number 223.1.1.1   **3 marks**

    (iii) Draw a forwarding table for the router.   **3 marks**

    (iv) Show the steps involved when a datagram is sent from host machine 223.1.1.1. to host machine 223.2.0.1.   **5 marks**

THE UNIVERSITY
of LIVERPOOL

QUESTION 5

    (a) What are the differences between repeaters, bridges and routers?   **4 marks**

    (b) What is a checksum function? What purpose does it serve?   **3 marks**

    (c) What is a multiple access protocol? Why are these protocols needed?   **6 marks**

    (d) What is the difference between random access protocols and turn-taking protocols?   **3 marks**

    (e) Briefly describe TDMA, FDMA and CDMA multiple access mobile communications protocols. Use a diagram to illustrate the differences between these.   **9 marks**

QUESTION 6

    (a) What is measured in a communications channel by the signal-to-noise ratio?   **2 marks**

    (b) What is the maximum rate in bits per second at which data may be transmitted over a communications channel with channel bandwidth of 3100 Hz and signal-to-noise ratio of 1000:1 (i.e. 30 dB)?   **3 marks**

    (c) Briefly explain the difference between *in-band* and *out-of-band* communications. What is the usual reason for deploying an out-of-band channel in a communication interaction?   **4 marks**

    (d) What is a virtual circuit in the Internet? How do virtual Internet circuits differ from voice circuits in telecommunications networks?   **4 marks**

    (e) Imagine you are designing an application-layer protocol for streaming video. How would you deal with the unreliability of the Internet Protocol? Which aspects of unreliability would most affect your application? What trade-offs would you have to make? Which Transport-layer protocol would you likely use? Why?   **12 marks**