

PAPER CODE NO.
COMP211

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THE UNIVERSITY
of LIVERPOOL

JANUARY 2006 EXAMINATIONS

Bachelor of Arts : Year 2
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.



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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) 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. **6 marks**
- (d) Explain how a peer device in a *peer-to-peer (P2P)* network may discover which other peer devices has some information which the first device seeks. Illustrate your answer with appropriate diagrams. **6 marks**

QUESTION 2

- (a) What information is contained in an Internet socket? **2 marks**
- (b) What is the name of a model of distributed computing in which one computer requests something from a second computer, and the second computer seeks to fulfill this request? **1 mark**
- (c) What does an Application-Layer protocol provide to protocols in the layer beneath? **3 marks**
- (d) What is the difference between a “push” and a “pull” protocol? **2 marks**
- (e)
- (i) What do the letters “HTTP” stand for? **1 mark**
- (ii) What is the purpose of this protocol? **2 marks**
- (iii) Is HTTP a “push” or a “pull” protocol? Why? **2 marks**
- (f)
- (i) The Simple Mail Transfer Protocol (SMTP) is an Application-Layer protocol for mail transfer between hosts. Is SMTP a “push” or a “pull” protocol? Why? **2 marks**
- (ii) Why is SMTP not always used for the final leg of mail transfer, between the receiver host machine and the receiver mail software program? **3 marks**
- (g)
- Suppose you were tasked with selecting an Application-Layer communications protocol to support distributed electronic commerce. What would be the main advantages and disadvantages of using HTTP for this? If you used HTTP, what technologies could overcome the main disadvantages? **7 marks**



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QUESTION 3

- (a) A message is 5300 bytes long, and is broken into segments of 900 bytes each. The Sender chooses a random start value of 3200.
- (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 116 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(b) above. **7 marks**
- (d) Explain how TCP responds 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 8 host machines and 1 router all connected together, with the following IPv4 addresses:
- Two hosts have addresses in the network 215.1.1.0/24.
 - Three hosts have addresses in the network 215.2.0.0/16.
 - Three hosts have addresses in the network 215.1.3.0/30.
 - The router has addresses 215.1.1.40, 215.2.0.9 and 215.1.3.85.
- (i) Draw a diagram to represent this configuration. **5 marks**
 - (ii) Draw a forwarding table for the host machine with IP number 215.1.1.1 **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 215.1.1.1. to host machine 215.2.0.1. **5 marks**



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QUESTION 5

- (a) At which protocol layers do repeaters, bridges and routers operate? **4 marks**
- (b) What is a checksum function? What purpose does it serve? **3 marks**
- (c)
- (i) Draw a diagram to show the main elements in a GSM mobile network architecture, and briefly explain the functions of each element. **5 marks**
- (ii) What are the functions of the Home Location Register and the Visitor Location Register in a mobile communications network? **4 marks**
- (d) 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 communications network? **5 marks**
- (d) What are the major differences between the structure of the Internet and the structure of public voice telecommunications networks? How can both the Internet and fixed voice telecommunications operate over the same physical infrastructure? **5 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? **10 marks**