

UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2002

MSc in Computing Science
BSc Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part IV
for Internal Students of the Imperial College of Science, Technology and Medicine

*This paper is also taken for the relevant examinations for the
Associateship of the Royal College of Science*

PAPER M313

COMPUTER NETWORKS AND DISTRIBUTED SYSTEMS

Wednesday 1 May 2002, 10:00
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators required

Section A (Use a separate answer book for this Section)

1a Discuss the requirement for data framing with:

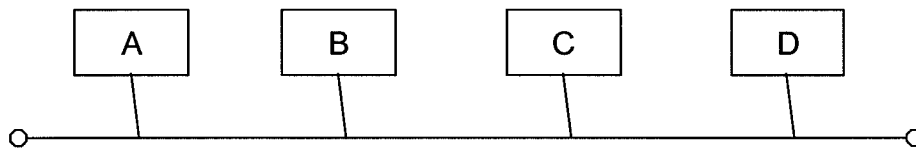
- i) RS232
- ii) IEEE 802.3 (Ethernet)

Include the data-encoding scheme used and what delimiters are required in each case.

b According to RFC1180, TCP offers a connection-oriented byte stream, instead of the connectionless datagram delivery service provided by UDP.

- i) Explain the differences between the two services and their implementations.
- ii) Describe the “three-way-handshake” used with TCP and why it is needed. Why does UDP not require it?

c Imagine that you are the network administrator for the 10Mb/s bus LAN illustrated below:



This network is used within an office. The users at nodes A and B are engaged in a video-conference, while the boss' children are playing a graphical networked game on nodes C and D. All are finding that their applications are slow and jumpy.

- i) What is the likely cause of the problem?
- ii) Briefly describe three technical solutions to enable the users at A and B to obtain improved network performance. Consider:
 - How the solution causes an improvement.
 - Where in the OSI network model the solution operates.
 - What change will each pair of users experience.
 - The costs, implementation complexity and flexibility of the solution.

The three parts carry, respectively, 30%, 30%, 40% of the marks.

2a Describe the medium access control for:

- i) IEEE 802.11 (Wireless LAN)
- ii) GSM (Wireless mobile telecommunications)

Include why the method chosen is appropriate for the intended uses of each network (data / voice) and the deficiencies it causes for other traffic types.

- b
 - i) One way to optimise responses to DNS requests is to cache responses at a local DNS server. Explain how “stale” responses are dealt with, to ensure that accurate mappings are provided.
 - ii) Briefly describe the organization of DNS domains and IP networks. Give examples of how names / addresses are grouped and how individual names / addresses are defined within those groups. Where hierarchy or special identifiers exist identify examples of these.
- c
 - i) Nodes on a bus-based CSMA/CD network communicate at 10Mb/s. If their minimum frame size is 64 bytes and the signal propagation speed in the wire is 200,000,000 meters/sec determine the theoretical maximum length of the cable.
 - ii) Compare your answer with the IEEE recommended maximum length for Ethernet (which is 2,500 m). Explain the apparent disparity.
 - iii) If transmission speed stays the same what effect would reducing the maximum wire length to 1km have on minimum frame size? Would this be worthwhile? (Assume IEEE802.3 framing.)
 - iv) Describe the differences between the handling of frame length in IEEE802.3 and token ring (IEEE802.5).

The three parts carry, respectively, 25%, 35%, 40% of the marks.

Section B (Use a separate answer book for this Section)

3a The following message passing primitives are supported by a set of library calls:

send (dest, msg) – an *asynchronous* send message primitive, where dest is the name of the process to which the message msg is to be sent.

receive (source, msg) – this causes the receiving process to block waiting for a message from the process with name source. msg is a buffer into which the incoming message is copied.

receiveany (source, msg) – the process is blocked waiting for a message from any source. The name of the sender is received in source and the incoming message is received in msg.

- i) Explain what is meant by an *asynchronous* send message primitive and why it may lead to buffer exhaustion at the receiver.
- ii) Why is there a need for two types of receive primitives?

b Using the above message primitives, design a simple printer service for a distributed system with multiple printers, each controlled by a process called *printer*. When a *user* process wants to print a document it sends a message containing its process type (i.e. user) to a single *coordinator* process which allocates free printers. The coordinator replies with the name of a free printer when one is available. When a printer is free it sends a message containing its process type (i.e. printer) to the coordinator to indicate it is now available for printing.

Give pseudocode outlines for the *user*, *coordinator* and *printer* processes, using the above message primitives. Your solution should describe any datastructures needed by the coordinator process.

Assume the printer process has sufficient buffer space for a single message containing one page to print, and that communication is reliable so timeouts and retransmissions can be ignored.

The two parts carry, respectively, 20% and 80% of the marks.

- 4a Explain each of the following security terms:
- Authentication
 - Authorisation Policy
 - Confidentiality
 - Integrity
 - Non-repudiation
- b Discuss the properties of a message digest. Explain how a cryptographic (asymmetric) public-key system can be used, together with a suitable hash function, to generate a message digest to detect modification and guarantee authenticity of a message.
- c The Department has decided to implement an electronic token payment system which allows staff and students to print to any print server, by sending a file, plus required tokens to the server. Tokens are generated by a central token server. The print server acknowledges receipt and returns any change in the form of tokens. Tokens come in a range of values and cannot be forged or reused. They are issued to individual members of the Department, they cannot be used by anyone else and they expire at the end of the academic year. Assume an asymmetric public key system.

Describe the format of a token justifying each of the fields. Explain what actions the print server must perform in order to check the validity of the token. Describe what information the print servers maintain in order to process print requests and what must be held by the central token server, discussing how the information should be organised to improve performance.

The three parts carry, respectively, 25%, 30 and 45% of the marks.