THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma

April 2004

EXAMINERS' REPORT

Network Information Systems

The number of candidates selecting this module continues to increase and this year the number taking the examination rose by 36%. The majority of whom were well prepared and it is pleasing to report that the number achieving a pass standard was 86%.

Many of those candidates who failed to reach the pass standard had answered only one question well. Such candidates need to prepare themselves to answer questions from a wider selection of the published syllabus.

An indication is given below of the points expected; however any valid point which was relevant to the question received marks.

Question 1

You have been tasked to provide a review of user requirements for a new distributed system which is being planned for your organization. Discuss the issues you would consider under the following three headings and provide suitable explanations of the factors associated with each.

a) Functionality. Among the factors you need to consider are operating systems. Discuss the following three options:
- *i)* Adapt the existing operating system.
- *ii)* Move to an entirely new operating system designed specifically for distributed systems.
- *iii)* Emulation. (9 marks)

b) Reconfigurability.
In your discussion ensure you consider the following:
- *i)* Short term changes.
- *ii)* Medium to long term evolution. (8 marks)

c) Quality of Service.
Include the following three factors in your discussion:
- *i)* Performance.
- *ii)* Reliability and availability.
- *iii)* Security.

(8 marks)

Answer Pointers

a) Functionality: services for users & application writers, minimal requirements, improvements, sharing, new functionalities, costs of new SW, transition problems; operating systems: option-1 is limited in new functionalities, option-2, ideal for designers but not for current users, option-3 may not be practical e.g. emulation of Unix.

b) Re-configurability: scalability, heterogeneity; short term changes: coping with failed process or component of computer or network, shifting of workload, activities transfer to reduce network communications; medium to on term evolution: re-assigning new roles to machines, new/more machines/servers.

c) Quality of service: response time, consistency, communications optimization at all levels; coping with failure, convenience or absolute req't, reliability & response time, critical applications e.g. financial & air traffic control, fault tolerance, resilience against HW failure; security: two main threats: against privacy & integrity of data passing thro the network, interference with sys SW, e.g. bogus file server.

Examiner's Comments

A very popular question attempted by over 90% of the candidates and with a 98% pass rate. Good overall average of 17 with some candidates achieving full marks. The quality of the answers varied widely. The subject matter has clearly appealed to the interest of the candidates who, to their benefit, reflected their own experience in answering the question.

Question 2

Within the context of Local Area Networks describe the functionality of ethernet, token ring and token bus, giving the major advantages and disadvantages of each**.** (25 marks)

Answer Pointers

Ethernet is a broadcast LAN. It uses either co-axial cable or twisted pair. It uses CSMA/CD collision detection. It is very easy to install and use. The major problems are that when the load increases the collision rate rises drasticaly. Worst case delivery time is infinite. (9)

Token ring is a ring topology linking computers. It is often implemented as a star shaped ring. A token circulates the ring. A computer can only transmit if it own the token. To ttansmit it wairts for the token and then sends the message. A new token is generated which is then circulated. It is very efficient and has a finite worst delivery time. There are delays waiting for the token. A break in the ring stops all messages transmission(9)

A token bus is a virtual token ring on a broadcast LAN. The position in the virtual ring is established on connect. Otherwise similar to a token ring. Advantage if a node disappears it can be configured out. (7)

Examiner's Comments

Most candidates attempted this question. Many didn't state that a token bus is a virtual token ring over a bus topology LAN. A common failing was to talk about LAN's in general and about high level protocols such as TCP/IP. The correct answer should have been a description of the level 1 and 2 details - the hardware requirements and the operation of the MAC layer. The overall average obtained by the candidates selecting this question was 13 and 69% passed with a few candidates obtaining full marks.

Question 3

Distributed processes often need to co-ordinate their activities. For example, if a collection of processes share a single or a collection of resources managed by a server, then often mutual exclusion is required to prevent interference and ensure consistency when accessing resources.

a) Explain the requirements for mutual exclusion in terms of safety, liveness and ordering. (9 marks)

b) The simplest way to achieve distributed mutual exclusion is to employ a server that grants permission to enter a critical section, commonly referred to as 'the central server algorithm'. **Figure 1** below depicts such a server managing a mutual exclusion token for a set of processes. Explain the structure and operation of this algorithm. (16 marks)

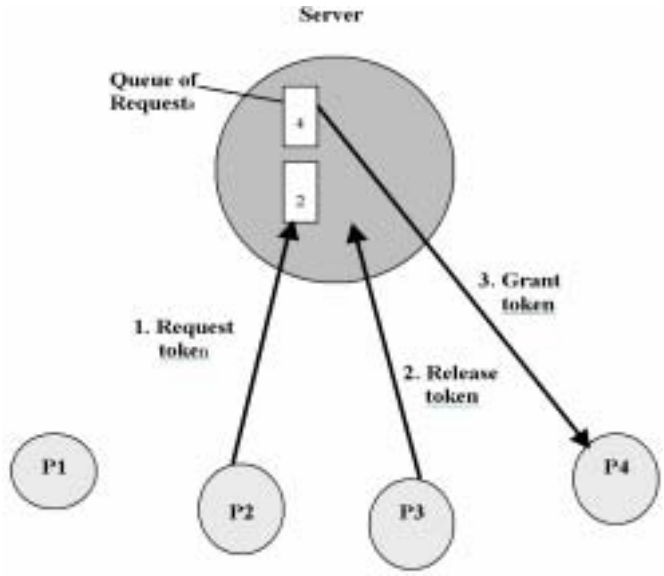

Figure 1

Answer Pointers

a)

Safety: only one process inside a critical section (CS) at a time, use of semaphores in Wait & Signal ops; liveness: a process requesting entry to CS is eventually granting access when CS is no longer occupied; ordering: access to CS is granted to processes in the time order of the request.

b)

A process sends a request to the server & awaits a reply, the reply is a 'token' permitting entry to the CS; if no other process has the token the server replies immediately granting the token, otherwise server doesn't reply but queues the request; on exiting the CS a message is sent to the server returning the token; if queue is not empty, then server chooses the oldest process in the queue, removes it & replies to it, the chosen process then hold the token. In the figure, P2's request has been appended to the queue which already has P4's request; P3 exits CS and the server removes P4's entry and grants permission to P4 by replying to it; P1 has no need to enter CS.

Examiner's Comments
A question which was avoided by most candidates, only 22% attempted, and of those 80% passed with an overall average of 13.

This was a new type of question which caused difficulty for those students who relied heavily on revising past exam papers rather than acquire a more broad spectrum of knowledge from the recommended books and the module syllabus. Some good answers, which attracted almost full marks, were evident and which demonstrated that some candidates knew the material quite well, perhaps from actual experience rather than knowledge of syllabus material; some demonstrated fair knowledge of the material but were confused as to which section it was most appropriate to deliver their knowledge..

Question 4

a) Describe the technologies which are required to implement an E-commerce Web site which supports on-line ordering and payment. (15 marks)

b) Describe two mechanisms which can be used to allow end users to update Web content on a commercial Web site. (10 marks)

Answer Pointers

a) A Web server; some form of dynamic Web content generation such as PHP, CGI, Java Servets, ASP; a database to store product and order information; SSL for secure connections; credit card verification and debiting software; email for order summary and confirmation (15).

b) FTP can be used if the Web content is under a user's FTP home directory. HTTP PUT and DELE can be used if the Web server is configured to support it and a suitable HTTP client such as Mozilla is used. WebDAV is a better solution. It is an extension to the HTTP protocol which allows remote management of Web content. Clients such as cadaver and DAVExplorer can be used.(10)

Examiner's Comments
Most candidates attempted this question however very few candidates scored high marks as clearly they did not read this question carefully. In part a) such candidates offered as an answer the issues, and not the technology as the question stated, to be considered when implementing an e-commerce site.
In part b) candidates clearly did not understand "mechanisms" and gave for example 'WAP' and 'GPRS' as their answer, which if discussed in context attracted marks.
As a result only 28% of candidates passed this question with an overall average mark of 7. However a number did answer the question correctly and of those some obtained 80% of the marks available.

Question 5

A process group is a collection of processes that co-operate towards a common goal or that consume one or more common streams of information. Group structures are defined according to the pattern of communication in which the members of a group are involved.

a) **Figure 2** below shows one such group structure, referred to as client-server group. Explain how requests from clients are handled and the subsequent actions of the servers. (9 marks)

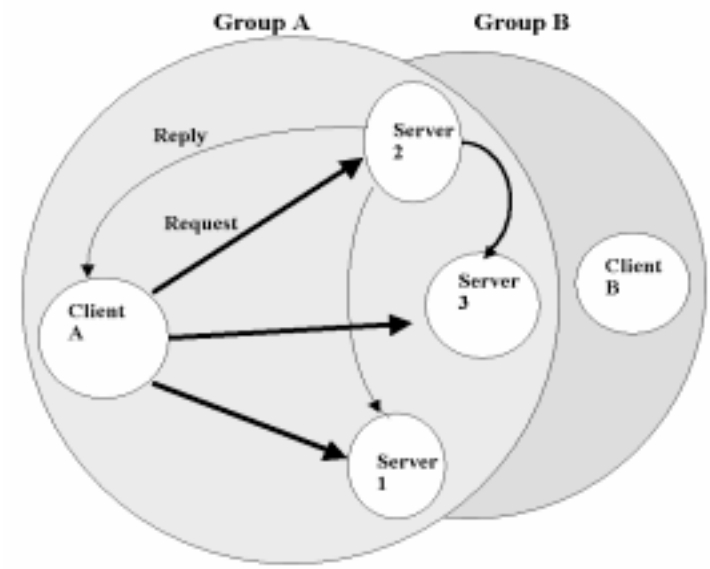

Figure 2

b) Other examples of group structures are:

- Peer group
- Server group
- Subscription group
- Hierarchical group

Using diagrams where appropriate, explain the principles of operation of such groups. (16 marks)

Answer Pointers

a) Requests from clients are multicast to all members of the server group, but the server that processes the request from a particular client multicasts the reply to the client-server group, which contains all the server group members plus the client itself; there is only one client-server group for each client so the system has to support many overlapping groups for each service, and the other servers are able to update their state according to the results returned.

b) Peer group: all comm. Is directed from processes within the group to the group,- suitable for processes implementing a multi-user editor (give diagram). Server group: a client multicasts its request to the group, and all members of the server group receive it, in simple case only one process need reply,- the one known to have the info by all group members, e.g. the oldest, or if info is partitioned among servers only the relevant server process the request. Subscription group: sent the same info from the source, don't reply to messages but process info in their own app-specific way, e.g. trading room brokers workstations, central computers multicast their gathered data to such a group. Hierarchical group: avoid management overheads of very large group by dividing into sub-groups with one member joining a root group; multicast to root group whose

members multicast to sub-groups,- can be extended to sub-sub-groups; advantages: parallel comm. And smaller vector timestamps for causal ordering; dis-ad: latency increase.

Examiner's Comments

Just over 36% of the candidates attempted this question and of those 80% passed the question. The overall average mark was 14 with the better answers obtaining almost full marks.

This was another new style of question, which seems to have puzzled some candidates who, probably, had not seen similar material in their revision of past exam papers. However, most who attempted it managed to give a good answer but only to some parts of the question.