THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma

April 2002

EXAMINERS' REPORT

Networked Information Systems

The number of candidates selecting this option increased significantly this year and it is pleasing to report that the number achieving a pass standard also rose to 81%. Many candidates however failed to follow standard examination technique of clearly identifying on each page the question they were seeking to answer.
In some cases candidates chose to complete the answer to a question on the same page as the answer to a different question.

Others failed to attempt three questions. A few, who failed to reach the pass standard by a few marks, 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

1. *a)* Jane in Cardiff sends an email message to Jamil in London. Jane uses Eudora as her mail client on a Windows PC, while Jamil reads his email using Netscape on a Sun workstation running Solaris.

Identify the different software components that are involved in forwarding the message from Jane's mail client to Jamil's. Your answer should also briefly describe the protocol involved. (10 marks)

***b)* Jamil has started a new job recently as a sales consultant. As a consequence, he has to travel a great deal and must use a laptop or the computer at an Internet cafe to read his email which is held on a server at his company. If Jamil tries to read his email from different locations this may scatter his mailbox, leaving some on the local machine from where he reads his email, the rest at his mail server.**

Identify ways in which this could be prevented at the protocol level and suggest properties that Jamil should set on his mail server in order to read email from untrusted clients.

(10 marks)

***c)* State the additional properties a protocol should support to enable Jamil to read his email from a mobile device, for example a Personal Digital Assistant (PDA) with limited memory.**

(5 marks)

Answer Pointers

Of the 50% of candidates who attempted this question 86% achieved a pass standard. The average mark was 13.

Reasonably popular question with relatively few failures. As expected the answers showed variations in the level of comprehension by candidates and reflected both their academic knowledge and practical experience.

Part a
Answers were expected to contain discussion of some of the following issues:

The candidate were expected to identify the various aspects of email systems, such as the user client software/user agent (Netscape, Eudora, ELM, Pine etc.), the mail server, the mail relay agents, the message transfer agents, and the protocol that operates between mail servers, for example SMTP.

Part b

Answers were expected to contain discussion of some of the following issues:

This could be prevented by tagging mail messages based on the location from where they are being read, and to support update functionality on the mail server. This depends on the protocol used between the user agent (i.e. mail reading software) and the mail server. Reference to protocols such as POP3 or IMAP obtained marks. Candidates were also expected to discuss issues in migrating an entire mail box to the local disk before initiating a read, vs opening a connection to the remote mailbox for each read/send operation.

Part c

Answers were expected to contain discussion of some of the following issues:

The protocol should be able to detect the kind of device from which the email is being read, and check the 'content' field in the mail message. The protocol should therefore prevent download of large attachments (such as images, audio files, etc) based on some configuration file that the device maintains (to avoid download of particular media types). The PDA could also discard messages after a certain time limit has expired, and as determined by the user in a configuration file. The PDA could also support a compression approach, which could be used to reduce the size of the mailbox.

Use the following passage to answer questions 2 and 3

BrillTech has been established by two University graduates, and specialises in developing network management software. BrillTech brings together the expertise of Tom Schmutsky (a statistician) and Bill Zork (a computer scientist). The company aims to develop specialised monitoring software to enable Telecom vendors to meet their Quality of Service (QoS) criteria, especially for the new multimedia services being announced by many Telecom vendors. QoS is an important criteria for many companies, as it allows them to determine bounds on timing delays that are likely to affect packet flows for applications they create. In the era of Application Service

Providers (ASPs), the QoS criteria becomes an important factor to monitor and enforce.

Question 2

BrillTech have the potential to measure and record a large quantity of data about a network. This data may, for example, include traffic flows at a particular point in the network and the network configuration.

a) Identify five different network components that could be monitored within a local area network up to the point where the company connects to the external Telecom vendor.

(10 marks)

b) Describe the function of each of the network components mentioned in *a)* above. (10 marks)

c) Identify the reasons why one of the network components mentioned in *a)* above is the most critical component in supporting QoS. (5 marks)

Answer Pointers

Of the 77% of candidates who attempted this question 80% achieved a pass standard. The average mark was 12.
The thorough answers in part b clearly demonstrated that a large proportion of candidates knew the material fairly well, from a combination of actual experience and syllabus material.

a). Components include: network cabling technology, network topology, type of network protocol (+ hardware to support it), switches, hubs, repeaters, bridges, routers.
A brief description of each of these components should be presented.

b) The candidate was required to demonstrate an understanding of the different aspects of network set up, and the function of each of the components involved and to mention how they relate to each other.

c) The candidates were expected to select one of three different components which support QoS.
1) switches/hubs, 2) routers, 3) bridges. Each of these supports QoS to various extents. In answer to this question, the candidate is not explicitly required to know about QoS, but just about the components within a network that are likely to contribute most towards traffic patters and flow control.
The candidates were however required to justify their answers. For those candidates who choose ‘routers’, then the candidate was expected to mention that these could be programmed to allow data packets from only a handful of sites, thus implementing a ‘flow control’ strategy etc.

Use the passage on the previous page for this question.

Question 3

Bill Zork suggests that the software developed by BrillTech could be best utilised at each router within a network. His theory is that a network router would be able to monitor traffic patterns and flow rates, and therefore adapt the routing tables appropriately using the software.

Tom, on the other hand, feels that this is too complex, as the software must respond to events in real-time, and this is likely to have a high computational cost. Tom believes the software will always lag behind actual traffic patterns. His alternative suggestion is that the software should be deployed at specialised nodes in the network, and run on dedicated hardware.

a) As an adviser to BrillTech, discuss the two suggestions and how you would help Bill and Tom make a decision on the correct suggestion to adopt.
(15 marks)

b) Often an end-to-end network connecting a company with another is not owned by a single Telecom vendor as it is made up of many different network segments. However, when reporting Quality of Service (QoS) criteria, a company like BrillTech must take into account that each of these network segments may offer a different QoS.

Suggest ways in which BrillTech could help achieve a better estimation of QoS.
(10 marks)

Answer Pointers

Of the 35% of candidates who attempted this question 90% achieved a pass standard. The average mark was 14.
This question was clearly not as popular as the other questions. This is probably due to the more abstract/theoretical nature of the question, where two suggestions have been put forward and the candidate was asked to discuss them and, by implication, compare and contrast them in order to make a decision on the correct suggestion to adopt.

Candidates were clearly cautious in considering this question, but those who did choose it answered it well, resulting in very few failures and some excellent high marks being achieved.

Part a

Answers were expected to contain discussion of some of the following issues:

The candidate was required to evaluate the trade off in network design and flow management at particular points in the network. The candidate was expected to be able to identify and comment on the suitability of a software vs. hardware based data flow control, and also on whether dedicated nodes for monitoring network traffic are a good idea. Issues of bottlenecks at these nodes vs. complexity of nodes should be evaluated and discussed. The candidate was expected to discuss issues of distributed vs. centralised processing.

Part b

Answers were expected to contain discussion of some of the following issues:

Here the candidate was required to identify how a network may be split into multiple segments, and how bounds on performance for these segments could be determined. Issues of network isolation and flow management along particular parts of the network should also have been discussed.

Use the following passage to answer questions 4 and 5:

Southwest University has 50 academic departments including a Computer Science Department. The Computer Science Department has 3 user areas which generate a lot of network traffic, most of which is between the user area computers and a user area server machine. The University has registered the domain name southwest.ac.uk and it has been allocated the class B IP address block 150.100.0.0/16. The University needs to set up a campus network, using Ethernet, which is also connected to the Internet. The network design must be efficient and scalable.

Question 4

a) Design a network topology which will meet Southwest University's campus network requirements. Your design should be presented in diagrammatic form and should address the following issues:

i) **Identify the subnet requirements** **(8 marks)**
ii) **Identify the router requirements** **(6 marks)**
iii) **Suggest an IP addressing scheme for the subnets** **(6 marks)**

b) Briefly describe how the campus network should be connected to the Internet. **(5 marks)**

Of the 40% of candidates who attempted this question 36% achieved a pass standard. The average mark was 8.
Many candidates who answered this question did not appear to understand the principles of subnetting or the function of a router. Only one candidate mentioned a backbone. Few appeared to understand IP addresses and how to subnet a class B address space.
The issues expected, included the following.

Part a)
The class B IP block could be subnetted with a 24 bit netmask. This will give the IP subnets 150.100.1.0/24 through 150.100.254.0/24. (2 marks)
Create a campus backbone with addresses 150.100.254.0/24. (3 marks)
Create a subnet for each academic department except for computer science with addresses 150.100.1.0/24 through 150.100.49.0/24. (3 marks)

Create a backbone for the computer science department with addresses 150.100.50.0/24. (3 marks)
Create a subnet for each of the 3 user areas and a fourth subnet for the rest of the department with addresses 150.100.51.0/24 through 150.100.54.0/24. (3 marks)

Place a router between the backbone and each of the departmental subnets. (2 marks)

Place a router between the backbone and the computer science backbone. (2 marks)
Place a router between the computer science backbone and each of the computer science subnets. (2 marks)

Part b)
There would need to be a demilitarised zone with routers at each end between the campus backbone and the internet. The demilitarised zone would have a bastion firewall. (5 marks)

Question 5

The Computer Science Department at Southwest University offers some of its courses for remote access. Registered students can connect to server machines over the Internet and access course material and submit coursework for continuous assessment.

Discuss the security requirements for implementing a remote access coursework system addressing the issues of physical security, operating system security, network security, data access and user authentication.
(25 marks)

Answer Pointers

Of the 97% of candidates who attempted this question 69% achieved a pass standard. The average mark was 11.
Obviously the most popular question which was answered by nearly all of the candidates. Most wrong answers were due to candidates not reading the question.
Many candidates discussed security policies and principles whereas the question was looking for mechanisms for securing an actual networked computing environment. (the questions asked " discuss security requirements")
Many confused physical security with the physical network layer - rather than securing the machines in locked rooms.

The points candidates were expected to mention include-

physical security: the server machines should be locked into a machine room where only authorised staff members have access(2)

operating system security: file permissions should be such that users should not be able to access each others files; all unused software should be removed.(5)

network security: use Secure Sockets Layer to encrypt network data, or use public key or other encryption at the application layer(6)

data access: the course material should only be available to users who successfully authenticate themselves, once coursework has been submitted it must be accessible by authorised staff members only, the data must be backed up frequently and stored securely(6)

user authentication: user must be able to identify themselves using user names and passwords, digital certificates could be utilised as an alternative mechanism(6).