THE BCS PROFESSIONAL EXAMINATIONS
Diploma

April 2007

EXAMINERS' REPORT

The Internet & World Wide Web

General Comments

In general, candidates produced work of good quality for this paper with some excellent answers to every question provided in some cases. However, a recurring theme is the inability of some candidates to read the question and therefore there were several occasions where a candidate submitted a long answer on a topic mentioned in the question but did not address the question and consequently scored low marks. Such candidates will probably be surprised by their results!

QUESTION 1

(a) Expand each of the following and define their meaning:
i) TCP/IP
ii) FTP
iii) HTTP
iv) IMAP
v) HTML **(10 marks)**

(b) The current Internet Protocol allows for approximately 4,000 million unique addresses – which is quickly becoming exhausted.

Define what is meant by IPv6 and NAT (sometimes known as IP masquerading). How can these help in solving the address shortage? **(5 marks)**

(c) Explain the role and architecture of the Domain Name Service (DNS) in the operation of the Internet. **(5 marks)**

(d) Building on, but not repeating your answer to (c), explain how the HTTP protocol facilitates the stages between a user requesting and receiving a web page. **(5 marks)**

Nearly all candidates answered this question and part a) was generally well done. Many candidates erroneously indicated that IMAP was used in webmail. By definition, webmail uses http. Few candidates demonstrated a good understanding of how IPv6 and NAT could help in addressing the address shortage. The operation of DNS was poorly understood and many candidates were unable to give any depth in their answer to part d)

Answer Pointers

(a)
i) Transmission Control Protocol / Internet Protocol – A set of two communications protocols which offer reliable delivery (c.f. UDP/IP) across diverse networks. IP defines the underlying network layer, whilst TCP is the transport layer, providing the reliable delivery over IP.

ii) File Transfer Protocol – A protocol used for efficient transfer of files across the Internet using the client-server model

iii) Hypertext Transfer Protocol – A protocol used for the transfer of web files across the Internet using the client-server model.

iv) Internet Mail Access Protocol – A mail protocol used in the final delivery of mail that interfaces with mail stored on a server, rather than fetching and storing mail on the local host machine.

v) Hypertext Markup Language – A markup language used to create web pages.

(b)
• IPv4 worked on 32-bit addressing. IPv6 (Internet Protocol version 6) uses 128-bit addresses, allowing for 3.4 x 1038 addresses. This is in the order of 1029 times greater than IPv4.

• NAT (Network address translation) allows private networks to share a limited number of external IP addresses. Traffic inside the network uses internal IP addresses (in the ranges 10.x.x.x, or 192.168.x.x) which do not have to be unique across the entire Internet, only on the local network. Traffic heading outside of the network has its IP address rewritten to one of the external IP addresses.

(c) These are computers on the Internet which perform the address translation from IP to the more common addresses such as www.bcs.org.uk. These allow the Internet to function without the need for hierarchical structure. Each ISP/company will maintain its own local name server. As well as maintaining details of the local network it will also cache recent requests. If it doesn't have the information required, then it will contact the root domain server. This will tell it which primary name server and secondary name server have the information about the requested URL.

(d)
1. The user types the URL into the browser.
2. The browser users the DNS to identify the host web server.
3. The browser uses HTTP to transmit the following request to the server: "GET /request-URI HTTP/version", where version tells the server which HTTP version is used.
4. When the server receives the HTTP request it locates the appropriate document and returns it. However, an HTTP response is required to have a particular form. It must look like this:

```
HTTP/[VER] [CODE] [TEXT]
Field1: Value1 Field2: Value2
...Document content here...
```

The first line shows the HTTP version used, followed by a three-digit number (the HTTP status code) and a reason phrase meant for humans. Usually the code is 200 (which basically means that all is well) and the phrase "OK". The first line is followed by some lines called the header, which contains information about the document. The header ends with a blank line, followed by the document content.

QUESTION 2

(a) Briefly explain the purpose of each of the following:
SMTP Server
Proxy Server
POP3 Server
DNS Server
DHCP Server

(10 marks)

(b) Explain the technical differences between webmail and conventional email systems. **(5 marks)**

(c) Broadband has accelerated the use of the Internet as a multimedia environment. What are the issues that need to be addressed when multimedia content is delivered on the Internet? Illustrate your answer with reference to specific examples of multimedia formats. **(10 marks)**

Three quarters of candidates answered this question. Many ignored the word "server" in part a) and focussed on the protocol. Similarly in part b) many candidates ignored the word "technical" and focussed on cosmetic differences. In part c) there was insufficient technical depth with many candidates giving rather generic answers.

Answer Pointers

(a) A SMTP server on the Internet is used for the transfer of email using the Simple Mail Transfer Protocol. It takes connections from email clients and transfers messages to other SMTP servers.
A proxy server sits between client Web browsers and a Web server to filter and cache Web content and improve network performance. The primary purpose is the security function to inspect incoming and outgoing traffic and determining what should be denied transmission, reception or access.
A POP3 server on the Internet is used in the last stage of email delivery. It accepts connections from email clients and handles the delivery of email using the Post Office Protocol Version 3.
A DNS server provides the address resolution function of the domain name system.
A DHCP server manages the allocation of dynamic IP addresses on internal networks. It provides each network client with an IP address, subnet mask, default gateway, an IP address for a WINS server and an IP address for a DNS server.

(b) Webmail is a way to read and send email messages using a web browser. Webmail does not require the use of any email client software. Webmail uses a web browser, web server, and mail server instead of an email client program to read and send messages. Webmail is a web application that uses a web server for both the user interface and to communicate with a mail server for reading and sending messages. This means that it uses the HTTP protocol rather than POP3/IMAP. SMTP is still used for the transportation of email from the web server to other email hosts.

(c) This question is fairly open. A wide range of formats could be mentioned. Issues include file size, download times, compression techniques, quality and browser support. Formats: a selection from GIF, JPEG, FLASH / SHOCKWAVE, WAV, MIDI, MOV, AVI, PDF etc.

QUESTION 3

You have been invited to give a talk to local business people about the Internet.

For each of the following sub-topics, list the main points that you will include in your talk:

(a) The architecture of the Internet **(5 marks)**
(b) Services that run on the Internet **(5 marks)**
(c) Who funds the Internet? **(5 marks)**
(d) The roles of Internet Registrars and Internet Service Providers **(5 marks)**
(e) RFC, W3C & IETF **(5 marks)**

Most candidates attempted this question. Many wrote far too much and did not use the given structure. This led to repetition of material. Services were poorly understood as was the role of Internet Registrars. Only a few candidates gave coherent answers to parts c) and e).

Answer Pointers
Whilst a prescriptive answer is inappropriate, a good answer is likely to include:

(a)

- Internet is a collection of thousands of individual networks and organisations which cooperate with each other so that information can pass among them
- Networks found in private companies, universities, government agencies & ISPs.
- Local networks join to form regional networks linked together by backbones
- Hubs link groups of computers to each other
- Bridges link LANs to each other
- Routers examine packets to determine their destination and route them appropriately

(b) Services might include WWW, email, file sharing and transfer, VOIP etc

(c)

- Given its nature, no single group funds it
- Funded by the organisations which own the networks including private companies, universities and government agencies
- ISPs derive funding by charging for Internet access

(d)

- Internet Registrars are private companies responsible for registering Internet domains
- ISPs provide access to the Internet usually via dial-up and broadband connections
- May provide additional services such an email and web hosting
- Many own their own networks and may supply backbone facilities

- RFC are requests for comment which are the ways that procedures and standards are agreed
- The World Wide Web Consortium (W3C) is the organisation responsible for drafting, circulating for review and modifying web standards.
- IETF is the Internet Engineering Task Force and is responsible for overseeing how the Internet's TCP/IP protocols evolve

QUESTION FOUR

(a) When is it appropriate to use client-side scripting or to use server-side scripting? Illustrate your answer with suitable examples. [Do NOT write any code.] **(10 marks)**

(b) Describe the issues associated with browser compatibility for client-side scripting languages. **(5 marks)**

(c) Discuss FIVE factors that contribute to a good navigation scheme for a website. **(10 marks)**

Only a quarter of candidates attempted this question. Most could recall examples of programming languages for the client-side and server-side. For the client-side the manipulation of the Document Object Model (DOM) was poorly understood. Most recognised that a browser needed to have the capability of interpreting Javascript, but few mentioned the issue of the feature being disabled by the user within their browser.

Answer Pointers

(a) Both offer the ability to dynamically change the web pages depending on the users' choices. They can be combined together to include the best of both features.

On client-side – Javascript offers embedding code that is visible to user in source and can manipulate the DOM objects. It can be used to verify data before the synchronous transmission to the server. This can save time in communication to the server and return to client.
On server-side – Likes of PHP used to communicate web pages that are typically driven by a database. Often used to verify session / cookie and passwords for security.

(b) Needs browser to have JavaScript functionality
Needs to be turned on
May deal with interaction with DOM in different ways
Debugging is difficult and poorly supported

(c) Navigation

The usability and ease of use of a website is essential to provide guidance through its links.
It is important to be:

- Consistent - function the same every time they use the same links.
- Group related items together
- Describe the links in clear terms
- Each page or frame should give Top-Level Site Navigation and include Bread Crumb Navigational Trails
- Web Accessibility should also be considered with the use of tables and frames and text ALT/TITLE tags to explain each item on the page to screen readers

QUESTION FIVE

(a) Outline THREE distinct methods by which a home user can connect their PC to the Internet. **(5 marks)**

(b) List FOUR factors that a user should consider when choosing a method of connecting their PC to the Internet. **(6 marks)**

(c) Evaluate EACH of the methods identified in part (a) against EACH of the factors identified in part (b). Present your answer as a table, e.g.

	Factor One	**Factor Two**	**Factor Three**	**Factor Four**
Method One				
Method Two				
Method Three				

(14 marks)

Over two-thirds of candidates attempted this question. Many candidates discussed leased lines and ISDN for part (a). Few mentioned wireless in detail – WiFi. For those that did mention wireless many included mobile phone connection and satellite. When comparisons were made the relative speeds should have been stated in more detail. The factors of speed and bandwidth were often stated as two completely separate factors, but they should have been related together. Security was not approached correctly. Many did not include the table as required with the generalised captions exchanged for their choice of factors and methods.

Answer Pointers

(a) Broadband
- Wired
- Wireless through a router

Dial-up

(b) Example

	Performance	Reliability	Downtime	Security issues
Broadband - Wired	High capacity – 100Mbit Ethernet to router and then limited by line speed from 512Kbit upwards	too many people looking to sign-up to the service (high uptake) - too many users on at once and server can not cope with demand (loading)	Always connected	Normal username and password issues
Broadband – Wireless	High capacity – 54Mbit Ethernet to router and then limited by line speed from 512Kbit upwards Requires a router with WiFi capabilities			WPA or other encryption to enhance security to stop others using your router and bandwidth
Dial-up	Limited to 56kbit	Not supported as well and not intended for any upgrade to service	Required to connect each time	Normal username and password issues

General points between each:

Comparison of performance in Kilobytes / Megabytes versus cost to
- Install Equipment – modem type
- Telephone line support – distance for exchange / quality of cabling
- Ongoing monthly cost

Reliability
- is the bandwidth that is quoted in the signup agreement achievable
- too many people looking to sign-up to the service (high uptake)
- too many users on at once and server can not cope with demand (loading)
- is the provider reputable and offers helpful service for problems

Downtime to be minimised

QUESTION SIX

Acting as a consultant for a small company wanting to sell products via the Web, describe how you would configure their web server to host a fully interactive website with a back-end database by answering the company directors' specific questions:

(a) What sort of approaches and technologies are available for hosting and serving the web pages and what are the benefits of each? **(15 marks)**

(b) How could the website be used securely by both external and internal users? **(5 marks)**

(c) What audit facilities would you recommend to monitor user activity? **(5 marks)**

Half the number of candidates attempted this question. Part (a) was very poorly answered with few giving more than the standard explanation of the hosting methods. In part (b) few directly mentioned an intranet and few described benefits to internal users over external users. Very few grasped the control that is available to a coder in auditing their own developed pages for information about traffic.

Answer Pointers

(a) Hosting choices to suit the demand and control the company want.

Heavy reliance – collocation servers – owned by company and has full control, but located at the Internet providers premises for best internet access performance.

Moderate reliance – dedicated server with preconfigured setup that the company needs to hook in to and cannot change.

Little reliance on web for high demand selling - shared/virtual servers with performance issues and potential security issues

Issues of the freedom of the programming language used by service provider and if any company scripts are allowed on the server.

If there is freedom to serve full range of scripts then a flexible application can be written to give and retain information.

Languages like ASP, PHP, Perl, Python on server

Server software like: Apache, IIS and Java web server

Some are free to use

Database options include Oracle, MySQL and ACCESS

Each have their benefits depending on the scale of data to retain and perhaps interoperate with existing company databases.

(b) Allow for delivery of dynamic content across the web to both the Internet and intranet.

Users need to identify themselves by logging in and then they have different access rights to the material.

External users would only be able to buy products and certain employees would be able to update the list of products offered. Some employee's accounts having access to more pages on the intranet than others.

(c) Logging of entries to the system and then detailed information on the pages and data requested.