The use of Computer Based Training for Network Concepts

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Session 2001/2002

The candidate confirms that the work submitted is their own and the appropriate credit has been given where reference has been made to the work of others.

I understand that failure to attribute material which is obtained from another source may be considered as plagiarism.

(Signature of Student)………………………………………………
Summary

I embarked on this project due to my interest in networking, training using computers/ the World Wide Web and web design. This project incorporates all of these areas and has allowed me to create something in a field I particularly enjoy.

The overall objectives of this project are:

- To produce a survey of Computer Based Training packages on networking that are currently available for use publicly and their features and benefits.
- To identify topics which the Network module Lecturers believe the School of Computing students find difficult.
- To identify topics Network module students find difficult and whether they feel they would benefit from a Computer Based Training package specific to the Network concepts taught in the modules.
- To build a prototype CBT package to aid the study of Network concepts.
- To provide some initial evaluation of the CBT package.

The project achieves the following:

- The design and development of a Computer Based and Web Based Training package that teaches the user about the Network Layer of the OSI Reference Model.
- The design and development of a website for the ‘Computer Networks’ Module (SI22) taught in the School of Computing.
- The identification and understanding of areas students struggle with, in both the ‘Computer Networks’ Module and ‘An Introduction to Networking Computing’ Module (SI11) from both the students’ and lecturers’ view.
- A survey of Computer and Web Based training already available.
- A brief evaluation of current multimedia and web authoring tools.
- Learning and using Macromedia Flash and ActionScript.
- The testing and evaluation of the training package by the students.
- The advantages/disadvantages of CBT packages, a brief look at how they are used in industry compared to other learning aids and who uses them.

This project successfully meets all the minimum requirements set. A Computer and Web based Training package has been designed and developed which teaches the user about the Network Layer. The package contains a number of modules to cover the networking concepts and these have been developed with the use of text, diagrams and animation. Multiple Choice Questions have also been incorporated into the training package.
Acknowledgements

I would like to thank my project supervisor Paul Brna for the continued support he has given me throughout the course of my final year in which this project was carried out. The advice he has given me throughout the project has been invaluable. Thank-you.

I would also like to thank the support staff in the School of Computing, for their help with setting up the web space needed for hosting the CBT.

I would like to thank David Potter from British Telecom for taking time out of his busy schedule to attend an interview about the use of CBT in industry, the benefits and the effect CBT has on businesses.

I would like to thank my friends Rosanna, David and Narjan, my fellow students and Roger Boyle (lecturer within the School of Computing) who gave up their time to attend interviews and carry out testing of the prototype Computer Based Training package.
Dedication

I would like to dedicate this project to my Mum and Dad. They have helped me through so much and been there every step of the way. Thank you for everything!
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Chapter One: Introduction

1.1 Background
Computer Based Training is used in many areas today. Businesses use them to train employees and universities use them as additional learning aids. An example of this is the Virtual Science Park situated at the University of Leeds. This system is available on line and it provides a ‘high quality learning environment’. Having this tool allows users to gain access to facilities at all times, [17]. Computer Based and Web Based Training has become quite a competitive force for on-line users with millions of people using these facilities worldwide. David Beers from the Vancouver Sun has stated that there is ‘a world-wide target market of 50 million, on-line learners are expected to more than triple by the year 2025,’ [15].

The advantages of Computer Based Training are:

- It gives people the opportunity to learn new skills and enhance their skills to their maximum potential without having to travel.
- Therefore saving on travel and tuition costs.
- Businesses can train numerous employees with the same tool/software at the same time at no extra cost.
- Gives you the opportunity for learning at your own pace, CBT gives flexibility.
- CBT offers students additional learning tools.

This project, as the title suggests, is about Computer Based Training being used for the teaching of computer networking concepts. This project will show what concepts students struggle with in computer networks and whether they feel a Computer Based Training package would benefit them. It will also provide a survey of certain Computer Networking Computer Based Training packages that are publicly available today.

1.2 Definitions
WWW – World Wide Web
The World Wide Web abbreviated to WWW is a collection of files stored on servers all around the world ([6], p15). These sites are viewed using browsers e.g. Netscape and Internet Explorer; they are all linked together in some way. Users are able to travel from site to site by clicking on hyperlinks. The pages that make up the sites are written in HTML (Hypertext Mark-up Language). The protocol that allows clients using browsers to communicate with a web server is the Hypertext Transfer Protocol. [6]
**Internet**

Sometimes confused with the World Wide Web, the Internet is a massive network made up of other networks. This collection of networks is connected together using the TCP/IP suite of protocols, [6]. It has a common addressing scheme and is used to publish web pages. The Internet grew from the original Arpanet, [2].

**CBT – Computer Based Training**

Computer Based Training is a term used for describing the use of computers to run software or applications that have a teaching element. They are special packages that are developed to teach different aspects of subjects. ‘Training (of humans) done by interaction with a computer. Programs and data used in CBT are known as “courseware”.’, (On-line dictionary, 2002).

Throughout this report CBT will be used to refer to the result of this project although it will essentially be available on the web.

**WBT – Web Based Training**

Web Based Training is the term used for describing training achieved via the World Wide Web. Web sites are accessed that contain training packages that again are developed to teach different aspects of subjects. Teaching or training is completed on-line. This is also known as E-learning.

**Distance Learning**

‘Education in which students take academic courses by accessing information and communicating with the instructor asynchronously over a computer network’ (On-line Dictionary, 2002). This can also be used to describe Computer Based and Web Based Training in the context of this project.

**Tool**

Described as ‘something that is necessary to carry out one’s job’ (On-line dictionary, 2002). In this project the word ‘tool’ could be used to describe the actual training package or the application or software being used to create the training package.
1.3 Project Methodology

It is important when carrying out a project of this kind to plan what needs to be done. For this purpose the model below shows the structure in which this project will be completed:

- Defining the Problem
  - Research sections
    - CBT
    - WBT
    - Flash
    - HTML
    - JavaScript
    - Director
    - Interviews
  - Collect and Record Information found
  - Interpret the results and Report on the findings
  - Designing the CBT
  - Implementing and Testing the CBT
  - Evaluation of the CBT
# 1.4 Project Plan

<table>
<thead>
<tr>
<th>Month</th>
<th>Task</th>
<th>Complete By</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>Analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deciding on provisional project titles</td>
<td>30/09/2001</td>
</tr>
<tr>
<td></td>
<td>Find out who is my Project Tutor</td>
<td>12/10/2001</td>
</tr>
<tr>
<td></td>
<td>First meeting with tutor to discuss Project</td>
<td>16/10/2001</td>
</tr>
<tr>
<td></td>
<td>Questionnaire meeting</td>
<td>26/10/2001</td>
</tr>
<tr>
<td></td>
<td>Discuss with tutor about Minimum Aims and Requirements</td>
<td>30/10/2001</td>
</tr>
<tr>
<td>November</td>
<td>Submission of Minimum Aims and Requirements form</td>
<td>02/11/2001</td>
</tr>
<tr>
<td></td>
<td>Questionnaire Meeting with tutor</td>
<td>06/11/2001</td>
</tr>
<tr>
<td></td>
<td>Decide who I am going to require information from – is a questionnaire going to be successful in getting this information</td>
<td>07/11/2001</td>
</tr>
<tr>
<td></td>
<td>Mid Project Report meeting</td>
<td>09/11/2001</td>
</tr>
<tr>
<td>Design</td>
<td>Background research into CBT</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Completed interviews with lecturers</td>
<td>07/12/2001</td>
</tr>
<tr>
<td></td>
<td>Background Research continuing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mid Project Report review with tutor</td>
<td>06/12/2001</td>
</tr>
<tr>
<td></td>
<td>Final write up of Mid Project Report, reviewed with tutor</td>
<td>11/12/2001</td>
</tr>
<tr>
<td></td>
<td>Submission of Mid Project Report</td>
<td>13/12/2001</td>
</tr>
<tr>
<td></td>
<td>Completed preparation for the forums with students, getting together a select group from each year who have taken the Network modules</td>
<td>18/12/2001</td>
</tr>
<tr>
<td></td>
<td>Email students about the forums and asking for their co-operation with the forums</td>
<td>18/12/2001</td>
</tr>
<tr>
<td>January</td>
<td>Exams and revision</td>
<td>23/01/2002</td>
</tr>
<tr>
<td></td>
<td>Receive Mid Project Report feedback</td>
<td>28/01/2002</td>
</tr>
<tr>
<td>Implementation</td>
<td>Student forums</td>
<td>01/02/2002</td>
</tr>
<tr>
<td>February</td>
<td>Design of the CBT</td>
<td>14/02/2002</td>
</tr>
<tr>
<td></td>
<td>Start writing up what has been accomplished so far – the interviews, forums</td>
<td>20/02/2002</td>
</tr>
<tr>
<td></td>
<td>Keep students in the loop, asking their thoughts on what has been done so far</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>Meeting with tutor to discuss how the project is going</td>
<td>28/02/2002</td>
</tr>
<tr>
<td>Testing</td>
<td>Writing meeting</td>
<td>25/02/2002</td>
</tr>
<tr>
<td>March</td>
<td>After writing meeting – make alterations to the report</td>
<td>05/03/2002</td>
</tr>
<tr>
<td></td>
<td>Continue writing report</td>
<td>13/03/2002</td>
</tr>
<tr>
<td></td>
<td>Implementation of CBT Prototype</td>
<td>15/03/2002</td>
</tr>
<tr>
<td></td>
<td>Keep students in the loop, asking their thoughts on what has been done so far</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>Submit Contents and draft chapter to tutor Completed 18/03/2002</td>
<td>13/03/2002</td>
</tr>
<tr>
<td></td>
<td>Progress Meeting with assessor – go through what has been done so far</td>
<td>22/03/2002</td>
</tr>
<tr>
<td></td>
<td>Completed 14/03/2002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Testing and Evaluation meetings with students, have a meeting with the students to discuss the outcome of the project and whether they feel this will be off some benefit in the future. Modified: Completed during Progress Meeting</td>
<td>22/03/2002</td>
</tr>
<tr>
<td>Systems Maintenance and Evaluation</td>
<td>Easter Break</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Have a meeting with the lecturer to discuss the outcome of the project and whether he feels this will be of some benefit to the students in the future. Modified: Completed during Progress Meeting</td>
<td>22/03/2002</td>
</tr>
<tr>
<td>April</td>
<td>Getting together the final report</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Go through report and CBT with tutor Completed 13/04/2002</td>
<td>15/04/2002</td>
</tr>
<tr>
<td></td>
<td>Easter Break finishes</td>
<td>22/04/2002</td>
</tr>
<tr>
<td></td>
<td>Any final amendments</td>
<td>25/04/2002</td>
</tr>
<tr>
<td>May</td>
<td>Submit the finished report</td>
<td>01/05/2002</td>
</tr>
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</table>
**Specification of milestones during the project**

When carrying out a project of this size you have to allow for amendments to be made to your initial plan. You are undoubtedly going to face problems that are not included in the initial planning stages e.g. other deadlines, coursework etc.

Throughout, the Project Plan has been updated and modified where necessary. These points have been highlighted in bold along with milestone dates in other areas when they have been completed.

As you can see from the table above, the dates for progress meetings with assessors and supervisors were to be during the week ending 22\textsuperscript{nd} March 2002. Due to unforeseen circumstances this was brought forward to the 14\textsuperscript{th} March 2002. Unfortunately due to other deadlines around this time, the Contents and Draft Chapter submission would not be finished for the 13\textsuperscript{th} March 2002. Agreement has been made, with the appropriate people, to have the progress meeting a week earlier and submit the Contents and Draft Chapter on the 18\textsuperscript{th} March 2002. This allows for the time needed to complete other work due in during this particular week. Thanks to this planning in advance everything was completed and handed in accordingly.

The testing and evaluation with the students began in the early stages of implementation and have been carried on throughout. The testing and evaluation as a consequence was not finished until April, when the implementation had also been completed. Carrying out the testing in this way gave a more thorough evaluation.

A major milestone in this project was finishing all five sections of the Network layer in the Computer Based Training package as it was originally thought that it would take too long to finish all of them. As a result, completing two or three sections was the original approach.

In the last five months of the project, meetings with the authors’ supervisor took place every week. This helped immensely, as encouragement and guidance was always available.
Chapter Two: Analysis - The Problem

2.1 The Problem
This project has been undertaken to investigate Network Computer Based Training that is available on the Internet. This project has also been carried out to create a CBT prototype for use within an appropriate Network module taught in the School of Computing and to provide a preliminary assessment of its likely value.

2.1.1 The Problem Owner
The problem owner for this project is essentially the student of the Networking modules. They will benefit from having a Computer Based Training package that is specific to certain aspects of the Network modules. This CBT could be an essential learning aid to the students who are having difficulties understanding these aspects.

2.2 Minimum Requirements
The minimum requirements for this project are:

- To produce a survey of Computer Based Training packages on networking that are currently available for use publicly and their features and benefits. **Modification** – The survey will be carried out on packages that cover Network concepts.
- To identify topics which the Network module Lecturers believe the School of Computing students find difficult.
- To identify topics Network module students find difficult and whether they feel they would benefit from a Computer Based Training package specific to the Network concepts taught in the modules.
- To build a prototype CBT package to aid with the learning of Network concepts.
- To provide some initial evaluation of the CBT package.

2.3 Further Enhancements
- How CBT packages are viewed in general, their advantages and disadvantages.
- Look into how many people actually use them in industry in comparison to other learning aids.
- Develop and implement a preliminary website which would contain the CBT and develop a membership system and chat room for students. As this will be on the Internet, it will be accessible publicly. Therefore it will have people other than the
University of Leeds students logging in and taking part in the Chat room/Newsroom. This would in turn give Students the benefit of asking questions, having general conversations about network concepts and also a wider range of people available to answer these postings in a friendlier and less intimidating way.

Modified
This enhancement has been modified. After speaking to the students during the forums and speaking to the lecturer, it came to my attention that a website for the module would be much more appreciated, than a global website that just hosts the CBT. Therefore the website that will be developed will host the CBT but will also become the website for SI22. It won’t have any login screens or chat rooms hosted on the site however; it will be connected to the relevant newsgroups.

2.4 Deliverables
The deliverables of this project are:

- The final Report.
- A Web based CBT package covering the concepts of Networks.
  - Source code
- An on-line Help system\(^1\)
  - Source code and hard copy

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\(^1\) See Appendix D for User Guides or the URL for just the online User Guide
Chapter Three: Background Research

3.1 Background on CBT packages

There are many different approaches when it comes to training people. In the past the emphasis has been on teaching and training being carried out in the classroom. However, over the past few years Computer Based and Web Based training has become a substantial and important part of training. This is partly due to the World Wide Web creating a new way for learning and giving us access to a wide variety of information. ‘The International Data Corporation estimates that the U.S Corporate market for training and education presented over the Internet will increase from $550 million in 1998 to approximately $11.4 billion in 2003,’ [18]. It is obvious from these figures that Computer Based and Web Based Training is becoming a fundamental part of training people in both new and old concepts in both industry and education across the world.

From carrying out searches on the Internet through the Google search engine, many sites offer some kind of CBT/WBT. Examples of these are:

A Web Based Training Website offering a training package on LAN technologies. Fig 3.1 below shows website http://www.bcr.com/cbt/default.htm (March 2002)
http://www.uwex.edu/disted/lobother.htm (March 2002)
http://1trainingcenter.com (March 2002)
http://www.mindleaders.com (March 2002)
http://www.freeskills.com (March 2002) is a website that hosts 336 online training packages in 87 categories. This is a membership website which asks for an annual fee of $99, you can then access these training packages whenever you like.

Although there are now hundreds of Computer Based Training packages available on the Web, the majority of them tend to be at a cost. CBT packages range from between £50 and £1000 and as a result, students are unable to afford these packages.

3.2 How and Where CBT packages are used

Computer Based Training packages are in use in both industry and education. Most Universities will have some sort of Physical Science Park on campus [21], the University of Leeds has developed the Virtual Science Park (VSP). It is a ‘web-based campus with a user-friendly interface’ [21]. It is based around the physical metaphor of buildings, reception areas, personal offices and project rooms [19]. This offers a ‘set of web-based collaborative tools’ [19]. The services this VSP offers are:

- Web based access to the resources of a major research library
- E-learning support for graduate, professional or executive education and training
- On-line support for collaboration with individuals and groups within the University [19]

From conducting an interview with a Manager from British Telecom, it was found that the use of Computer Based and Web Based Training in industry is growing quite rapidly as more and more companies’ start using them. BT uses Computer Based Training quite extensively and it is also very common in many other companies and organisations e.g. Nortel Networks and International Engineering Council (IEC). BT uses Computer Based Training as pre-requisite training packages to formally delivered courses. The uses of Computer Based Training in BT are:

- Pre-requisite training packages
- Refresher courses
- Suppliers of BT use CBT as a way of updating BT on new products and services

It was felt that a well-constructed CBT package should be easy navigable and clearly presented.¹

¹ See Appendix B for Interview with BT Manager
Some CBT packages currently available within companies are 100% text based. The CBT is essentially a word-processed document with no interactivity available. A text-based document can be tedious enough to read, but actually having to learn something from it as well can be even harder. Computer Based Training packages allow the user to take the course at anytime and anywhere at their own pace of learning.

3.3 Benefits of CBT

From researching into Computer Based Training on the Internet, the following benefits have been found:

- It was found that interaction between the CBT and the user is an important aspect of this training as it keeps the user interested and involved, therefore preventing any distraction.
- Saving on travel and tuition costs
- Learn new technologies without having to travel anywhere
- Learn at your own pace
- Complete courses to cater for your individual needs
- Offers flexibility and convenience to both the public and businesses
- Drastically reduces the cost of training in businesses

[18], [8]

These are all-important aspects of Computer Based and Web Based Training and are also some of the reasons businesses are beginning to use them and why the general public may start to use them as a tool to build on their skill base.

3.4 Using the Web

The World Wide Web is full of information and has evolved into a catalogue of facts over the years. This information is accessed and viewed via browsers such as Netscape and Microsoft Internet Explorer. Web designers are now taking advantage of the possibilities the Web holds and are designing more and more Web Based Training packages.

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1 See Appendix B for Interview with BT Manager
3.4.1 Evaluation of Multimedia Authoring Tools

The following is an evaluation of the tools available to create Web/Computer Based Training packages.

**Director**

Macromedia Director Shockwave Studio can create highly extensible multimedia content. It is used to create 3D games and learning applications that can be viewed across multiple mediums e.g. Web, CD, and DVD. An example of a web page using Director is [http://www.shockwave.com](http://www.shockwave.com) (March 2002). [10]

**Flash**

Macromedia Flash is used to create lightweight but high quality web content. It creates interactive fast loading graphics, animations and application user interfaces for the web. These are accessible via all browsers and platforms. The Flash Player that is used to view the movies is built into every browser and the products that can be used in conjunction with Flash are Macromedia Freehand, Macromedia Fireworks and Macromedia Generator. [5] Flash can be viewed on all platforms and creates smaller files with images because they are produced as vector graphics, the information held is the object size, shape, colour and position. Flash also takes advantage of the Real Time Streaming Protocol; this means that movies continue downloading whilst the movie starts playing. An Example of a Flash Movie being used on a Website is [http://www.tiffany.com](http://www.tiffany.com) (March 2002). [10]

**JavaScript**

‘JavaScript is a simple object-oriented programming language that was created to execute scripts within HTML on the client side’ [7]. With Netscape’s JavaScript being executed on the client side, this results in less processing time for the server. All browsers are not JavaScript compliant and this can cause major problems with accessibility of websites using JavaScript as the script is embedded into the HTML.

**HTML**

‘This is the language in which World Wide Web documents are written’ [7]. HTML is a tag based language, this means that you use tags to format text, paragraphs etc. Pure HTML produces static web pages; dynamic content can be added by embedding scripts e.g. JavaScript, CSS, PHP and ASP.
3.4.2 Benefits of using the Web for Training

Using the Web to access a training package has many advantages:

- It can be used whenever and wherever as long as you have access to the Web.
- Updates to the package only need to be carried out once.
- Reaches a vast audience.
- Cheaper than other forms of Training e.g. CD-ROMs.
- They can be held as downloadable documents.
- Has a good basis for interactive participation using Multimedia authoring tools.
- Web pages can contain dynamic content.
- Gives the user access to other on-line resources.
- Different media can be used therefore increasing the quality of interactivity [22].

3.5 Background on Network Modules

The current Network modules within the School of Computing\(^1\) are ‘An Introduction to Networking Computing (SI11)’, ‘Computer Networks (SI22)’ and ‘Advanced Computing and Multimedia Networks (SI32)’.

An Introduction to Networking Computing covers the following concepts:

- The role of a computer as a machine for executing standalone applications
- How a computer can communicate with other computers and why this is important;
- How operating systems provide abstraction for applications from computer hardware;
- How the World-Wide Web permits information dissemination.

Some of the topics covered in these concepts will be:

- **World Wide Web**: Servers and browsers; html; active components; search engines; data compression.
- **Networks**: The Internet; Client/server model and distributed applications; LAN’s, MAN’s and WAN’s; Hardware and media for LANs; Network operating systems; Standards; Data compression.
- **Operating Systems**: Their role; Interaction with applications;

This module covers the basics of Networking and the theory learnt here should give a suitable basis of understanding for the following Network modules in the following years.

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\(^1\) See Appendix C for Module Information
Learning aids available for students with relation to this module:

- A website has been constructed which contains the course notes, useful links which students are encouraged to look at. It also contains example questions that students can use as a revision tool.

Computer Networks is a second year module and covers the following concepts:

- Understand the history and development of networking that has created the services in use today.
- Understand properly the phase’s data go through in travelling from one application to another over a network.
- Understand the meaning of 'protocol', and the layering of protocol suites.

Some of the topics covered in this module are:

- The OSI 7 layer model
- Physical and Data Link layers
- Network, Transport and Application layers
- Medium Access issues

[2]

1Learning aids available for this module are minimal; students are informed of URL’s in the lectures that contain useful information for them. There is no website available for the module, therefore students can only receive information about the module (coursework, exams etc) via News or the lectures.

After conducting an interview with the relevant lecturers it is felt that the topics dealt with in these modules are 'easy stuff'. The topics are taught in a bottom up manner, meaning that they start with the theory at the very base of these concepts, for example the Physical Layer, what we see as being invisible to the everyday person using the applications like Email. They then work towards the top and how these are used in real every day life with the topics of Email, HTTP, News and Compression. Students are expected to go away from lectures and research into more detail the topics discussed in order to gain a better understanding. The topics are discussed in little detail in the lectures but enough information is given to give students an idea of what is happening.

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1 See Appendix C for Module Information
2 See Appendix B for Interview with lecturer
From the lecturers’ point of view, it is felt that the students are struggling with the mathematical component and the coding details of SI22. SI11, again the mathematical component, the search engines and compression techniques are seen as areas of difficulty, Unix and HTML are also unpopular topics as they are expected to learn HTML completely on their own.

From this interview it implies that SI22 – Computer Networks is the module that really needs concentrating on. This module goes into many areas in detail about Networks, therefore when creating the Computer Based Training prototype consideration will be taken to include the topics covered in Computer Networks.

Carrying out interviews with students is a major part of the research in this project; essentially the Computer Based Training will be produced for the students taking the applicable module. Therefore talking to the students to find out what concepts they struggled with during the module is necessary to be able to evaluate what concepts to concentrate on in the Computer Based Training package.

Four discussion forums were carried out that involved talking to groups of 5 students who had previously taken either the first year module Introduction to Network Computing or the second year module Computer Networks.

After talking to a group of 5 students who took SI11 (Introduction to Network Computing), it was found that these are the areas that students found most difficult:

- Search Engines
- Algorithms for the search engines
- Mathematical based components
- Compression techniques
- Unix

After talking to groups of 5 students who took SI22 (Computer Networks), it was found that these are the areas that students found most difficult:

**General**

- TCP/IP
- Hamming Codes, Error checking
- Areas that contained Maths
- Protocols (7 layer model) and simulator
From the Physical Layer

- Fourier Issues
- TP/Broadband/Baseband/Fibre/Radio
- ISDN
- Cellular Radio

From the Data Link Layer

- Framing
- Data Link protocols
- Error: correction and detection
- HDLC, SLIP/PPP

From the Medium Access Issues

- ALOHA
- CSMA
- Wireless MACA
- IEEE 802
- IEEE 802.3
- Bridges between 802.x
- Fast LAN’s

A few people found all of these concepts under the Medium Access Issues difficult.

From the Network Layer Issues

- Subnet masking – IP addressing
- Congestion
- Routing

The students identified these network concepts as quite difficult.

In order to gain this information the groups discussed the topics that were dealt with in the module. First of all 5 minutes were spent describing to the group the intentions for the Computer Based Training package. The response from this was extremely positive and most of the students thought this would be a valuable learning aid to those doing the module. One by one the group shared the topics with the group that they had found difficult; as real problem areas (those which were frequently highlighted and discussed in great detail) were identified a list was compiled\(^1\). These are shown above under the appropriate module heading. This method was carried out at each of the four sessions that took place.

\(^1\) See Appendix B for the forum write-ups.
Chapter Four: Initial Ideas for Solution

To refresh, the problem encountered for this project was to build a CBT package to act as a learning aid for a module in the School of Computing. This CBT has been proposed as a solution to promote the understanding of the module. The main areas to building this solution are shown in this chapter, starting with the methodology behind creating the CBT.

4.1 Methodology
In order to design the training package adequately, a plan was required. The following model shows the structure of creating the CBT:

- Ideas to be sought for what should be in the CBT
- Decide what tool should be used to create the CBT
- Survey of Computer or Web Based Training packages on Networking – to provide design ideas for the CBT
- Decide what is to be included in the CBT and why
- Design of the CBT
- Design of the Website to host the CBT
- Implementation of the CBT
- Implementation of the Website
- Testing the functionality of the CBT
- Testing the usability of the CBT
- Testing the functionality behind the website

This model to be followed in the production of the CBT and website.

4.2 Why Flash
Macromedia Flash is used for lightweight but high quality web content (see Chapter 3, section 3.4.1). Flash gives great flexibility in designing animations; many file types can be imported into Flash ranging from standard graphics types, e.g. gif and jpeg to sound files to enable incorporation of sound in your Flash movies. Flash movies are also very small in file size therefore giving a fast download time for web pages. The entire movie is downloaded at the same time as one web page; so working through the movie in the context of a Computer Based Training package is painless as there is no extra time wasted waiting for individual pages of the Flash movie to be downloaded as the movie starts playing immediately.
The advantages of using Macromedia Flash 5 over JavaScript, HTML and Director are:

- The user can include interactive content
- The user can include dynamic content
- All browsers now have the Flash Player built in, plug-ins for older versions of browsers are also available
- All platforms are Flash compliant
- It is fast loading
- Small file sizes
- Provides high quality web content
- Flexibility with designing animations
- It can also publish executable files of the movies that can be made available for download so the movies can be viewed off-line.

Flash has everything required to deliver a high quality Web/Computer Based Training package that is fully downloadable over even the slowest of modems.

Flash was chosen as the multimedia application to develop the CBT in because of the advantages above. Director, HTML and JavaScript, used individually, contain some of the attributes needed for developing the CBT however, all of these attributes were needed, which contributed to the decision of using Flash. Some of these factors against using these tools include:

- Not all browsers are JavaScript compliant giving problems with accessibility
- Dynamic content can only be added to HTML by using scripting languages
- HTML produces static web pages
- The player for Director is not a standard in all browsers.
- The author had some knowledge of Flash before the project began, therefore it would be a case of building on this knowledge rather than learning from the very beginning.

4.3 Why Web Based

As Computer Based Training has become more and more widespread, the concept of making training web based has become a popular alternative, it is cheaper and a more efficient way of reaching the user (see Chapter 3, Section 3.4.2). Web Based Training is a creative method for delivering the training modules to a widespread audience; users will have access to the training package whenever and wherever they are as the modules/website will be stored on a web server. An update to the training modules or website only needs to be
done once, but with Computer Based Training issued as CD-ROMs etc, the update would need to be done and distributed again to the users, which can be extremely costly. With the training modules viewable on-line they can also be made available as documents to download, this gives the added advantage of not needing to be online to view the training package. If and when the training modules are updated, a date can be added to the website to show this.

Using the web to train people has many other advantages apart from those detailed above. If users use the web for training purposes then they have the potential to have or gain access to email and newsgroups. They can also access other World Wide Web sites that contain other relevant information that may be useful. The World Wide Web uses a vast collection of networked computers to share and deliver information, why should we not use this to deliver fast, efficient and cheaper training.

The website will be developed using standard HTML and Dreamweaver. HTML can be edited via any text editing application and also in Dreamweaver. Dreamweaver is a WYSIWYG (What You See Is What You Get) application that is used for developing standard web pages; the content needed for the CBT could not be done with HTML or Dreamweaver alone, this is why Flash will be used to implement the CBT. The content needed for the web page is basic, the Flash files can be embedded into the HTML and the requirements for the website can be completed using standard HTML.

4.4 Areas of Difficulty
Before work on the training package could begin, an understanding of Macromedia Flash was required. In order to gain this understanding, several methods were used:

- Consultation of the Flash 5 Bible [5]
- Online tutorials
- Online newsgroups and websites e.g. http://www.flashkit.com (January 2002)
- The help and reference given with Flash 5

Other areas of difficulty encountered in preparing the Training package were:

- Learning about ActionScript language that works with Flash - this is the scripting language that allows you to include actions and responses to inputs in the movies created.
- The timescales available to complete all the requirements of the project.
- Finding the appropriate information needed for the Training tool.
Chapter Five: Design

5.1 Survey of present Networking CBT packages

A survey of existing Computer Based Training packages was carried out to help with the design of the one being created for this project. By looking at other Computer and Web Based Training packages available on the World Wide Web, a better design could be created. The criteria to be used for the survey on Computer Based Training packages were:

1. Use of Animation within the CBT/WBT package
2. Whether the CBT/WBT package is a text based document or in some other format, e.g. Flash files
3. The use of colour in the CBT/WBT package
4. Is interactivity used in the CBT/WBT package?
5. Is the CBT/WBT web based, viewable from CD-ROM, downloadable document?
6. Has sound been used in the CBT/WBT package?
7. Clarity of the description, is it clear?
8. Relevancy of the information
9. Is the information provided in an appropriate order?
10. Is any kind of feedback on questions included?

The web sites found that contain training packages are:

http://www.freeskills.com (March 2002)
http://www.iec.org (April 2002)
http://www.bcr.com/cbt/default.htm (March 2002)
http://1trainingcenter.com (March 2002)

The survey will include these websites and also a CD-ROM that is supplied as part of an Open University course.

The website http://www.freeskills.com contains some example tutorials that could be viewed in order to complete the survey on training packages available on this site. There are over 300 training modules available on this web site. The tutorials had no animation and they were text based with the text embedded in the centre of the web page. There was use of colour in diagrams but the interactivity involved was clicking on ‘Next’ or ‘Previous’ to move on to the next or previous page. These example tutorials were purely web based, however it stated on the web site that once you had paid the subscription fee, the training modules were available for download or again could be viewed online. There was no use of sound but the
description seemed to be very clear with an appropriate order of information. There was no feedback given in the training modules as questions were not incorporated. The information given in the tutorial was relevant.

The website http://www.iec.org contains many tutorials in the form of PDF documents. They can be downloaded or viewed online. There is no cost for using these tutorials, however you do have to become a member to gain access to them. Companies such as Nortel Networks, Marconi, Illuminet and Trillium provide the tutorials. There is no use of animation in these tutorials and they are text-based documents (.pdf). There is use of colour occasionally in diagrams but there is no interaction or sound at all in the tutorials. It can be viewed via the WWW or the PDF documents can be downloaded onto the users PC. The description of the information is very clear and in an appropriate order. The information in each document always seemed relevant to the title. Again there was no use of feedback, as questions were not used.

The website http://ciips.ee.uwa.edu.au/~morris/Year2/PLDS210/huffman.html#huffman_anim contains animations of algorithms e.g. binary search algorithm, the Huffman encoding and decoding algorithm and Dijkstra's algorithm. The algorithms on this site are run completely through an animation, the code for the algorithm is displayed on the right hand side of the screen. There are two buttons labelled 'Run Huffman Encoding' and 'Next step'. When you click on 'Run Huffman Encoding', its starts executing the code and on the left hand side it shows an animation of what the code is doing. In reference to the criteria, this is not a text-based exercise, it is run by interaction with the user and animation is used to show what is happening. This animation is web based but there is no use of sound. The rest of the criteria aren't relevant for this particular package. This web site is excellent in the way it shows you what every piece of code is doing, the use of animation in this model enables you to see the code executing step by step therefore you don't have to understand and work out the code for yourself. Feedback could not really be incorporated in this tutorial as it was purely an animation showing the working of the algorithm.

The website http://www.bcr.com/cbt/default.htm did not contain any examples of the tutorials therefore a survey could not be carried out on this site. When this site was originally found in November 2001, examples of tutorials were given and it was thought that this could be of some use in the future. Returning back to this site in March 2002 to carry out the survey, the example tutorials could not be found.

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1 See website for details http://www.iec.org
2 See website for details http://ciips.ee.uwa.edu.au/~morris/Year2/PLDS210/huffman.html#huffman_anim
The website http://1trainingcenter.com has some example tutorials for you to view before you pay the fee to join and get the full course list. From these examples there was no animation used and the training packages were completely text based with some diagrams in which colour was used. Interactivity is used in these tutorials, not only the ‘Next’ page buttons but also questions where incorporated in the tutorials to monitor the delegate’s progress. The tutorials are web based and there is no use of sound. The tutorials on this site are very neat and well laid out, the description is clear and to the point. The information given is relevant and the tutorials seem to follow an appropriate order. When questions are asked, there is a small amount of feedback given when the delegate finds out whether they got the answer correct or not.

The final survey was carried out on an Open University CD-ROM\(^1\) that contains training modules relevant to different parts of the course. The CD is based around animations; there was no use of text in the tutorials viewed; however sound is used to talk over the animations. As the animations run through there is a voice talking the user through what is being shown. The sound is sometimes jittery and not easily understood. Colour is used a lot in the tutorials to differentiate the different items in the diagrams. There isn’t a lot of interaction in these tutorials, you can move back and forward in the tutorial with the use of a scroll bar. When text is used to describe a concept you sometimes need to read through it again, this is a little awkward when the information is spoken. The information given on the CD is relevant and it does follow an appropriate order.

Looking back at the criteria after carrying out the survey, the important features that came across as being a fundamental part of a CBT package are:

- Animation should be used within the CBT to keep interest
- The use of colour is also important
- Interactivity is needed to keep the user interested
- Information should be relevant and to the point
- Try not to produce a completely text based document
- Include the use of feedback with questions

All of these features will be taken into consideration when designing the CBT and they should be included.

\(^1\) Course title: Digital Communications
5.2 What the CBT will include

From the forums that were carried out it was clear that the students were finding difficulties understanding the Medium Access issues and the Network Layer issues. Looking at these two areas alone, it was apparent that the Network Layer Issues gave the biggest problem, as this area was addressed by many of the students as being quite difficult to understand. Only a few people seemed to find the Medium Access issues difficult. (Chapter 3, section 3.5)

From this information, the Computer Based Training package will focus on the Network Layer issues for the initial prototype. The network layer controls the way in which addressing is accomplished between linked networks and covers about 5 major areas in the module:

- Role and Functionality
- Routing
- Congestion
- Internetworking
- IP

5.3 Design of the CBT

Following will be the design that the CBT undertook. From the survey carried out earlier in this chapter (Section 5.1) certain aspects will be considered in the design. From looking at these training packages different ideas will be incorporated into the prototype to give the best overall result.

The CBT prototype is going to be based on the web. It needs to involve interactivity and stay away from a fully text-based solution as much as possible and it was decided in the previous chapter that Flash will be used to create the modules (Chapter 4, Section 4.2). Using Flash will allow for an interactive solution, it will also allow the modules to be available as executable files that can be downloaded as well. This gives the user the option to view online or offline as and when they please. This is an important feature and benefit of the system as well, as it is a well-known fact that students are ‘poor’, this means that they don’t have to stay on-line to carry out the module if they are completing it at home. It can be downloaded and activated as if it were on the web. The executable files cannot be modified in any way without the original Flash file.

The implementation of questions at regular intervals within the modules makes the users think about what they have just learnt and will aid them in the understanding process. Interaction between the PC and the user is also needed to move on to the next or previous
This page, this will not have any bearing on the overall learning, but this should keep the user involved. This feature will allow the user to move through the module at his/her own pace, it will also allow the user to backtrack through the module to check something or revise an area. This again is an important feature as the user has full control of speed and movement through the module, creating a greater efficiency and benefit to the user. Some CBT packages available within companies at present are 100% text based e.g. Freeskills and IEC (Chapter 5, Section 5.1). In this case the CBT is essentially a word-processed document with no interactivity involved, in some cases but not all the documents are available for download from the web. A text-based document can be tedious enough to read but actually having to learn something from it as well is even harder. This is another main reason why it was felt that interaction between the user and the Computer Based Training package is important.

To try and reduce the intensity of trying to learn everything at once and within one module, the CBT will be broken down into smaller modules, one module to each topic of the Network layer e.g. Internetworking will be a separate module from IP. This will allow the user to stop and start after each module if they wish rather than having one long module covering everything. This is important as the user may have to stop or get distracted and if they have to keep restarting they may not progress at all.

In the CBT prototype the author hoped to cover at least 2 of the bigger topics in the time available e.g. IP and Internetworking.

5.3.1 User requirements

From the forums with the students it was possible to find out their requirements for the CBT. These included:¹

- Breaking the topics up into smaller sections, with proper structure.
- Questions with answers in the CBT would also be useful.
- Make it easy accessible so there is no extra hassle.
- Interactivity is important, this makes you get involved in what is happening with the CBT.
- Found that sometimes doing something interactively you understand better and this is more use than a text based Word document.

¹ See Appendix B for forum write ups
From these comments it was easy to see that the requirements that the user has listed have already been mentioned in the design of the CBT. Other design issues have also been considered such as the navigation through the CBT, the use of colour and diagrams/animation.

5.3.2 User Interface

The user interface needs to be as simple as possible and take into account Human Computer Interaction issues e.g. input devices. The interface is the only part that the user interacts with so they don't want to get lost in the navigation of the modules or get confused because there is too much information on the screen. This was overcome by creating a simple interface that contains all the necessary information, buttons etc. The user will use the keyboard and mouse as input devices.

The buttons located at the bottom right hand side of the screen are used to navigate through the CBT.
Exit – This button exits out of the CBT and takes you back to the Home Page (SI22 index page).
Contents – This button returns the user to the introduction and contents page of the modules contained in the CBT.
Previous – This button will take the user to the Previous page of the module.
Next – This button will take the user to the Next page of the module.
This layout will be universal across all the modules.
5.4 Design of the website

For the CBT to run via the World Wide Web, a website needed to be developed to host the CBT. The students of the Computer Networks module thought the introduction of a module website was a good idea. Therefore the CBT can be run off the module website and be easily maintained. There is one design factor that required the use of JavaScript; this will be used to build a menu system. No other requirements need scripting languages therefore only HTML was used to build the rest of the website, Flash Files can be easily embedded into the HTML. Web pages can display differently on different browsers therefore the design will stay away from any browser specific features.

5.4.1 User Requirements

It was found from the forums with the students that a website for the module would be useful, the requirements that were listed included¹:

- Useful links can be made available through the site.
- The website can hold past exam papers and coursework.
- It could hold information about present pieces of coursework, lecture rooms and basic information about the module.

All these requirements should be met in the design of the website for the module.

5.4.2 User Interface

Again the interface of the website is quite simple and takes into account Human Computer Interaction issues such as input devices and ease of use. Navigation devices are needed in both the CBT and website and on the website there is a menu system in place which is used to navigate. This is available on each page on the site, therefore it is possible to reach any page on the website from any other page. There is a section on the menu bar for ‘E-Learning’; this is the section under which the CBT is listed. There is also an ‘About’ page for the CBT explaining what the CBT covers, a ‘User Guide’ to explain how the CBT works and how to download the Flash Plug-ins if they are required.

The web pages again take a design approach that uses the same format throughout. An example of the layout is shown on the following page.

¹ See Appendix B for the forum write-ups
The menu system is in a tree structure:

- Home – this will be linked to the home page
- E-learning
  - About the CBT – link to the page that tells you what the CBT covers
  - CBT Modules – linked to the introduction flash movie containing the contents page which links to the different areas of the CBT
  - Download the CBT – links to a page where the user can download the CBT
  - User Guide – links to the user guide for the CBT
  - Flash Plug-ins – links to the page where the user can download the Flash Plug-ins if required
- Useful Links – linked to a page which will contain useful links to other websites that contain information on Networking concepts
- Search Engines
  - Google – linked to the Google search engine
  - Yahoo – linked to the Yahoo search engine
  - Lycos – linked to the Lycos search engine
• Contacts
  o Roger Boyle – allows the student to email the lecturer
• Glossary – links to the page that contains a Glossary of Networking terms
• Lectures – Links to the page containing information on when and where the lectures are
• Coursework – Links to the page containing information on the coursework
• Exam
  o Past Exams – links to a page which contains documents with download capability of past exam papers for the module
  o Questions – links to a page containing some example questions with regards to the module

Design for the CBT
Introduction Module

Role and Functionality Module

Routing Module

Optimality
Shortest Path Routing
Flooding

Page 27
Fig 5.3, A general layout of the design of the CBT

This diagram shows the initial design that the CBT was based on; the individual modules are shown as flow diagrams showing what topics should be covered under each heading. The navigation of the modules was kept as easy as possible; the introduction module is linked to the other modules and vice versa.
Chapter Six: Implementation & Testing

6.1 Implementation

This section will describe how the CBT and Website were developed. First, an introduction to the hardware and software that was used and then a brief introduction to Flash and its interface will be carried out. Then the stages of development will be shown.

Hardware used

A PC running Windows ME operating system with a Pentium IV 1800 GHz processor. It has 256MB of RAM and a 40 GB hard disk using a 56k modem.

Software used

The software used in this project includes: Macromedia Flash 5, Microsoft Internet Explorer, Netscape Navigator, FrontPage for live editing within the university, Dreamweaver and Notepad for creating the HTML, Paint Shop Pro 7 for creating and editing images and Microsoft Visio for the computer and networking images.

6.1.1 The Features of Flash 5

The Timeline (Fig 6.1.1a)

This is the timeline that exists in Flash; this is used to implement the Frames and Layers that make up the movies. As you can see, there is only one layer in this timeline with only one frame. This when a movie is being created contains different information in each of the cells known as frames. The frames make up the movie and show you what is happening step by step through a movie. If you click on an individual cell within a movie, this highlights anything that has been drawn or written in that frame on that layer. Beneficial features on the timeline are the capability of being able to hide layers so that you don’t get confused with objects on different layers; this is useful when you are creating an animation. There is also the capability of locking layers, this takes away the capability of being able to modify or edit that particular layer, however this doesn’t prevent you from adding comments and ActionScripts.
The black on the Layer shows that this is the layer presently being worked on, the red line viewable above the frames shows that this is the frame being worked on, on that layer.

Other information held in this part of the screen includes the frame number currently selected, how many frames per second are to be viewed (default is set to 12fps) and how long the movie will run for in one go.

**Toolbars**

These are the toolbars and inspectors available on the default view. The ‘Info’ inspector shown above (Fig 6.1.1b) holds details such as the size (width and height) of objects in the frames and the x and y coordinates of objects in the frames. The ‘Stroke’ allows you to select the type of stroke you would like on your drawing and ‘Fill’ allows you to choose the type of fill required, solid, gradient etc.

On the ‘Text Options’ inspector (Fig 6.1.1c), you are able to choose the size and type of font, how you want the text formatted, the colour of the text and whether the text should be static text, dynamic text or input text (used for forms).

The ‘Sound’ inspector (Fig 6.1.1d) allows you to create animations on the ‘Frame’ tab by choosing motion and the correct parameters. The ‘Effect’ tab allows you to change the way in which objects and text appear, e.g. fading text in and out. The ‘Instance’ tab lets you control the behaviour of objects.

The ‘Tools’ bar shown opposite (Fig 6.1.1e) contains all the regular tools you would normally find in a Paint or Drawing application, e.g. the text tool which allows you to input text in the scene, the eraser tool, the box and circle tool and the arrow tool. Also on here you can change the colour of objects that have been selected.
The ‘Library’ palette shown opposite (Fig 6.1.1f) holds all the objects that have been created within the movie, including buttons, graphics and movie clips. These can be added to other frames by ‘dragging and dropping’ from the library palette.

**Fig 6.1.1f**

**ActionScript**

ActionScript is the language associated with Macromedia Flash; it allows the user to implement actions and behaviours when an event such as a mouse click has occurred. Below is the ‘Frame Actions’ palette; the actions are input on the right hand side and all the commands allowed are listed on the left hand side of the palette. ActionScript now mirrors the JavaScript language ([5], p436).

**Fig 6.1.1g, The ActionScript window**

Actions can be placed on objects such as buttons, graphics and movie clips but they can also be added to Frames as an action that happens when that frame is reached.
Above is the interface of Flash; the white box in the middle is the main area where the movie is created. All objects are placed in this area to make up the movie. Anything placed outside this area is not seen when the movie is played.

6.1.2 Implementation of the CBT

This section will show you how the CBT was implemented; each module had the same setup, e.g. the same size movie with the same background, the same font and size was used for the text and headings in the movies. This is shown in the example below in Fig 6.1.2a (using the Internetworking module as the example).
To make sure that the movies would fit and be completely viewable on a webpage the size of each movie is 700 x 475px. The background colour in hexadecimal is #CCCCFF. The amount of frames per second was kept at the default of 12.

Pages were kept uncluttered and when they contained just text, the text was spaced out, bulleted where possible and only when absolutely necessary larger paragraphs were used.

Questions have been incorporated into the movies; these are to test the user on the information they have just been reading about. They are spaced out and the questions are also validated using ActionScript (an example is shown below). If the user gets the question correct they get directed to a page telling them the answer was correct, then they can continue on with the rest of the module. If their answer was wrong then they are taken to a page telling them this and advising them to go back and revise this section again. This is possible by a 'Revise' button that is provided on this page that takes them back to the relevant part of the module or they also have 'Try Question again' button. If they do not wish to revise or try again at this point they can continue on with the module by using the 'Next' button.

![Fig 6.1.2c](image), An example of a question incorporated into the module.

![Fig 6.1.2d](image), An example of the page the user gets directed to if they get the answer correct.
The ActionScript needs to consider the possible entries into the answer field. The user has the choice of ‘Yes’ or ‘No’ for this particular question; therefore answers of ‘Yes’, ‘yes’, ‘No’ and ‘no’ are the possibilities. The answer field is given a variable name (in this case ‘question2’) and the entries into this field are checked against the possible answers, when the argument is found in the code, the action is carried out. In this case if the answer is ‘yes’ then the user is taken to the next frame when they click on the ‘Next’ button. If the answer is ‘no’ then the user is taken to frame number 419 when the ‘Next’ button is clicked (as you can see in the diagram shown above).

As you can see there is a ‘Revise Devices’ button available on this page and a ‘Try Question again’ button, if selected they will be taken back to the Devices part of the module or the question again depending on their choice.
Title Screen
The first screen that will be seen when the CBT is activated is the Title Screen (Shown below).

Fig 6.1.2g, This screen tells you what the CBT is about and also tells you about the author. The buttons in the module are easily visible and it is easy to understand the intent behind them. The graphics used here and in other modules were taken from Microsoft Visio, an application, which allows you to design networks using the objects, e.g. PC, Firewalls.

As throughout all the modules, the buttons have ActionScript behind them so that when clicked on, they navigate the user on to the appropriate page. There are two other buttons available throughout the modules that are standard and they are ‘Contents’ and ‘Previous’, they are not necessary on this page.

Contents page
The contents page is designed so that clicking on the section required e.g. Internetworking, the user will be taken to the module on Internetworking. This page is in the Introduction module and allows the user to connect to the modules by clicking on the appropriate link. On each page in each of the other modules developed there is a button named ‘Contents’, this gives the user the ability to return back to the contents page and move onto another module whenever they want.
The Buttons

As mentioned earlier there are several buttons in use in the modules, Next, Previous, Exit and Contents. Next and previous do exactly what their name suggests and takes the user to either the next or previous page. Contents takes the user back to the Introduction module and Exit takes the user back to the SI22 home page (index.html).

The above image shows the ActionScript behind the ‘Exit’ button.  `on (release) {` shows that when the user releases the mouse button the action ‘getURL (“index.html”, “_top”);’ is performed. This opens ‘index.html’ in the same window.
Last Screen
The last screen in each of the modules is a congratulations screen. The user is told they have reached the end of the module and the button available on this screen is the ‘Contents’ button.

![Congratulations Screen](image)

Please see Appendix E for an example run through of one of the modules from the CBT.

6.1.3 Implementation of the Website
The pages located on the website are structured around the menu (see Fig 6.1.3a below).

![Website Menu System](image)

The pages on the website are all based around the module and the CBT. The menu appears on each page of the website apart from the pages containing the CBT modules. The requirements of the users have been taken into account and web pages covering the
coursework, past exams, questions and lectures have been included in the site. The home page (index.html) contains general information about the module e.g. syllabus and objectives. The pages containing the CBT modules have a link associated with them, at the bottom of each page there is a link to the User Guide which when selected from these pages will open another window so both the user guide and the CBT module can be viewed.

Fig 6.1.3b. This is the home page, allocated on here is space for News to do with the module e.g. change of lecture room and coursework is now available from the Coursework link. There is also some text on the left hand side focusing on the CBT, telling the user where to find it etc.

The 'e-Learning' link on the menu contains all the information and web pages regarding the CBT. There are five options under this link:

- About the CBT – This page contains general information about the CBT package, what it will teach you about and how to go about getting started.
- CBT Modules – This is a link that takes the user directly to the 'Introduction' module to start the CBT package.
- Download the CBT – This page contains the CBT files that can be downloaded onto the user's PC. They can either download the CBT in one ZIP file or download the individual modules separately.
- User Guide – This page contains a simple user guide to getting started with the CBT, how to download the files, about the plug-ins and viewing the CBT online.
- Flash Plugins – This page contains links to download the appropriate plug-in for either Internet Explorer or Netscape.

Other useful pages included in the website are the:

- Glossary – This contains some Networking terms that students may find useful.
- Useful Links – This contains some useful URL links for the students to Network related sites.
Fig 6.1.3c, The ‘About the CBT’ page is shown above.

Fig 6.1.3d, This is the page you are taken to when you click on the ‘CBT Modules’ page. This is the Introductory module.

Fig 6.1.3e, The ‘Download the CBT’ page is shown above.

Fig 6.1.3f, The ‘User Guide’ page is shown above.

Fig 6.1.3g, The ‘Flash Plug-in’ page is shown above.
6.2 Testing

Testing is an important part of the software engineering process. It not only tests whether the software is working correctly it also tests whether it has met the requirements of the users. This section will cover the testing that has taken place on the CBT and website.

There are different kinds of testing that has taken place, these are:

- User acceptance testing for the CBT
- Functionality testing of the CBT
- Functionality testing of the website
- User acceptance testing for the website

The testing of the CBT was carried out throughout the implementation stage to ensure that the CBT was being developed to the acceptance of the end user. The first round of testing took place after the implementation of the Introduction Module and the IP Module of the CBT.

This testing uncovered the following facts:

- Functionality and spelling mistakes were found in the IP module, these where:
  1. The previous button doesn’t work on some of the pages
  2. ‘Ip’ addresses on the CIDR page needed to be ‘IP’
  3. The ‘Contents’ button directs the user to ‘Page Not Found’

At this stage overall suggestions were also asked for:

1. Could implement some sort of page numbering on the pages of the modules to give the user some idea of how long the module is.

The second round of testing took place after the Role and Functionality Module had also been implemented. Again, general comments, suggestions and findings were asked for.

The user recorded the following:

- ‘Overall it’s good, everything is interlinked’
- The modules being centralised on the web page is a good feature
- ‘Everything is there, and all the information is referenced, this makes life easier for the user’
- ‘Integrated testing forces you to revise’
- ‘Difficult to read the blocks of text on screen’

Both of these testing rounds brought back some faults and suggestions that are listed above. All of these were taken into account and the changes and suggestions were all completed.
The third round of testing took place after the website and the Introduction Module, the IP Module, the Internetworking Module, the Routing Module and the Role and Functionality Module had been implemented. This time the testing was more structured, rather than just asking for the users general opinion or the user finding functionality faults, an interview was carried out after the user had been through the entire website and CBT. During the testing phase if any functionality faults were found they were also recorded. At this stage 4 testers were used and the testing was carried out individually. It was felt important to have a number of different testers as they could all come up with different ideas on how to make the CBT better. It was taken into account that more than 4 testers would have been more useful however in the time that was available it was decided it would be best to use just 4 testers. The final 4 testers were students from the School of Computing, students who had taken the SI22 module previously.

As the CBT comprises of 6 modules in total covering the different sections of the Network Layer, including the Introduction, the testers were to go through each one in turn and also navigate around the website.

General functionality faults that were found:

- In the IP Module, on the 2nd page the previous button was linked wrong.
- In the Introduction Module the ‘Internetworking’ link on the contents page was set up incorrectly – occasionally the link would work and direct the user to the correct module, other times the link would direct the user back to the beginning of the ‘Introduction Module’.

These faults were corrected in the final Computer Based Training package.

6.2.1 User Feedback

As the training package had been designed based on the survey of other CBT packages in Chapter 5, Section 5.1, it was felt important that the testing should refer back to the criteria used in the survey. The interviews carried out with the testers were in two parts. The first part was asking for feedback on the website itself and the second part was asking for feedback on the CBT package. The questions were pre-planned against the criteria in the survey and used as a checklist of things to ask the testers about. The questions posed to the testers and their answers can be seen in Appendix F, however a summary of the main points have been put together in the following table as shown below:
<table>
<thead>
<tr>
<th>Tester</th>
<th>Easy to navigate?</th>
<th>More instruction on Navigation?</th>
<th>Are the questions a useful feature?</th>
<th>Information relevant?</th>
<th>Is feedback useful when questions are correct?</th>
<th>Anything you would like changing?</th>
<th>Use of colour and graphics appropriate</th>
<th>Opinions on general appearance</th>
<th>Any other Comments</th>
<th>Would this CBT have been useful for the module SI22?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes, include an index on each module and change the text size were possible</td>
<td>No, include a 'Next' button on the Intro Module Contents page</td>
<td>Yes especially having the revise button available.</td>
<td>Yes</td>
<td>Yes</td>
<td>More praise on the Correct pages. Implement 'Try question again' button.</td>
<td>Very well put together, I liked the use of the colour and the graphics in the animation</td>
<td>Looks very professional</td>
<td>'Diagrams are really good. It's good showing how something works with diagrams and animation.'</td>
<td>'Yes very much so.'</td>
</tr>
<tr>
<td>2</td>
<td>Yes.</td>
<td>No I think it is quite self explanatory</td>
<td>Yes, it makes the user think about what they are reading a little bit more.</td>
<td>Yes</td>
<td>Very useful. It's like an extra form of revision.</td>
<td>No, not really.</td>
<td>Yes</td>
<td>Looks very good. Very well designed.</td>
<td>'I like the use of the animations and diagrams to show what is happening.'</td>
<td>'Extremely useful.'</td>
</tr>
<tr>
<td>3</td>
<td>Yes, pretty simple. Nothing too demanding, it all worked.</td>
<td>No it was self-explanatory.</td>
<td>Yes, especially when I got them right. Makes the learning more interactive. Gives a sense of accomplishment when you get them correct.</td>
<td>Definitely, it all seems to follow a logical pattern.</td>
<td>Yes, if you guessed the answers, it's good to know why it was correct. The 'Revise' and 'Try question again' buttons were excellent features.</td>
<td>Possible the size of the text.</td>
<td>Yes, definitely, the animations were good for showing what should be happening.</td>
<td>'Very neat, looks professional'</td>
<td>'Excellent informative learning tool.' Being able to download the modules is very useful as reading through once probably isn't enough so having it available on your PC is a great idea.</td>
<td>'Definitely, I struggled with this module so any extra help would have been great.'</td>
</tr>
<tr>
<td>Tester</td>
<td>Easy to navigate?</td>
<td>More instruction on Navigation?</td>
<td>Are the questions a useful feature?</td>
<td>Information relevant?</td>
<td>Is feedback useful when questions are correct?</td>
<td>Anything you would like changing?</td>
<td>Use of colour and graphics appropriate</td>
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<td>Any other Comments</td>
<td>Would this CBT have been useful for the module SI22?</td>
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</tr>
<tr>
<td>4</td>
<td>Very easy, seem self-explanatory.</td>
<td>No, it is obvious how to navigate but there are also helpful hints along the way as well.</td>
<td>Yes, it gives the user a sense that they are learning something by doing the training.</td>
<td>Yes</td>
<td>Yes I like that feature. I also like the Revise and Try Question again buttons when you get a question wrong. You are given more freedom about how to navigate through the training to your benefit.</td>
<td></td>
<td>The size of the text in large paragraphs is a little difficult to read sometimes, but I wouldn’t say this was a major problem.</td>
<td>Very much so, I really liked the animations in the Internetworking module.</td>
<td>Looks very neat, not cluttered.</td>
<td>‘Would be an excellent learning aid for the students taking the module, I wish I had the benefit of it.’</td>
</tr>
<tr>
<td>Tester</td>
<td>Easy to navigate?</td>
<td>Does it contain all the relevant Information?</td>
<td>Would you like anything changed on the website?</td>
<td>Any other comments?</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Yes it was easy to navigate but maybe you could put a link on the Introduction Module page saying ‘if you are having problems with the CBT please consult the User Guide’. Add a more obvious link to the CBT, out of the menu system.</td>
<td>Yes all the relevant information is there but a link could be added to the Computer Departments Home page.</td>
<td>Maybe make the purple on the menu a little lighter so it is a little easier to read.</td>
<td>‘It’s really good, I’m very impressed’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Extremely easy to navigate, the menu system is really good, it’s just a shame you can’t view the menu on konqueror.</td>
<td>Yes all the relevant information seems to be available; you will have access to all the SI22 details such as coursework, lectures and exam papers as well as the CBT.</td>
<td>No</td>
<td>‘It looks very good, it’s nicely designed with not too much clutter.’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>‘Yes, extremely simple, concise and very well laid out. I liked the glossary and the menu system is really good.’</td>
<td>Yes all the information that is possible to fill in right now was available.</td>
<td>No</td>
<td>‘Very useful, no website was available before so it should be very good for students.’ ‘Superb website, I only wish I had the opportunity to use it.’ ‘Contains all the information you need.’ ‘The glossary, useful links and exam questions are all very good.’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Yes it seemed relatively easy to navigate. I had no problems finding the required information.</td>
<td>It contains all the areas relevant to the module - coursework, exams and lectures. I think it has the potential to hold everything needed.</td>
<td>No, I like it, easy to understand, not too crowded with information.</td>
<td>‘It’s simple and easy to read. A useful website for the students. I like the design.’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.3 Browser Compatibility
It was important to test that the CBT worked on a selection of browsers as it was not
guaranteed that all users would use the same browser to view the CBT. The university
provides students with browsers such as Netscape, Internet Explorer and Konqueror. The
CBT worked considerably well and was viewable on all of these browsers and no problems
were encountered with them. The more popular browsers: Microsoft Internet Explorer and
Netscape seemed to be the most important to test as the majority of the public now use
either Internet Explorer or Netscape, however it was important to make sure it was viewable
on all the browsers the University provides.

The website was also tested on the browsers and was viewable on both Internet Explorer
and Netscape. Konqueror would not show the menu system, so it is now advised on the
home page to use Internet Explorer or Netscape to view the website.

6.4 Platform Compatibility
As it was important to test the CBT on a selection of browsers, it was also important to test it
on different types of Platform. The platforms available to test on were Linux and Windows
95, 98, ME, 2000. The University provides students with PC’s running either Windows 2000
or Linux; the CBT worked well on both of these platforms and had no problems whilst running
on the web. If the files are downloaded, the files can run on any Platform provided the Flash
Player has been installed.

6.5 Evaluation of Testing
The criteria used in the survey were also used as a major part in the final testing phases.
The questions asked centred around and covered those topics in the criteria were possible.
There were certain criteria that could not be used as part of the testing phase but were used
for design and implementation. Below are the criteria with an assessment of this Computer
Based Training package:

1. Use of Animation within the CBT/WBT package
2. Whether the CBT/WBT package is a text based document or in some other
   format, e.g. Flash files
3. The use of colour in the CBT/WBT package
4. Is interactivity used in the CBT/WBT package?
5. Is the CBT/WBT web based, viewable from CD-ROM, downloadable
document?
6. Has sound been used in the CBT/WBT package?
7. Clarity of the description, is it clear?
8. Relevancy of the information
9. Is the information provided in an appropriate order?
10. Is any kind of feedback on questions included?

The solution to this problem has led to the creation of a Computer Based Training package, animations have been used to some degree in this training package and the CBT is not displayed as a text or PDF document, the CBT is displayed using Flash files. Colour has been used effectively in the package along with interactivity. Interaction has been incorporated through the use of buttons to navigate the user through the CBT; multiple-choice questions are also implemented throughout the different modules to test the user on the information they are revising. Users cannot cheat at this stage, they either get the question correct or incorrect but they can make the decision to move on through the module independent of getting the question right or wrong. This training package is available as both Computer Based and Web Based, firstly the training package is available on line and hosted on a website, the SI22 Home page. The training package can also be downloaded from the site and run separately as executable files on the users PC. Sound has not been included in the training package. All of the information is relevant to the subject matter and is in an appropriate order. Feedback is included when questions are answered correctly, if answered incorrectly then the user is given three options; the user can revise the section again, try the question again or move on in the module. Overall this CBT/WBT package evaluates very well against the criteria for the survey.

Problems with the CBT
The testers stated only one problem with the CBT that was the size of the text in some of the modules. This was difficult to correct in the modules that had already been completed due to the size of the movies but it was taken into account with the implementation of other modules.

More questions may have been useful throughout the modules or an extended multiple-choice questionnaire at the end of the package that could cover all of the topics involved.

Testing
The overall reaction from the testers was extremely positive and the author is pleased with the outcome, this can be seen in the tables holding the details of the testing. The testers were placed at a PC with connection to the Internet and they spent 1-1½ hours viewing the
tutorial and the website. They were then interviewed\(^1\) and asked for their comments on both the CBT package and website. Very few problems were found in both the functionality testing and the user testing and the faults that were found have been fixed. Suggestions of features to add were made by the testers and these were taken into consideration and implemented by the author where possible as soon as the testing had taken place, therefore these features were then available for the next testing session. Features that were included in the CBT and website after the testing are:

- Indexes have been included where appropriate at the beginning of the modules e.g. the Internetworking module.
- ‘Try Question again’ button has been implemented on the incorrect pages when the user gets a question wrong.
- An extra link has been added for the CBT on the Home page.
- An extra link has been added for the School of Computing Home page.

The reaction from the testers was one that the CBT is an extremely useful tool to have, however this is not replacing the importance of books and users will still need access to books to help them read around the subject matter. The tool is an ‘excellent’ (Anon, 2002, testing interviews) additional interactive learning aid to books and lectures.

Some of the main comments given by the testers in the testing interviews were:

- ‘Excellent informative learning tool.’
- ‘Very neat, looks professional.’
- ‘Looks very professional.’
- ‘Would be an excellent learning aid for the students taking the module, I wish I had the benefit of it.’

In conclusion, the CBT and website came through the testing very well. The website and the CBT both downloaded at reasonable times on the university machines and viewing from home on a standard 56k modem and phone line, the site downloaded again in a reasonable time frame. The individual modules of the CBT were made small enough to download from the World Wide Web. The testers were very helpful and gave their honest opinions about features that could be added.

\(^1\) See Appendix F for the ‘Testing’ Interviews
Chapter Seven: Evaluation of my solution

7.1 Limitations
When carrying out a project of this size in such a short space of time, limitations are always going to be a factor. The limitations met whilst carrying out this project mainly centred around the time available to complete it and be able to maintain a balance between the project and other commitments e.g. final year modules. Managing to complete all the minimum requirements and to some degree the future enhancements was a major milestone, but having the time to properly carry out testing on this would have been the next step. Testing and evaluation of the CBT was carried out with 4 testers (students from the School of Computing), to really test the CBT properly more testers would have been required from a broader spectrum of people; if users not taking the module could understand it and learn from it then it would be a fair assumption that the students within the school would find it beneficial.

The last two modules implemented were Routing and Congestion, the author felt that detail was not as complete as the previously implemented modules, however during the testing this was used as a feature. It was not part of the official questions but it was noted what the testers thought of individual modules, comparing them to one another. As it is stated in the testing evaluation 3 out of the 4 testers found nothing wrong with the information given in the modules, however 1 tester stated the Routing Module could have possibly had more information or a more detailed animation of an algorithm, (see Chapter 6, Section 6.5).

It is felt by the author that given more time more interactivity between the user and the CBT could have been included and feels that this is an important part to learning.

Also the executable files that are available for download from the site would have been created slightly differently from those viewable on the web, the ‘Next’ and ‘Previous’ navigational buttons are fine, however, the ‘Contents’ and the ‘Exit’ button attempt to connect the user to the Internet to open the appropriate web page and module of the CBT.

7.2 Future Enhancements
In the time available to implement this Computer Based Training package it was not possible to complete everything that could have been included. Due to the time it takes to implement each module of the CBT it was only possible to concentrate on one area of the Computer Networks module and implement this as the prototype CBT package. By finding out what
areas the students struggled with most it became possible to eliminate certain areas of the module, as the students understood them. After succeeding to implement one area in this project it seems practical to assume that any future enhancements made could include the implementation of other areas in the module SI22.

To summarise, the future enhancements that could take place are:

- Implement further areas of the SI22 module and modify the CBT to include these. The areas could include:
  - Physical layer
  - Data link layer
  - Medium access issues
  - Transport layer
  - Application layer
  - General overview or introduction to TCP/IP and the OSI 7 layer model

- Implement areas outside of the SI22 module that are still in the Networking area to act as an additional learning aid to the module and a tool that can be used to let the user learn more about the subject in a broader sense.

- Upgrades to the software could be implemented.

- Inclusion of sound into the modules; sound explanations over animations.

### 7.3 Alternatives

For this type of solution there is only one other alternative that could be suggested, this would be to use Macromedia Director instead of Macromedia Flash. Director can offer the same features as Flash and can also offer 3D graphics and is also used in some circumstances for creating learning aids. Director however does not offer the same graphic abilities that Flash does and better graphics can be developed using Flash. If using Director to produce a solution like this, consideration has to be taken about compliance with web browsers.

### 7.4 Conclusion

The subject area of Computer Networking is unfortunately found difficult to understand by students and only through examples and thorough reading of the subject matter can it be possible to understand.

The main aim of this project was to produce a Computer Based Training package that could be used to support students undertaking the Computer Networks module within the School of
Computing. It was important to the author that the solution to this project would be to the benefit of real life users, the author achieved the main aim mentioned above and hopes that the CBT and associated website that has also been constructed will be implemented for use within the School of Computing, however, the CBT's information should be validated before it is used. It was mentioned by the lecturer that he would like to be able to use this CBT in the future with the SI22 module. The author is confident that the solution is good enough for this purpose and that it would be beneficial to the students as an additional learning or revision aid; this is justified by comments from the testers when they were asked whether they would have found it useful when doing the Computer Networks module e.g.

- ‘Yes very much so.’
- ‘Extremely useful.’
- ‘Definitely, I struggled with this module so any extra help would have been great.’
- ‘Absolutely, it would have been great to have access to something like this to help revise etc.’

The overall feedback from the testers was very encouraging. It has been an enjoyable experience carrying out this project and it is felt the author was able to use knowledge and experience gained through the university and industrial experience to solve a problem that other students may benefit from. It was originally thought by the author that in the time given it would only be possible to implement 2 of the major areas within the Network Layer (Chapter 5, Section 5.3), however the author has managed to complete all of the areas in the Network Layer - IP, Internetworking, Role and Functionality, Congestion and Routing.

All the minimum aims and requirements of this project have been met, research was carried out on Computer Based Training packages, how they were used and their benefits and a survey was also carried out on Computer Based Training packages covering Networking concepts that are publicly available. All of the research and the survey contributed to the design and implementation of the solution given. It is felt that the correct and best methods were used when dealing with the design issues and proper justification is made to back these decisions up.

Notes for assessor:
The URL available within the university to view the Website and CBT is http://www.csdb.leeds.ac.uk/csyjm/Project/index.html
For the original Flash files, see the CD given to the supervisor – Paul Brna.
Bibliography


URL’s

[8] Business Communications Review

[9] Distance Education Clearinghouse
   http://www.uwex.edu/disted/lobother.htm (April 2002)

[10] Freeskills


[12] Introduction to Networking: and Data Communications
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[15] Learning Circuits


    (January 2002)


Past Projects


Appendix
Appendix A - Reflection on the Project Experience

After spending the last 7 months working on this project, I am extremely happy with the result and I have enjoyed working on it. This was due to a number of reasons, my interest in Networking and Data Communications, my interest in web design and multimedia authoring and the thought that the result could actually be implemented in the School of Computing.

Seeing the result of the project was extremely satisfying, knowing that all of my aims had been met and I had also managed to substantially increase my knowledge in Networking and Data Communications and also enhance my web designing skills at the same time. I am hoping that I will be able to use these skills in my future career.

I feel that the project has helped me build on my personal skills as well, such as my time management skills, project management skills, communication skills and presentation skills – these are all skills that you can be told about but you can never learn unless you put them into practice. After working in industry for a year I knew the only way I was going to complete this project and other work was by creating a schedule, I stuck to this to the best of my ability. This was drawn up at the beginning and covered everything that would be carried out during the timeline of the project. This was very important as it also helped me work around other coursework deadlines and other unforeseen circumstances.

I wasn’t afraid of changing the way things had been done, I didn’t see suggestions by the testers as being complaints, only as possibilities for a better result. This was important to me, as at the end of the day, the testers (students) would be the ones to use the tool and not me.

Would I have done anything differently?
With hindsight, mainly to give me more time, I would have liked to start the CBT earlier. This would have meant however, that the students would not have had the opportunity to research this module fully before my structured questions were put to them, as the forums would have had to be conducted before the students were examined in this subject. If I had more time I would have liked to spend more time working with students on the interface design of the CBT and Website, however I am very pleased with the final result.
Appendix B - Interviews

Interviews with the students of SI11

Group forum conducted on Tuesday 5th February at 11:00am to discuss the module ‘An Introduction to Networking Computing’ (SI11), a 1st year, first semester module.

Question: The areas you found difficult in SI11?

Answer: Search Engines and Algorithms
Mathematical based components
Unix
Compression techniques

Question: How did you find the way the lecture was taught?

Answer: Liked the way it was taught. Thought there was enough information on the handouts etc and enjoyed looking around the topic and the having the web site for consulting was a great help.
Didn’t like having to learn HTML themselves

Question: If you had access to a Computer Based Training package that is based around the more difficult concepts of SI22, which contains interactivity and explanations. Do you think this would have been useful in explaining the more difficult concepts to you as an additional learning aid?

Answer: Overall feeling was that a interactive CBT would have been a useful learning aid for the module.
Interviews with the students of SI22

Group forum conducted on Tuesday 5th February at 2:00pm to discuss the module ‘Computer Networks’ (SI22), a 2nd year, first semester module.

Question: The areas you found difficult in SI22?

Answer: Error checking
Hamming Codes
TCP/IP
Seven layer model
Fourier Issues
Framing – Data link layer
Routing
Congestion
ISDN
DL protocols
TP/Baseband/Broadband/fibre/radio
Subnet masking – IP addressing
All of Medium Access Layer
Public and Private keys

Question: How did you find the way the lecture was taught?

Answer: Didn’t like the way the lecture was taught.
Textbook ‘Computer Networks’ was a great help.
Liked the way it was taught as the lecturer interacted with the students therefore you had to listen in case you were asked a question.
Didn’t like it when the lecturer just mentioned a topic and told you to find out about it yourself.
Question: If you had access to a Computer Based Training package that is based around the more difficult concepts of SI22, which contains interactivity and explanations. Do you think this would have been useful in explaining the more difficult concepts to you as an additional learning aid?

Answer: Yes a CBT on the difficult areas would have been very useful. Interactivity comes across as a bonus, you are involved in what the CBT is doing therefore you understand more.

Question: Would you have found a website dedicated to the module of any use?

Answer: The majority of the group said Yes (4 out of 5).
Reasons why:
The general opinion was that it would just be a useful tool to have available, useful links could be made available this way.
Group forum conducted on Thursday 7\textsuperscript{th} February at 12:00pm to discuss the module ‘Computer Networks’ (SI22), a 2\textsuperscript{nd} year, first semester module.

Question: The areas you found difficult in SI22?

Answer: TCP/IP
Seven layer model as a whole
Routing
Congestion
ISDN
TP/Baseband/Broadband/fibre/radio
Fourier Issues
Subnet masking – IP addressing
All of Medium Access Layer

Question: How did you find the way the lecture was taught?

Answer: Liked the way it was taught. Thought there was enough information on the handouts etc and enjoyed looking around the topic.
A lot of work for one module, broadening the scope of the module too much.
Lecturer was very enthusiastic.
A little ambiguity about what you actually needed to know for the course.
Lecturer told you some things throughout the module that wasn’t needed for the exam; it was just for your information. They should have been told this at the time and not the day before the exam in a revision lecture.

Question: If you had access to a Computer Based Training package that is based around the more difficult concepts of SI22, which contains interactivity and explanations. Do you think this would have been useful in explaining the more difficult concepts to you as an additional learning aid?

Answer: Some computer based aid that broke up the topics into smaller chunks, with proper structure would be good.
Questions with answers in the CBT would also be useful.
If it is easy to access with no extra hassle.
If this is available then let it be known to the class via the lecturer.
The way it was taught was not very good – taking time to learn something practically via a CBT would be good.

Question: Would you have found a website dedicated to the module of any use?

Answer: Two didn't think it would be of much use.

Three said they liked the idea of a website as long as it held useful information and was updated regularly.

Reasons why:

Could hold past exam papers, coursework's.
Group forum conducted on Thursday 7th February at 2:00pm to discuss the module ‘Computer Networks’ (SI22), a 2nd year, first semester module.

Question: The areas you found difficult in SI22?

Answer: Error checking
Hamming Codes
Mathematical parts
TCP/IP
Seven layer model
Fourier Issues
Framing – Data link layer
Wireless MACA
SLIP/PPP
Routing
Congestion

Question: How did you find the way the lecture was taught?

Answer: Overall feeling was that the module was taught to quickly.
The Tanenbaum textbook ‘Computer Networks’ was very good as the module followed this book more or less exactly.
Felt as though the lecturer expected students to know a lot more than they did before and during the module.
Depends on the student too much.

Question: If you had access to a Computer Based Training package that is based around the more difficult concepts of SI22, which contains interactivity and explanations. Do you think this would have been useful in explaining the more difficult concepts to you as an additional learning aid?

Answer: On the areas I found difficult, yes I think a CBT would have been very useful.
A practical application such as a CBT would have been very useful. Found that sometimes doing something interactively you understand better and this is more use than a text based Word document.
Question: Would you have found a website dedicated to the module of any use?

Answer: Everyone said Yes.

Reasons why:
   It could hold information about Coursework, lecture rooms and basic information about the module.
Interview with the lecturer of SI11 and SI22

Regarding: SI11 and SI22
Lecturer: Roger Boyle

Areas to discuss

1. Syllabus – Breakdown of the syllabus.
   SI11 –
   Introduction to Unix
   Creating Web pages
   World Wide Web
   HTML
   Internet
   LAN’s and WAN’s
   LAN basics – Topologies, Ethernet and Token Ring
   Cables and Devices for LAN’s
   Operating Systems

   SI22 –
   TCP/IP – overview
   Layer OSI model – Complexity of the Networking task
   Physical Issues – Bandwidth, Physical media, Wireless, Telephones, Multiplexing, ISDN, Satellites
   Data-link Issues – Stuffing, Error Detection & Correction
   Medium Access Issues – Contention, ALOHA, CSMA, 802.3
   Network Layer Issues – Datagrams, VC’s, Routing, Congestion, Internetworking, IP
   Transport Layer Issues – Complexity of Transport, Sockets, TCP
   Application Layer Issues – Mail, HTTP

2. Do you have any teaching assistants? Is research for the module part of their job? Do you know what their resources are?
   Liz Minton is the teaching assistant. Liz does administration duties, no technical input to modules.

3. Which areas do you think students struggle with the most and why?
   Lecturer – Maths content and Coding tend to be the areas the lecturer thinks are the hardest parts for the students to grasp in SI22.
For SI11, Maths, Search Engines, Unix, Compression techniques (maths) seem to be the parts students struggle with.

4. What other Teaching or Learning aids are available to the students for the modules?
   In SI11 there is a web site available that contains useful web links for the students to aid with their understanding. This also contains example exam questions and which the students should attempt.
   In SI22 there is a demonstration simulator which students are told about and advised to have a look at.

5. Where do you get your information from – what resources do you use?
   Information for the modules and any research is done using Books and web sites. The book ‘Computer Networks’ by Andrew Tanenbaum is the recommended module textbook and this talks you through the layers of the OSI model in great detail.

6. How far into the topics do you go? What depth?
   For SI11 the lecturer works on a bottom up teaching structure. A lecture for an hour should equal another hours worth of research into what was discussed in lectures. Students are expected to go away and research these topics in more detail for themselves.

7. Lecture Notes/Slides!
   Lecture notes and handouts are available for both modules.
Interview with a BT Manager

With:  David Potter
Position:  Sales Tools Design Manager BT Ignite, Solutions.

Question:  Is CBT used in BT?

Answer:  Yes, CBT is used extensively throughout BT and is common in many companies and organisations I have dealt with through BT and as a private individual. Examples would be Nortel Networks training packages for new CPE, The International Engineering Consortium (IEC) and our own training packages.

Question:  How is CBT used?

Answer:  BT generally uses CBT as initial training courses, usually as a precursor to a formally delivered course and would come as CD-ROM or Web based tutorials.

My own area, which deals with the delivery of software to sell Data and Voice Communications solutions, use an online CBT package. The training package is constructed of modules, which finish with the delegate taking a test and the results are then automatically forwarded by e-mail to our training delivery team.

The construction of the package has the advantage of allowing the delegate to work and if necessary page back, through the CBT modules until the delegate feels able to complete a test design and submit an answer. This enables the training team to ascertain whether the candidate is able to progress through to the formal course.

The course’s other function, is to give non-sales people, who may not need to use the tool, an appreciation of what the software offers. It also allows users to refresh their skills and is used as an online release note where new functionality can be presented in a way that allows new material to be stepped through to complement a written release note.
Some of our business partners and suppliers use CBT as a way of updating BT on new products and services and there are on-line CBT packages available that allow certification in the delivery subject.

BT also uses CDROM as well as online CBT and provides training rooms in most buildings specifically for using these packages where the delegate can get away from their working environment to take the course.

Question: Have you ever taken a CBT yourself?

Answer: Yes on a number of occasions, I have even taken our own Course and thankfully passed it. I have also obtained certification through CBT. Some years ago I obtained a City and Guilds certificate in this way and have taken a formal course where after three tries to answer a question correctly you were locked out of your PC and had to ring a number to release it!

I have taken CDROM packages as prerequisites to formal courses. Some were directly related to the specific course I was due to attend and on one occasion the course was designed to cover a number of courses from different perspectives. This was a course on LAN’s and dependent on which version of the course you were attending I.E. Sales, Design or Maintenance the CDROM contained elements of all these areas.

Currently I am studying with the Open University and they make good use of this technology in a well presented and sometimes amusing way.

Question: What do you see as the advantages and disadvantages of CBT?

Answer: CBT has obvious advantages as it has over the years drastically reduced training budgets and especially with the increased use of online courses, allows updates to be of immediate effect. Information can be cascaded down through teams a lot more efficiently. The last few BT CBT packages I have taken were mandatory and had more of an effect than a broadcast email brief. These were on regulatory changes and safety training, they were registered so you had to have worked through them and answered all the questions successfully before being issued with a certificate of completion.
The disadvantages are that where formal delivery, in BT as an example, has historically been given by people with experience in that particular field (It is not unusual that BT Trainers used to work in the area they tutor), an online course may have been written by someone from a script with no domain knowledge but with the necessary media skills. Inaccurate information may therefore not be challenged and will be available to be passed onto a wide audience to be treated as fact!

My counter to this is that BT people tend to be very media aware and many use multimedia packages to great effect in presentations and demonstrations. There are still those however that insist on subjecting their audience to death by Power Point!

Courses that are not mandatory require team members to find a suitable working environment. Attempting a CBT while in your normal place of work is not a suitable environment. There will always be something that is deemed more urgent or a call that needs to be taken.

Question: What is your personal opinion of CBT?

Answer: Being involved in the creation of CBT packages and having taken a fair few, I believe they provide an excellent media for getting information to a wide audience at minimum cost. A well-constructed CBT should be easily navigable, clearly presented (Not cluttered with information) and where possible entertaining (though not essential, interested subjects tend to learn better than those bored out of their brains!).

CBT is being used more extensively in BT and I believe will continue to be so.
Appendix C – Module Information

SI11 – Introduction to Networking Computing Syllabus

Operating Systems
- Their role
- Interaction with applications
- Examples: Unix and Windows NT

Networks
- rationale
- Local Area Networks vs. Metropolitan Area Networks vs. Wide Area Networks
- Mechanisms for LANs
- Hardware and Media for LANs
- Client/Server and distributed applications
- Network operating systems
- Standards

World Wide Web
- Servers and Browsers
- HTML
- CGI Scripts
- Java and ActiveX
- JavaScript and VBScript
- Active Server Pages

1. Why Networks
   • Evolution
   • Features and uses
   • Terminology
   • Future
   • Network architectures; models, protocols and services
   • TCP/IP
   • Internet genealogy
2. Physical Layer Issues
   • Fourier issues
   • TP/Baseband/Broadband/fibre/radio
   • Telephone networks
   • ISDN
   • Cellular radio
   • Satellites
3. Data-link Issues
   • Errors
   • Framing
   • Errors: correction and detection
   • DL protocols
   • Protocol specification
   • HDLC, SLIP/PPP
4. Medium Access Issues
   • ALOHA
   • CSMA
   • Wireless MACA
   • IEEE 802
   • IEEE 802.3
   • Bridges between 802.x
   • Fast LANs
5. Network Layer Issues
   • Role and functionality
   • Routing
• Congestion
• Internetworking
• IP

6. Transport Layer Issues
  • Role and Functionality
  • TCP
  • Performance

7. Application Layer Issues
  • Crypt
  • Compression
  • Email
  • News
  • WWW

Syllabus taken from Roger Boyles Lecture Slides and Handouts, 1999.
Appendix D – User Guides

User Guide for using the CBT

Viewing the CBT Online

This couldn't be simpler, in a few easy steps you can be learning about the Network Layer!

1. On the menu above, select e-Learning -> CBT Modules. This will take you to the Introduction module of the CBT.
2. Work through the pages of this module and on page 3 you should find a Contents page. These contents are hyperlinked to the appropriate modules, therefore if you want to learn about the Role and Functionality of the Network Layer, click on the 'Role and Functionality' link. This will again take you to the appropriate module.
3. In all of the modules and on every page you will find a 'Contents' button. Clicking on this button will take you back to the Introduction module.
4. You will also find an 'Exit' button on each of the pages. Clicking on this will take you back to the SI22 Home page.

Unable to view the CBT and Downloading the Flash Plug-Ins

If you are having problems viewing the Training package please ensure:

1. You are using either Internet Explorer or Netscape Browsers
2. You have the appropriate Flash Plug-in installed. If you are unsure whether you have the Flash plug-in then please download this from the plug-in page. In the menu above this can be found under 'e-Learning' -> 'Flash Plugins'. Choose the appropriate plug-in from the 2 available options (IE or Netscape).

Downloading the CBT to view off-line

As well as viewing the CBT online, it is also possible for you to view this offline as well.

1. First, go to the download page, 'e-Learning' -> 'Download the CBT'.
2. You then have 2 options, you can download the entire CBT in a zip file or you can download the individual modules.
Download the ZIP file

1. Click on the link and save the file to an appropriate directory on your PC.
2. Open the .zip file and extract the files to a directory (make sure they are all saved in the same directory).
3. To activate the CBT, go to the directory where you saved the files in Windows Explorer and double click on the 'Intro.exe' file.
4. You are now up and running with the CBT, to view any of the other modules double click on the appropriate .exe file.

N.B. When viewing these executable files offline, the html links will not work unless you are connected to the Internet. The 'Next' and 'Previous' buttons will work but 'Contents' and 'Exit' will not. To exit the .exe file offline click on the 'cross' in the top right hand corner.

Download the individual EXE files

1. Click on the appropriate link in the table of files and save the file to an appropriate directory on your PC.
2. To activate the CBT, go to the directory where you saved the files in Windows Explorer and double click on the 'Intro.exe' file.
3. You are now up and running with the CBT, to view any of the other modules double click on the appropriate .exe file.

N.B. When viewing these executable files offline, the html links will not work unless you are connected to the Internet. The 'Next' and 'Previous' buttons will work but 'Contents' and 'Exit' will not. To exit the .exe file offline click on the 'cross' in the top right hand corner.

Buttons in the CBT

EXIT - this will take you to the SI22 Home page if you are connected to the Internet.

CONTENTS - this will take you back to the Introduction Module so you can view a different module.

PREVIOUS - this will take you to the previous page in the module.

NEXT - this will take you to the next page in the module.
User Guide for creating a module of the CBT

Starting Flash
To create a Flash movie you first need to open Macromedia Flash, in a Windows environment do this by:

1. Clicking on the Start icon, then Programs
2. Then select Macromedia Flash 5
3. Select Flash 5

Creating a Movie
By default a new movie will already be open when Flash is activated. If another movie is required, do the following:

1. Select File from the Menu bar
2. Select New from the drop down menu
3. A new movie will now be opened

Setting the movie up in relation to the CBT
This is to set the initial background and size of the movie up so you can then start creating a module.

1. Select Modify from the Menu bar
2. Select Movie from the drop down menu
3. The following window will appear:

![Movie Properties Window]

4. Change the Dimensions of the movie to:

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 px</td>
<td>475 px</td>
</tr>
</tbody>
</table>

5. On Background Color click on the arrow to drop the colour panel down and click on the colour shown below which corresponds to the following hexadecimal number: 

#ccccff

![Colour Panel]
6. Now you can click on OK  
7. The movie should now have changed size and colour.

The toolbars

This toolbar, the 'Info' window is used for storing data about the objects in the movie. If an object is drawn in one frame and you require the object in another frame later on in the movie in exactly the same place (or an animation is taking place), by highlighting the object the x and y coordinates of the object are shown in this window. This also shows the width and height measurements of the object.

Other tabs in this window include:
- Transform – this is used to rotate or skew an object that has been highlighted
- Stroke – If an object has been drawn using the drawing tools e.g. line, box etc then you can change the width of the lines on this window.
- Fill – If an object has been drawn with drawing tool e.g. box, circle etc then you can change the colour of the object by using this window. Just select the colour required after highlighting the object.

The ‘Character’ window is used for the text that is input into the movie. Here you can change the size and font of the text, select bold and italic if required and you can also change the colour of the text.
Other tabs on this window include:

- **Paragraph** – the user can change the alignment of the text on this window.
- **Text Options** – the user can select the different types of text that can be used e.g. **Static** where text is just written to the screen, **Dynamic** where the text can change and possibly be read in from a file and **Input**, where a text box is available and when the movie runs the user can enter text in this area.

The ‘Sound’ window can be used for a variety of different reasons.

The Sound tab allows sound to be incorporated into the movie.

The Instance tab allows behaviours to be added to the objects in the movie.

The Effects tab allows the user to make objects fade in and out and to change the brightness of the object etc.

The Frame tab allows the user to add motion and shape tweening into the movie.

This toolbar is similar to any other toolbar found in drawing packages. You have the add text option, drawing a box, a circle, a line. Filling objects with colours and painting. You can also use the eraser and the arrow options.

This toolbar is also where the colours of objects you are drawing can be selected.
The Timeline

This is an example of a timeline from one of the modules in the CBT.

- The rows are known as layers, which can be named on the left hand side as you can see above. Do this by double clicking where the name is.
- The columns are known as frames, and these are what you click on to enter objects into a particular frame on a particular layer.

Publishing a Movie

When you want to see what the movie will look like once it has been published do the following:

1. Select File from the Menu bar
2. Select Publish, you will see the following scroll bar going across the screen as the movie is published.

3. When this scroll bar has completed the movie will be published and you should find the default setting files of ‘#####’.swf and ‘#####’.html. The .swf file is the movie in the Flash Player and the .html is a web page produced with the same background colour as your movie with the movie embedded in it.
4. You can change the types of files produced on publishing the movie (see To set the properties for the publishing below).
To set the properties for the publishing:

1. Select File on the Menu bar
2. Select Publish Settings, you will see the following window appear.

3. You can produce as many of the files shown listed in this window as you want when publishing. For the CBT Flash (.swf), HTML (.html) and Windows Projector (.exe) are selected using the .exe files for the download files. None of these files can be changed without the .fla file.

4. Once the files have been chosen you can click on Publish on this window to publish the movie.

5. Once it has been published you can click on OK.

Saving and Exiting Flash

To Save a file in Flash:

1. Click on File in the Menu bar and select Save As
2. You are then asked to enter a name for the file to be saved as (saved as a .fla file)
3. If you have already saved the file once and you wish to save again as the same name then select File and then Save.

To Exit Flash:

1. Click on File in the Menu bar and select Exit.
2. If you haven’t recently saved your file you will be prompted to do so. If you do not wish to lose your work then save your file before exiting the application.
This user guide contains the basic information required for getting started with a movie to implement another module of the CBT. For further and more advanced information please refer to the Flash 5 Bible written by Robert Reinhardt and Jon Warren Lentz, published by Hungry Minds Inc. in 2001.
User Guide for updating the web pages

The Website
The web pages are written in standard HTML therefore updates to the text in the web pages can be done by using a text editor e.g. Notepad. Alternatively if you are not really confident with HTML then you can use either Dreamweaver or Microsoft FrontPage, these are WYSIWYG (What You See Is What You Get) interfaces, therefore you are given a picture of what the web page would look like as displayed on the WWW and you can make alterations to it this way adding and editing text in the same way you would with a word processor.

How to update the Menu system on the website
The menu system is fairly easy to use; the only file you will ever need to change to add or modify the links is the HM_Arrays.js file (annotated and shown below).

```javascript
HM_Array2 = [
    [100, 30, 225, "black", "white", "#9999ff", "blue", "black", "black", 1, 1, 0, 1, "null", "null", false],
    ["Home","index.html",1,0,0],
    ["e-Learning","",1,0,1],
    ["Useful Links","links.html",1,0,0],
    ["Search Engines","",1,0,1],
    ["Contacts","",1,0,1],
    ["Glossary","glossary.html",1,0,0],
    ["Lectures","lectures.html",1,0,0],
    ["Coursework","coursework.html",1,0,0],
    ["Exam","",1,0,1]
]
HM_Array2_2 = [
    The top area of the file is the setup of the menu, whether you want it to be horizontal or vertical, the colours of the menu upon certain actions. The menu width and height can also be set here.
    This is where the menu is constructed, each item in the menu is held as an array within the [] brackets. The first item in the brackets is what will be seen in the menu e.g ‘Home’. Then there is the link attached to the item
```
HM_Array2_4 = [
[],
["Google","http://www.google.co.uk",1,0,0],
["Yahoo","http://www.yahoo.co.uk",1,0,0],
["Lycos","http://www.lycos.co.uk/",1,0,0]
]

HM_Array2_5 = [
[],
["Roger Boyle","contact.html",1,0,0]
]

HM_Array2_9 = [
[],
["Past Exams","pastexams.html",1,0,0],
["Questions","questions.html",1,0,0]
]

If in the setup it is decided that there will be a submenu from an item in the top level, the submenu is constructed by another set of links. It is constructed as follows:

HM_Array2_4 = [
[],
["Google","http://www.google.co.uk",1,0,0],
["Yahoo","http://www.yahoo.co.uk",1,0,0],
["Lycos","http://www.lycos.co.uk/",1,0,0]
]  

The number 2 in the HM_Array line means the second submenu, the number 4 means it is a submenu for the 4th item at the top level of the menu. The rest of the menu is constructed in the same way as the top level.

N.B. You can have as many submenus as you like within the menu system.

Any changes made to this file need to be saved, once you have saved this file, the menu on all the web pages it appears on will have been updated.
Appendix E – An example of a Module in the CBT
Network Layer - Internetworking

A bridge has access to the physical addresses of all the stations connected to it which means that when a frame is received at the bridge, the bridge will retransmit the frame to the other stations connected to it. This is called network-level addressing. It will then forward the retransmitted frame to the segment to which the address belongs.

**Example:**
- A 5000 bridge is a bridge that has two segments together. It carries traffic to all the addresses of the stations connected to both segments. It may prepare a new frame for each new address. It will forward the frame to the segment to which the address belongs.

**A Bridge:** A bridge that is used to connect more than two LANs.

**A Transparent Bridge:** A bridge that has at least two segments together. It contains a table of all the addresses of the stations connected to both segments. It may prepare a new frame for each new address. It will forward the frame to the segment to which the address belongs.

**A Forwarding Bridge:** A bridge with three segments together. It contains a table of all the addresses of the stations connected to both segments. It may prepare a new frame for each new address. It will forward the frame to the segment to which the address belongs.

**A Reversing Bridge:** A bridge with four segments together. It contains a table of all the addresses of the stations connected to both segments. It may prepare a new frame for each new address. It will forward the frame to the segment to which the address belongs.

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**A Bridge:** A bridge that is used to connect more than two LANs.
Network Layer - Internetworking

How it works!
Routing decisions for packets are made separately; these decisions can sometimes depend on the amount of traffic at the time it is being sent.

Disadvantages of this method are there are no guarantees that the packets will arrive in the correct order, there is also no guarantee that they will arrive at all.

Network Layer - Internetworking

What are they used for?
A Firewall is a security device that protects a local area network from attack by unauthorized users attempting to access the LAN from the Internet.

There are 2 categories of Firewalls:
- Filter-based Firewalls install a list of IP addresses that characterize the packets the Firewall can and cannot let through. This list contains the IP address and port number for both the source and destination addresses.
- Proxy-based Firewalls use a proxy process that sits between a client process and a server process. This allows the proxy to access the server and then return the results to the client.

Acknowledgements

Congratulations, you have finished the course on Internetworking.

The Movie Explorer for Internetworking.
Appendix F – ‘Testing’ Interviews

Tester 1 Interview

Questions on the Website
1. Did you find the website easy to navigate?
   • Yes it was easy to navigate but maybe you could put a link on the Introduction Module page saying ‘if you are having problems with the CBT please consult the User Guide’.
   • Also add a more obvious link to the CBT, out of the menu system.
2. Does the website contain all the relevant information?
   • Yes all the relevant information is there but a link could be added to the Computer Departments Home page.
3. Would you like anything changed on the website?
   • Maybe make the purple on the menu a little lighter so it is a little easier to read.
4. Any other comments?
   • ‘It’s really good, I’m very impressed’

Questions on the CBT
5. Did you find the CBT easy to navigate?
   • Yes it was easy to navigate but maybe the inclusion of an index at the beginning of each module would be useful.
   • Change the text size were possible to make it easier to read
6. Should there be more instruction on the navigation?
   • No, I think it was ok.
   • Maybe include a ‘Next’ button on the Introduction Module contents page so the user can just run through the CBT from start to finish.
7. Did you find the questions a useful feature of the CBT?
   • Yes especially having the revise button available if you got the question incorrect, it will take you back to the section you need to revise.
8. Is the information relevant?
   • Yes all the information is relevant
9. Did you find the use of the feedback helpful when you got questions correct?
   • Yes
10. Is there anything you would like changing?
    • A little more praise on the pages saying you got a question correct.
    • Implement a ‘Try question again’ button on the Incorrect pages.
11. Use of Colour and graphics appropriate?
   • Very well put together, I liked the use of the colour and the graphics in the animations.

12. Opinions on the general appearance.
   • Looks very professional

13. Any other comments?
   • The diagrams are really good.
   • It's good for showing how something works with the diagrams and animation. More diagrams were appropriate as just text is not really that helpful.

14. Would you have found this CBT useful to help you with the module SI22?
   • Yes very much so.
   • Emphasis on the CBT from the lecturer would make me look at it.
Tester 2 Interview

Questions on the Website
1. Did you find the website easy to navigate?
   - Extremely easy to navigate, the menu system is really good, it's just a shame you can't view the menu on Konqueror
2. Does the website contain all the relevant information?
   - Yes all the relevant information seems to be available; you will have access to all the SI22 details such as coursework, lectures and exam papers as well as the CBT.
3. Would you like anything changed on the website?
   - No
4. Any other comments?
   - 'It looks very good, it's nicely designed with not too much clutter'.

Questions on the CBT
5. Did you find the CBT easy to navigate?
   - Yes
6. Should there be more instruction on the navigation?
   - No I think it is quite self explanatory
7. Did you find the questions a useful feature of the CBT?
   - Yes. It makes the user think about what they are reading about a little bit more.
8. Is the information relevant?
   - Yes
9. Did you find the use of feedback helpful when you got questions correct?
   - Very useful. It's like an extra form of revision.
10. Is there anything you would like changing?
    - No, not really.
11. Use of colour and graphics appropriate?
    - Yes
12. Opinions on the general appearance.
    - Looks very good. Very well designed.
13. Any other comments?
    - I like the use of the animations and diagrams to show what is happening.
14. Would you have found this CBT useful to help you with the module SI22?
    - 'Extremely useful'.

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**Tester 3 Interview**

**Questions on the Website**

1. Did you find the website easy to navigate?
   - ‘Yes, extremely simple, concise and very well laid out. I liked the glossary and the menu system is really good.’

2. Does the website contain all the relevant information?
   - Yes all information that is possible to fill in right now was available

3. Would you like anything changed on the website?
   - No

4. Any other comments?
   - ‘Very useful, no website was available before so it should be very good for students.’
   - ‘The glossary, useful links and exam questions are all very good.’
   - ‘Contains all the information you need.’
   - ‘Superb website, I only wish I had the opportunity to use it.’

**Questions on the CBT**

5. Did you find the CBT easy to navigate?
   - ‘Yes, pretty simple. Nothing too demanding, it all worked’

6. Should there be more instruction on the navigation?
   - No it was very self-explanatory.

7. Did you find the questions a useful feature of the CBT?
   - Yes, especially when I got them right.
   - Makes the learning more interactive
   - Gives a sense of accomplishment when you get them correct

8. Is the information relevant?
   - Definitely, it all seems to follow a logical pattern

9. Did you find the use of feedback helpful when you got questions correct?
   - Yes, if you guessed the answers, it’s good to know why it was correct.
   - The ‘Revise’ and ‘Try question again’ buttons were excellent features.

10. Is there anything you would like changing?
    - Possibly the size of the text in some areas

11. Use of colour and graphics appropriate?
    - Yes definitely, the animations were good for showing what should be happening.
12. Opinions on the general appearance.
   - Very neat, looks professional!

13. Any other comments?
   - ‘Excellent informative learning tool.’
   - Being able to download the modules is very useful as reading through once probably isn’t enough so having it available on your personal computer is a great idea.

14. Would you have found this CBT useful to help you with the module SI22?
   - Definitely, I struggled with this module so any extra help would have been great.
Tester 4 Interview

Questions on the Website

1. Did you find the website easy to navigate?
   • Yes it seemed relatively easy to navigate. I had no problems finding the required information.

2. Does the website contain all the relevant information?
   • It contains all the areas relevant to the module – coursework, exams and lectures. I think it has the potential to hold everything needed.

3. Would you like anything changed on the website?
   • No, I like it, easy to understand, not too crowded with information.

4. Any other comments?
   • ‘It’s simple and easy to read. A useful website for the students. I like the design.’

Questions on the CBT

5. Did you find the CBT easy to navigate?
   • Very easy, seem self-explanatory.

6. Should there be more instruction on the navigation?
   • No, it is obvious how to navigate but there are also helpful hints along the way as well.

7. Did you find the questions a useful feature of the CBT?
   • No, it gives the user a sense that they are learning something by doing the training.

8. Is the information relevant?
   • Yes

9. Did you find the use of feedback helpful when you got questions correct?
   • Yes I like that feature. I also like the ‘Revise’ and ‘Try question again’ buttons when you get a question wrong.
   • You are given more freedom about how to navigate through the training to your benefit.

10. Is there anything you would like changing?
    • The size of the text in large paragraphs is a little difficult to read sometimes, but I wouldn’t say this was a major problem.

11. Use of colour and graphics appropriate?
    • Very much so, I really liked the animations in the Internetworking module.
12. Opinions on the general appearance.
   • Looks very neat, not cluttered.

13. Any other comments?
   • 'Would be an excellent learning aid for the students taking the module, I wish I had the benefit of it.'

14. Would you have found this CBT useful to help you with the module SI22?
   • 'Absolutely, it would have been great to have access to something like this to help revise etc.'