CNDS Project

Module details

Module number CO32006
Module name: Computer Networks and Distributed Systems
Session: Semester 1, 2001/2002
Version: UK (requires localisation)
WWW reference: http://www.dcs.napier.ac.uk/~bill/cnds.html

Student workload

Lectures/Tutorials	24 hours
Practicals/Project Work	12 hours
Examination	2 hours

Assessment

Examination	40%
Project	60%

Module aims

The main learning outcomes are:

- To provide an understanding of importance of the OSI model, and how standard protocols and networking types fit into this model.
- To describe the advantages and disadvantages of differing network topology types, and how topology affects the performance of a network.
- To outline the operation of typical networking technologies, especially Ethernet and ATM.
- To describe methods of routing used on the Internet and with ATM networks.
- To understand the architecture of the Internet, and how data is routed from one node to another, over interconnected networks.
- To understand how data travels from one application to another, over a network

Module content

The areas covered are:

- **Network fundamentals**. OSI model. Data encapsulation. Network Topologies. Network elements: hubs, bridges, routers and switches. Peer-to-peer and client/server networks. Ethernet and ATM.

- **LAN/WAN network types**. Practical network types, especially Ethernet and ATM.
- **Network protocols**. TCP/IP. IP: Functions, IP addressing, IP routing, IP header, IP addressing, subnetting. TCP: Functions, TCP header, UDP header, three-way handshake. Network programming.
- **Network security**. Security: IP spoofing, session hi-jacking, and so on. Firewalls/Proxy servers.
- **High-level protocols**. WWW page delivery (HTML, VBScipt, JavaScript, ASP/PHP, CGI).
- **Mobile computing**. WAP.

Project selection

Students must select **one** of the two projects attached with this document. The first involves research/analytical skills in tracing routes over the Internet, and the other involves design/development skills in developing a small prototype of a network application. The generic aim of both is to illustrate how data is transmitted over a network from one host to another.

CNDS Project 1

Details

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ASSIGNMENT/COURSEWORK AIMS

The aims of the assignment are:

- To investigate the connection of Napier University to the Internet.
- To investigate the connection from SuperJANET onto the Internet.
- To investigate how IP data packets are routed from Napier University onto the Internet.
- To investigate the main routes that data packets take around the global Internet.

ASSIGNMENT/COURSEWORK BRIEF

Select a **single** organisation which has at least **three** WWW servers which are distributed over a large area (possibly in three different continents). For example Intel has a site in Australia (www.intel.com.au), in Brazil (www.intel.com.br) and in the USA (www.intel.com). Trace the route that data packets take to reach these three severs. If possible, identify:

- The common route that all the data packets take after they leave a PC in Napier and go to their external destination.
- How the data is routed out of the UK, and onto a destination.
- The differences in the routes to the destination WWW servers.
- The main routes the data packets take when they traverse across a country/continent.

Background

The Universities around the UK attach onto a common network, which is known as SuperJANET (Joint Academic NETwork). SuperJANET is mainly constructed using MANs (Metropolitan Area Networks), which connect to one of four main hubs (see Figure 1). The hub points are in Leeds, Bristol, London and Manchester. The universities in Edinburgh connect onto the EaStMAN (Edinburgh and Stirling MAN), as shown in Figure 2, and Table 1 outlines some of the currently developed MANs around

the UK. Normally after data is routed out of the SuperJANET network it will be routed onto one of the main Internet backbones, such as:

- Teleglobe network. [teleglobe.net]
- C&W backbone. [cw.net]
- UUNET backbone.
- BBNPlanet backbone [USA]. [bbnplanet.net]

JANET and SuperJANET

JANET is the UK's academic and research network, which is funded by the JISC (Joint Information Systems Committee) of the Higher Education Funding Councils of England (HEFCE), SHEFC (Scotland), Wales (HEFCW) and the Department of Education for Northern Ireland (DENI). JANET is managed and developed by UKERNA.

The JANET network connects to many higher education and research institutes. It also provides a connection onto the Internet, other National Research Networks (NRNs) in Europe, the US and the rest of the world. Gateways out of the network to the rest of the world are located within SuperJANET.

SuperJANET was initiated in 1989 and provided a broadband fibre optic based network. It was envisaged as a network of networks formed by a national network complemented by a number of regional networks (MANs) serving areas where several HE institutions are located closely together. The SuperJANET project has transformed the JANET network from one primarily handling data to a network capable of simultaneously transporting video and audio as well as data.

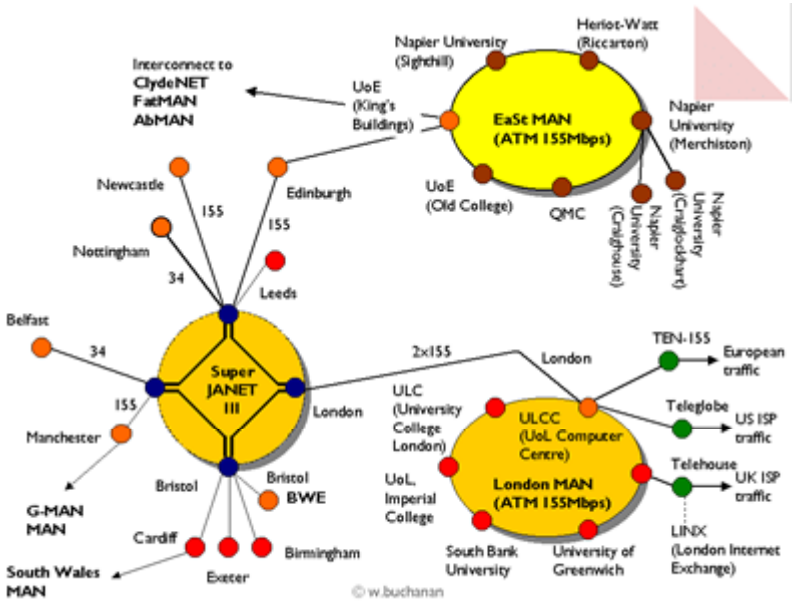

Figure 1: Connections onto SuperJANET

EaStMAN

The EaStMAN (Edinburgh and Stirling MAN) network connects all of the universities around Edinburgh (Figure 2). It consists of two rings on ATM and FDDI, which run around the Edinburgh sites. This also connects to the University of Stirling through a 155Mbps SDH connection. The main connection to the SuperJANET network is at the University of Edinburgh.

The 100Mbps FDDI dual rings link 10 Edinburgh city sites. This ring provides for IP traffic on SuperJANET and also for high-speed metropolitan connections. Initially a 155Mbps ATM network connected five Edinburgh sites and the University of Stirling. The main connected sites are:

- University of Edinburgh (King's Buildings/ Old College/ New College/ Pollock Halls).
- Heriot Watt University (Riccarton Campus).
- Napier University (Sighthill/Merchiston).
- Edinburgh College of Art.
- Moray House (Holyrood Campus).
- Queen Margaret's College (Corstorphine).

The network is now being expanded to connect the other Scottish MANs, such as FatMAN, AbMAN and ClydeNET. This will support a Virtual Campus around Scotland. With this, lectures can be transmitted from one of the sites, and viewed by students on other campuses and institutions.

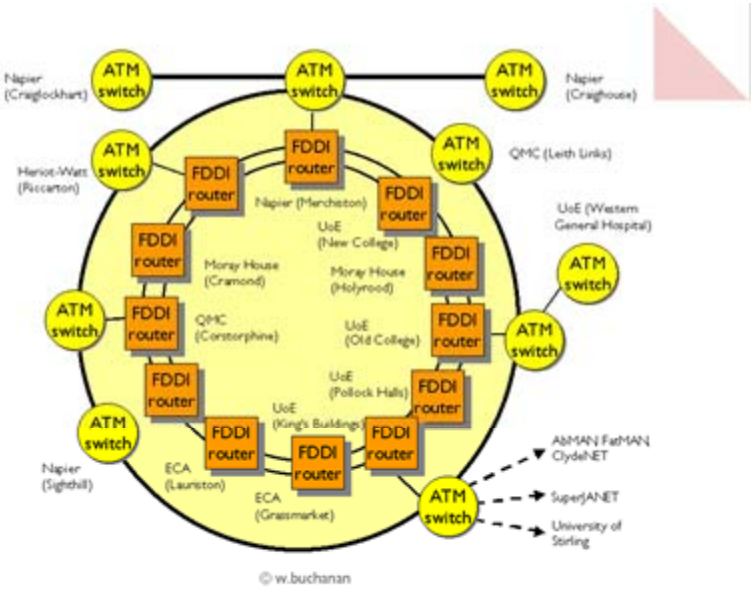

Figure 2: EaStMAN connections

RESOURCES

- TCP/IP programs, such as ping, telnet, and so on.
- Windows 95/NT network utilities (such as NetLab 1.4, Wsock, Ping Pro, and so on).
- PC and a network connection.

Marking Schedule

A report should be submitted which will normally have less than 20 pages of typed A4 (*quality is more important than quantity*), and additional material and appendices should be put on your WWW site, or submitted on disk.

This report should investigate the connection of the Napier network to three remote WWW servers. The assignment will count for 60% of the final mark of the module. The marking schedule which will be used is:

Abstract	[10%]
Introduction	[10%]
Theory	[15%]
Research into network connections	[20%]
Test results	[20%]
Conclusions	[15%]
Report structure/ references/ research techniques	[10%]

Each of these sections will be given a grade:

Excellent.	A+ (100%),	A (92.5%),	A- (85%),
Good.	B+ (77.5%),	B (70%),	B- (62.5%),
Fair.	C+ (55%),	C (47.5%),	C- (40%),
Weak.	D+ (32.5%),	D (25%),	D- (17.5%),
Poor.	E (10%) or		
Extremely poor.	F (2.5%).		

The final mark will be generated using these grades and the weighting given above. For example:

Abstract	*Introduction*	*Theory*	*Research*	*Test results*	*Conclusions*	*Report structure*	*Final mark*
10%	10%	15%	20%	20%	15%	10%	100%
A+	B	B	A+	D	C-	B-	65%
C	C	C	C	C	C-	C	46%

Report structure

A possible structure for the report could be:

1	**Abstract** [10%] A focus summary of the complete report.
2	**Introduction** [10%] Objectives, background, methods used.
3	**Theory** [15%] TCP/IP, TCP/IP commands (Ping, nslookup, tracert).
4	**Network research** [20%] SuperJANET backbone, Connections onto SuperJANET, External connections from SuperJANET. Outline of the routes taken to the remote WWW servers.
5	**Test results** [20%] Discussion of why you have chosen the destination WWW servers. Listing of your three traceroutes with an outline description of each of the routes.
6	**Conclusions** [15%] Strong conclusions which summarise your main findings.

CNDS Project 2

Details

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ASSIGNMENT/COURSEWORK AIMS

The aims of the assignment are:

- To demonstrate how applications transfer data over the Internet, using a structured approach based on the OSI model.
- To implement a prototype of an application which implements code which illustrates how data passes between applications on the Internet.
- To illustrate how the prototype can be expanded into a complete system.
- To present background theory to underpins the system prototype.

ASSIGNMENT/COURSEWORK BRIEF

Develop a prototype of a networked application which achieves the above aim. A basically outline is given below, but should also contain **enhancements** to the basic specification. It is possible to develop the prototype as an individual or as part of a group of two or three, but the report must be an individual one, and the part of the code completed by each person must be identified.

A. Session-layer protocol prototype

Design and implement a prototype of a Windows-based client-server system using WinSock programming (with VB/ Java/ C++/ Delphi/ and so on), which will implement a basic session layer protocol. This might include a basic PUT and GET command structure, sending some file/directory information, and with some form of authentication. Possible skills: Software development, WinSock.

B. Chat client-server program

Design and implement a prototype of a stand-alone system which allows two users to communicate over a network. The program will typically use either Macromedia Flash or WinSock programming to implement the system. It should have several enhancements over the basic client/server system, such as the ability to pass a user name, and the ability to create a time-out on the connection, so that the each side will disconnect the connection if the other side is not communicating. An excellent enhancement is for the client to scan a whole subnet looking for a server on a given port. Possible skills: Flash development/WinSock programming.

C. XML-based sports content delivery prototype

Many types sports and news content are now delivered in XML format, to a WWW-based system. This project involves the development basic prototype for the reading of XML-based data into a WWW-browser. The prototype should be able to read an XML file from a server which has some media content, such as sports results or news flashes, and report them to the WWW page. Enhancements might include the ability to read the XML file at regular intervals, which would be reflected in the displayed content, and the ability to read content from several different sources (a distributed system for delivery). Possible skills: Flash development/WWW integration.

D. Secure WWW-access

Design and implement a secure system which allow users to register their details, and gain access to WWW pages. The system should detect the user's network address, domain name, and so on, and base the security on this. An enhancement to this might be to implement it using a database, rather than using text files. Skills: WWW integration with PHP/Apache server (and, possibly, MySQL) or ASP/IIS or PWS and, possibly, Microsoft Access).

RESOURCES

Code snippets for these projects can be found at:
http://www.dcs.napier.ac.uk/~bill/code_snippets.html

Marking Schedule

The assignment will count for 60% of the final mark of the module. The marking schedule which will be used is:

Introduction	[10%]
Theory	[15%]
Design	[20%]
Implementation	[35%]
Conclusions	[20%]

Each of these sections will be given a grade:

Excellent.	A+ (100%),	A (92.5%),	A- (85%),
Very Good.	B+ (77.5%),	B (70%),	B- (62.5%),
Good.	C+ (55%),	C (47.5%),	C- (40%),
Weak.	D+ (32.5%),	D (25%)	D- (17.5%),
Poor.	E (10%) or		
Extremely poor.	F (2.5%).		

The final mark will be generated using these grades and the weighting given above. For example:

Introduction	*Theory*	*Design*	*Implementation*	*Conclusions*	*Final mark*
10%	15%	20%	35%	20%	100%
A+	B	B	A+	D	75
C	C	C	C	C	48

Report structure

A possible structure for the report could be:

1	**Introduction** [10%] Objectives, background, methods used.
2	**Theory** [15%] Outline of TCP/IP. Research (FTP/TELNET/etc). DO NOT COPY DIRECTLY FROM THE WWW.
3	**Design** [20%] Some formal design of the system. This could be using abstract methods such as block diagrams of the system, data flow diagrams, structure charts, or could be formal design of the modules/components.
4	**Implementation** [35%] A discussion of the actual prototype, with important code snippets which should the operation of the main elements of the project.
5	**Conclusions** [20%] Strong conclusions which summarise your main findings. Don't just say that it was a really good project, and everything think went really well, as it's unlikely that it did. Every system has its faults, and things that can be improved on. If you've found a better way to do something, then talk about it. As much as possible discuss the good things about your system, and outline the problems, and how they could be overcome.