Chapter 61 - The Internet

61.1 Introduction to the Internet

'The Internet' is the term used to describe the many individual computers and networks that are interconnected across the world. The term 'Internet' encompasses a number of features. The main ones are:

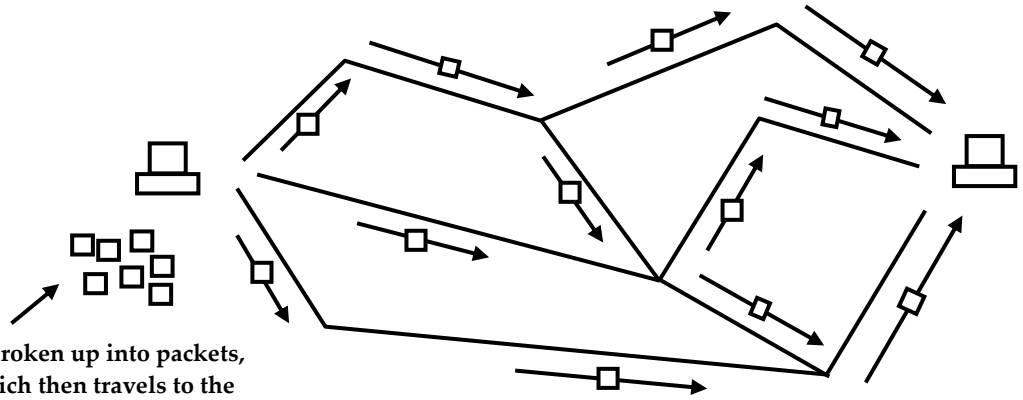
- The World Wide Web.
- Email.
- File transfer.

61.2 Communication on the Internet - TCP/IP

If two computers are going to communicate, they must use a communications protocol. This is simply a set of rules that govern how communication will take place. The two basic protocols used on the Internet are IP (Internet Protocol) and TCP (Transmission Control Protocol). Together, they are referred to as TCP/IP. TCP/IP controls how information is successfully transferred between two computers. The computer systems communicating may not be of the same hardware or the same software but so long as they use the TCP/IP, a bridge can be built between them over which information can pass. This protocol is the foundation for other protocols. So, for example, the SMTP protocol used for sending and receiving emails calls on the TCP/IP protocol to aid it sending and receiving emails. When pages are requested using http, TCP/IP has a role in the communication that takes place.

61.3 Packet Switching

You studied packet switching and circuit switching in a previous chapter. To recap briefly, when computers on the Internet communicate, information is sent in packets. The original information is split up into a number of packets. The destination IP address is added to each packet, along with reassembly information. The message is then sent. Each packet may well travel along different paths to get to the final destination! The recipient will collect the packets together as they arrive. When they have all arrived, it will recombine them into the original information. Packet switching is only as fast as the slowest packet to arrive. It is very secure because it is practically impossible to intercept all of the packets for a particular communication.



An email broken up into packets, each of which then travels to the destination by a different route.

The Internet is a packet switching network.

61.4 IP addresses, domain names and domain name servers

Each computer on the Internet has got its own unique IP address, or Internet Protocol address. 204.75.342.16 is an example of what an IP address looks like. It is attached to packets so that they know where to go! You can only send information if you know the IP address! However, humans prefer to use words rather than numbers so many computers are called by a **domain name**. For example, Microsoft.net is the domain name of the Microsoft Corporation. When you want to go to the web page for Microsoft, you type the website address into the **URL** and press enter on your keyboard. This is intercepted by a domain name server. The job of the domain name server is to look up in its database the website you have typed and find the matching IP address (or contact another DNS and see if they know it). Then it forwards the request onwards, using this address. When the request reaches the destination, the pages are sent back.

61.5 Uniform Resource Locator (URL)

The URL is the unique address for a website. An example of a URL is **http://www.theteacher.info**
Three pieces of information can be contained in a URL.

- It will state what communications protocol to use (in this case Hyper Text Transfer Protocol).
- It will also specify the domain name to use, in this case theteacher.info.
- It may also specify a particular file. For example, the URL **http://www.bbc.co.uk/news** would take you to the news web page, at the domain name bbc.co.uk using the communications transfer protocol http.

Each domain name is unique. To use a domain name, you must register it with a company set up for that purpose. It is not particularly expensive - you can register your own **co.uk** domain Name for a few pennies! In the last few years, many of the 'good' domain names ending in **com** or **co.uk** have been registered. Domain names are highly prized and you have to be quick (or inventive) to get a really good, memorable name. Some domain name registration companies can be found via the links page. You could also do a search for 'Domain Name Registration UK'. You'll find many sites! New domain names ending in **biz**, **info**, **cc** and **name** have been recently created to allow more domain names to be registered and new ones are added all the time. The endings (biz, name and so on) are all directed at particular users. For example:

- Domain names ending in **.com** were designed for commercial businesses but are in practise unrestricted. For example, you could register a site called **www.alwaysworkhard.com** if it were available.
- Domain names ending in **.name** are designed for individuals. For example **www.david.cooper.name** could be registered if it were available.
- Domain names that end in **.info** can be registered by anyone. For example, **www.backgroundreading.info** could be registered if it were available.

61.6 FTP

As well as putting information on the Internet, you can make files available for downloading. There are different ways of achieving this but a common way is to use ftp or the File Transfer Protocol. A user needs to log into the host's computer using an ftp program. They type in an ID and password. They can then view the files available and download what they require. You can use a web browser to access ftp sites, although it is worth having an ftp program if you intend uploading and downloading lots of files - the Graphical User Interface with drag and drop capabilities is a lot easier to use than typing in commands into a web browser. Many companies make a number of files available by creating a public area. Users can log in using the ID 'anonymous' and password 'guest'. You can download and try out a wide range of ftp programs such as Cuteftp or WS_ftp from **http://www.tucows.com/** before you decide which is the best one for you.

61.7 Your own web site

If you decide to buy a Domain Name, then you will want to create a web site for others to access. To do this, you will need to find a Web Host. This is a company that stores people's web sites so they are available on the Internet. One to look at is **http://www.reg-123.co.uk** or you could use a free Web Hosting company. Search here: **http://www.freestuffjunction.co.uk** or alternatively, set up a **Yahoo** account and use their excellent free **Geocities** web hosting service (found on Yahoo in Services). Your own ISP will often give you plenty of free web space to use although it will be a very basic package with no facilities, such as being able to use MySQL or Perl or CGI scripts, for example. Businesses, however, typically pay for web space from a specialised company. They give you many more features and facilities that wouldn't be available from your ISP. Try doing a search on the Internet for 'web hosts UK' and see what you can find out! Once you have a Domain Name and a Web Host and you have actually made your web site, then you will need to use an ftp program to enable you to **upload** your web pages to your Web Host. You will need to find out the ftp address. Look on their web site or email them and ask them!

61.8 Email

Email is a way of sending and receiving information. Each user will have a unique email address that is made up of the Domain Name of the ISP and their unique user name with that ISP. Mail is transferred using communications protocol known as SMTP, or Simple Mail Transfer Protocol. SMTP makes use of the TCP/IP protocol to aid communication.

61.9 Intranets

Companies and organisations often have 'Intranets'. This is a system that provides the same kind of facilities as the Internet but they are only available from within the organisation itself and runs from a local server, so web pages of information can be accessed very quickly indeed. Users on the Internet, however, may be able to dial into an organisation's Intranet and use the Intranet's resources. This might be very useful, for example, for a customer to get access to specialised technical data or for a salesman to check availability from a database kept on the Intranet or for a company to advertise itself. Internet access to an

intranet is sometimes referred to as accessing an **extranet**! Intranets need to be very secure and will typically make use of firewalls and proxy servers to control access to sensitive information.

61.10 The features of HyperText Markup Languages (HTML)

HTML is a computer language whose purpose is to create **multimedia pages** on a computer. The following are some of the features of a web site written using html.

- The first page of a web site is called the 'homepage'. Its file name is usually either index.html or index.htm
- HTML is a mark-up language. It is written as a script - a sequence of instructions (tags) that tell the browser how to display something. It is not a programming language as such - it doesn't use SEQUENCE, SELECTION and ITERATION. It is possible to 'embed' into an html page a program written in e.g. Java.
- Instructions or tags in an html document tell a web browser how to display a web page. Many but not all tags come in pairs. You can view tags and pairs of tags by viewing the HTML code of this page. In Explorer, go to VIEW - SOURCE. In Netscape, go to VIEW - PAGE SOURCE. The tags are in angled brackets.
- A web page has a HEAD and a BODY. The information held in the HEAD isn't displayed. It contains things like the words a search engine will look at when deciding if the web page is relevant to a search request. The BODY holds both the information to be displayed and the tags used to format the display.
- Web browsers decide how to layout information - carriage returns and extra spaces are ignored in web browsers. If you need to create spaces between words, or to layout text in a certain way, there are many tricks around. For example, you can use 'invisible' tables to layout work, or space work out using the non-breaking space code.
- Web browsers use hypertext linking (also known as **hotlinks** or **hypertext**) to jump you from one web page to another. It is quicker and more accurate than typing in a URL.
- HTML pages contain text, pictures, animation, movies and sound, collectively known as multimedia.
- The content and the style of a web page can be divorced in newer versions of html. That means that you can set up different 'style sheets'. A style sheet is simply a text page that contains information about how to display information! For example, you might have some tags in a style sheet that say "Display all headings in size 1, underlined and red"! If this style sheet is then applied to a web page then whenever it comes across a piece of information that's a title, it formats it according to the style sheet's instructions. Style sheets in html are very useful. Imagine, for example, you have written 100 pages of information, each with a green page background. If you changed your mind and wanted a blue background, you would only need to change one page, the style sheet, instead of 100 individual pages.

61.10.1 Web site organisation and hotlinks

You can access web pages by typing in a URL in a web browser. However, you can also access pages by using **hotlinks** (also known as **hyperlinks**) as mentioned earlier. This is simply a technique used in HTML that allows a reader on one web site to quickly access other pages in the same web site, or on other web sites, by clicking on a word or picture that has been set up for that purpose. It saves the user having to type in long URL links, which is time-consuming and prone to mistakes. Somebody who designs a large web site will typically split up their site into a number of pages. There will be the 'homepage', which is the main, introductory page and then there will be many other pages, each with some logically grouped information on them. Connections between each page in a web site will then be achieved through the use of hotlinks.

61.11 Advantages and disadvantages of email over non-email methods.

One very important part of the Internet is email. Email has many advantages and some disadvantages compared to more conventional methods of written communication.

1) You can send email at **any time**. You can also receive email at any time. This would not be true for letters.
2) An email will get delivered very quickly, sometimes in a **few seconds** although sometimes it can take a little longer. Letters will take days. Faxes are immediate but the **quality** of faxes is not good compared to letters or emails and you still have to pay for the price of the phone line.
3) You can easily send one message to many people. You can set up a group called 'A LEVEL PUPILS', for example, and put all their email addresses into it. Then, as a deadline for an assignment approaches, you can write one message and send it to all the members of that **group**.
4) You can send **carbon copies** and **blind carbon copies** of a message (CC and BCC). A blind carbon copy means the recipient will get the message but not see who else the message has been sent to. With CC, they would get the message and also see the addresses of the other recipients.
5) You can **filter** out messages. If you don't want to receive a message from a particular email address, you can reject mail from that address. If a message contains certain words then it can be blocked.

6) You can send the email you receive directly into **different folders**, depending on who they are from. This can help you organise your communications, especially if you have very large numbers of messages being delivered to you.
7) You can **attach** pictures, sounds and movie clips to emails easily.
8) Email messages are **cheaper** to send than letters. This is especially true if you have a lot of communication abroad. This is assuming that you already have the computing equipment and an ISP account set up!
9) You can set up your email program so that a **receipt** is sent to you when it has been delivered.
10) You can '**digitally sign**' your emails.
11) Emails can be **encrypted** easily (using Pretty Good Privacy, or PGP) for security of sensitive communications.
12) You need to have a computer in the first place and have set up an account. This **costs**!
13) You need to have a **basic knowledge** of how to use a mouse, keyboard, logging into an email account and how to use the features of an email application. It is not difficult, but a novice will require some help getting started.
14) You can download **viruses** from emails if you are not careful. Files ending in .exe and .bat, for example, should never be opened unless you are sure of the source. Anti-virus programs will help reduce the potential problem.

61.12 Viruses, worms and Trojan horses

A **virus** is a program that has been written by someone. It can replicate itself, be attached to files and applications and can cause a lot of damage because it can change the contents of your hard disk as well as use up your memory. They can spread very quickly, usually by shared storage devices or email attachments. You should **never** open an email attachment unless you know and can trust where it comes from (by checking a **digital certificate**, for example). Attachments to be especially careful of include file names ending in **.exe .bat .pif .scr and .vbs.**

Other types of viruses include 'Worms' and 'Trojan horses'. **Worms** are programs that can spread themselves via vulnerable network connections. They are standalone programs, unlike viruses, which 'piggyback' on other programs. In addition to unauthorised use of systems and causing damage, they can take up a lot of bandwidth as they spread and slow networks right down. A particularly nasty one called **MSBlaster** affected computers worldwide in August 2003. It spread very quickly, hunting for computers on the Internet without a firewall. When it found one, it jumped into the computer through the open communication port and infected it without the user knowing - until their PC closed down every time an Internet connection was made!! Another one, **W32.Sobig.F@mm** mails itself to all the email addresses it can find on an infected computer. **Trojan horses** are viruses hidden inside seemingly innocent programs. They, too, can cause major problems for your computer.

61.13 Cookies

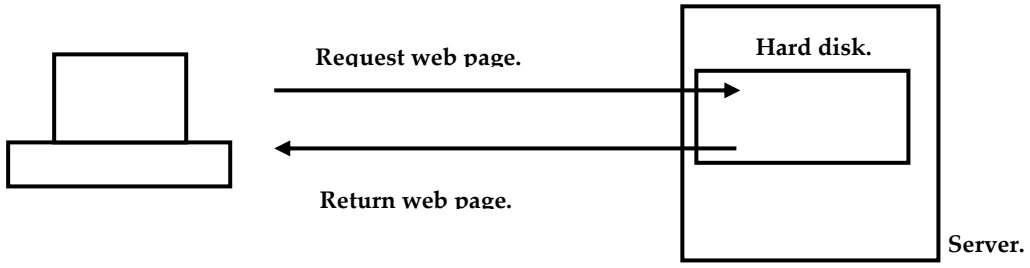
A cookie is text file deposited onto your computer by a website that you have been to. When you next visit the website, the cookie detects that you have been there before and can display content based on what has been accessed previously or can retrieve information entered last time, such as personal details or account details. Many people block cookies on their computer because they don't like the idea that information is being collected about their surfing habits and potentially, being sent back to the websites that they visit. Websites now have to legally ask your permission to put a cookie on your computer.

61.14 Phishing

This is a term used to describe when criminals try to get hold of your credit card details or other personal information by pretending to be someone they are not over the Internet. They do this by sending out bogus emails e.g. pretending to be from a bank and asking you to confirm passwords for security reasons or by setting up a web site that looks like it is a legitimate business and luring you into entering personal data, perhaps by advertising very cheap prices for goods. Despite numerous warnings that organisations never ask for personal details by email, and reminding people that if an offer is too good to be true it probably is, people fall victim to Phishing attacks regularly and can suffer huge financial loses.

61.15 Active Server Pages (ASP)

When you request a web page from your computer, the web server looks for the page and returns it, like this:



Requesting a 'static' web page from a web server.

This type of web page is static. The web page returned always has the same information on it. Developers could add a degree of interactivity in their web pages by using a language such as Perl or CGI. A program in one of these languages would sit on the web server. When the page was visited, these programs would then be called up and run. These types of languages are limited in what they can do. For example:

- **They can't provide the quality of user interfaces that are easily possible with Visual Basic.**
- **They have another problem. Languages such as Perl are interpreted. By the very nature of interpreted languages, they are slow. This slows down the operation of the web page.**

ASP is a technology that allows web page designers to embed code such as Visual Basic into their web pages along with pre-written modules of code known as **components**. This allows each web page to be designed with far more **interactivity** than is otherwise possible. They give the designer the ability to create **dynamic web pages**. ASP pages are pages that can call other programs to run, such as a database application. A database could be searched in response to a specific request from a user. The results of the database search can then be sent back to the user. The web page is **dynamic** because it can respond in different ways to different inputs. ASP pages can also call components and run those. Two examples of components commonly used are:

- **REQUEST (Get information from a web page user).**
- **RESPONSE (Give information to a web page user).**

We can see an example of how these components might be used in a web page. An ASP page is simply an HTML page with some extra instructions in. Below is an example of a ASP page. If you save the file (use the extension .asp) and then upload it to a server that can use ASP, you should see 'My first ASP page!" appear on the screen.

```
<HTML>
<HEAD>
<TITLE>ASP pages</TITLE>
</HEAD>
<BODY bgcolor=blue>
<% Response.Write("My first ASP page!") %>
</BODY>
</HTML>
```

61.16 Java and applets

In the chapter on object oriented programming, we saw how Java was used. We saw that a program is compiled into something called **bytecode**. When you downloaded a web page, your machine interprets any bytecode using its bytecode interpreter. The real beauty of this system is that a Java programmer can write very sophisticated programs in Java and be totally confident that they will work on **any** machine that downloads the web page, regardless of the CPU, the operating system or any applications that are on the machine. This is assuming that the web user has loaded up the bytecode interpreter for their computer! When a programmer writes a program, they compile it into something called an **applet**. An applet is simply a self-contained program in bytecode that can then be sent with a web page. They are self-contained, which means they do not need to communicate with the server that they came from to work. Because they are self-contained, they have the potential to cause problems on a computer. Many individuals and businesses don't like the idea of importing programs into their network via web pages and use their firewalls to block them out. This is unhelpful to the web page designer! Applets are loaded with a request for a web page. They can therefore slow down the loading of a web page. This is especially true if they are particularly large in size.

Q1. What is meant by the 'Internet'?
Q2. Describe what TCP/IP is used for.
Q3. What does URL mean?
Q4. Describe how domain name servers are used to deliver requested web pages to a computer.
Q5. What is an Intranet?
Q6. What are the main features of HTML?
Q7. Discuss the disadvantages of using email compared to non-email methods.
Q8. Define 'Worm' and 'Trojan horse'.
Q9. Use the Internet for research. Are cookies a threat to your computer?
Q10. What is an applet?

Chapter 62 - Security of data

62.1 Maintaining confidentiality of data

The Data Protection Act 1998 requires that an organisation take steps to keep data secure. Any computer system that is accessible to people, either physically or over a network, has a problem - how does it make sure that only those people who should have access to data or resources on a network can do so and everyone else is excluded? How can it ensure that it keeps data secure? You could use firewalls, proxy servers and authorisation, encryption and authentication techniques.

62.1.1 Firewalls, proxy servers and authorisation

A Firewall, according to the British Computing Society's 'A Glossary of Computing Terms', "is a computing program used in a large computing system to prevent external users (even if authorised) getting access to the rest of the system. Network users' access is restricted to a small part of the system and the firewall software prevents a user (including unauthorised users) accessing data or executing any programs in the rest of the system". When a user on a network wants to access data or applications held in a main server, it sends a request for the information. The request is intercepted by the firewall program sitting in a **proxy server**. A proxy server is a server set up to control access to the main server. The firewall program will look at the request and the information about the user that is attached to it. It then checks that both the user is valid and that they have the right to the information they are requesting. It is able to do this because it holds a **database** of all the users and their **associated rights** - it just needs to look up its database! If the request is valid, then the firewall will send a message to a proxy server to retrieve the requested data. The proxy server will then access the data from the main server and pass it out through the firewall to the user. The user cannot access the main server directly but must go through the firewall and proxy server.

62.1.2 Firewalls and authorising a user from outside a LAN

Many computer networks are set up so that users can dial into them to retrieve files and use their resources. To prevent only authorised users dialling into the network, a firewall program on a proxy server can be used. A user dials in to the network with a user ID and password. The firewall looks at these and also looks at the other information automatically attached to the request, such as the individual's IP address. Using all of this information, it attempts to authorise the user. If the user can be validated, then access is granted. The user, however, will continue to work through this firewall and proxy server and will not have direct access to the network itself.

62.1.3 Encryption

As a last line of defence, sensitive data should be encrypted. Encryption is a technique that takes data and scrambles using a key it so that it doesn't make any sense until you decrypt the message using the same key. Users may want to encrypt data for various reasons. For example, data may be encrypted as part of a company's procedures to comply with the Data Protection Act (to keep data secure). It may be that sensitive emails are being sent, for example holding medical, financial, national security or legal information. Remember, emails are sent across the Internet using packet switching. There are programs that hackers can use to 'grab' packets on a network. Since email is simple text, it would be easy to read a packet. It is also possible that you could send information to the wrong address or that messages end up in the wrong place by accident.

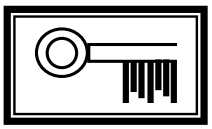
62.1.3.1 Encryption using PGP

Pretty Good Privacy, or PGP, is a very secure method of encrypting data. It takes a message and applies some complex maths to it to scramble the data. PGP is freeware so you can download a copy of PGP from **http://www.tucows.com/** and try it out. There are lots of people interested in PGP - if you do a search for it on the Internet, you will find a lot of information about PGP. How does a pupil called Max use PGP to send secure messages to his friend Alfred?

1) Alfred and Max both download and set up the PGP program from **http://www.tucows.com/**
2) When Alfred sets up the PGP program on his computer, the program generates two software keys for him. These are known as his **public key** and his **private key**.

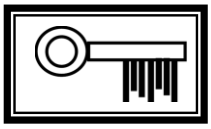
Alfred's public key **Alfred's private key**

3) The private key stays with Alfred on his computer. He sends the public key to whomever he wants to communicate with, in this case, Max. It doesn't matter if this key is intercepted by anyone. It is a 'public' key.



Alfred's public key → **Alfred gives out his public key to anyone who wants it, e.g. to Max!** → **Max**

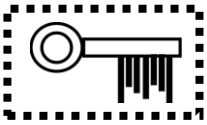
4) Now when Max wants to send a secure message to Alfred, Max writes his email and then using his PGP program and Alfred's public key, he encrypts it. Then he sends the encrypted message.

Max writes an email using his PGP program +  → **Max sends encrypted message to Alfred.** → **Alfred**

Alfred's public key

5) Alfred receives an encrypted message from Max.
6) Alfred uses his PGP program and his own private key to decrypt and read the message.

Alfred receives the encrypted message, opens his PGP program and uses his private key to decode it.



If Alfred wants to return a secure message, he must ask Max to send him his Public Key first.

62.1.4 Authentication and digital signatures

When someone sends you an email, how can you be sure that it comes from whom you think it comes from? You can achieve this by using **digital signatures**. PGP can be used to sign an email digitally, with a special signature. It works like this.

1) Alfred writes an email to Max.
2) He digitally signs it. By that, we mean that the PGP program takes the message and Alfred's Private Key and then generates a signature (a mixture of characters from the keyboard). The signature is attached to the email.
3) Alfred then sends it.
4) When Max receives it, he opens his PGP program and uses Alfred's Public Key to check the signature. If there is any change in the message or Alfred's Private Key hasn't been used, then Max will be told by the computer that authentication has failed and he should consider that the message is not from Alfred or has been compromised.

Digitally signing emails is a very good way of letting your users check communications received. You do not want anyone pretending that they are you and your users need a way of being confident that an email is from who it says it's from.

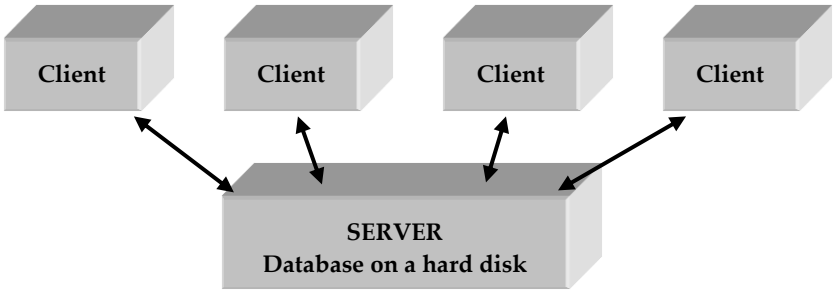
62.1.4.1 Digital certificates

A digital certificate is another way of proving who you are when you do business on the Internet. Certificates are only issued by special companies after a series of stringent security checks. If someone goes to a web site to buy something and the web site has a genuine digital certificate, it increases the confidence of that buyer to do business with the web site.

Q1. What is a proxy server on a network used for?
Q2. What is a firewall?
Q3. What is meant by encryption?
Q4. What does 'authorisation' mean?
Q5. What is a 'public key' as used in PGP?
Q6. What is a 'private key' as used in PGP?
Q7. How can you get a public and private key?
Q8. What is a digital signature?
Q9. How can you sign an email using a digital signature?
Q10. What is a digital certificate used for? How can a company get a digital certificate?

Chapter 63 - Distributed databases

63.1 Introduction

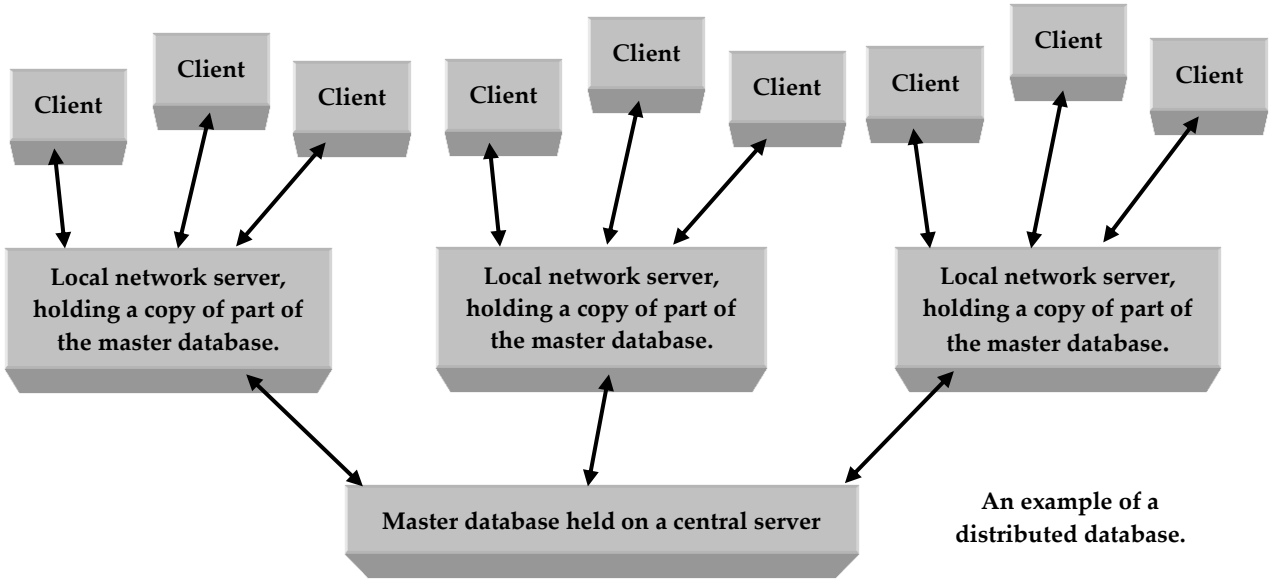


A typical client-server database.

A database actually held on a server and accessed via clients on the network is known as a 'client-server database'. Databases held on a server like this are very secure because security methods can be addressed at one point, the server. It is also going to contain up-to-date data on it - after all, there is only one database of data! The consistency and the integrity of the data can be maintained. Client-server databases have been around a while. Their technology is understood. An example of a client-server database would be the user names and passwords held by on a school's server. When a pupil requests to log in to the school network, the request is sent to the server. The pupil's ID and password is checked against the centrally-held database of authorised users. The request is then either accepted or rejected.

63.2 Distributed databases

Client-server networks are excellent for networks where the clients are physically close to the server, for example, in a LAN. Where the clients are physically far away from a server, then a rethink needs to occur. This is because the time for communication between clients and servers becomes important. In addition, the availability of processing time on the server cannot be guaranteed - another client's request might be being processed. Also, a client might only ever need to access a small part of a database yet it can tie up access to the whole database. This is inefficient. Look at the following diagram.



An example of a distributed database.

Instead of having a centralised database, the database can be **distributed**. There are a number of ways to achieve this. One way is to take the central database, make a copy of it and then split up the copy. Each portion of the database is then stored remotely on a local server, whilst the master database remains on the central server. What each portion actually comprises of will depend upon the needs of the local users. Clients now access the data held on their local server. The local server will periodically access the master database, to update it. This system brings some benefits to users. Since the data for a particular local server is now close to its clients, data access and associated processing is speeded up. Access to the data is now more reliable because the data is local and availability of the data is improved because you don't have to rely on remote communications. There are some

drawbacks, however. Distributed systems are far more complex to manage compared to a centralised, client-server network. This means that software and management costs are higher. Because the data is spread over a number of different servers, there are far more security issues than if the database was in one place only. Keeping the master database up-to-date is an issue that needs to be addressed. For example, you don't want the data in one local server to be different to the same data held in the master database for too long. Also, you don't want the data on a local server to be different to the same data on other local servers for too long either. When updating takes place depends upon the application.

63.3 A classic use of a distributed database - Domain Name Servers (DNS)

Microsoft.com and theteacher.info are examples of Domain Names. The Internet has been around for a long time now and there are literally billions of Domain Names. Every day, new ones are added and old ones become available. We have already seen that the Domain Names system has been devised so that humans, who understand words better than numbers, can type in the address (Domain Name) of a web site and that web site will pop up on the screen. Of course, the real web site address isn't actually a set of words like bbc.co.uk but is an IP address, or Internet Protocol address. An example looks like this: 143.66.43.16
You can look up your own computer's IP address at many different sites here: **http://www.whatismyip.com/**
When you type in a web site, for example, **www.bbc.co.uk**, that Domain Name gets sent to your ISP. Your ISP has a special database kept in a server known as the **Domain Name Server**, where it keeps a database of Domain Names and their corresponding IP addresses. It finds the corresponding IP address and then uses it to locate the server where the web site can be found. The site is then downloaded to your computer.

63.3.1 But where does a distributed database come in to all of this?

Two people cannot have the same Domain Name. There is a central database of Domain Names kept by a company called Network Solutions. When you want to register a Domain Name, you will probably contact an Internet company that specialises in doing this, such as this one: **http://www.reg-123.com** You will type in your address and they will check Network Solutions database. If it is available, you will fill out a few details and pay a small fee. The Domain Name is then yours to use for the period paid for. Network Solutions maintains the master database of all Domain Names. However, every ISP will want to keep its own database of Domain Names. It doesn't make sense for every ISP to keep every Domain Name on its own DNS, however, but only those Domain Names it is likely to need.

63.3.2 How does the DNS distributed database work?

When you type in a web address like www.africam.com, the request goes to your ISP. They look the address up on their DNS database. A number of outcomes are possible.

- Your DNS holds the IP address you are looking for. It uses it to request web pages from other servers.
- Your DNS cannot find the IP address in its own database, but it knows other Domain Name Servers who may be able to help! It then contacts those other Domain Name Servers until one of them returns the IP address that was being looked for. Your DNS then uses it to request the web page for you.
- Your DNS doesn't hold the IP address nor does any DNS it has contacted. It reports that it doesn't exist.

That's how it works! The master database is kept by Network Solutions. All the ISPs keep the part of the master database that they think is most helpful to them on their own DNS. Whenever you request a web site, your own ISP's DNS tries to locate the IP address first and if it can't find it, it enlists the help of other Domain Name Servers.

63.3.3 What happens when a new Domain Name is registered?

When you register a new Domain Name, you will register it with a company set up to take new registrations. That company will send details of your new registration to Network Solutions. Network Solutions will update its master database. They will then send details of the new registrations to those ISP Domain Name Servers who need to know! A new Domain Name can take a couple of days to completely filter down to all of the distributed Domain Name Servers.

Q1. Define 'network'.
Q2. What is a peer-to-peer network?
Q3. What is meant by a client-server network?
Q4. Define 'database'.
Q5. Describe one way a distributed database is organised.
Q6. What do the initials DNS stand for in relation to distributing web pages on the Internet?
Q7. Use a website to find out what your current IP address is or your IP address at home.
Q8. What happens if a DNS cannot find a website you have requested?
Q9. Use the Internet for research. How do your register a domain name?
Q10. Use the Internet for research. What typical range of prices are charged for domain names?

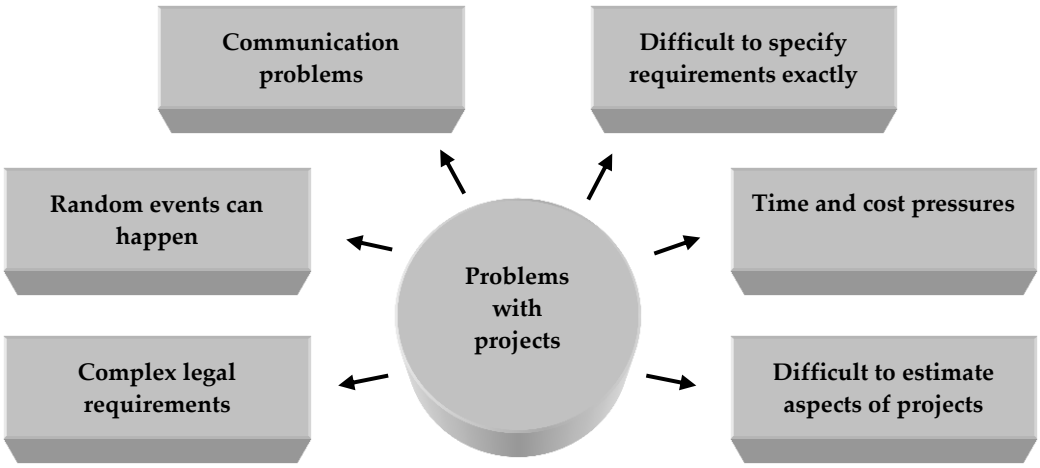
Chapter 64 - Project management

64.1 The aims of any project

There are three main aims of any project. They are easier to state than achieve!

1) The project must satisfy the requirements of the customer.
2) The project must be done within the budget allowed for the project.
3) The project must be completed within the agreed timescales.

64.1.1 Problems with projects



There are often a lot of people working on a project. Projects themselves can be highly complex. Because of these facts, passing information around and ensuring that people get the information they need can be a problem, especially if written documentation is incomplete, not up-to-date or non-existent. This could happen when workers are pressured into completing jobs rather than the paperwork. It could happen if people do not follow procedures when they change something in a project. Communication between different people in projects can be a problem. It can be difficult to get different people to agree to parts of the project. For example, the Project Manager must agree with the customer EXACTLY what the requirements of the project are and must agree with the customer EXACTLY how it will be decided if a requirement has been met or not. The customer may want a system that is 'user-friendly'. How will 'user-friendliness' be measured? What happens at the end of the project if the Project Manager thinks they have built a user-friendly interface but the customer finds it difficult to use? It is a very difficult user requirement to include in a specification. The poor specification of user requirements is one area that can cause problems as well producing requirements for sub-contractors. There is a lot of pressure on people by management to get a project finished on time. Employees are often pressured to start on a task before the task-preparation has been completed. Complex projects are difficult to plan, manage and control. For example, it is difficult to estimate appropriate amounts of time and resources to projects. Because of this, projects can overrun their deadlines and their budget. There are a lot of complex regulations and laws that must be taken into account when building any project. There can be problems if they are not all fully known about, understood and adhered to. However good the skills of a Project Manager, they will find it difficult to plan for random events such as strikes, war, fire or personality clashes, for example. One of the valued personal qualities of a Project Manager is their ability to deal with new situations as they arise and to be able to adapt the project to them.

64.1.2 Why project management is important and the role of the Project Manager

Project management should result in a complex project being split up into stages. The Project Manager can therefore 'see' the project more clearly and can see more clearly what has to be done and by when. This may well be aided by the production of Gantt charts or Critical Path Analysis diagrams. Breaking a project down allows the Project Manager to more accurately allocate resources to tasks. Resources include people's time, contractors and access to a particular piece of equipment, for example. In addition, it is easier to allocate a budget to lots of little stages rather than one big project. Project management should allow the progress of a project to be 'measured'. Each stage will have associated with it 'deliverables' and 'milestones'. Deliverables are the actual jobs or documentation that must be completed whilst milestones are the actual dates by when certain things must be done. At key dates, the Project Manager can review the milestones and deliverables and take appropriate action if a job has slipped behind. Project management involves laying down rules and procedures for employees on the project to follow. If there

is a change to a design, for example, the procedures will ensure that everyone knows who needs to be told and what must be done. In short, it instils discipline and predictability into a project. Project management ensures that health and safety issues are considered before tasks are carried out. Good project management ensures that project documentation is complete and up-to-date. This might be important, for example, if employees leave their job and someone else has to take over. It will be very important if the Project Manager leaves!

64.2 Structured Systems Analysis and Design Method (SSADM)

How does a Project Manager go about managing a project? She will almost certainly use a project methodology! Methodologies are formal ways of doing things. SSADM is a project management methodology. According to the British Computing Society's 'A Glossary of Computing Terms', SSADM is "a standard method of analysis and design of large-scale software packages used within Government departments in the UK". It has been used in a wide range of project situations.

64.2.1 Why SSADM helps projects

SSADM helps structure a project into manageable chunks. It breaks the project down into a very clear set of stages. This facilitates better estimation, management and control of costs and time. For each stage, there are well-defined activities that must take place. For each activity, there are clear deliverables that must be produced (diagrams that must be produced, letters that must be written and signed, lists and so on). All the required deliverables must be completed and signed off before the next stage in a project can start. Deliverables (for example Data Flow Diagrams, Entity Life Histories and E-R diagrams) are produced to tightly defined standards that ensure they are precise and clear to all. If any change takes place in the project, for example, the customer adds an extra feature to the project then there are clear procedures and paperwork that must accompany any change. SSADM promotes teamwork because employees are all using the same methodology. CASE tools are commonly used to aid SSADM. These are discussed later in this section.

64.2.2 The difference between SSADM and a project life cycle

We have already examined the project life cycle in the Systems Development Life Cycle chapter. A project was found to have distinct stages. One way to summarise the stages (but not the only way) is to split them up under the headings: Feasibility study, Systems analysis, Design, Implementation (of the design), Testing, Installation and Maintenance.

SSADM is very closely related to the project life cycle model shown above. There are some differences, however. For example, there is no SSADM stage that relates directly to the 'Implementation' stage in the life cycle. Having said that, many of the activities in SSADM can be mapped to the project life cycle. Certainly, many of the activities and documents produced in the project life cycle (which we have already discussed) appear as part of the SSADM methodology. SSADM can be summarised as comprising of the following stages: Feasibility study, Requirements analysis, Requirements specification, Logical design and Physical design.

64.2.3 SSADM and CASE tools

We have already said that SSADM is a methodical approach to project development. It splits up projects into stages. It lays down rules about what must be done in each stage. Documentation is tightly defined and cross-checking and cross-referencing is a key feature of this approach. The approach of SSADM makes it an ideal target for computer programs. Why not write a program that allows a Project Manager to manage the stages in SSADM on computer? A program that does this is known as a CASE (Computer Aided Software Engineering) tool and there are various CASE tools on the market, such as SELECT SSADM. CASE tools help Project Managers using a methodology such as SSADM in many ways. These include the following:

- Templates are pre-defined. This promotes standard documents and cuts down the time to produce documents such as a DFD. In addition, standard naming conventions are used across all documents.
- Not only are documents pre-defined but also one document can be used to start off another document. For example, when a DFD level zero diagram (the context diagram) is drawn, the start of the level one diagram is automatically generated with the correct number of data flows into and out of the system.
- Cross-checking can take place. If someone makes a change in one document then the CASE tool can flag up where any changes should be made in other documents.
- If a Project Manager leaves a project then another will take over. By using an 'industry standard' methodology it should be easy for a new manager to take over. If the new manager had to pick up a project that followed an unfamiliar methodology, it would take time to learn.

64.3 Rapid Application Development (RAD) and Prototyping

One particularly effective technique at the disposal of a systems analyst/designer is the use of **prototyping**. This is where a designer makes a simplified version of a program to illustrate how the final product might look and feel. A prototype may show a customer or others in a design team what input screens might be present, what the reports may look like and what functions

would be available. Many of the features may not work but it is a very good way of illustrating to a customer what the designers are think of. You may well use this approach for parts of coursework! There are often marks available in coursework for considering different approaches and showing good user involvement. What better way of providing evidence of these things than a number of prototypes! Once you have decided and justified a particular approach, you can then refine it in the light of feedback from your customer. Prototyping could be used to help you develop a Requirements Specification. It could also be used in the design section, to involve the user in the final 'look' and 'feel' of the product. The prototyping approach is also known as the **Rapid Application Development** methodology. The benefits of this approach can be summarised as follows:

- You can quickly explore and compare a range of approaches by developing a number of prototypes.
- Prototyping can help in the production of a clear Requirements Specification because it can be used as an aid to discussion. This is especially true when technical people and non-technical people need to communicate together. The final specification can be refined through discussion and feedback.
- It can be used in the design section to involve the user in the product at all stages, for example, in the detail of how a report will be laid out. Involving your user as much as possible is a good way of ensuring that mistakes or 'nasty surprises' in the end product don't happen because your user will be able to highlight them with you at one of your regular meetings.

It's possible, of course, that the prototypes you put together one afternoon will give your customer the wrong idea of how long it will take to do the final product! For example, it might only take an afternoon to put together some input screens with function buttons on them in Access. Actually coding up the function buttons so they carry out the functions they're supposed to may involve weeks of design, coding and testing!

64.4 Documentation, logical progression and cross-checking

Projects can quickly become complicated. Even small projects can suffer if they are not approached in the right way. It is important, therefore, that a systematic approach be adopted. This involves ensuring that complete and up-to-date documentation is kept at all stages of a project. It means that projects should be methodical and calculated and should flow naturally from one stage to the next. Project Managers should ensure that those working on projects are not tempted to start parts of a project prematurely. Regular reviews should take place and checks should be made to ensure that different parts of a project and different documents are consistent with each other. This is especially important when changes are made.

64.4.1 Documentation

System designers use documents. Documents are useful tools for a number of reasons. They summarise data, bringing it together into a compact form. Diagrams aid understanding. A designer can visualise what is happening in a Data Flow Diagram, for example, a lot easier than a number of written down steps. Diagrams act as a discussion tool between team members. A first-draft E-R Diagram, for example, can be used in a meeting to discuss whether it is the best design for a project or to see if anything has been missed out. Documents can be used to help a new team member pick up a project in the middle of it. Technical documents can go in the Technical Manual. If system maintenance is needed in the future then they will greatly assist whoever is doing the maintenance. The design team can use diagrams when they meet customers. Customers are not designers and designers do not know the customer's business as well as the customer does. Diagrams can help bring the customer and designers together. They can have a discussion around a diagram that they all can understand.

64.4.2 Logical progression

There are many pressures on projects. There are pressures from managers to meet deadlines and costs. There are pressures from the customer to get the job done with all the functions that they need. Each member of a design team has their own pressures. For example, a database designer will be keen to get on and design. An analyst will want to investigate the system. Examples of the problems that could occur in a project are below.

- Unless the scope of the problem is defined properly, a solution may be designed for the wrong problem!
- Unless a feasibility study is done, the project might not be worth doing.
- Unless you investigate the business and what they want, you won't know what to make!
- Unless the needs of the customer are clearly defined, what is to stop them changing their mind later on? If you have spent many hundreds of hours designing a database and then the customer changes their mind, you might be faced with hundreds of hours of redesign work - who will pay for it?
- Unless you clearly design a solution, how can you be sure that what gets built is what is needed? If there is little design, how will the business cope with a team member leaving for another job?
- If a proper test plan hasn't been written, how can the customer have faith in what you have done?
- If there is a change in the future, how can you guarantee that future designers can actually make the necessary changes if there is little documentation?

All these pressures present a problem for any team: how to make sure the job is done properly. The way to go about reducing the risks to any project is to use a methodology. This will structure the project and provide everyone with clear guidelines and rules. It will clearly define the deliverables at each project stage and ensure that stages do not start before the appropriate time.

64.4.3 Cross-checking

As a project develops, stages will be completed. Before the next stage is started, however, deliverables need to be checked against the previous stages, to ensure that they marry up to previous stages' deliverables. For example:

- When a system is being designed, it will need to be checked back to the User's Requirements Specification document. If they don't match up, then appropriate action must take place.
- When an E-R diagram has been produced, it should be cross-checked with a dataflow diagram.
- Processes in a DFD need to match up with queries in a database.
- Items in a Data Dictionary need to appear in a table or be removed.
- Naming conventions need to be established and maintained otherwise different names will be given to the same piece of data across different documents, resulting in confusion.

It is clear from above that the documents and tasks that produce those documents are all in fact related in one way or another. If they are related then they can and should be cross-checked. This is especially true when a design change takes place and one of the documents has a small change made to it - other documents will now not be 'consistent' with the document that has just been changed. Every time a change happens, all the other relevant documents should be cross-checked. Cross-checking is a valuable way of ensuring that errors don't creep into projects. Correcting small errors can be very expensive if they are done after a project is completed. The use of CASE tools makes cross-checking relatively effortless!

64.5 Managing projects

Effective project management is important for a number of reasons. Overrunning a project can cost a company millions of pounds. There are also many people involved with projects, both people within a company and contractors. Their time must be booked in advance. It must also be paid for. If the times when they are needed slip, those people may not be available. They may be booked for other projects. This could have major implications for getting a project done on time and to budget. A company may have to pay a premium to get them or someone else in on short notice. If a company needs to hire 6 trucks for the day on Day 12 of a project and then they find out on Day 11 that they can't use them until Day 15, they may find that the trucks are unavailable then. The project could slip or the company may have to pay a premium to get what they want at short notice. To manage a project effectively, a Project Manager needs to be able to break down a project into tasks, estimate how long each task will take, how much each will cost and the resources needed to complete each task and to work out the inter-dependencies between tasks. If they don't know these things, it will be difficult for them to manage a project effectively.

When you do a large computing project for your course, you will have been told many times by your teacher to plan your time carefully. You may know from experience what happens when you don't plan properly. Before you know it, you are burning the midnight oil as deadlines approach. You get stressed out and irritable and your teacher appears not to care! All of this because you didn't plan your work carefully at the start of the project and didn't pick up time problems early enough. When you don't plan a project you get stressed. When a company doesn't plan properly it can cost them millions of pounds. Fortunately, there are some tools available to help Project Managers manage projects.

64.6 Gantt charts

Gantt charts show you in an instant if a project is on schedule. Consider building a house. A Project Manager would start by writing down each of the stages and then estimating how many days it would take them to complete that stage.

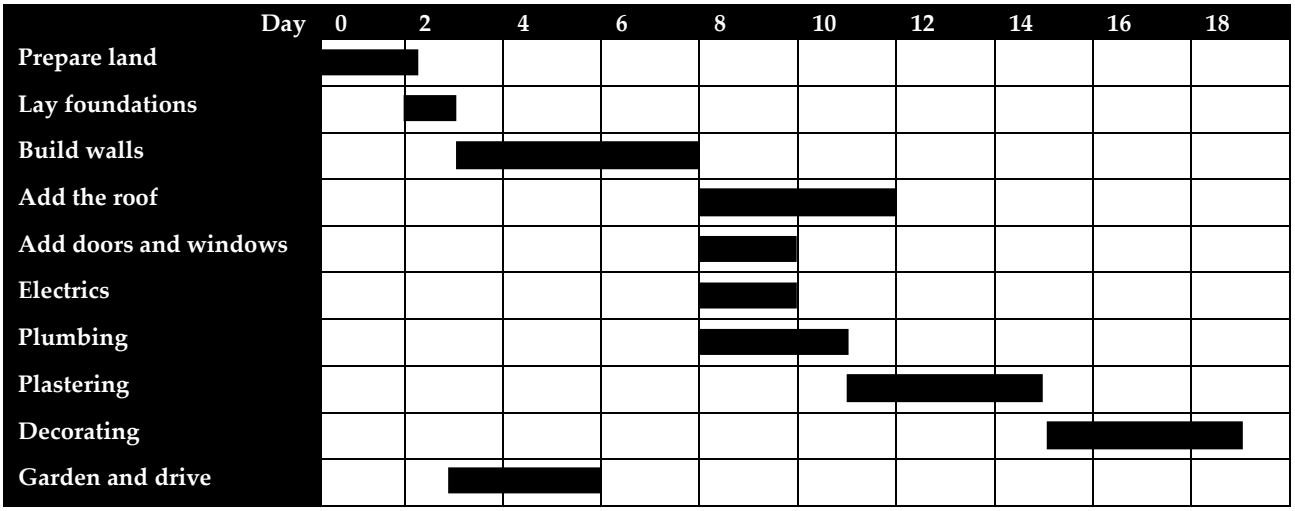
Prepare land	**2 days**
Lay foundations	**1 day**
Build the walls	**5 days**
Add the roof	**4 days**
Add the doors and windows	**2 days**
Electrics	**2 days**
Plumbing	**3 days**
Plastering	**4 days**
Decorating	**4 days**
Garden and drive	**3 days**

Estimates of how long it will take to complete each job in the construction of a house.

If you did one job after another in sequence, you could add up how long each job would take to build the house - 30 days. On the other hand, if all the tradesmen could work at the same time, then to build the house would take only as long as the longest job - 5 days. In fact, some jobs have to finish before others begin whilst others can be done at the same time. For example,

- You cannot do the foundations until the ground has been prepared.
- You cannot build the walls until the foundations are complete.
- You cannot decorate until the walls have been plastered.
- The roof, plumbing, electrics, doors and windows can all be done at the same time, as soon as the walls are built.
- You can start the garden and drive (arguably) as soon as the foundations have been laid and at the same time the walls are being built.

So how do you estimate how long the house will take to build? You produce a Gantt chart. This chart plots the jobs against the number of days each job will take and takes into account when a job can be started. This is shown in the following Gantt chart for the house-building project.



A Gantt chart for building a house.

The job starts at day zero. The first job is to prepare the land. That takes two days. When the land is prepared, the foundations are laid, which takes one day. Then both the walls and the garden/drive jobs can be started. The walls take 5 days but as soon as they are complete, the plumbing, electrics, roof, doors and windows jobs can be started. The moment that the plumbing is done, the plastering can start. This will take 4 days, after which, the decorating can start. This will take a further 4 days. To build this house should take 19 days.

64.6.1 How can the Gantt chart be used to help the Project Manager?

The above example has been simplified. Although we have described the most important part of what Gantt chart software will do, other facilities in Gantt chart producing software are usually provided. To summarise, Gantt chart software applications:

- Provide a Project Manager with a visual representation of the tasks in a project. It is faster and easier to 'understand' what must be done in a complicated project if you have a diagram rather than a written description, for example.
- Provide a Project Manager with a visual representation of how tasks are related to each other, what tasks must be completed before others begin.
- Tell a Project Manager how long each task should take (as well as best and worse times) and start and finish dates.
- Allow a Project Manager to enter in a 'percentage completed' value for any task at any time. A visual representation of this can then be provided. This is very important when many jobs are happening at the same time.
- Allow a Project Manager to produce a 'Master List' of resources that may need to be used in a project (such as a labourer, a plumber, a scanner, a Video Conferencing suite, a forklift truck and so on.) As well as producing a Master List of resources, the Project Manager can assign a Cost per Day to each of those resources.

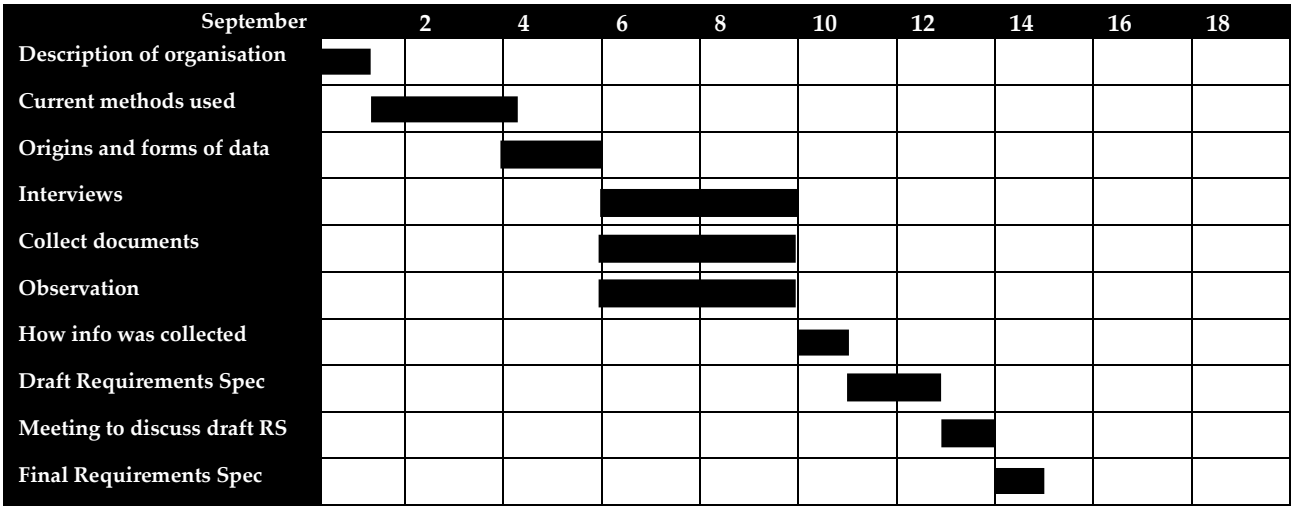
- Allow a Project Manager to assign resources (not just equipment but also skilled people) to each task and to then decide when they need to be used (and be on-site) and when they should be finished with.
- Allow reports to be automatically generated. The most obvious one is a report on the cost of each task (calculated from the cost of each resource assigned to each task) and the total cost of the project.
- Allow 'milestones' to be set so that automatic reviews are triggered.
- Allow changes to be made to the project resulting in automatic recalculations of timescales and reports to be done.

The chart will help the Project Manager in many ways.

- They ensure that a Project Manager thinks methodically about the tasks that need doing, and the costs and time scales involved.
- They will be able to tell the contractors when they need to come on site - that information is clear from the Gantt chart. They will also be able to book resources that are needed in advance, such as a forklift truck or a contractor skilled in writing VB applications.
- If the project is falling behind schedule, this can be picked up early and action taken to bring the project back on schedule. After day 8, for example, the Project Manager can compare what jobs have actually been completed with the Gantt chart timetable. If the walls haven't been finished after 8 days, then all of the other jobs will slip back and the house will take longer to build. The manager could decide to get some extra workers in to get the job done, for example.
- The Project Manager will be able to keep a tighter control on costs. They will be able to compare how much each task actually cost to complete against the cost calculated automatically by the Gantt chart software. It is crucial to the success of a project that any financial concerns are identified as soon as possible.
- They are simpler to produce and clearer than the more complicated Critical Path Analysis diagrams.

64.6.2 How can a Gantt chart help you plan a Computing project on your course?

It would be very sensible to use a Gantt chart to help you plan you Computing project. If Day Zero was the end of August / the beginning of September, the first part of your Gantt chart might look like this:



Planning a computer project.

This tells you that your project starts at the beginning of September. By the end of the first day, you should have described the organisation that you are doing a project for. By September 4th, you should have written up the way things are currently done and by the 6th, you should have done tables that describe each piece of data used in the current system; where it comes from, its data type and validation rules, who uses it and why and so on. By the 10th, the information collecting should have been completed and documented and by the 15th, the Requirements Specification should have been approved by the customer and be in your folder. You should be ready to move on to the Design stage of your project by the 15th September and if you are not then you need to think hard about what to do to get back on track. For each task, you will also have allocated resources. This means that you will have identified the hardware, software and people you need access to, to help you complete each stage.

You should produce a Gantt chart for your *entire* project before you begin. Your teacher will have told you what the start and finish date is. Producing a Gantt chart will really help you to focus on splitting up all of the jobs that have to be done to meet the deadline and the length of time each one is likely to take. If you then constantly refer to your Gantt chart, updating the % of

each task as it is completed, you will be able to see the moment your project runs into difficulties and will be able to have a burst of energy to get it back on track. Don't worry too much if you find it difficult to estimate how long a task should take. This is largely down to experience. However, the next time you do a project, perhaps at university or with a company, you will find it much easier to estimate tasks.

64.6.3 Some problems with Gantt charts

Gantt charts aren't the answer to everything, though! It can be difficult to estimate how long jobs will take and drawing a Gantt chart assumes that the Project Manager can estimate the time each task takes reasonably accurately. Estimating how long jobs take improves with experience but it is always difficult! The most important drawback with Gantt charts, however, is that they don't tell you which jobs MUST get finished on time, or the whole project will fall behind. Some jobs are critical and must get done on time. For example, in the house-building example, getting the walls built might be deemed critical because so many other jobs depend on that one getting done on time. If the garden and drive take a little longer than planned, then the project can still be finished on time - it isn't a critical task. Gantt charts do not highlight which jobs are critical. Another method is needed for this. It is known as Critical Path Analysis, or CPA.

64.7 Critical path analysis

CPA gives a Project Manager some information that Gantt charts do and some information that is not supplied by Gantt charts. Like Gantt charts, CPA diagrams tell the Project Manager what tasks need to be done, what tasks can be done at the same time as other tasks, what tasks need to follow on from other tasks, how long tasks will take and how long the whole project will take. In addition, CPA diagrams tell the Project Manager what the critical tasks in a project are. A 'critical' task in a project is a job that, if it weren't completed on time, would make the whole project slip back and therefore affect the project completion date. They also show the minimum time the project will take to complete and what the best way of speeding up projects is, where the application of additional resources would be most beneficial. Do note, however, that CPA diagrams are not as easy to construct as Gantt charts. They can appear complicated to inexperienced managers compared to the more easily understood Gantt charts and there are CASE tools (Computer Aided Software Engineering) that can help a Project Manager to produce and interpret CPA diagrams relatively quickly and easily.

Projects that are not managed properly and actively are heading for a disaster; when a problem occurs, ill thought through 'corrective' actions may be put into place too quickly. If projects are managed, however, then a problem can be identified very early on or even before a situation becomes a problem and appropriate, planned action taken. Gantt charts and critical path analysis documents help Project Managers to manage projects.

64.7.1 Critical path analysis - an example

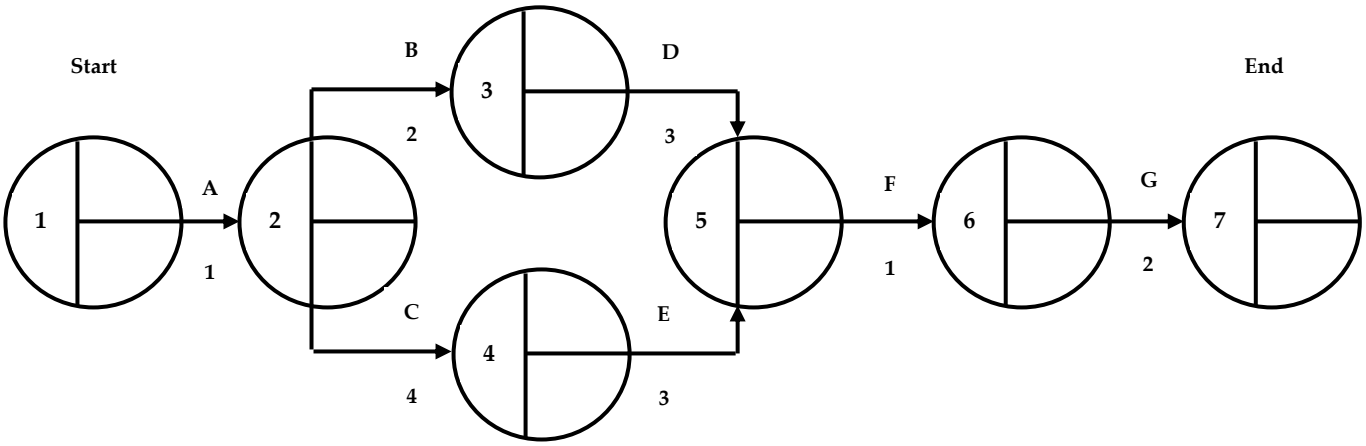
A school wants to develop its computing facilities. To ensure that the facilities are developed in a way that meets the needs of the staff and the pupils, the Head of Computing has decided to seek the opinions of all interested parties. She will carry out structured interviews with the staff. She will also send out questionnaires to the parents of all the pupils and ask them to fill them in with their sons and daughters and then return them. The Head of Computing will then look at the results and draw up a Development Plan for the school. The Head has requested a Critical Path Analysis of this opinion-gathering project.

64.7.2 The first step: identify the order the tasks must be done in

Each task is broken down and given a reference letter. The amount of time each task is estimated to take is recorded against each task. In addition, the Head of Computing will indicate when a task can begin, what actual tasks must be completed before another particular task can start. This is summarised in the table below.

Ref	Task	Time (weeks)	When can the task start?
A	**Planning.**	**1**	**This is the first job.**
B	**Design structured interview.**	**2**	**Begin when A is completed.**
C	**Design questionnaire.**	**4**	**Begin when A is completed.**
D	**Carry out interviews.**	**3**	**Begin when B is completed.**
E	**Send out questionnaires and collect in the replies.**	**3**	**Begin when C is completed.**
F	**Analyse interviews and questionnaire data.**	**1**	**Begin when D and E are completed.**
G	**Create the Development Plan.**	**2**	**Begin when F is completed.**

We can now start to create the CPA diagram.

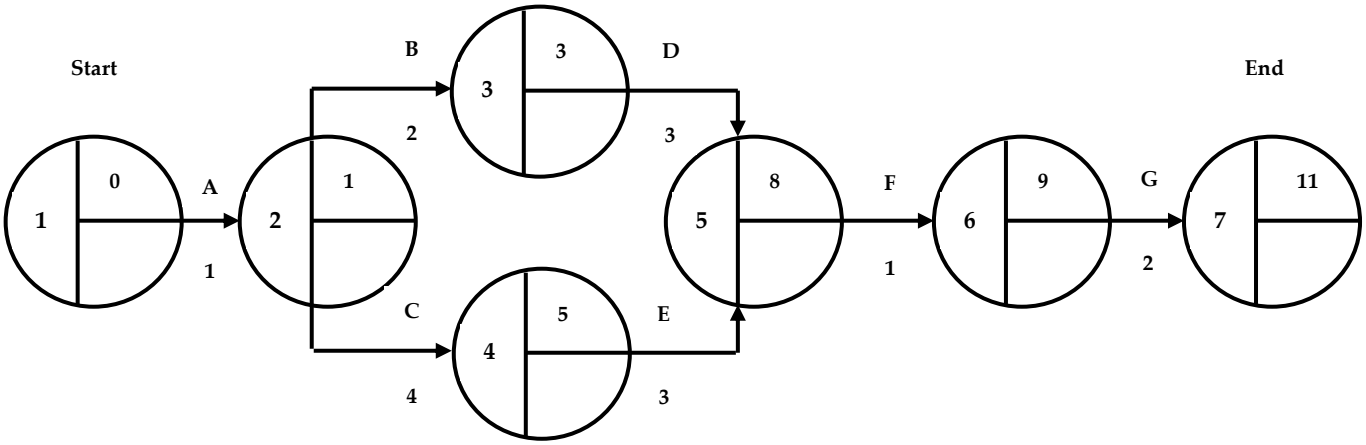


In the diagram, circles are more commonly known as 'nodes'. Nodes contain useful pieces of information. The first piece of useful information is a node reference number. We can now refer to each node as 'node one', 'node two', and so on. The nodes do **not** represent tasks. The arrows between nodes represent tasks. Each node simply represents the beginning or end of a particular task. Against each arrow (each task), we write the task reference and the length of time that task will take.

64.7.3 The second step: identify the earliest starting times

We need to identify the earliest possible time that every task can begin. Remember, tasks are shown by the arrows, not the nodes. When we have worked out a number for the earliest possible start time for a task, we put it in the node at the beginning of the arrow in the top right hand position. We always work from the left-hand node to the right-hand node when working out the earliest starting times.

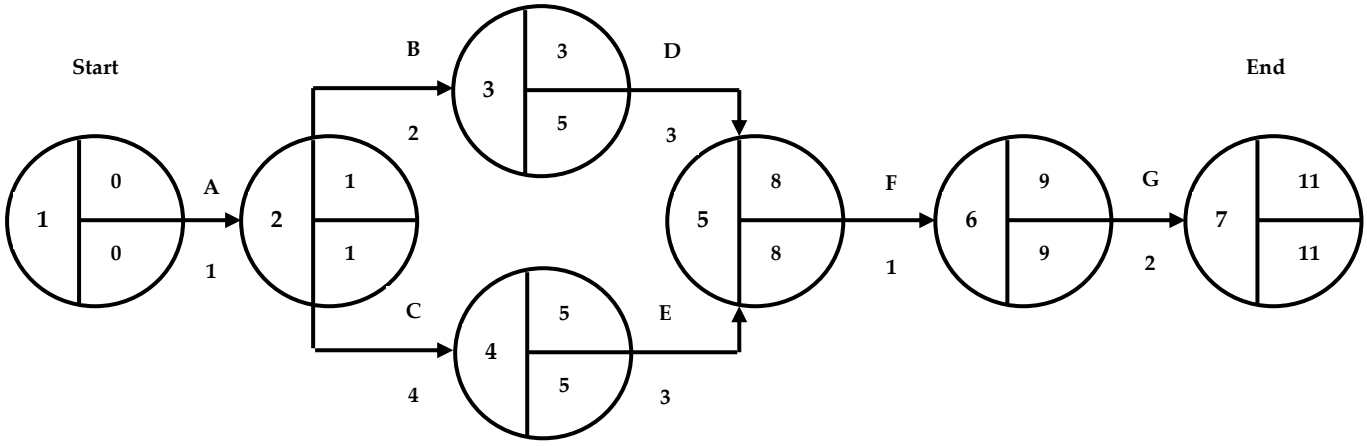
- The first task, (task A in this case), can always begin straight away. Zero is put into node one in the top right hand position.
- Task B and task C cannot start until task A has finished. The earliest time that task B and task C can start therefore is after one week (because that is how long task A has been estimated to take). One is put into node two in the top right hand position.
- Task D cannot begin until task A (one week) and task B (two weeks) have been completed. The earliest time that this can happen is therefore after one plus two = three weeks. We put three into node three.
- Task E cannot begin until task A (one week) and task C (four weeks) have been completed. The earliest time that this can happen is therefore after one plus four = five weeks. We put five into node four.
- Task F cannot start until both tasks D and E have been completed. But what number do we put into node five? Do we put the time it takes to do tasks A + B + D or do we put the time it takes to do tasks A + C + E? The answer is that we work out how long each route will take and then put the *biggest* number into node five. A + B + D = one + two + three = six weeks. A + C + E = one + four + three = eight weeks. We put eight into node five. Even though we are working out the earliest start time, we use the biggest number! This does make sense! Task F cannot start until tasks D and E have been completed. Since task F is dependent on both of these tasks being finished, we will have to wait until the task that takes the longest amount of time is done. That's why we select the longest path through the diagram.
- We need to use the longest (most time-consuming) route when working out the values for future nodes. Task G cannot begin until A, C, E and F have been completed. The earliest start time for G is therefore one + four + three + one = nine. We put nine into node 6.
- The last node contains how long it will take to finish the project. In this case, it takes nine weeks up to node six and then a further two weeks to do task G. We therefore put 11 in node seven.



64.7.4 The third step: identify the latest finish times

We now have to work out the latest finishing time for each task. When we have worked out a number for the latest finishing time for a task, we put it in the bottom right hand position of the node. We start with the right hand node this time and work towards the left hand node.

- Starting with the right hand node, node seven, we make the latest finishing time in that node equal to the project length. In this case, we must put eleven in node seven.
- The latest finishing time for any task is the latest finishing time for the preceding task minus the time that that task takes. The latest finishing time for task G is therefore eleven minus two = nine. We put nine into node six.
- The latest finishing time for task F is nine minus one = eight. We put eight into node five.
- The latest finishing time for task E is eight minus three = five. We put five into node four.
- The latest finishing time for task D is eight minus three = five. We put five into node three.
- The value for the latest finishing time for task B and C will go in node two. But do we select five minus two = three or do we select five minus four = one? We always select whichever is the smallest value. In this case, we select five minus four = one as the latest finishing time and put this value in node two. There is another way to work out this value. To go from node five to node two, we could calculate eight – (three plus two) for one path, or eight minus (three plus four) for the other path. We always select whichever answer is the lowest. We put one into node two as the latest finishing time.
- The latest finishing time for task A is two minus two = zero. We put zero in node one.



64.7.5 The fourth step: identify the Critical Path

We can identify the Critical Path of this project by looking for the nodes where the earliest start time equals the latest finishing time. In fact, this is the case for all nodes except node three. Our Critical Path is therefore **A – C – E – F – G**

The Critical Path shows the tasks that must not be delayed if the project is to be completed in the eleven weeks estimated. If any of the tasks in the Critical Path are delayed for any reason, then the project will take longer than planned. Interestingly, if you look at tasks B and D, you will see that these are not on the Critical Path. Together, these tasks are estimated to take five weeks. If they get delayed a little bit, then the project as a whole can still be completed on time. This is because the project cannot

continue until tasks C and E are finished and these will take seven weeks to do. In fact, you have up to two weeks delay completing tasks B and D without the project being delayed. We talk about there being a 'float' of time available. This is the amount of delay available without affecting the project.

64.8 Documentation

In any project life cycle, documentation is important. We have already said that if the documentation for a project is not accurate and complete, then all kinds of problems can occur. In addition, it should be pointed out that all projects should have fixed procedures for dealing with modifications that have been requested or errors that have been discovered. These are known as 'change control procedures'. It is a set of formal documents that must be filled in for each change that occurs for any reason. It ensures that every place in the project documentation the change can influence has been revisited and modified appropriately. It also ensures that all the people who need to know about the change are informed. Any project methodology will include places where formal reviews take place. This forms an important part of documentation as proof is needed that reviews have indeed taken place. Reviews may take the form of meetings with the customer to discuss the user Interface, for example, or they could be project meetings with the system designers to examine and sign off deliverables for a project stage.

64.8.1 Software and hardware audit

If a project uses software and/or hardware then it is important to keep track of what has been installed. In particular, records should be kept about the version of any software being used and the technical specification of any hardware. This information will be needed if any future modifications to a system are made or if some hardware needs to be returned under warranty. There should be formal procedures to ensure that this information is complete and accurate, with a named person responsible for the ensuring the procedures are followed. Any software bought should be backed-up in case the original media gets damaged. The software needs to be stored in an appropriately secure place, perhaps a fire safe and the licences should be carefully filed and documented. Free access to the software should not be allowed because if people copy the software for their own machines then the company will be breaking the copyright laws and could have legal action taken against them.

64.8.2 Quality control and management

Only through the use of methodologies and correct documentation can a project progress to a high standard. Documentation can too easily be side-stepped (with the genuine intention of completing it later). All too often, however, that can cause great problems. People soon forget what they did, what they agreed to do, what changes they made or what someone told them they wanted, for example. Word soon gets around about a company's reputation. It is the job of management to ensure that all the procedures are followed, although this may well conflict with their other main role - to get jobs finished!

Q1. What are the main aims of any project?
Q2. Why are projects difficult to manage?
Q3. What is a project methodology?
Q4. Explain how CASE tools can help a Project Manager manage a project.
Q5. What is Rapid Application Development?
Q6. Give some examples of reasons why projects might fall behind schedule.
Q7. Use the Internet to do some research. What qualities should a Project Manager have to do their job effectively?
Q8. What does a Gantt chart show?
Q9. Compare the information shown using Critical Path Analysis diagrams to those shown on a Gantt chart.
Q10. Why is it important to keep track of the hardware and software installed as part of a new computer project?

Chapter 65 - Specifying a computer system

65.1 The technical requirements of a system

Before anything in the way of design begins, the designer will need to find out a few things! These include who is going to use the new system, how will they get data into it, when will they use it and how often, where will they use it and what they want to do with the data/information they get from the system?

65.2 Software

When these questions have been answered, the software can be considered. When deciding what software to use, the designer should consider a number of alternative approaches and be ready to justify the software selected. This is because each piece of software has features and functions that the designer can exploit. It is up to the designer to work out what she needs to do and then to investigate possible software solutions. This should include both off-the-shelf and bespoke software. When these have been considered, the designer will be able to say which piece of software is the best software for the job and will be clear about how the Requirements Specification can be met by the facilities of the software. They should be able to justify the selection of whatever software approach they have selected.

The selection of the application software will lead to the selection of an appropriate operating system. The software needs determine the hardware requirements, not the other way around. There are also a lot of software utilities that might make life easier for users when using a system.

- Compression utilities. These compress files to make them smaller. That means they can be stored in less space and sent over a communication link in less time.
- Download Managers. If a lot of communication takes place over the Internet, you may consider using one of these. If you are half way through a download and you lose the connection, this software has the ability to re-establish the connection and start downloading again from where the connection was lost rather than from the beginning again!
- Virus checkers. These speak for themselves!
- Firewalls. You may want this type of software to prevent unauthorised access to a network's applications and data files.
- Encryption software. If some data is sensitive, you may want to encrypt it using an encryption program such as PGP (Pretty Good Privacy).

65.3 Hardware

Once the designer has worked out what software is needed for the project, the specification of the hardware can begin. Every application has a minimum hardware specification needed to run it. You can find this information on the side of the product box in a shop or you could look on the Internet. The information you will be given usually includes the minimum processor speed, the minimum RAM needed, the amount of hard drive space required and the operating systems that the software will run on.

In addition to the minimum specification, you may sometimes find a '**recommended specification**'. The reason for this is that while the software will run on the minimum hardware specification, it may not be able to run all the features at once or may run slowly. It is usually always a good idea to look at what is recommended rather than the minimum specification.

65.4 The configuration

The hardware configuration will have an impact on your ability to run an application or a number of applications efficiently. It needs to be carefully considered.

1) **Processor speed**. Processor speed is a very simplified measure of how many operations can be done by the computer in a second. For example, a 2 GHz computer can do approximately two thousand million operations every second. If you have to process a large amount of data, for example, video data, sound files, a large database or the latest operating system, then processor speed is important.
2) **RAM**. The amount of RAM you have is important. Applications and data files run in RAM. The more you have the more you can multi-task effectively i.e. at reasonable speeds and the less use you need to make of virtual memory. Heavy virtual memory use will slow down a computer.

3) **Cache**. Cache affects performance. Although it is relatively expensive compared to RAM, it allows you to access parts of a program or data much faster than from RAM so it speeds up processing. Get lots of it!
4) **Hard disk**. As technology moves on and applications get bigger and more complex, the need to access data from a secondary storage device efficiently is important. You need to get a hard drive that holds all your data and applications. Get one that spins as fast as possible so that data is accessed as fast as possible.
5) **Drives**. Applications, media and drivers can come as an Internet download but you may also need drives such as a CD / DVD drive, to play films or backup work.
6) **Communications**. You need to think about communications when specifying technical requirements. How much data is likely to be transferred? If light Internet connection is likely then a dial-up connection using a 56K modem and a phone line should suffice. If a larger bandwidth is needed then an ISDN or an ADSL line should be considered.
7) **Interfaces**. Some thought needs to be given to the likely connections that would be made to a computer. What ports and interfaces are needed? A **port** is simply a socket at the back of the computer that can be used to connect up a piece of equipment. An **interface** is simply some hardware or software that allows you to connect up a peripheral to your computer. They are needed because peripherals often use different voltages to the computer, have incompatible software or non-standard plugs, for example. An interface may come with a port. How many parallel ports do you need? How many serial? How many special interfaces such as a SCSI (Small Computer Systems Interface) do you need? What about USB interfaces and firewires? Different peripherals such as digital cameras, scanners, printers and digicams may all require different interfaces. When you are thinking about specifying the hardware for a computer, the consideration of ports and interfaces should not be missed out.
8) **Peripherals**. Some consideration needs to be given to peripheral selection. For example, what kind of quality of printer output is necessary? Is colour required? What resolution is required for scanners and digital cameras? Will sound be recorded? What speaker quality will you need? What input devices are needed?

65.5 There are two further points that deserve a mention.

1) It is important to recognise that not only do you need to consider the hardware you need to run a proposed system now, you must also consider possible future developments. You need to strike a balance, however, between '**future-proofing**' a new system and spending money on something that isn't immediately needed.
2) It is possible to go over-the-top when specifying hardware. Often, you do not need the latest equipment for a particular system.

In summary, then, your customer will pay for any software and hardware and you should be able to justify what you are getting them to pay for. It is important to strike a balance between specifying what you need now, specifying what you might need in the future and not specifying too much! The specifications for both hardware and software and a justification for the selection should be included in the Technical Manual. This is because the system may undergo maintenance in the future, for example, when the hardware is upgraded.

Q1. What are the fundamental questions that need to be asked before specifying the hardware and software for any new system?
Q2. Should you specify the hardware or the software first for any new system? Explain your answer.
Q3. What is a compression utility used for?
Q4. What does a firewall do?
Q5. State the areas that need to be considered when specifying the hardware for a new system.
Q6. Why does cache affect a computer's performance?
Q7. Why does RAM affect a computer's performance?
Q8. What is a port?
Q9. What is a peripheral?
Q10. What is meant by future-proofing a computer?

Chapter 66 - E-commerce

66.1 Introduction

Commerce is all about business, about the buying and selling of goods and services. Consider buying a new computer. The functions that need to take place by the buyer of the computer include searching for the right computer, asking for information about different products from retailers, paying for it, taking delivery, getting support and having problems dealt with.

66.2 A traditional business

A typical computer retailer (not yet using e-commerce) will need to provide the following to be involved in commerce:

- **A set of products.** Customers want to be able to look at a range of products with different specifications and prices. The retailer must provide products to view, technical information, a catalogue and be able to offer assistance.
- **A place.** Retailers need a place to work from and customers need to know where to go.
- **Marketing.** Customers will not know of the computer retailer unless the shop advertises. This can be done in a number of ways such as paper adverts, word-of-mouth or flyers, for example.
- **Accepting orders.** The retailer will need to process orders, either face-to-face or via fax or the phone.
- **Payment.** Different methods of payment need to be accepted and processed.
- **Delivery.** The products paid for by a customer must be packaged up and delivered.
- **Warranty.** Products that have a guarantee and prove to be faulty need to be dealt with. The retailer needs to accept returned faulty goods and replace them or refund the customer's money.
- **Support.** Customers may need help to make changes or buy extra parts for their computer. The shop needs to be able to provide this.

All of the above comes under the banner of 'commerce'. Whatever the product or service, then, the above elements in any business need to be present.

66.3 How is e-commerce different to traditional commerce?

A business using e-commerce will need to provide the same facilities as one not using e-commerce. It is ***how*** they provide those facilities that are different.

- **A set of products.** As before, a business will need a set of products. The information about each product, however, will be held on the web site. Customers will need some way of searching for products and some way of finding out more about them. The web site may have a searchable database, for example. When a customer is taken to the actual page where the product is, a wide range of information could be provided. These might include detailed photographs and technical data, video, links to reviews by magazines and reviews by other customers who bought the same product.
- **A place.** The place of business for the customers is now a web site. Customers can search for products, get information, contact the company, make selections and pay, all from the site. As far as the retailer goes, they could physically be anywhere. For example, there would be no particular advantage having an expensive-to-rent shop in a London high street. They could have the actual business in a far cheaper part of the country, away from high-rent areas or even abroad and will be open 24 hours a day every day!
- **Marketing.** This can still be done using traditional methods such as using paper flyers, radio and TV advertising and putting adverts in newspapers. Now, however, the possibility of advertising on other sites exists. The business could pay successful sites to include a hotlink on their site to the company's web site. Pop-up boxes to advertise could also be used as could email to mail-shot customers directly. A business would have to think carefully about doing these two things, however, as a lot of people find them very irritating and the law is taking an interest in these practices. An e-commerce business could also allow affiliate sites to be set up by other organisations that then market and sell their products for a commission.
- **Accepting orders.** This may now be done using an online ordering system. Customers fill in an order form. A popular method of selecting goods involves mimicking shopping in a real shop. Customers select the goods they want. These are then transferred to a shopping trolley. When the customer has finished selecting items, they go to an online checkout web page. This lists the products that have been selected, along with their cost and the cost of any addition items such as post and packing or insurance. The customer verifies their order by ticking a box or clicking on an OK button to say that they have read the order and checked it. They can then make the payment by one of a number of methods.

- **Payment.** A customer could still make payments to an e-commerce trader by sending them a cheque or by faxing them credit card details. However, the e-commerce retailer would also make use of a **merchant account**. This is simply part of the web site that accepts **secure** online credit card payments. You know if you are on a secure web site because it uses the protocol **https** in the URL. It used to be quite difficult to get a merchant account but it is now easy for anyone to accept credit card payments through a third party. One such organisation that anyone can use (for a commission) can be found at **http://www.paypal.com** and you should visit this site to see the sort of services it provides. Try searching Google for other companies that provide a similar service to PayPal. When a customer pays for an order using an organisation such as PayPal, PayPal will accept the payment (making sure that the credit card is valid) and then forward details of the order to the e-commerce retailer. They will then send the goods off.
- **Delivery.** The retailer still needs somewhere to store physical goods, have them packaged up and then delivered. Of course, if the product is MP3 music or software, the retailer could simply allow the customer to download the files once payment had been cleared. If the e-commerce trader were acting as an agent for another company, then they would need to contact that company and get them to send the order off to the customer directly.
- **Tracking.** Another feature of the e-commerce trader is that the customer can be kept informed at all times about the progress of an order. For example, a confirmation could be sent when an order is placed. An order number could be issued to the customer. The customer can then use this to access a database via the web site that keeps details of that order. They could use this to see if something has been sent, or part-sent, or is waiting to be sent, for example. If you have ever ordered a CD or textbook from a company such as www.amazon.co.uk then you will have seen this system in action!
- **Warranty.** The retailer still needs a method of accepting returns and dealing with them, much in the same way as a traditional business.
- **Support.** Online support can be provided. This could be done in a number of ways. The retailer might provide bulletin boards for customers so that they can discuss any problems amongst themselves. They might provide a FAQs (Frequently Asked Questions) section on their website so customers can see if their problem has occurred before and what the solution was. They might provide some form of email support so customers can ask specific questions of the technical and support team. The e-commerce retailer could also provide a phone help-line, perhaps at a premium rate, for those customers who want an immediate response by a human! They might provide live chat facilities or help via webcams over the Internet.

66.4 Pros and cons of e-commerce for the customer and seller

Customer	Seller
Advantages: • You can shop 24/7. • You can shop for a much greater range of products. • If you have a disability, it may be more convenient. • You can often see customer reviews and get more product information so can make a more informed choice. • No travel and time costs. • Cheaper goods because the seller has lower overheads. • Detailed tracking of an order is possible via email.	**Advantages:** • You can offer goods 24 / 7. More sales. More profit. • You can monitor customers' purchases and then target market them. • A website offers lower overheads than a shop. • Can display links to much more product information e.g. via hyperlinks. • Can use affiliate programs to boost sales. • Less need to handle cash so lower costs and lower risks.
Disadvantages: • You don't get the goods immediately. • Must pay electronically – not everyone has a credit card. • There is a risk of fraud using credit cards online. • Phishing websites are a problem for customers. • Lacks personal service. • Cannot try goods on before you buy them e.g. shoes.	**Disadvantages:** • Must constantly update the website to keep it interesting. • You need a way of taking online payments. • Different skills needed to run a business via a website. • Too much business may put the resources of the company under strain. • Lack of customer communication can lead to loss of sales.

Q1. What general activities are carried out by any business that sells something, whether online or not?
Q2. What is meant by marketing?
Q3. Discuss how support can be provided by an online business.
Q4. What are the advantages to a shopper of buying a product online?
Q5. What are the disadvantages to a business selling online?

Chapter 67 - The value of data

67.1 Introduction

Think for a moment about the different kinds of data that is held by a company. It could include, for example, information about who your customers are, who owes you money, who you owe money to, current orders, information about orders you are trying to win, details about your staff, how much they're paid, meetings that have been arranged and so on. Imagine if it disappeared! What would the consequences be?

67.1.1 Why is data valuable?

Data is valuable for a number of reasons. It takes time to compile, a long time! It takes time to input the data into the computer. To recompile data or re-enter it into a computer is expensive because you have to pay someone to do it, when they could be doing something far more productive for your company. You need information about an order placed with your company so that you can process the order and then be paid for it - that's how your company makes a profit! You need to know when to pay your bills and taxes so that you don't get taken to court. You need to be able to chase up people who haven't paid you so that you can pay your bills and keep trading.

67.1.2 Commercial data is valuable

If you were running a supermarket and you lost the data in your stock control system, you wouldn't know what you had on the shelves. You wouldn't know when you needed to re-order stock and you would lose money while you sorted out the problem. If you kept historical data on your supermarket's computer and you lost that, you would lose valuable information about product trends, what sells well and at what times and doesn't sell very well, for example. This would have an effect on your business's potential to maximise their profits.

If you were in the business of offering loans to people, you would want to be able to check their financial background before you handed over any money to them, in case they had a criminal record for fraud, for example! If credit agencies suddenly lost all of their data, then loan companies wouldn't be able to ask them about individuals who have applied for loans. Imagine if credit companies lost all of their data! They wouldn't know who owed them money. If you were in the business of data warehousing or data mining (see later in this section) then losing your data would be catastrophic. Your whole business is based on having historical data to work with!

Take this opportunity to review a backup strategy that a company might employ to protect their data. Remind yourself about the need for a written procedure, about what information would go in a procedure and what hardware might be used in a backup regime.

67.2 What might cause a company to lose its valuable data?

This could happen in a number of ways, including hardware failure, software failure, losing data because of a virus, hacker, espionage or having the equipment that data was on stolen. Data could be accidently deleted by an employee, or deliberately stolen by them, there might be a natural disaster like an earthquake or a terrorist incident.

67.2.2 What hardware could be used to backup data?

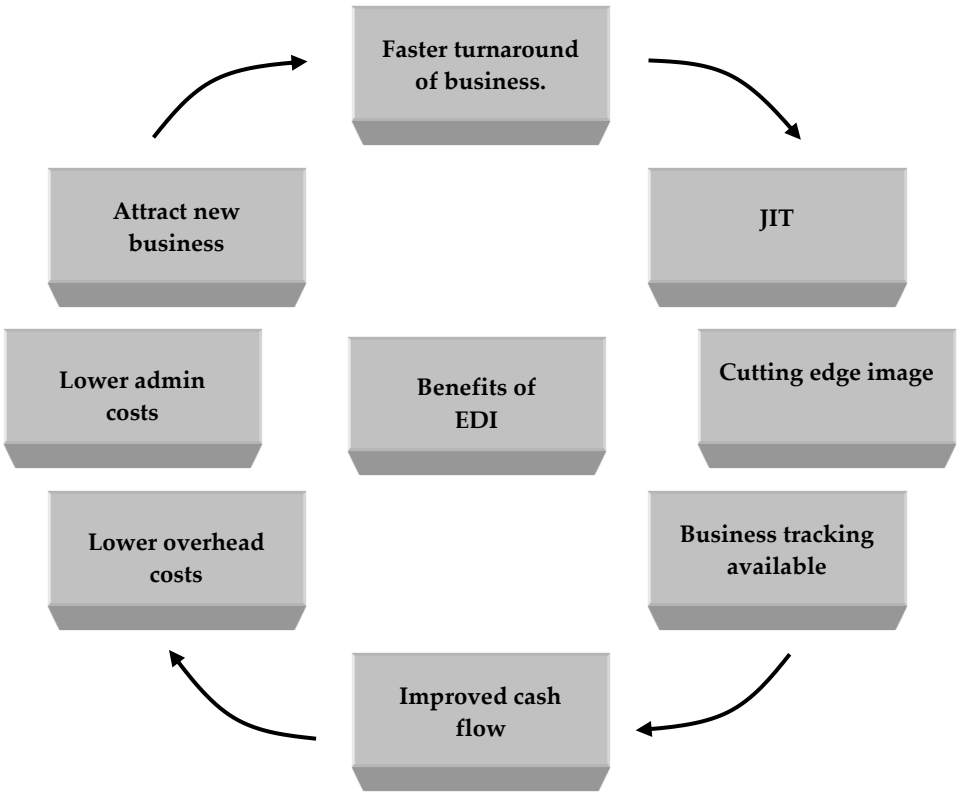
There are a range of possible backup devices that could be selected. Each has its own advantages and disadvantages and areas where it is particularly suited. Possible devices include USB pen drives (memory sticks), CDs and DVDs, magnetic tapes, creating a mirror hard drive or backing up to the 'cloud'

67.3 Electronic Data Interchange (EDI)

Historically, when a business started to automate functions like orders and invoicing, the systems it developed were only useful to that organisation. For example, a company might generate an order and send it to a second company. That second company couldn't just take the order and process it electronically!! It had to take the order, re-enter the details of the order into its own system and then action it! This was because each company had its own systems. This was a waste of time and resources.

EDI was developed to provide an interface between two separate computer systems. Each company could have its own way of doing things, but by using EDI, they could now 'talk' to each other without one company having to re-enter data or redesign its system to match the other company's system. A company who wants to use EDI with another company forms an EDI trading agreement with that company. They need to agree which EDI protocols they will use. Once this has been agreed, Company A will write a program that converts a document that it wants to send from its company's format into the agreed EDI format, or

they will ask a specialist company to do this for them. Company A will also write a program that converts documents received in EDI format into documents in the company's standard formats. Company B will write a program that converts a document that it wants to send from its company's format into the agreed EDI format. Company B will also write a program that converts documents received in EDI format into documents in the company's standard formats. Both companies can now send and receive documents; each can keep their own systems and their employees can send and receive documents without realising they are being converted into a different format. It's all done automatically in the background!



67.3.1 Strategic benefits of EDI

- If information between two companies is exchanged more quickly then their turnaround for business transactions will be faster. The faster you can turn an order around, from the moment it is ordered to the moment it is paid for and signed off, the more business you can do in the same time period. This leads to more profit!
- There are areas of business known as Just In Time (JIT). These exist primarily to ensure that a company doesn't order and hold on to materials that it needs for its business until the absolute last minute, when it actually needs them. If a company does have material on the shelves then it is tying up money. EDI offers some companies the ability to introduce or streamline JIT systems.
- A business that uses EDI is more likely to attract new business and therefore make more money from other companies that have already established EDI practices. If you were a company that used EDI, who would you want to buy your raw materials from - a company that had EDI or one that didn't?
- Companies that use EDI can portray themselves as being a company at the cutting edge of technology. Image is very important in business.

67.3.2 Operational benefits of EDI

- If you are using EDI then you are using less paper and have less postage costs. This cuts costs.
- Companies that use EDI have less money tied up in stock and an improved cash flow. This cuts costs.
- Companies that use EDI will be using less time for filing documents in filing cabinets, typing data into computers and retyping data into computers for validation. This cuts costs because you need less hardware and less staff.
- Companies that use EDI issue receipts every time there is an exchange of information and these are electronically stored. They provide an audit trail of documentation. This cuts costs because problems and misunderstandings can quickly be sorted out.

67.4 Value Added Networks (VANs)

As EDI became more widespread, enhanced communication links known as Value Added Networks (VANs) between businesses started to be offered by companies. VANs simplify the communication links between companies but also provide extra services that improve the way information is passed between them. They provide, for example, services that:

- allow different EDI protocols to be used by different companies
- allow companies to store data within the VANs so they can more easily be accessed from outside the company, for example, by other organisations
- allow audit trails so that the history and progress of information being exchanged can be recorded and traced if necessary
- provide a vehicle by which companies can set up an EDI trading agreement
- provide technical know-how on EDI systems for companies.

67.5 Data warehousing

Data warehousing has been around since the 1990s. The idea behind data warehousing is that:

- historical data from past transactions and orders the company has had are separated out from the business
- the data is re-organised in such a way as to allow it to be analysed
- the newly structured data is then queried
- the results of the query are reported.

Data warehousing could be used as a predictive tool, to indicate what should be done in the future. However, the main use of data warehousing is not as a predictive tool but as a **review** tool, to monitor the effects of previous operational decisions made in the course of a business. For example, if Marks and Spencers decided to open stores in Asia, data could be collected as the stores opened and over the first few months. This could then be passed to a data warehouse. The wisdom of opening stores in Asia for the business as a whole could then be reviewed and conclusions backed up with statistical evidence.

67.6 Data mining

Data mining burst onto to the scene only a few years ago. Data mining is the term applied to the software technique that looks at a huge set of data and tries to find hidden trends in it. Data mining can be used to answer such questions as "Who is most likely to buy a book at Christmas?" and "Why are they more likely to buy a book at Christmas?" The most important thing to remember about the role of data mining is that it is **predictive**. It seeks to answer questions about the future. Compare this to the retrospective use of data warehousing. Data mining (and data warehousing) has become possible in the last few years for a number of reasons.

- Sophisticated software is now available.
- Vast data storage is possible.
- Vast processing power is available, for example using parallel processors.
- The price of sophisticated hardware has fallen dramatically.
- It is far easier to collect and process information because so much of a company's business is now digital.

Q1. Why is data valuable?
Q2. State five ways that a company's data might be lost.
Q3. State five media that could be used to backup data.
Q4. What is meant by cloud storage?
Q5. Compare the advantages to a company of backing up data to cloud storage rather than a tape.
Q6. What is meant by EDI?
Q7. What are the benefits of EDI?
Q8. What is meant by a 'just In Time (JIT)' system of manufacture?
Q9. What is a VAN in the context of EDI?
Q10. What is meant by data warehousing and data mining?

Chapter 68 - Work patterns and training

68.1 Training and re-training

It cannot be assumed that when the latest new technology is introduced into a workplace, the users of the technology know how to use it. Neither can it be assumed that, just because someone has been taught or trained in some new technology, they are using it effectively. (Witness, perhaps, your own experience. Sometimes teachers show you how to do something new and guide you through some exercises yet you still cannot confidently do a question on the topic in an exam!) Re-evaluation and re-training must take place periodically for learning to be considered effective. In addition to this, re-training must take place regularly because software and hardware are constantly being upgraded with more functions being added to the latest versions. Re-training is needed to help users make good use of these new functions.

68.1.1 Training programs

Careful thought needs to be given to training programs. Individuals learn in different ways. How a child learns is not the same as a teenager, which isn't the same as an adult, which isn't the same as a pensioner. Age isn't the only consideration, however. Other considerations include the prior experience of the users, the educational background of the users, the motivation of users, the time the users have available to train and the facilities available so that effective learning can take place.

68.2 Effective use of new technology

Training and re-training needs to take place so that employees can get the best out of new technology. It should help them to use new technology but more than that, it should help them to work more effectively. For example, you can learn how to use an email program and all the functions in it but you also need to learn how it can enhance the way you currently work so you become a more effective worker. In the example of an email program, you might have had training to send emails but you may need extra help so that you can set up the program to send emails automatically. This would free up some workers from dealing with mundane tasks such as emailing price lists in response to a request because this job could be done automatically.

68.3 Changing roles

Secretaries have seen their roles change dramatically over the last decade or two. Managers often no longer need letters typing up - they can compose and send an email immediately or else use voice recognition software to compose letters themselves. Secretaries have become far more flexible personal assistants but that has required re-training. For example, they would have needed re-training so they can maintain contact lists and contact groups in email programs. Some will have been asked to produce the company newsletter, for example. This would require training in a DTP package.

Of course, some workers might find that their jobs have been completely replaced with new technology and these people will need to be re-trained to fulfil a different role completely. This can be very difficult if you have been doing the same thing for many years and will require a carefully thought through training program. For example, if you are a telephone operator and an automated computer-telephone system has been introduced then you will need to be re-trained in a new area.

68.4 Changing work patterns and improved output

By far and away the best way to appreciate the changing nature of the way people work is through background reading. You will find many descriptions as you read newspaper articles of the way things were done and the role that new technology has played in changing those ways. You will also find examples where the quality of a product has improved. You cannot do enough background reading!

68.4.1 Examples of changing work patterns

Here are some examples of changes in workplace methods that occurred as a result of computerised systems being introduced:

1) Managers now write fewer letters because they can use email. This is especially true for younger managers who have grown up with new technology. Voice recognition is decreasing the need for the traditional skills associated with secretaries. Their role has changed as a result.
2) Video-conferencing means that managers can spend less time travelling to meetings. For example, a one hour 'very important meeting' in Tokyo can now be done in one hour. Before, a manager might have been out of the office for three days just to attend that one-hour meeting. This was because of the travelling involved.
3) Some workers can work at home for at least some part of the working week. For example, an Environmental Agency inspector can do all the paperwork at home and email them to work when she is finished. This is good for the employee but also helps the environment because less travelling in cars needs to be done and good for the

Agency because they do not need to provide so much workspace at their headquarters. They could rent/buy a smaller building and save money.

4) Universities can set assignments over a network, send out reminders, receive assignments on the network which have been date and time-stamped, mark it and return it, again online. Results can be logged on a database that can then be accessed by students. This has reduced the need for paperwork, has meant that work cannot get lost; there is an audit trail of when work was handed in, marked and returned and the lecturer can retrieve, mark and return work from anywhere.
5) Supermarkets' stock is now monitored and re-ordered automatically using computerised stock control systems. This has removed some of the tasks that used to be done by workers, for example, making a decision about when to reorder. The collection of sales information has also led to the growth of data mining and data warehousing. These industries have helped companies maximise their profits.
6) Kitchen designers such as MFI now design kitchens using sophisticated 3D design software. You take in your kitchen measurements, they tap them in to their software and you can then get a very good picture of what your final kitchen would look like from a variety of angles. This has decreased the likelihood of misunderstandings between the sales staff and the customers and has helped customers to picture exactly what they will be getting.

68.5 How a modern telephone system enables employees to work from home (teleworking)

A modern phone network allows workers to use broadband. This enables the use video conferencing and instant messaging services, email and the sending and receiving of work in the form of attachments. In addition, Faxes can be sent and a range of phone facilities can be employed, such as 'call waiting', hands-free phone calls, voicemail and 'ring back'. VoIP (Voice over Internet Protocol) can be used to make free or cheap phone calls, especially useful if many calls are made abroad. Skype is one of the biggest companies leading the expansion of VoIP.

68.6 Pros and cons of working from home

Working from home means flexible working hours, which is good if you have small children, although sometimes, it can be hard to stop work for some people, and can be hard to motivate yourself for others. You might miss working with colleagues and it may be difficult to work in a team and share information and ideas. You may not have the space to work at home and you need to consider security of data, for example and health and safety issues. You may find your household bills will go up, too. If you don't travel, you save time, money and stress, the roads are clearer and there is less pollution.

68.7 Improved quality

Computerised technology has not only bought about changes in the way people work but also in the quality of work produced.

1) The flat-pack kitchen manufacturing process that MFI uses has improved over the years. Sophisticated computer technology has meant that self-assembly furniture is now manufactured very accurately. This means not only greater customer satisfaction but also less time and money spent by MFI putting problems right.
2) The increasing use of robots in the car manufacturing industry has meant that less time needs to be spent correcting human errors. Robots can produce work to a much higher standard than humans. They can work to finer tolerances and can produce higher quality work consistently.
3) The quality of animation used for entertainment has improved considerably. If you compare the animation in Jurassic Park, Toy Story, Spiderman and The Hulk for example, with that from films made a few decades ago there is a world of difference!

Q1. Why is retraining as important as training?
Q2. Suggest ways that software can be used to train and retrain workers.
Q3. Give examples that demonstrate your understanding of changing work patterns.
Q4. What is meant by teleworking?
Q5. How does a modern telephone system aid teleworkers?