ICDL Module 1

Concepts of Information Technology

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Chapter 1. General Concepts

Hardware, Software, Information Technology

Understand the terms hardware, software, Information Technology (IT).

Hardware	refers to the physical components of a computer. These are the parts that you can see, feel and hear. Examples are the CPU, the keyboard, the monitor, memory, cables, mouse, printer and power supply.
Software	refers to the **programs** that control the computer and make it function.

Note the spelling is program and not programme.

Program	a set of instructions that the computer obeys. Computer programs can be extremely long and complex sets of instructions. It is quite common for computer programs to be tens of thousands of lines long. The application programs that you use on your PC for word processing and spreadsheets are in fact even longer.
Information Technology	Information Technology is a broad term which covers all aspects of the use of computer technology. It includes not only hardware and software, but also communication technology applied to linking computer systems, software engineering, and the administration and use of computer systems.

Types of Computer

Understand and distinguish between mainframe computer, network computer, personal computer, laptop, personal digital assistant (PDA) in terms of capacity, speed, cost, and typical users.

In the early days of computer technology, it was easy to categorise computers. Today, even the basic desktop machines are extremely powerful by the standards of a few years ago and rival the early mainframes in computing power.

Mainframes

These are the largest and most powerful of computers. The biggest of these are sometimes called **Supercomputers**. Mainframes are usually only found in large corporate institutions, research organisations, government ministries and tertiary academic institutions.

They provide centralised processing and storage of data. They are usually used for large database systems such as the accounts of a municipality, patient information at a large hospital or student records at a university.

Because desktop (personal computers) and laptops are relatively cheap, many activities such as word processing, creation of spreadsheets and general office tasks are carried out using these types of computers. This frees the mainframe for processing large databases.

Networking, in which computers are connected together and are able to communicate,

allows data to be **downloaded** from the mainframe to the personal computer or be **uploaded** from the personal computer to the mainframe. In effect, networking creates one large system comprising all the different computers linked together.

Capacity and speed: Mainframes have the largest capacity in terms of data storage and processing speed. The capacity of a modern mainframe can be hundreds or even thousands of times that of a modern personal computer.

Cost: Mainframes are also the most expensive machines in terms of both initial cost and maintenance. A mainframe can cost millions of Rands.

Typical users: Because the mainframe provides services to all sectors of a large corporation or institution, users can include systems analysts, programmers, database administrators, data capturers, accountants, accounts administrators.

Network computer

Network computers are also sometimes known as **thin clients** or **dumb terminals**. They provide access to a mainframe via a network and have little, if any, computing capacity of their own. Network computers provide remote access to a mainframe. They allow the user to input data or commands and receive output. The actual processing would be done on the mainframe.

Capacity and speed: Network computers do not have any processing capacity of their own. Their speed will depend on i: the speed and capacity of the mainframe; ii: the speed of the network to which they are attached; iii: the number of users accessing the mainframe. Thus in periods of low demand, they will appear to function very quickly but would appear to slow down when the demand on the system is high.

Cost: Network computers are relatively simple devices, hence they are fairly cheap.

Typical users: These would generally be the end-users of the system such as managers, accountants, receptionists, accounts clerks and data capturers.

Personal computers

Personal computers or PCs for short are the type of computer that most users are familiar with. Because they are usually found on users desks, they are also sometimes called desktop computers. Operating systems such as Linux and Windows were designed specifically for personal computers. The same applies to the thousands of application packages that are available including OpenOffice.org and Microsoft Office. A typical PC consists of a main unit housing the CPU and disk drives, a VDU (Video Display Unit), a keyboard and a mouse. PCs are self contained computing systems that can be used for thousands of different tasks from creating a simple document to controlling a large industrial machine.

Capacity and speed: Because of the rapid advances in technology, the PC of today is more powerful than many mainframes of a few years ago. There is little sign that the rate of development is slowing down. Typically, a modern PC can store the equivalent of a few million pages of printed text and carry out millions of instructions in a second. What complicates the issue of speed in talking about PCs is the use of graphics. Most applications make intensive use of graphics. This demands enormous computing power. Computers, which would otherwise appear to be very fast, can appear to be quite slow because of the demands placed on them by the graphics used in an application. Other components, such as the graphics card, also play a role in the speed of a PC.

Cost: There has been a steady decline in the cost of computing power. Although the cost of PCs has been fairly steady, the computing power that has been supplied has increased

drastically. The cost of a personal computer is greater than that of a network computer or PDA but less than that of a laptop and a very small fraction of the price of a mainframe.

Typical users: Everyone is a potential user of a personal computer since there is virtually no sphere of human activity that does not make use of information technology. The list could include scientists, researchers, mathematicians, statisticians, technologists, engineers, students, teachers, accountants, actuaries, managers, doctors, librarians, receptionists, book-keepers, writers, and journalists. These are just a very few.

Laptop

Laptops are similar to personal computers except that they comprise an integrated unit. Instead of a separate monitor, the lid contains a screen. The keyboard is built into the base. Usually they make use of a touchpad instead of a mouse. The term notebook computer is often used instead of laptop computer.

The main feature of a laptop is its portability. This is possible, not only because of the reduced size and weight, but also through the use of a built-in battery which is able to power the computer for a few hours without being connected to a mains power supply. Laptops are also designed around low power and smaller devices. For example, laptops use small 2½" hard drives as opposed to the 3½" drives of desktops. In addition, these drives have special components built-in to protect them against movement.

Capacity and speed: These are the same as for personal computers.

Cost: Because of the more expensive components and the smaller market for laptops, these are usually quite a bit more expensive than personal computers. Increased volumes and improvements in manufacturing techniques will bring the price of laptops down in the future.

Typical users: Although the users could be any of those mentioned under personal computers, cost tends to limit the users to those who need portability or who can afford the cost. You would find them most commonly used by people such as managers and journalists. It is quite common to see a laptop and the desk of senior members of staff and personal computers on the desk of staff. This is not always a matter of status but often due to the fact that managers tend to take work home with them.

PDA / Personal Digital Assistant

The **PDA** is the smallest of all computers. Their main task is to maintain a diary and keep contact lists. On many you are able to make use of a word processor or spreadsheet, but, because of physical constraints, the amount that can be done is far more limited than on a PC. PDAs vary considerably in the features they contain. Top of the range cell phones now contain a PDA.

Usually, all the components of a PDA are solid state – they do not contain any moving parts. Some of the larger PDAs, often called subnotebooks, may contain a miniature 1½" hard drive. One feature that distinguishes a PDA from a subnotebook is that the latter has a built-in keyboard whereas the PDA makes use of a light pen and character recognition for data input.

Most PDAs are able to connect to a personal computer so that data can be exchanged. A common feature is **synchronisation** where software on the PC automatically updates both the PC and PDA at the same time by using the most up-to-date data on each.

Capacity and speed: PDAs have much less storage capacity and are slower than personal computers. They were designed with convenience and low power requirements in mind rather than power.

Cost: Usually a PDA is less expensive than a personal computer, but top of the range PDAs can actually be more expensive than an average personal computer.

Typical users: Typical users are those with high mobility who need to keep track of their agendas. These would include managers, representatives and doctors.

Cost comparisons

The cost of a computer depends on a range of factors including the components, labour and demand. As a result, any price that is quoted will be out of date within weeks. Further, as demand increases for one type of computer and decreases for another, their relative prices will change.

The following table attempts to give a graphical representation of the relative prices of different types of computer:

	Most Expensive	Least Expensive
Mainframe	————	
Laptop computer	————	
Personal computer	————	
Network computer	————	
PDA	————	
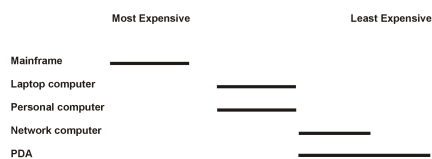
Main Parts of a Personal Computer

Know the main parts of a personal computer such as: central processing unit (CPU), hard disk, common input and output devices, types of memory. Understand the term peripheral device.

Central Processing Unit

The **Central Processing Unit** or **CPU** can be thought of as the brain of the computer. The function of the CPU is to execute the instructions in the programs. At the heart of its operations are **arithmetic** and **logical operations**.

The CPU is made up of millions of electronic components called transistors, capacitors and resistors. Transistors are the active components of the CPU. Modern CPUs contain millions of transistors.

Figure 1.1. Processor Chip
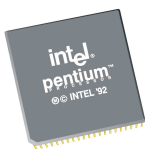
It was the miniaturisation of components and the creation of the **integrated circuit** that has made the development of modern computers possible. Although integrated circuits contain enormous numbers of components and connectors, the whole object is manufactured as a single item through special manufacturing techniques. From the outside, the integrated circuit looks like a small black box with a number of electrical connectors on the outside.

Figure 1.2. Integrated Circuit
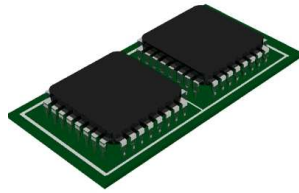
Hard disk

The hard disk is the component that stores data and programs even after the computer has been switched off. It consists of a number of rotating platters which are covered with a magnetic film. Information is stored using the magnetic properties of the film. The platters rotate from between 5000 and 8000 rpm or faster.

Heads are attached to the end of arms that are able to move backwards and forwards across the surface. These heads move very close to the surface, typically only a speck of smoke could fit between the head and the surface.

Because a hard drive is both mechanical and electronic in construction, it is called an **electro-mechanical device**.

Figure 1.3. Hard Disk

Input devices

Input devices are components which are used to feed commands and data into the computer. These include devices such as keyboards and mice.

Output devices

Output devices are devices that the computer uses to send us the results of the processing. These include the VDU (monitor) and printers.

Peripheral devices

A computer system comprises the case which houses the motherboard, CPU, hard drives, power supply and various other components. Devices such as printers, monitor, keyboard and mouse which are connected to the main unit by various types of cables and connectors

are called **peripheral devices**.

Memory

There are two general categories of memory: primary and secondary.

Secondary memory consists of the various devices that are able to store data and programs even when the power is off. This includes devices such as hard drives, floppy drives, tape drives, CD drives and DVD drives.

Primary memory is the memory that is intimately associated with the actual working of the computer. This includes memory that holds the start-up routines as well as the current program and data it is working with. There are various forms of primary memory: RAM, ROM and Cache memory.

RAM or Random Access Memory holds the current running program and its associated data.

ROM or Read Only Memory contains certain key routines (small programs). One example, is the set of start-up routines. These take control of the computer when you switch on and ensure that the computer boots-up. Booting-up is the process of starting the computer up so that it is able to load and run computer programs.

Cache memory is very high speed memory that is used by the CPU in executing the individual instructions of the program. It is used to hold items such as instructions that are next in line to be executed and data that is likely to be needed by the CPU.

All of these concepts will be dealt with in more detail in the next chapter.

Computer Performance

Know some of the factors that impact on a computer's performance such as: CPU speed, RAM size, the number of applications running.

The performance of a computer is determined by a number of factors, all of which work together. Often a single item that is functioning poorly will cause a bottleneck resulting in poor performance.

CPU: The model of the CPU and its speed are the first factors that determine computer performance. Generally, the CPU so far outperforms the other components, that poor performance is usually due to other factors. One important factor in the performance of the CPU is the amount of on-board cache memory. If the CPU has sufficient cache memory it can queue future instructions and data in cache. Since access to cache memory is far faster than that to RAM, the overall processing performance is improved. On-board cache memory helps especially where the CPU is involved in processing of graphics.

RAM: If a computer does not have sufficient RAM, it has to make use of the hard disk to store intermediate data that it would normally store in RAM. This is referred to as **virtual memory**. Since hard disk access is much slower than access to RAM, this will slow down the computer. The more RAM a computer has, the less need there will be to make use of virtual memory.

Number of applications: Modern computers are designed to run more than one application at a time and to allow applications to be working on multiple sets of data at the same time. For example, a user may be working on four documents at once. However, the more open applications and documents there are, the more this will place a burden on the processing power of the computer. For best performance, only open the applications and

documents you need. Close others.

Graphics cards: The graphics card is the unit that converts the signals from the CPU into a form that can be displayed on the monitor. A good graphics card can take over many of the tasks of the CPU in generating the output. This leaves the CPU free to do other processing tasks. The quality of the graphics card is a key factor in the performance of a computer, yet is one which is often overlooked.

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Chapter 2. Hardware

Central Processing Unit

Understand some of the functions of the CPU in terms of calculations, logic control, immediate access memory. Know that the speed of the CPU is measured in megahertz (MHz) or gigahertz (GHz).

Parts of the CPU

There are three main components to the CPU: the arithmetic-logic unit (ALU), control unit and on-board cache memory.

Control unit: The control unit is responsible for loading and interpreting the individual instructions that comprise the computer program. These instructions are in a language called **machine code**. Machine code is a pattern of ones and zeros. The control unit also has the task of getting the data needed by the instructions and returning the results of the processing after the instruction has been executed.

Arithmetic-logic unit: The ALU is responsible for carrying out arithmetic operations such as addition and subtraction as well as logical decisions such as whether one number is bigger than another. All programs consist of complex sets of arithmetic and logical operations. Another way of thinking of a logical operation is as a decision making operation.

On-board cache memory: Because the CPU can perform its operations much faster than data can be transferred from RAM, many CPUs have on-board cache memory. This is memory that the control unit can access very quickly and use for intermediate storage. Further, data and instructions can be loaded into cache before they are actually needed. When they are needed, the transfer is much faster than it would have been if RAM had been used.

Speed of the CPU: The CPU operates as a result of electronic pulses sent to it by another device on the motherboard called the clock. The speed of a CPU is measured by the maximum number of pulses it is able to handle. This is measured in MHz (megahertz) or millions of pulses per second or GHz (gigahertz) thousands of millions of pulses per second. A good personal computer will use a CPU with a clock speed of over 2 GHz. This means it receives 2 000 000 000 million pulses every second from the CPU.

Previously CPUs could only do one operation per pulse. With improvements in technology, they have been able to improve on this. For example, they can do one operation at the start of the pulse and one at the end of the pulse.

Memory

Understand different types of computer memory such as: RAM (random-access memory), ROM (read-only memory) and distinguish between them.

As mentioned in the first chapter RAM is used to store the current data and programs

whereas ROM is used to store the routines that enable a computer to boot up.

The following table compares RAM and ROM.

	RAM	**ROM**
Function	Store the currently active programs and their data.	Stores certain fixed routines such as the boot-up routines.
Volatility	RAM is volatile: When the computer is switched off, the contents are lost.	ROM is non-volatile: When the computer is switched off, the contents are not lost.
Changeable	The contents of RAM can be changed or deleted.	The contents of ROM cannot be changed or deleted.

Memory Measurements

Know how computer memory is measured: bit, byte, KB, MB, GB, TB. Relate computer memory measurements to characters, files and directories/folders.

Bits

In all the components of a computer, data and instructions are stored as patters of ones and zeros. These individual ones and zeros are called bits.

In electronic components the one is stored by switching an electronic switch on and a zero by switching it off. On a magnetic material, such as the surface of a hard disk, the one may be stored with a clockwise magnetic field and a zero with a counter-clockwise field.

The reason for the use of only ones and zeros stems directly from the fact that modern circuitry makes use of electronic switches and these can only be on or off. The term for circuitry based on switches is **digital**. Arithmetic based on the use of only ones and zeros is called **binary arithmetic**.

Bytes

Bits are grouped together into sets of eight. A set of eight bits is called a **byte**.

ASCII or American Standard Code for Information Interchange was a system of representing all the characters of the western alphabet and certain special characters in a single byte. You can think of the byte as the amount of memory required to store a single character.

As there are only 256 possible variations within eight bits, this is not sufficient to represent other alphabets. As a result a new system, called uni-code, has been developed to represent all the alphabets of the world. This makes use of two bytes or sixteen bits. With two bytes, 65536 different characters and symbols can be represented.

Units of memory

Understand how computer memory measurement is expressed using the metric system.

Because we use very large numbers of bytes for storage, abbreviations are used for large numbers. These are based on powers of two and are set out in the following table.

kB	kilobyte	2^{10} = 1 024 bytes	approx. 1 000 bytes
Mb	Megabyte	2^{20} = 1 048 576 bytes	approx. 1 000 000 bytes
Gb	Gigabyte	2^{30} bytes	approx. 1000 000 000 bytes
Tb	Terabyte	2^{40} bytes	approx. 1000 000 000 000 bytes

The capacity of hard drives is measured in bytes. A modern hard drive has a capacity of 40 Gb or more.

When files are stored on disk, the amount of space they occupy is measured in bytes. The following screen shows a partial listing of files in a directory. Notice the fourth column which contains the size of the file in bytes. (Don't be concerned with the detail of this screen – it is shown purely for illustrative purposes.)

Figure 2.1. Directory Listing

```
[david@Linux1 david]$ ls -l
total 636
drwxrwxr-x    3 david     david         4096 Jan 20 18:32 Desktop/
drwxr-xr-x    2 david     david         4096 Jan 11 15:34 Documents/
-rw-r--r--    1 root      root         42853 Jan  6 12:49 MyFirstDocument.sxw
-rw-rw-r--    1 david     david        60088 Jan 11 13:42 snapshot10.png
-rw-rw-r--    1 david     david        13241 Jan 11 15:36 snapshot11.png
-rw-rw-r--    1 david     david        56729 Jan 21 17:35 snapshot1.png
-rw-rw-r--    1 david     david        25389 Jan 20 16:30 snapshot2.png
-rw-rw-r--    1 david     david       104870 Jan 20 15:19 snapshot3.png
-rw-rw-r--    1 david     david        89470 Jan 20 15:20 snapshot4.png
-rw-rw-r--    1 david     david        29193 Jan 20 15:21 snapshot5.png
```

When we work with files and directories, we often need to know how large the files are or how much space a directory and its files occupies.

- One **byte** is one character which is a number, letter or symbol. It consists of eight bits (binary digits) and is the smallest unit of information a computer can process.
- One **kilobyte** is 1,024 characters and is approximately equal to one page of text in double-spacing.
- One **megabyte** is 1,048,576 characters and is approximately equal to one book.
- One **gigabyte** is 1,073,741,824 characters and is approximately equal to 1000 books.
- One **terabyte** is 1,099,511,627,776 characters and is approximately equal to a whole library.

Input Devices

Identify some of the main devices for inputting data into a computer such as: mouse, keyboard, trackball, scanner, touchpad, lightpen, joystick, digital camera, microphone.

Any device which allows us to send data or instructions to the computer can be regarded as an input device. We can use any mechanical movement, sound, light, heat or electronic signals to input data and instructions.

Keyboard

The most familiar input device is the keyboard. Users type the text directly into the computer.

There are a number of layouts of the keyboard. The most important are the language variations. For example, the US and UK keyboards are quite similar but are very different from the French keyboard.

Figure 2.2. Keyboard

Mouse

The mouse is a point and click device. As you move the mouse across a surface, it senses this movement either mechanically or optically. This is translated into the movement of a pointer on the screen. Functions are represented as icons on the screen. When you click on these using a mouse button, the function is executed.

Figure 2.3. Mouse
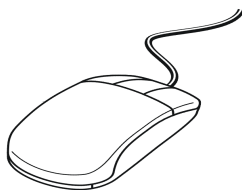
Touchpad

A touchpad is a device that senses pressure to guide the pointer on the computer screen. It is generally a small square area below the keyboard. As the user moves his/her finger across the touchpad, the pointer moves on the screen. Next to the pad are two buttons used for clicking in exactly the same way as those on a mouse.

Trackball

A trackball acts as a type of overturned mouse. The ball is on the top side of the object. By rolling the ball you can move the pointer across the screen. Some keyboards have an in-built trackball.

The trackball has been superseded by the touchpad.

Figure 2.4. Trackball
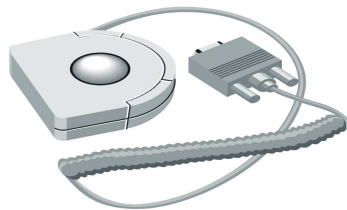
Lightpen

A light pen is a device which is sensitive to variations in patterns on a surface. Light pens act like a miniature scanner and can read text as they are dragged across the printed page. This can be transferred directly to the current open document.

Figure 2.5. Lightpen

Bar code reader

A bar code is a pattern of vertical lines in which the spacing and thickness can be used to represent data. A bar code reader is a device that can read and interpret bar codes and input the data into the computer.

Figure 2.6. Bar code reader
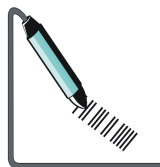
Joystick

A joystick is a device that is familiar for use in games to move objects on the screen. However, it is also used to control the movements in computerised industrial machines such as lathes. It consists of a small vertical lever which can move in any direction. These

movements are translated to the computer which in turn uses them to control the movements of machinery.

Figure 2.7. Joystick

Digital camera

Instead of film, a digital camera uses a light sensitive screen at the back of the camera. A small computer inside the camera converts the pattern on the screen into a standard graphics file which can then be transferred to a computer.

Microphone

A microphone translates speech into an electronic signal. Modern speech recognition software is able to translate this into either commands or data. This enables the user to use a microphone as an alternative to the keyboard.

Scanner

A scanner is similar to a photocopier, except that instead of producing a paper copy of the document you place on it, you get an electronic copy which appears on your computer screen.

Text recognition software can be used with a scanner. This software is able to recognise the individual letters in the image. Instead of creating a single image of the document, the software inserts actual text into your application which can then be edited.

Figure 2.8. Scanner

Output Devices

Identify common output devices for displaying the results of processing carried out by a computer, such as: monitors, screens, printers, plotters, speakers. Know where these devices are used.

An output is any device that the computer uses to send the results of processing to the user. The output can be a hard copy (paper), visual or sound.

Visual Display Unit (VDU)

Virtually all computers use some type of screen as their primary output device. There are two categories of screen: cathode ray tube and LCD.

CRT screens: The cathode ray tube (CRT) type screen is usually called a **monitor** and makes use of the same technology as a television screen. A beam of electronics is fired from an electronic gun at the back of the tube. This strikes the front of the tube which is covered in a phosphorescent material which glows when struck by electrons. Between the electron gun and the screen the beam is modulated by a signal to produce the image you see on the screen.

With CRT type screens, an important measure is the refresh rate. Roughly speaking, this is the number of times the image is refreshed every second. A low refresh rate makes the image appear to flicker. You need a refresh rate of at least 72 Hz (72 times a second) to avoid the appearance of flicker.

Solid state screens: Solid state screens, also known as LCD or Liquid Crystal Displays, make use of tiny transistors to emit light and create an image. Originally, LCD screens were confined to laptops, but they are increasingly used with desktops. They are usually called flat screens when used as separate units with desktops.

Resolution: An important characteristic of all screens is their resolution. Each point of light on the screen is called a pixel. The resolution of a screen is the maximum number of pixels that the screen can display. This is given as the number of pixels across (horizontal resolution) by the number of pixels down (vertical resolution). For example, 800 x 600. The greater the resolution the better. Modern screens can display 1024 X 768 or better.

Printers

Printers produce a hard copy of the output on paper. There are three main types of printer: Dot matrix, Inkjet and Laser. The following table compares the three types.

	Dot matrix	**Inkjet**	**Laser**
Initial cost	Low	Medium	High
Cost per printed page	Low	High	Medium
Speed	Low	Medium	High
High volumes	No	No	Yes
Noise level	High	Low	Low
Print quality	Low	Medium	High

	Dot matrix	Inkjet	Laser
Print graphics	No	Yes	Yes
Print in colour	No	Some	Some
Print source	Ink ribbon	Ink	Toner powder

Plotters

A plotter consists of a device that can move paper both backwards and forwards. On the top of the device one or more pens are able to move horizontally across the paper. The combined movement of the pens horizontally across the paper and the vertical movement of the paper allows complex continuous diagrams to be drawn.

Some plotters allow different colour pens to be used to create diagrams in multiple colours.

In other types of plotters, the paper lies on a flat bed. The mechanics of the plotter are so designed that the pens can move both across and down the paper to create the diagram.

Figure 2.9. Plotter
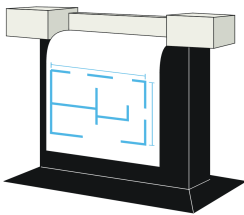
Plotters are usually used in conjunction with CAD (Computer Assisted Design) programs. These are used in everything from the design of ships and machines to buildings.

Speakers

Modern computers using the appropriate software can turn text in a document into audible speech. This is known as **speech synthesis**. Other types of software allow music and other sounds to be created and played back.

The line between the computer and a home entertainment system is becoming blurred. Computers are able to play music directly from a CD or play a film from a DVD. You can even fit your computer with a radio or TV card to add these functions.

In all cases, the sound is transmitted through a speaker in the same way it is in a sound system or radio.

Input/Output Devices

Understand some devices are both input/output devices such as: touchscreens.

Some devices function as both input and output devices.

A touchscreen is a special type of screen in which the screen not only displays output but also responds to being touched.

A typical example is their use in autotellers at banks. Part of the screen contains information. Other parts may contain a menu. When you touch one of the icons on the screen, the system responds to the associated command.

Another example is to be found in information screens in shopping malls. The lower half of the screen consists of a number of icons representing menu items. If you touch one of these, either information will be displayed in the top half or a sub-menu will appear allowing you to refine your search for information.

PDAs have touch sensitive screens. You would use a special stylus to touch icons on the screen or to write. Character recognition software then converts your writing to input text for the PDA.

Storage Devices

Compare the main types of memory storage devices in terms of speed, cost and capacity such as: diskette, Zip disk, data cartridges, CD-ROM, internal, external hard disk.

Diskette

A diskette comprises a plastic flexible disk enclosed inside a tough plastic cover. At one end is a window. When the diskette is placed inside a diskette drive, the window is pushed to the side. The read-record head inside the drive makes contact with the magnetic disk.

Figure 2.10. Diskette

Diskettes are slow and have a low capacity (1,44 Mb). Since they are cheap, they still tend to be commonly used for storing small amounts of data. Another advantage is that they can be used over and over again. Unfortunately, many are not very good quality and data can become corrupted and unusable. Because of this they are not suited to backup purposes. The disks can become corrupt through many causes including disk, heat, magnetism or moisture.

Zip disk

A zip disk is a removable magnetic disk which fits into a special zip drive. The surface is coated with a special scratch resistant material which makes a zip disk a very robust storage device. It comes in a number of capacities: 100, 250 and 750 Mb. The speed of a

zip drive is faster than all but the very fastest of CD drives. Its robustness and speed make it an excellent backup device. However, its capacity is much less than that of hard drives and tape drives which limits its use for very large amounts of data.

Data cartridge

A data cartridge is a tape very similar to that found in a tape recorder, only much higher quality. These are used in a device called a **tape streamer** to record data. Data cartridges, especially if good quality, are reliable and cheap devices for creating backups of large quantities of data. They are, however, rather slow. Data cartridges are **sequential devices** which means that to access an item of data on them, all the preceding data reads to be read first. They are tending to become obsolete as newer faster and more reliable technologies are available. A single tape can stored many Gb of data.

CD ROM

A CD ROM uses optical technology. When data is written, small pits are burned into the surface using a highly focussed laser beam. These are read by another laser beam.

There are two types of CD ROM used for storage. The CD-W disks can only be written to once. Once data has been written to part of the surface, this part can no longer be used. CD-RW disks are designed so that one set of data can overwrite another. This allows the disks to be re-used many times.

CD ROM provides a reliable and storage medium for backing up and storing data. The speed is greater than that of a diskette but slower than that of a hard drive. Writing to a CD ROM is a much slower process than reading it. The capacity of a CD ROM is 640 Mb. It is sometimes possible to store about 700 Mb on a disk.

CD ROM technology is improving all the time with continued improvements in quality and speed.

DVD

The **Digital Versatile Disk** is a development of the storage technology of the CD ROM. Using newer storage methods and higher quality media, a DVD can store about 4 Gb of data. This is enough to store a full length film.

Hard disk drive

A hard disk drive can be **internal** or **external**. An internal drive is housed inside the main unit and is connected directly to the motherboard of the computer. An external drive is housed inside a special caddy which connects to the computer through one of its ports. Most now use the USB or firewire ports to achieve maximum performance.

An external hard drive is a good backup medium and allows large quantities of data to be stored. Since the same drive can be connected at different times to different computers, these drives provide a useful way of transferring data between computers that are not connected through a network. As they are electromechanical devices, they are subject to mechanical failure if not handled with care. The small 2½" drives used in laptops make excellent external hard drives since they are constructed to be moved around.

Modern hard drives have capacities from 40 Mb to 120 Mb. They are also relatively cheap in terms of the storage capacity they offer.

Because they contain moving parts, they do eventually fail. When a hard drive fails is quite

unpredictable. Any suspicious noise coming from a hard drive should be viewed with great caution and the data it contains should backed up immediately. The expected life span of a hard drive is measured as the **mean time between failures**. This is a very rough average of the working life. Figures of 250 000 hours are often quoted but these should be viewed with caution.

Numerous systems have been developed to protect data on hard disks. One of these is **mirroring** where the data is stored simultaneous on two disks. The one disk becomes the mirror image of the other. If one fails, the data is still one the other. In this case, the first disk is replaced, the system creates a mirror image of the first disk automatically and the system continues.

There are a number of measures of performance of a hard disk. One is the speed at which the platters turn. Typically this is somewhere between 4800 and 7200 rpm. There are faster, more expensive disks. Another is the access time. This is the time it takes the disk to access an item of data. A good figure here would be around 10 ms. An ms or millisecond is one thousandth of a second. Disks are also sometimes compared in terms of their data transfer rates. This is a measure of how many bytes can be read or written per second.

Flash memory and memory sticks

A new type of external memory is the flash disk or memory stick. This is a solid state device (no moving parts) that connects to the computer via the USB port. It provides a very fast and reliable method of storing data externally.

They are at the moment fairly expensive, especially the larger capacity devices. They tend to be limited to a maximum of about 2 Gb. This figure can be expected to increase quite dramatically over time.

Relative cost of storage

As in the case of computers, the cost of memory is continually changing. The price varies from country to country as well as according to international demand. In order to compare the cost of memory, a common measure is to calculate the cost per Mb. The following table compares the cost per Mb of the different media.

Medium	Hard disk	CD	Data cartridge	Zip disk	Flash disk	Floppy disk
Relative cost per Mb	0.04	0.15	0.3	0.3	3	4

This table tells you that it is about 100 times as expensive to store a Mb of data on a floppy disk as it is on a hard drive.

Use this table with caution. Treat the values as very approximate relative values. In other words use them as comparative values, not as monetary values.

Formatting disks

Understand the purpose of formatting a disk.

A new diskette or hard disk is not able to record data immediately. The disk first needs to be prepared by a process known as formatting. This marks out concentric circles called

tracks. Each track is divided into a number of sectors. The tracks and sectors are marked out using magnetic markers.

As data is recorded on a disk, it fills up. To be able to re-use a disk, it may also be formatted. This releases the areas that contain data so that new data may be stored in its place. When a disk is reformatted, the old data is lost.

When data is stored on a disk, it is not always stored in a continuous pattern. Rather, the system stores data in the first free area it finds. When this has been filled, it looks for additional free space and continues storing the data. A file ends up being stored as a series of segments across the disk. This breaking up a a file into many segments is called fragmentation.

Fragmentation slows down the operation of the disk as the system needs to keep track of all the different segments. A disk may be re-organised to reduce fragmentation by a process called **defragmentation**.

There are different **file systems** available, but in all cases the disk needs to be prepared with the index area, tracks and sectors through formatting.

As mentioned previously, disk can be **reformatted**. In this process everything on the disk is erased and the disk is formatted as if it was a new disk.

The following diagram represents the tracks (green) and sectors (red triangular area) that are created when the disk is formatted and ready to store data.

Figure 2.11. Disk Sectors and Tracks
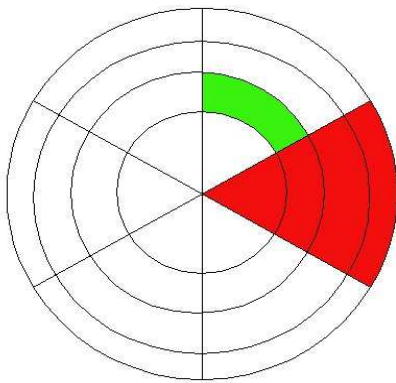
Chapter 3. Software

Types of Software

Distinguish between operating systems software and applications software.Understand the reasons for software versions.

Software is divided into two broad categories: **systems software** and **application software**.

Systems software is the term used to described programs that enable the computer to function, improve its performance and access the functionality of the hardware. Systems software sole function is the control of the operation of the computer. You can think of systems software as providing the foundation for applications software.

Systems software is further subdivided into **operating systems** and **utilities**. The operating system is the program that actually makes the computer operate. Utilities are programs which either improve the functioning of the operating system or supply missing or additional functionality.

Applications software is the term used for programs that enable the user to achieve specific objectives such as create a document, use a database, produce a spreadsheet or design a building.

Versions: Software developers continually strive to improve the performance of their products and add new features. Especially in a world of competing products, each developer needs to make their product perform better, have fewer problems and have more features. The new releases of software products are called versions. The versions use a numbering system such as Mandrake Linux 9.2 or OpenOffice.org 1.1. A change in the first number represents a major new version while a change in the second number represents a less significant change.

Operating System Software

Describe the main functions of an operating system and name some common operating systems.

As mentioned above, it is the operating system that actually makes the computer function. The following is a list of some of the functions of the operating system:

- Boot-up the computer.
- Control the hard drives: This includes such features as formatting and defragmenting disks as well as saving files to and retrieving files from disk.
- Control input devices such as keyboards, mice and scanners.
- Control output devices such as the video display and printer.
- Control the external ports: Ports are the external connections that enable peripheral devices to be connected to a computer. Common types of ports are serial, parallel, usb

and firewire. Of these the USB ports are the most important.

- Provide the functionality for computers to be linked in a network.

- Provide the foundation for application software to be launched.

- Enable application software to access and use the hardware.

The following list names some operating systems. They are grouped according to similarity.

- Unix; Linux; Free BSD

- Windows 95; Windows 98; Windows Me, Windows NT4 Workstation / Server; Windows 2000 Workstation / Server; Windows XP; Windows 2003 Server.

Applications Software

List some common software applications such as: word processing, spreadsheet, database, Web browsing, desktop publishing, accounting, together with their uses.

The following table lists some types of application software, brand names and function.

Application	Brand names	Function
Word processor	OpenOffice.org Writer StarWriter, KWord Microsoft Word Lotus Ami Pro Corel WordPerfect	Create, store, format and edit documents, letters and articles. Word processors are used where the emphasis is on manipulation of text.
Spreadsheet	OpenOffice.org Calc StarCalc, KSpread Microsoft Excel Quattro Pro Lotus 123	Create financial statements, balance sheets, perform statistical and numerical analysis of data, make forecasts based on numeric data. Spreadsheets are used where the emphasis is on arithmetic.
Presentation	OpenOffice.org Impress StarImpress	Create slide shows, lectures, seminars and other types of presentation.

Application	Brand names	Function
	KPresenter Microsoft PowerPoint	
Database	Sybase, MySQL Microsoft Access	Store and convert data into information. Databases are particularly useful in working with large quantities of data.
Email client	Evolution, KMail Microsoft Outlook	Send, receive, store and organise electronic mail.
Web browser	Mozilla, Netscape Microsoft Internet Explorer	Surf the Internet and view web sites.
Desktop publishing DTP	Microsoft Publisher Page Maker	DTP is similar to word processing except that there is more emphasis on page layout and the integration of diagrams.
Accounting	GnuCash Pastel Accounting	Store accounting information and produce reports, statements and invoices.
Web development	Dreamweaver Microsoft FrontPage	Create web sites that can be read by a browser.
Graphics and imaging	The GIMP Adobe Photoshop	Create and manipulate graphics images and store images in a variety of formats.

Graphical User Interface

Understand the term Graphical User Interface (GUI).

A **graphical user interface** or **GUI** is designed to simplify the work of the user whether they are using the operating system or an application package. The interface consists of a screen with a number of icons or menus. Functions are executed by pointing and clicking with the mouse.

Some of the advantages of using a GUI are:

- Less work for the user. To execute a function all you have to do is point and click on an icon instead of typing out an instruction.

- Quicker to learn.

- Easy access to the basic functionality of the operating system or application package.

- Hides the underlying complexity from the user.

- Simplifies and integrates multitasking. Multitasking refers to using several applications at the same time. Opening a new application or document involves a couple of mouse clicks. Likewise switching between tasks also involves only a couple of mouse clicks.

There are some disadvantages to using a GUI based operating system.

- Not all the functionality is available. The icon represents the most commonly used form of a function. A text based system gives you access to all the options associated with a function. Power users tend to switch between the GUI and the system prompt as needed.

- Being graphics based, a GUI runs more slowly than a text based system. However, with the power and speed of modern computers this is not the problem it once was.

The following screens illustrate a GUI in Linux and Windows.

Figure 3.1. Linux

Figure 3.2. Windows
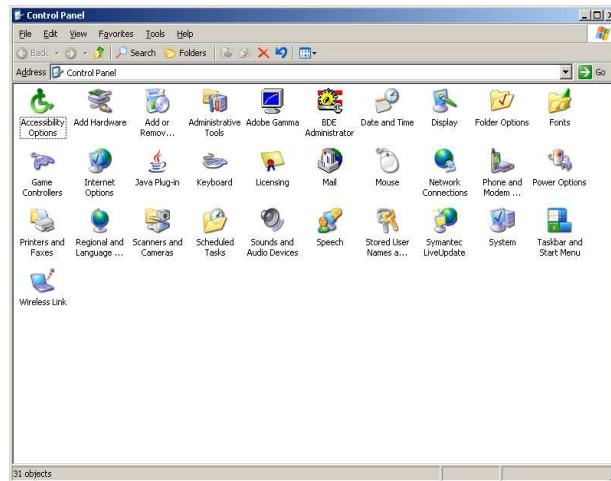
The following two screens illustrate the use of menus:

Figure 3.3. Desktop Menu Use
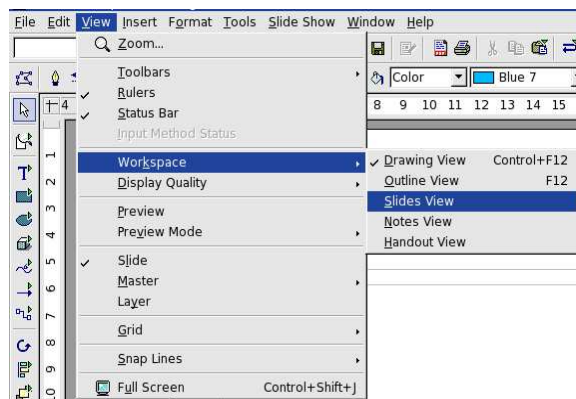
Figure 3.4. Application Menu Use
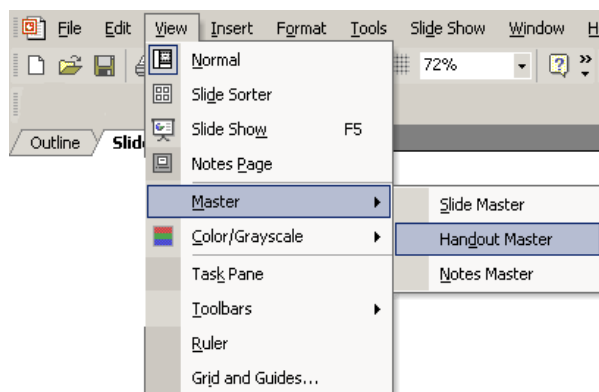
In each case, clicking on an icon will either execute a function or display another set of icons containing the function.

Systems Development

Understand how computer-based systems are developed. Know about the process of analysis, design, programming and testing often used in developing computer-based systems.

Program Development Life Cycle

The development of computer programs is a highly developed and structure process involving a number of distinct stages as shown in the table below. The stages of development are known as the **program development life cycle**.

| Stage	Description
Analysis	The problem or task is analysed and clarified. This involves analysis of the way the task is currently being done and consultation with end users. The project is set out in broad outline. The work of this stage is performed by systems analysts.
Design	The project is broken down into smaller sections. These too may be further broken down until there are units. The method of programming each unit is then specified in great detail. The most suitable programming language for each unit is then chosen. The complete specification is the final design. The work of this stage is also performed by systems analysts.
Programming	The design is handed over to programmers who code the design into programming languages such as C or Java. The work of this stage is carried out by computer programmers.
Testing	Since programs are long and complex, they may contain errors called bugs. These may be syntactical errors, in which the programmer made a mistake in the structure of the command, or logical errors. In these the program appears to work, but works incorrectly. The process of testing is designed to find and eliminate bugs. This stage involves end users to try out the program, programmers to fix syntactical mistakes and systems analysts to fix errors in the logic of the program.

The following are often also included as part of the development cycle.

Implementation	Once the systems analysts are satisfied that the system is operating correctly, it is installed and implemented. Usually this is done using a **pilot group**. In this implementation, the system is implemented on a limited scale to start with. If any further bugs are found, these can be eliminated before full scale implementation.
Further development	Once the system has been in use for a while, further problems, limitations or performance problems may become apparent. The system will then be modified and new versions released with the changes.

Chapter 4. Information Networks

Understand the terms, local area network (LAN), wide area network (WAN). Understand the term client/server.

Networks

A set of computers connected together so that they can communicate is called a computer network. This involves installing **network cards** in each computer. Each computer is then connected through cabling to a central device called a **hub**. Operating systems contain components that are dedicated to the task of enabling computers to communicate over a network. This software makes use of special rules of communication called **protocols**. There are many different types of protocols used for a variety of purposes. The most commonly used protocol for establishing and maintaining communication across a network is called **TCP/IP** or **Transmission Control Protocol / Internet Protocol**.

Client-server and peer-to-peer networks

Networks on which all computers have equal status are called **peer-to-peer** networks.

On most networks, certain computers have special dedicated tasks. Since these machines provide **services** to other computers, the are called **servers**. The computers that make use of the services or servers are called **clients** or **workstations**. A network such as this is called a **client-server** network.

A server which is used for the central storage of files is called a **file server**. Using a file server, users can access their work from anywhere on the network. They can also make these files available to users on other computers. File servers also enable users to co-operate on a task by centralising the results of their work.

A computer attached to a printer which users can access is called a **print server**. Having a single printer rather than a printer attached to each computer obviously saves capital.

An increasingly important type of server is an **applications server**. In the case of applications servers, application packages are not installed on the workstations but on the applications server.

A **communications server** is a computer dedicated to connecting a network to the outside world. These are often called **proxy servers**.

As the case of print servers illustrates, one of the values of having a network is that it enables **resources to be shared**.

LAN

A **LAN** or **Local Area Network** is a group of computers within the same building, or within a group of buildings that are in close proximity, that are connected together.

WAN

A **WAN** or **Wide Area Network** is a group of widely dispersed computers that are connected together. These could be across the same town, or across a country or even

across the world. Apart from distance, the other feature that distinguishes as WAN from a LAN is that the WAN would make use of a range of communication technologies such as telephone, microwave and satellite links.

Advantages of Networking

List some of the advantages associated with group working such as: sharing printers, applications, and files across a network.

Sharing Printers and Files

A peer-to-peer network is where two or more computers are linked together in order to share information and hardware.

It is a major advantage to be able to share printers, plotters and scanners. When computers are networked together, there can be many pc's sharing a printer as opposed to each one having to have it's own printer which is much more costly.

It is also possible to share data files across the network by creating a share on the harddrive and allowing other people access to that information.

If you want to share applications you would need to investigate a client/server network solution and some of the advantages are listed below.

File Servers

- Users can access their work from any workstation connected to the network.
- Users can easily exchange work with colleagues.
- Users can easily co-operate on tasks.
- Backing up is centralised and can be placed under the control of experts who will follow the correct procedures.

Printer Servers

- Instead of having printers attached to each computer, printers only need be purchased for the print servers. This results in financial savings.
- As there are fewer printers to look after, there is lower maintenance.
- As far fewer printers need to be purchased better quality printers with advanced features can be purchased.

Application Servers

- Software only needs to be installed on the applications server instead of each workstation.
- The software is configured in the same way for all users.
- Upgrading of software only needs to be done on the server.
- Cost of licensing software for an applications server is less than the cost of many stand-alone versions.

- Centralising applications software simplifies the process of implementing software policies in an organisation. Software policies refer to what software may be installed on computers and how it may be used.

Internet Connection Sharing (Proxy Servers)

Proxy servers contain a repository of internet sites recently visited and cached for quicker access at a future date.

- Proxy servers can be configured with **firewall** software. This helps protect the network from attack by hackers.

- Files can be filtered for computer viruses before being passed on to the network.

- Organisations can control access of users to outside sites.

- Since there is only one point of communication, there is a large saving on line costs.

Intranet, Extranet, Internet

Understand what an intranet is and understand the distinction between the Internet and an intranet. Understand what an extranet is and understand the distinction between an intranet and an extranet.

Internet

The internet is the collection of all computers across the world which can access each other in some way. The links between computers might include telephone, fibre optic cable, radio, microwave or satellite. Today tens of millions of computers are able to access each other. The Internet has no central organisation which controls its use. Because the Internet knows no borders, many governments have tried to control the flow of information across the Internet. However, communications technology is so varied and so widespread that this is a near impossible task.

Intranet

An intranet is similar to the Internet in operation. However, it is limited to an organisation. Users may browse computers within an intranet using a browser but will usually not be able to access the wider Internet. In the same way, outsiders will not be able to access the intranet of an organisation. An intranet can be thought of as a private Internet.

Extranet

An **extranet** is an extension of a organisation's intranet to include outside users. In an extranet, outside organisations or individuals are allowed access to certain parts of the intranet. This access is usually controlled by means of passwords and access rights. These restrict which users can access the extranet and what they can do once they have access. The purpose of the extranet is to facilitate business transactions with other organisations.

Uses of the Internet

Understand what the Internet is and know some of its main uses.

Some of its main uses are to:

•   Integrate the operations of multinational corporations.

•   Provide access to and share information and databases.

•   Transfer and share files between computers.

•   Facilitate business transactions.

•   Share resources.

•   Promote scientific co-operation between research institutions.

•   Provide a communications channel for the military.

The World Wide Web

Understand what the World Wide Web (WWW) is and distinguish it from the Internet.

The **World Wide Web** or **WWW** is a part of the Internet. The WWW consists of all the sites that can be accessed using a **web browser** such as Mozilla, Netscape, Internet Explorer or Opera. In order for a browser to access a web site, the web site must contain files that have a particular format constructed using **HyperText Markup Language** or **HTML**. These sites are developed using special web development applications. It is possible to create simple web sites using a word processor by saving the document in HTML format.

The HTML documents are stored as **web pages** on special servers known as **web servers**. These run special web server software such as **Apache Web Server** or **Internet Information Services**.

The WWW enables the free flow of information across the world. Developments in technology have made access easier and faster. As a result the WWW also became known as the **Information Superhighway**.

Most of the activities listed under the Internet in the previous section are now actually carried out using the Internet. In other words, the sites are created in HTML, or a similar format, are installed on web servers and are accessed by web browsers.

The Telephone Network in Computing

Understand the use of the telephone network in computing. Understand the terms Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), Asymmetric Digital Subscriber Line (ADSL).

Communications between computers rely heavily on the public telephone system. Newer telephone line technologies have improved the standard of communications between networks considerably. The following is a brief description of some of the technologies that are available.

PSTN

The **PSTN** or **Public Switched Telephone Network** refers to the originally telephone network. From a communications perspective it was slow and unreliable. Some of the exchanges on a PSTN may still make use of mechanical switches to route telephone calls. These add additional noise to the line. When lines are noisy, signals have to be resent repeatedly between the source and the destination. The PSTN makes use of analogue technology. Analogue technology uses continuously variable signals. An example of an analogue signal is ordinary speech. Newer digital technologies make use of pulses of fixed magnitude and duration.

In order to improve connections, it is possible to have an **analogue leased line**. This is a dedicated permanent telephone connection between two computers using the PSTN.

In order to connect a computer to a telephone network, you need a **modem**. This is an abbreviation for **modulator-demodulator**. The function of the modem is to convert the digital signals from the computer into an analogue form suitable for transmission on the PSTN.

ISDN

ISDN or **Integrated Services Digital Network** is a technological development that is able to make use of the existing PSTN cabling to transmit digital signals.

Technically ISDN is an international standard for the transmission of data, voice and video or normal voice or digital telephone lines. ISDN supports rates of up to 64Kbps. An ISDN connection consists of two lines which can be used independently or together to give a combined rate of 128Kbps.

If you wish to connect a computer to an ISDN line you need a special ISDN modem. This is a different type of modem to the one used with an analogue line. Its purpose, however, is the same, to convert the digital signals of the computer into a form suitable for transmission on an ISDN line.

It is possible to get a dedicated connection between two computers using ISDN. This is called a **diginet** connection.

The older telephone systems make use of electrical currents transmitted through copper cabling. As electric signals are subject to interference, they are not the ideal method of transmitting data. Newer telephone systems make use of fibre optic cable. In fibre optic technology, light is transmitted along the cable. As light signals are not subject to the same interference problems as electrical signals, fibre optic is a far more efficient and reliable system.

ADSL

ADSL or **Asymmetric Digital Subscriber Lines** allow the transmission of high speed digital data over ordinary telephone lines using a modulation technology called DMT or Discrete MultiTone. Ideally, fibre-optic is the ideal medium for high speed digital transmission. As the installation of fibre-optic is expensive, ADSL provides solution until copper cable is replaced by fibre-optic.

Communications Terminology

Understand the terms analogue, digital, modem, transfer rate, (measured in bps – bits per second).

Analogue signals

Analogue signals are used on the PSTN as well as for normal AM and FM radio transmissions. An analogue signal is one which varies continuously as, for example, in ordinary speech. An analogue signal has a graphical form as shown in the following diagram.

Figure 4.1. Anologue Signals
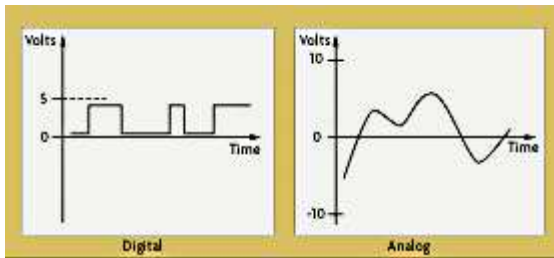
Digital signals

Digital signals are used in ISDN and ADSL connections. Newer television and radio transmission techniques are also making using of digital technology.

Digital signals are two state signals corresponding to a switch which is on or off. The same two state signal can also represent TRUE and FALSE or 1 and 0.

Graphically a digital signal is represented as in the diagram above.

Modems

A **modem** or **modulator-demodulator** is a device connected between a computer and a telephone line. Its function is to convert the digital signals of the computer into a form suitable for transmission over a telephone line. It must also do the reverse and convert the telephone line signals into a form suitable for the computer. Note that the modem used to connect to an ISDN line is different to that used to connect to an analogue line.

Figure 4.2. External Modem

Data transfer rates

Each 1 or 0 that is transferred is referred to as a **bit**. The speed of a data transfer is measured by the number of bits that can be transferred each second or **bps** (bits per second). This is also sometimes called the **baud rate** or **bandwidth**.

High speed lines have their speed measured in kbps or Mbps.

1 kbps = 1 024 bps (roughly 1 000 bps)

1 Mbps = 1 024 kbps = 1 048 576 bps (roughly 1 000 000 bps)

To put these figures in perspective, the maximum theoretically attainable speed with an analogue line is 56kbps. This figure is very seldom attained and the reality is usually substantially lower. ISDN lines operate at 64 kbps.

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Chapter 5. The Use of IT in Everyday Life

Computers at Work

Identify some situations where a computer might be more appropriate than a person for carrying out a task and where not.

Computers are ideal for repetitive work requiring speed and accuracy. This is especially true of those situations where human beings would become bored or simply cannot work fast enough.

Some examples include:

- Corporate data processing including functions such as sorting, selecting, summarising
- Analysis of census and other demographic data
- Administration of the national revenue system
- Actuarial calculations
- Statistical analysis
- Corporate accounting functions
- Creation of animations for films
- Weather forecasting
- Forensic analysis such as DNA and fingerprint matching
- Manufacture of electronic components and circuitry

Corporate Application

Know some of the uses of large-scale computer applications in business such as: business administration systems, airline booking systems, insurance claims processing, online banking.

Corporations have to keep records of their staff, details of their clients, the levels of their stocks, production schedules, debtors, creditors and a myriad of other details. Many of these activities are themselves linked in one or more ways. For example, stock levels of raw materials and production schedules are very closely linked.

The ideal solution in a corporate environment is **Enterprise software**. This is a complex suite of applications that are created to work together. Enterprise software is designed to automate all the activities of an organisation in one system. The different components or modules interact with each other. For example, if production requires certain raw materials, the appropriate production module will send a message to the stock module that certain materials are needed and when they will be needed. If the stock module determines that existing levels are too low, it will send a message to another module responsible for orders.

This module will then check which supplier to use and automatically generate an order stating the quantity needed and a deadline for delivery. Organisations do not buy an entire enterprise package, but only the modules that are relevant to the operation. Because of cost and complexity, enterprise software is usually found only in large organisations.

All organisations, no matter their size, can benefit from computer applications. Examples found in business include:

- Office application suites such as OpenOffice.org, Koffice, StarOffice or Microsoft Office for creating documents, spreadsheets and presentations.

- Accounting packages such as Pastel Accounting for keeping debtors and creditors records and creating statements and invoices.

- Inventory systems for keeping track of stock.

- Desktop publishing packages such as Microsoft Publisher and Page Maker for creating newsletters and press releases.

- Client tracking software such as Gold Mine for representatives to maintain regular contact with clients and record their activity.

- Airline bookings systems which manage large amounts of data and reservation details and also have the flexibility to handle frequent changes to bookings.

- Insurance claims systems to manage the processing and payment of claims.

- Online banking systems enable corporates and individuals to have easy access to funds transfer and account maintenance.

Public Sector Applications

Know some of the uses of large-scale computer applications in government such as: public records systems (census, vehicle registration), revenue collection, electronic voting.

Inland Revenue

The Department of Inland Revenue needs to keep records on millions of tax payers, both individual and corporate. It also needs to calculate the tax each has to pay and send out tax assessments. Sophisticated computer systems manage these tasks. SARS has a website that a taxpayer can register on and submit returns electronically by filling in the return online and authorising payment directly from their bank account.

National census and other demographic data

National economical and social planning require that governments have a good idea of the number of people in the country and in each region. They need to know income and health levels and size of families. They also need to know the skills and educational levels of different sections of the population.

This information is obtained by means of a national census. Part of this involves people filling in census forms and these being collected and checked by census officials. In other cases, figures are obtained by indirect methods such as aerial photographs. In all cases the data has to be analysed to produce summaries that planners can use. This task can only be done by specialised software designed for the purpose.

Other organisations also collect data for specific research purposes. For example, the

Medical Research Council will conduct research to determine the prevalence of aids. This research relies on sophisticated statistical software to analyse the data.

Vehicle Registration

Every vehicle has a unique registration number. This number, together with the vehicle and owner details is kept in a central database. This database can be accessed not only by the municipal officials, but also by other interested parties such as the police.

Voting registers

In order to vote, a person must be recorded on the voting register. This register of voters contains millions of records. Records need to be changed, deleted and added on a regular basis. Because of the sheer volume, it would be difficult to maintain in any other way than a computerised system.

Electronic voting

This is a system that is being introduced which will allow voters to register their choice online to submit their ballot instead of the traditional method of marking a piece of paper with a pen.

National Identity System

The Department of Home Affairs keeps records of all the citizens in a country. It keeps records of births, marriages and deaths. It also issues identity documents and passports. All this is only possible through the use of computerised systems.

Health Sector Applications

Know some of the uses of large-scale computer applications in hospitals/healthcare such as: patient records systems, ambulance control systems, diagnostic tools and instruments, specialist surgical equipment.

Patient records

Patient records need to record not only personal details such as name, address, relatives and employer, but most importantly detailed health history, record of operations and medication. The more efficiently this information can be stored and retrieved, the more efficiently the health care system can be administered.

Scheduling

Hospitals are extremely busy organisations which usually function amidst considerable stress. In order to use the facilities efficiently, where possible, activities need to be scheduled. For example, the availability or surgeons needs to be co-ordinated with the availability of operating rooms and the urgency of treatments. With good scheduling systems, much of the stress of the more routine activities can be reduced.

Ambulance control systems

By their very nature, ambulances do not work to a schedule. They are needed at unexpected places and unexpected times. The best a system can do is to optimise their use. That means knowing which ambulance is nearest to a scene at any given moment. In addition, modern software gives an ambulance driver details of the shortest route. The latest on-board software makes use of speech synthesis which actually tells the driver how to get to a destination as he is driving. This technology makes use of in-built maps and global positioning (GPS).

Diagnostic tools

With diagnostic tools, a doctor feeds information about a patient symptoms into the system. The system will respond with a series of possible causes. It may ask for further information to refine the diagnosis. At the moment these tools are not replacing the diagnostic skills of a doctor, but rather help him/her explore alternative diagnoses.

Other diagnostic tools connect the patient directly to the computer. This is commonly used in the diagnosis of cardiac problems. Not only are all the different heart waves displayed on the screen, but the physician has the option of magnifying or analysing any of the patterns in more detail. They can also be stored and compared with the heart patterns at a later stage.

Specialised surgical equipment

A modern trend is towards less invasive surgery. This involves inserted catheters into different parts of the body. Through these miniature cameras and surgical instruments are placed. The output from the cameras are displayed on large screens. Other relevant data is also analysed and displayed on screens. All of the activities are assisted by special computer programs.

Education Sector Applications

Know some of the uses of computer applications in education such as: student registration and timetabling systems, computer-based training (CBT), distance learning, homework using the Internet.

Student records

Education institutions have electronic registration that allows students to be registered on the system first and then further information such as personal records and results as they progress through the course.

Student records keep personal details of students as well as their academic records and fees accounts. Where students have had disciplinary problems, these are also recorded. Some institutions offering health and accommodation services to students. All this information needs to be recorded on a centralised system that can be accessed according to the rights different users have. For example, although health data may be recorded on a centralised system, only health workers would have access to it.

The same student administration system would need to send out examination results and accounts.

Timetabling

The process of timetabling involves scheduling staff, students and lecture rooms at the same time. The scheduling also needs to take into account the correct total amount of time allocated to staff, students and courses. Further public holidays and term holidays need to be taken into account. The larger the organisation, the more complex the process becomes. Software programs are now available which can factor in all the different parameters and produce a timetable. This can still be fine-tuned manually.

CBT

Computer Based Training makes use of the computer to instruct students. The quality of CBT material varies widely. Some CBT material is little more than a text book on the screen, but other makes use of interaction or simulation to instruct. For example, if a student were learning word processing, a simulated version of the word processor would appear on-screen. The program would demonstrate how to perform a task by showing the activity of the cursor and the display of the menus. Most of this software produces an audible output so that the student is able to listen to a commentary on headphones as the activity is taking place on-screen.

Automated examinations

Automated examinations allow computerised systems to test students skills. These are most relevant to knowledge based or skills based courses. Courses requiring critical analysis such as literature or philosophy are not suited to this type of testing.

Knowledge based courses can be tested using randomised multiple choice, true/false or similarly highly structured typed of questioning. If there is a sufficiently large test bank, students can be given a randomised set of questions. This would mean that no two students would get the same set of questions.

Skills based courses can be tested using a simulated environment. For example, a pilot could take a test on flying an aircraft by taking a test in a simulator. This would appear exactly like the inside of the cockpit. Instead of windows, there would be computer screens with a simulation of the outside. An examiner would control all aspects of the simulation from a computer. The pilot would be required to respond by actually "flying" the simulator. The computer in turn would be able to analyse the quality of the "flying".

Distance learning

In distance learning, the student controls the learning environment: when and where to learn and how long to take over a course. Information technology can facilitate the whole process. The student can send assignments and questions to the lecturer using email and the lecturer can respond using email. An institution may put the courses on a web site that is password protected. A student either reads the coursework directly on the Internet or downloads it from the Internet. This has obvious cost and administrative savings for the institution.

It also means it can recruit students from all over the world. Registration and payment of fees can also be done on-line.

Homework using the Internet

The Internet contains enormous quantities of information. Some of this is excellent, some very poor and much incorrect. To access information on the Internet, a student makes use of a **search engine** such as Google. Feeding in a number of key words can result in a list of many thousands of sites being displayed. Each of these is represented by a **hyperlink**. This

is a link to another site. When you click on a hyperlink, you are immediately taken to the site.

There are two important aspects to using the Internet to search for information to do assignments:

- The skilled use of a search engine: First you need to become familiar with the different ways of using keywords and the various criteria you can set. This comes with practice.

- Sifting the good from the bad: There is no control over the Internet. People can and do post deliberately incorrect or biased information on the Internet. You need to be able to assess the quality of what you read. For example, does the site give references to its sources or is the information corroborated by that on another independent site. Developing a critical mind in determining the quality of information is as important as being able to access information in the first place.

Teleworking Applications

Understand the term teleworking. List some of the advantages of teleworking such as: reduced or no commuting time, greater ability to focus on one task, flexible schedules, reduced company space requirements. List some disadvantages of teleworking such as: lack of human contact, less emphasis on teamwork.

Teleworking means literally doing work at a distance. This means instead of going into an office, you work from home, a holiday cottage, another country or any other location. When you do teleworking, you can be thought of as having a **virtual office**.

Modern technology such as email, the Internet and Virtual Private Networks (VPNs) have made teleworking a reality for many people. A **VPN** makes use of the Internet and various security protocols to enable remote users to connect to a company network. Apart from speed limitations, it will appear as if they are working on the network inside the organisation.

Not all occupations lend themselves to teleworking, but there are many that do. Examples include journalists, writers, computer programmers, graphic artists, consultants and representatives. Often teleworking is associated with contract work. Professionals are paid to do specific tasks and are given deadlines within which these have to be created. Where they do it is not relevant as long as it is done professionally and on time.

Advantages of Teleworking

Professionals

- do not waste time on commuting between home and work.
- are free to undertake work where ever they are.
- greater ability to focus on one task.
- have flexibility to arrange their work time according to their needs and inclinations.
- generally have tax advantages as they can claim business expenses.

Organisations

• save on office space, equipment and facilities.

Disadvantages of Teleworking

Professionals

• may suffer from lack of human contact.

• need to be highly self-disciplined.

Organisations

• will not get the benefits of teamwork.

• will have less control over workers.

The disadvantages of teleworking can be overcome by requiring professionals to spend a certain amount of time at the office. This does not require that they actually have a workstation or office of their own. They could be required to attend meetings or seminars. If they are structured as part of a team working on a project, they could be required to attend team meetings which focus on planning, allocation of tasks, feedback or general motivation.

Electronic World

Understand the term electronic mail (e-mail) and know its main uses.

Email refers to the transmission of messages between computers across a network or across the Internet. Email allows text, graphics and sometimes sound. Users are able to send files together with messages. These are sent as **attachments** to the email.

To use email, you need to have access to a network or the Internet. A mail client is installed on the computer. This is used for the creation, sending, receiving and storage of email messages. Well known email clients include Evolution, KMail, Microsoft Outlook and Outlook Express.

Web based email systems only require that you have access to the Internet. Many of these such as Yahoo, Hotmail and Eudoramail are free. Web based mail systems act as remote mail clients. Effectively, you log on to the mail client on the server using a web browser. From that point on, it acts in much the same way as a mail client installed on your own computer. You can log on to your web based mail system where ever in the world you happen to be.

Electronic Mail

Email addresses

Email address consist of two parts separated by an @ symbol. The first part is the name of the user and the second part is the name of the mail server.

For example, in the email address david@icdlafrica.com, the user name is david and the

name of the mail server is icdlafrica.com. This is the address of the computer which holds his mail.

Advantages of email

- It is very fast and efficient. Mail is transmitted from the sender to recipient in a matter of seconds. Recipients can reply immediately. If both happen to be on-line at the same time, they can conduct a conversation using email.

- Documents and files can be sent with the email. The only limitation is the maximum size of attachments that your system will permit.

- It is very cost effective. The cost of sending an email is a fraction of the price it would be to send it as a letter.

- There is a saving on paper, printing and envelopes.

- Email clients can be organised so that copies of emails that have been sent can be stored under appropriate directories.

Disadvantages of email

- If there is a problem with the telephone lines, email cannot be sent or received.

- There are certain security problems such as the interception of email by hackers. This can be overcome by **encrypting** email. This requires the email to be coded into an unintelligible form using a key. The recipients system has access to the key and is able to decrypt the email.

- Occasionally problems in the complex system between the sender and recipient occur which cause email to disappear. To know when this has occurred, it is possible for your system to request a receipt of delivery from the recipients computer.

- Unsolicited email or **spam** is becoming a problem. Because it is simple to send thousands of identical emails to users at the same time, some merchants acquire lists of email addresses and compile these into **distribution lists**. They then send the same advertising email to everyone on the distribution list. To overcome this, anti-spamming software is now available which identifies certain addresses as sources of spam and discards any mail that comes from them.

e-Commerce

Understand the term e-Commerce. Understand the concept of purchasing goods and services online, including giving personal details before a transaction can be carried out, payment methods, consumer's basic right to return unsatisfactory goods.

E-Commerce

E-commerce is the name given to the process of carrying out commercial transactions over the Internet.

One of the best known examples is Amazon.com. You can purchase books anywhere in the world from this web site. You make payment using your credit card at the same time as making the purchase. Amazon.com exemplifies many of the characteristics of e-commerce. You are entitled to post a comment on the site, whether good or bad, about any book you buy. Before you purchase a book, you can look through the comments of other purchasers. They also have a procedure in place that allows you to return books under certain circumstances.

To purchase goods using an e-commerce site you need to provide a name and physical address to which the goods must be sent and a credit card. You can also specify the delivery method. This will depend on how urgently you need the goods and how much you are willing to spend on delivery. Good e-commerce sites will tell you in advance, the availability of the goods, how long they will take using the different delivery methods and the cost of delivery.

There are two types of e-commerce site. **Business to consumer** or **B2C** sites sell directly to the consumer. Other sites involve transaction between business themselves. These are are **Business to Business** or **B2B** sites.

CNP transactions

When a purchaser uses a credit card to purchase goods, this is known as a **Card Not Present** or **CNP** transaction, since the vendor does not physically see the credit card. A purchaser not only has to give the credit card number but also the three digit security code. This means that there are a number of dangers associated with CNP transactions.

In utilising CNP transactions:

- Vendors need to be sure that:
    - The card is not being used fraudulently.

- Purchasers need to be sure that:
    - They can afford the goods they are buying. It is very easy to spend money using a credit card on the Internet.
    - The vendor will not abuse the information and make unauthorised debits. They should not deal with any unknown sites.
    - The information will not be stolen by employees and used fraudulently. Once again, well known reputable sites will have measures in place and will generally take responsibility if anything does go wrong.
    - The information will not be stolen and used by hackers. Only use sites that are able to encrypt the information you send using a secure link such as **SSL**. This eliminates the risk of insecure payment methods.

Doing Business over the Net

List some of the advantages of purchasing goods and services online, such as: services available 24 hours a day, opportunity to view a wide range of products. List some of the disadvantages of purchasing goods and services online such as: choosing from a virtual store, no human contact, risk of insecure payment methods

Advantages of on-line purchasing

- No restriction on shopping hours. You can purchase goods 24 hours a day, seven days a week.
- You are not put under pressure by a salesperson and have time to make a more rational purchase decision.
- You are not restricted to shopping in an area to which you have physical access. You can shop across the world.
- Usually it is much cheaper to purchase goods on-line from a virtual store. If you

purchase at source you can eliminate the mark up of intermediaries. Further, on-line sites have lower overheads than conventional shops.

- You have access to a wider range of alternatives.

Disadvantages of on-line shopping from a virtual store

- It is more impersonal as you do not interact with a human being with whom you can discuss the product you wish to buy.

- You cannot physically see and touch the item you are buying.

- There are certain risks associated with purchasing goods on the Internet with a credit card. See the section on CNP transactions above.

- Returning defective or incorrect goods can be a problem. This is especially the case if they have come from another country.

Chapter 6. Health, Safety and Environment

Ergonomics

Understand what elements and practices can help create a good working environment such as: appropriate positioning of monitors, keyboards and adjustable chairs, use of a mouse mat, use of a monitor filter, provision of adequate lighting and ventilation, frequent breaks away from the computer.

Ergonomics is the science of co-ordination the physical and psychological aspects of human beings with their working environment. Although computers present us with great opportunities for making our work easier, they do present some health and safety risks if used incorrectly. The science of ergonomics tells us how to use computers correctly.

Monitors

If you work with a monitor, tired, sore or blood-shot eyes indicate eye strain. The following points indicate some aspects of monitors to be aware of.

- Refresh rate: The refresh rate of a monitor is the rate at which it updates the images on the screen. When the refresh rate is too low, the screen appears to flicker. Apart from the annoyance factor, this causes eye strain. The refresh rate should be at least 72 Hz (72 times a second) and preferably higher.

- Monitor filter (Anti-glare screen): Reflections on the screen can cause eye strain. This can be overcome by using a monitor filter with an anti-glare screen or by placing a special anti-glare cover in front of the screen.

- Focus: The image on the screen should be sharp. Poor quality monitors have a slightly blurred effect. This causes the eyes to continually attempt to reduce the blur.

- Low radiation: The beam of electrons that strikes the screen to display the image also sends out electromagnetic radiation. There is some fear that this can be a health hazard, particularly to pregnant women. Use a monitor with low electromagnetic radiation.

- Position: Place the monitor in a position where you can look into the distance at regular intervals. To the side of a window is an ideal position. You need to change the focus of your eyes on a regular basis to prevent eye strain.

- Angle: The monitor should be slightly below eye level. Looking up at a monitor can cause strain in the neck.

- Rest: Take regular rest periods where you do not look at the monitor.

Keyboards and mouse

Repeated use of the same muscles and joints can result in a type of injury called **RSI** or **Repetitive Strain Injury**. This type of injury can range from inflammation of joints, to damaged ligaments and muscles or even hairline fractures in bones. RSI is usually caused by the incorrect use of the keyboard and mouse.

- Ergonomic keyboards: Ergonomic keyboards are designed in such a way that the strain

on the hands and finger are reduced.

- Touch typing: Learning to touch type can help reduce strain as it distributes the work evenly between the fingers. Users who can touch type also tend to use far less force when striking the keyboard.

- Mouse mats (pads): Mouse mats or pads are available with a cushion for the wrist to rest on. Repeated clicking of the mouse buttons can lead to inflamed finger joints. Resting the wrist on the cushion reduces this effect.

- Rest: Take regular breaks to rest the muscles and joints.

Desks and chairs

- Height and position of chairs: The height and position of the chair is an important factor in reducing strain. These should be adjusted so that:

  - the feet can rest flat on the floor. This maintains blood circulation.

  - the thigh is horizontal to the floor.

  - the head can be kept upright in line with the spinal column. If the chair is too high, the head will be bent. This will in turn cause backache.

  A chair with adjustable height will allow you to find the most appropriate and comfortable height for your build.

- Posture: The back should be slightly bent forward. Sitting rigidly upright for long periods can cause stress in the back and shoulders.

- Support: There should be support for the lower back to avoid sitting in a hunched position.

- Rest: It is important to get up and move around on a regular basis. Ideally should do some stretching exercises to help relax tense muscles.

- Height of the desk: A common problem is having a desk which is too high. This is largely a matter of trial and error. A good test is whether the elbows are able to rest comfortable on the work surface.

Health Issues

List some common health problems which can be associated with using a computer such as: injuries to wrists caused by prolonged typing, eye strain caused by screen glare, back problems associated with poor seating or bad posture.

Lighting and ventilation

It is important to ensure that there is adequate lighting, but does not cause a glare on the screen. Another important consideration is whether there is enough air circulation in the room as computers generate a lot of heat and if a room is not adequately ventilated it can become stuffy and cause fatigue. It is also not good for the equipment so most companies make use of air conditioning.

Other health problems associated with using a computer as discussed in the previous section are listed below:

- repetitive strain injury

- eye strain caused by the glare on the screen

- back problems due to poor seating or bad posture

Precautions

List some safety precautions when using a computer such as: ensuring power cables are safely secured, power points are not overloaded.

Apart from health issues, there are a number of safety issues associated with the use of computers.

Adequate earthing

A faulty earthing system can cause electrical shock. A good system will be properly earthed and will incorporate **earth-leakage** detection. If the system detects a fault that could lead to electrical shock, a switch will trip before any damage can be done.

Cabling

It is common to see electrical cabling lying on the floor of offices. Apart from the fact that it looks untidy, workers can trip over cabling. Electrical cabling should be installed by electricians so that there is the minimum of open cabling. Electrical power sockets should be installed close to workstations so that there is no need to run cabling across the floor. The cabling between the power point and the computer should be secured using cable ties.

Load on power points

There should be adequate power points for the equipment. Overloaded power sockets are a fire hazard. If there is any sound of sparking in a power socket, the cause should be investigated by a qualified electrician.

The Environment

Be aware that recycling printed outputs, recycling printer toner cartridges, using a monitor that consumes less power while the computer is inactive can help the environment.

Paper

One of the goals on information technology was the **paperless office**. The reality is quite different and users are often careless and wasteful in the use of paper. The cost factor will be considered in the next section. From an environmental perspective, waste of paper is very damaging. Here are some things that you can do to reduce the environmental impact.

- Do not throw paper away. Set up a storage area for paper that cannot be re-used. Have this collected on a regular basis for recycling.

- Print on both sides of the paper. Unless you are producing a document in final form, print on the reverse side of used paper.

- Alternatively, look for organisations that can make use of this paper. Many poor schools would be very glad to get supplies of paper that can still be used on one side.

Consumables

Often users throw used toner and ink cartridges away. There are two alternatives. You can have them refilled. If this is not an option because of guarantee restrictions on printers, you could resell them to companies which refurbish cartridges for resale. In either case, you reduce the waste output from your organisation.

Power

Another area where users are often careless is electrical power consumption. For example, many users switch only their monitors off at the end of the day so they do not have to boot up in the morning. Apart from the security risk, this means that the computer is running all night and wasting electrical power. Switch off any equipment that does not need to be on.

When purchasing equipment, low power options could be selected. An example, would be the purchase of flat LCD screens over conventional monitors as these consume less power.

It is also possible to configure the computer to save power. When a component, such as the monitor, has not been used for a while, the computer shuts it down.

Environmental Conciousness

Understand that using electronic documents can help reduce the need for printed materials.

Using networks and email, there is little need to send printed documents. Rather send them in electronic format. In addition to avoiding printing, it is faster and more efficient.

Avoid printing documents even for you own use unless it is necessary. It is quite possible to do much of your reading on-screen. Set the zoom and font size to facilitate on-screen reading.

Chapter 7. Security

Information Security

Understand the term information security and the benefits to an organisation of being proactive in dealing with security risks such as: adopting an information security policy with respect to handling sensitive data, having procedures for reporting security incidents, making staff members aware of their responsibilities with respect to information security.

Information Security

Because information and information technology are fundamental to just about all aspects of modern life, the modern era is often referred to as the **Information age**. By its very nature, much information is private and confidential. **Information security** refers to all the procedures which are used to protect information for deliberate or accidental misuse or dissemination. Technically, it refers to the maintenance of the **integrity** of information. Integrity means that the information remains correct at all times and cannot be accessed by unauthorised agents.

Personal privacy

If personal information such as health or finance status, personal or family issues and background details became available to unauthorised agents, this could lead to the standing of individuals being seriously compromised. In some cases it may have little more effect than a feeling of invasion of personal privacy, while in other cases in may lead to serious embarrassment, loss of status or job and even blackmail.

Company confidentiality

Business functions by trying to achieve a competitive edge. This is achieved by making better products and having better marketing strategies. If competitors found out the formulation of products or details of manufacturing or the marketing plans for new products, a company would lose its competitive edge. There is a whole dark area to business known as **industrial espionage** in which a variety of means are used to discover trade secrets and business dealings. Obviously, there is an absolute imperative to maintaining the confidentiality of all company information.

A less obvious breach of information security occurs through industrial espionage where information is either changed or deleted to sabotage the functioning of the organisation.

Protecting company information

There are a number of procedures companies can take to protect their information and these would usually be detailed in a company policy document which would be explained to the staff on appointment. Often a personal copy of this document is given to each employee for their records.

Staff employment practices

Basic to good company security are loyal and trustworthy staff. If staff are likely to have access to sensitive information, they should be thoroughly screened before they are

employed. The more sensitive the information they have access to, the more vital is this process. Promotion to more sensitive positions can be based on a good history or loyalty and trust. Part of the staff induction process and on-going staff training should inculcate in staff the importance of security and an awareness of the consequences of its violation.

Security procedures

Information should be classified on the basis of its sensitivity. Access rights to this information should be limited to those who need to know. To access certain information, an employee might need a special security clearance. All access to sensitive information should be recorded. The question of access rights is discussed further in the next section. Where sensitive information is stored in the form of paper files, these should be kept in a secure vault. Procedures should be in place that enable staff to report breaches or suspected breaches of security. They should be able to report these without fear of reprisal. In large organisations security departments can be established specifically for the purpose of providing such channels and monitoring security on an on-going basis. This is often done in conjunction with forensic auditing. This is a special form of auditing to detect mismanagement and corruption.

Privacy Issues

Know about privacy issues associated with computers, such as adopting good password policies. Understand what is meant by user ID and differentiate between user ID and password. Understand the term access rights and know why access rights are important.

Information stored on computers

All computers from laptop computers to mainframes contain information. Much of this, whether corporate or personal, is confidential. Many thousands of laptop computers containing important company or state information have been stolen. Since most corporate records are now kept in electronic form on computer systems, procedures need to be put in place to protect the computers.

Apart from deliberate violations by people, computers are also subject to accidental damage and natural disasters.

Physical procedures

Physical access to mainframes should be restricted to operators and systems administrators. Facilities should be fire and flood proof. Highly sensitive installations should also have adequate protection from criminal and terrorist activities.

Desktop and laptop computers are very vulnerable to theft. A simple procedure is to only allow authorised people access to offices. The use of security cameras can also act as a deterrent. Desktop computers can be physically attached to the floor or a work surface.

Laptop computers present the greatest risk. They are not only light and easy to pick up, but they are also more expensive and valuable than desktops. The best protection is not to let them out of site. If a manager is staying at a hotel, he or she can leave the computer in the hotel safe rather than their room.

Software procedures

Information can be stolen, altered or deleted without the computer being physically removed. The information may even be accessed across the Internet.

Firewalls

A firewall is the first line of defence against hackers. It is a computer program that is installed on a computer that connects a network to the Internet. The firewall analyses the packets that pass in and out of the network. It is programmed to follow certain rules which enable it to decide whether or not to allow a packet to pass. There is firewall software that can be installed on a stand-alone PC.

Access rights

Access rights can refer to both physical and software. In a physical sense, these refer to different members of staff who have to gain physical access to certain areas. For example, access to the room containing the mainframe may be restricted to operators. Software rights refer to the level of access different users have to different levels of data and information. For example, some users may have no access to certain data, others may only be able to read the data but not change it. Others in turn may have full rights to create and change data. Access rights are associated with a user id and password. A user id could be a user name or a combination of letters and numbers. To log on to a system a user would need a user id and a password. As other users may know the user id of colleagues, another level of security in terms of passwords needs to be added in the form of a password. Passwords are private and should never be divulged to anyone else. Users could have several user ids, each with a different level of security. They would log on each time with the lowest level of security they need to accomplish a given task.

Password policies

Password policies refer to guidelines or requirements on the structure and use of passwords. They can be required for access to a computer system or a group of files or a single file. The following are some guidelines for password policies:

- They should never be blank.

- They should not be the names of family members or pets or anything else that would be easy for an intruder to try out.

- Ideally they should never be words, especially words like **administrator**, **admin** or **root**.

- They should never be less than five characters and preferably longer. Short passwords can easily be determined by a **brute force password cracker**. This is a piece of software that repeatedly feeds in all combinations of letters and numbers until accessed is gained. With short passwords this can be done in seconds.

- A good policy is to use a meaningless combination of letters and numbers that is seven or eight characters long. What some users do is to take a meaningful word such as **looking** and replace the **o** with the number **0** and the letter **i** with the number **1** so that the password becomes **l00k1ng**. You could also make a less obvious change, for example replace **k** with **3** and **g** with **9** so that the password becomes **loo3in9**.

- Passwords should be changed on a regular basis. Administrators can set a policy that automatically causes passwords to expire after a certain period of time, for example 7 days.

When using a PC, you would need to use an operating that provides genuine access protection with a user id and password. This means using Linux or Windows

NT/2000/XP/2003. In Windows 95/98/Me the logon procedure can be bypassed. If Windows NT, 2000, XP or 2003 are used, it should be in conjunction with the NTFS file system.

Data encryption

Data should be encrypted. Encryption scrambles the data and makes it unintelligible without the use of a key. The key is used to decipher the data.

Vulnerability of data (Data Backup)

Know about the purpose and value of backing up data, software to a removable storage device.

Data is vulnerable in many ways:

- The system on which it is stored can fail. For example, a hard drive may crash due to component failure.

- The medium itself may become corrupt. Where data is stored on a magnetic medium, this can become corrupt due to a number of factors including moisture, heat, magnetic fields and electromagnetic radiation. Even optical storage which is highly reliable should never be regarded as infallible.

- The system can be stolen.

- The system could be physically damaged through war, criminal activity, vandalism or carelessness.

- The system could be damaged as a result of a natural disaster such as a flood, fire or earthquake.

- The data could be deleted or changed through criminal activity, vandalism or carelessness.

No matter what care you may take to protect a system, additional copies of data need to be made and stored on a regular basis. Copies of data are referred to as **backups**. The following are some guidelines to working with backups.

- Once backups have been created, they should be store in a secure area at a different site. Never keep backups on the same site as the system. They could be stolen or destroyed along with the rest of the system.

- Backups should be made on a very regular basis. Even for a small organisation, this should be done daily. Even the loss of a single day's work would be a major problem. In large organisations backing up may take place on an on-going basis. A schedule of backing up should be clear policy and adhered to.

- More than one copy of data should be made. If the data is very valuable, the different copies could be stored in different secure locations.

- Different versions of the backup should be retained. The following is an example of a backup schedule that could be followed.

  The cycle of backing up starts on the first Monday of the month. At the end of each day of the week a backup is made. At the end of the week, there is a Monday, Tuesday, Wednesday ... Saturday backup. On Sunday a backup is created and labelled week 1

backup. This is kept for the rest of the month. The weekday tapes are then reused and the process repeated. At the end of the month you end up with a series of weekly backups. The last one becomes the backup for the month and the process starts over the next month. At the end of the year you then have a series of monthly backups.

- An appropriate medium for backing up must be used. In the case of companies this would generally be done using tape, although optical storage is becoming more common. For personal use, a CD or DVD makes an excellent backup. DVD writers are still quite expensive. Never use diskettes for backup purposes. They are not reliable for this purpose. Even when backing up a PC, makes multiple copies and keep them at another site for safe storage. You could, for example, use a safety deposit box at a bank.

Often a network server has two identical hard drives, one being a mirror image of the other. This means that if one fails the other one can take over. In other words all the software on the first is identical to the software on the second.

Software can be backed up by making a copy of the cd/dvd media and then storing the originals and using the backups to install from. This is allowed by most software manufacturers. The original is kept under lock and key along with the licence numbers.

Implications of Theft

Be aware of possible implications of theft of a laptop computer, PDA, mobile phone such as: possible misuse of confidential files, loss of files, loss of important contact details if not available on a separate source, possible misuse of telephone numbers.

Highly portable devices such as cell phones, PDAs and laptop computers can containing vital and confidential information. Even if the information is not confidential, it could be vital to your work. Losing your contact list or diary will very seriously compromise your business operations.

PDAs, cell phones and laptops usually contain contact lists and diaries. Make sure that copies of these are kept elsewhere. Cell phones and PDAs come with **synchronisation software**. This software links the device with a personal computer or laptop and updates each of them with the latest data. In other words, if you keep your diary on your PDA, synchronising will automatically update the diary (and contacts) on the PC or laptop. You should make sure that your diary and contact list are on two different devices. These should be kept apart so that they are unlikely to be stolen at the same time. Ideally, you should make backups of these at the end of every day and keep these backups in a safe location.

Although you can at least retain your diary, contacts and files through the use of backups, loss of these can compromise you seriously. If for example, you keep information of your bank and credit cards details on your PDA, cell phone or laptop, a criminal could make use of these if they steal these devices.

Personal information and telephone numbers of friends and business colleagues could make them vulnerable to the activities of criminals.

Computer Viruses

Understand the term virus when used in computing and understand that there are different types of virus. Be aware when and how viruses can enter a computer system.

A **computer virus** is a program that is deliberately created to cause annoyance or alter or delete data. Some viruses cause computer systems to slow down to the point where they are not usable. One of the features of viruses is that they are designed to replicate and spread.

Types of Viruses

Trojan: A Trojan (or Trojan horse) is a virus that hides itself inside another legitimate program. When the program is used, the virus is released and can begin its work of replication and annoyance or damage.

Worm: A Worm is a program that replicates itself over and over in the computer's memory until the computer can barely function. One of the signs of invasion by a worm is the slowness of computers.

Time bomb: A time bomb is a virus which lies dormant until a certain date or time or for a period of time. At this date or time, the virus suddenly becomes active and carries out whatever task it is programmed to do. This can include the deletion of everything on the hard drive.

Logic bombs: A logic bomb is similar to a time bomb, except that instead of becoming active at a certain time, it becomes active when a particular activity happens. For example, instead of formatting a diskette, the virus causes the hard drive to be formatted.

Macro-viruses: Macro-viruses make use of a special customisation feature in applications called macros. Macros allow you to create mini-programs to carry out certain tasks in your applications.

Spread of computer viruses

Viruses are spread in a number of ways:

- Downloads from the Internet.
- Pirated software.
- Exchange of diskettes.
- In attachments to emails and in emails themselves.
- In documents. Macro-virus, described above, can be hidden in ordinary documents, spreadsheets and presentations.

Virus Protection

Know about anti-virus measures and what to do when a virus infects a computer. Be aware of the limitations of anti-virus software. Understand what 'disinfecting' files means.

The actions of computer viruses were discussed in the previous section. The measures you can take to protect yourself against viruses will be discussed in the next section. One of the main measures to protect against viruses, anti-virus software, is discussed in this section.

Anti-virus software

Anti-virus software scans files for pieces of code, called **signatures**, which it recognises as part of a virus. Updating anti-virus software mostly involves updating the signatures file.

This should be done on as frequent as basis as possible. This is even more the case when you receive files regularly from outside sources. The actual anti-virus program itself will be updated from time to time. These updates will include additional features and improved methods of scanning.

It is important to keep in mind that no anti-virus software is perfect. It is only as good as the techniques it uses for detecting viruses and the currency of the signature file. There is always the chance that a virus will go undetected. However, a good anti-virus system installed on your system is essential and will usually detect most viruses.

When a virus is detected, the software will attempt to remove the virus. This is called **cleaning** or **disinfecting**. It sometimes happens that the system can detect the virus but not get rid of it. In this case, you will usually be given the option of **deleting** or **quarantining** the infected file. When a file is quarantined, it is made unusable and so unable to spread the virus. A future update of the software may be able to remove the virus. If it can the quarantine is removed.

Best Practices when Downloading

Understand good practice when downloading files, accessing file attachments, such as: use of virus scanning software, not opening unrecognised e-mail messages, not opening attachments contained within unrecognised e-mail messages.

There are a number of measures you can take to protect yourself from viruses:

- Install good anti-virus software and update it on a regular basis, for example at least once a month but preferably once a week. But always remember, anti-virus software is not perfect. It cannot be the only measure you take.
- Scan all diskettes before reading them.
- Enable the auto-protection feature on the anti-virus software to scan emails.
- Be wary of emails from unknown sources, particularly if they contain attachments. Some very careful users delete emails they are unsure of without opening them.
- Use an Internet Service Provider than scans emails before delivery.
- Do not download files/software from unknown Internet sites.
- Be careful of using diskettes from unknown sources.
- Do not install pirated software.

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Chapter 8. Copyright and the Law

Copyright

Understand the concept of copyright when applied to software, and also to files such as: graphics, text, audio, video. Understand copyright issues involved in downloading information from the Internet.

Copyright

Copyright refers to the legally protected right to publish and distribute any literary, musical, artistic or software material. This means that only the developer and authorised sellers have the right to copy and distribute computer software, video materials, music or text.

Because there is no control over the Internet, there are hundreds of sites where software, music and videos can be downloaded. Access to permanent connections makes downloading of large files physically possible. Many of these sites are located in countries that do not protect copyright.

The fact that it is possible to do something does not make it legally and ethically right. Authors and developers are entitled to a return on their creative efforts. Downloading pirated material is both ethically and legally wrong. By reducing revenue, piracy can hamper the development of software. Software development is expensive and part of the royalties are needed for future development.

Software piracy is a form of theft. It is both a criminal and a civil offence. Developers are entitled to claim damages in cases of piracy. Increasingly they are making use of all legal avenues to reduce piracy and obtain compensation where it has occurred. They are entitled to claim damages against not only sites, organisations and individuals who make pirated software available, but also those who make use of it.

Downloading from the Internet is not the only form of software piracy. Making copies of software, other than for personal use, as well as installing software on more computers than specified in the licence agreement are both forms of piracy.

Copyright Issues

Understand copyright issues associated with using and distributing materials stored on removable media such as CD's, Zip disks, diskettes.

When you purchase software, you are actually purchasing the right to install the software on a specified number of machines. Software usually comes out in two forms: standalone and network. When you purchase standalone software, you are purchasing the right to install it on a single machine. Generally there are further restrictions that are specified in the licence agreement. Licence agreements are covered in the next section.

When you purchase a network version of the software, you purchase the right to install the software on computers attached to a particular network. This may give you the right to install it on all the computers on the network or a certain maximum number.

It is important to realise that you do not purchase the actual program. The program remains

the **intellectual property** of the developer. The concept of intellectual property is used as the developer owns something abstract, something which is the result of considerable intellectual effort. This also means that you do not have the right to alter the program in any way other than the configuration allowed in the installation.

However, you may store the program on CD, DVD, zip disk, diskette, hard drive or tape, the program still remains the intellectual property of the developer. This does not mean that you may lend the stored program out to others, though. This would be a breach of copyright. The stored version is for that purpose only as a backup and for the licensed user only.

The section on licence agreements in the next section specifies some of the copyright issues in more detail.

Licensing Issues

Know how to check the Product ID number for a software product. Understand the terms shareware, freeware, end-user license agreement.

Licence agreements

As mentioned in the previous section, when you purchase software, you only purchase the right to use the software subject to certain conditions. These conditions are specified in the licence agreement. When you install the software onto a computer, there is always a stage where you have to make a selection that you have read and accept the terms and conditions of the licence agreement. When you do this, you are agreeing to the developer's rights under copyright law.

The terms of the licence agreement include the following:

*   Clarification of the licence as meaning right to use the software not ownership of the intellectual property.
*   The number of machines on which the software may be installed.
*   Restrictions on copying the distribution CD.
*   Restriction on the resale of the software.
*   Prohibitions on altering the code and **reverse engineering**. Reverse engineering involves a process of uncovering the logic and algorithms used to develop the program.

Shareware

Shareware is software, generally downloaded from the Internet, which can be freely used and distributed. However, it does require that if users would like to continue using it, they pay the developer a fee. This is nearly always done by means of a credit card transfer across the Internet. When payment is received, users get a serial number which they insert into the software.

To attempt to enforce payment, developers usually employ a number of methods:

*   Nag notices. These are notices that appear on a regular basis reminding the user that the software has not yet been registered.
*   Time limitations. The software can be used for a certain period of time. At the end of this period it ceases to work.
*   Function limitations. The shareware version may exclude certain key features.

These limitations would be removed when a valid serial number is entered.

Freeware

Freeware is software which can be freely copied and distributed. Usually there are certain restrictions such as it may not be resold or its source should be acknowledged.

Open Source software

An interesting evolution in software development is the **Open Source Movement**. This movement has the objective of creating software that can be distributed freely and used at no charge. Developers all over the world are encouraged to become part of the movement. Many corporations are playing an active role in the development of open source software. Two examples are Linux and OpenOffice.org. The development of Linux is being actively supported by corporations such as IBM and Sun Microsystems. Sun Microsystems are central to the development of OpenOffice.org.

Open source software is still subject to a licence agreement. However, the licence agreement is quite different in tone and purpose to that attached to commercial software. The following is an extract from the licence agreement of KOffice, another Open Source office application suite.

Preamble
The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software-to make sure the software is free for all its users.
This license, the Library General Public License, applies to some specially designated Free Software Foundation software, and to any other libraries whose authors decide to use it. You can use it for your libraries, too.
When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.
To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library, or if you modify it.
For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link a program with the library, you must provide complete object files to the recipients so that they can relink them with the library, after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

Data Protection Legislation

Know about data protection legislation or conventions in your country. Understand the implications of data protection legislation for data subjects and data holders. Describe some of the uses of personal data.

Because of the all-pervading nature of information and communications technology as well as the ease with with data can be accessed and transferred, some countries have introduced legislation to protect the privacy of individuals and organisations.

The purpose of data protection legislation is to specify how data may be obtained, stored and used. This type of legislation can be very technical and complex. Some of the key points of the Data Protection Act of 1998 of the United Kingdom are set out below as an illustration of the issues covered.

- The provisions of the act refer to data in whatever way it is stored, whether electronic or paper.
- Personal data should be obtained in a fair and lawful way.
- Data should be processed in accordance with its original purpose. If data is to be used for purposes other than for which it is collected, safeguards need to be put in place to avoid abuse.
- Data must be up-to-date and accurate.
- Data must not be kept for longer than is necessary.
- Appropriate security measures must be in place to prevent:

Unlawful or unauthorized processing;

Accidental loss;

Damage;

Theft.

- Personal data may not be transferred.
- Data may not be used for certain purposes such as direct marketing.

In addition, subjects of the data have certain rights. These include the right to access data held about themselves.