

unit 2

Most organisations use computer systems to help in the day-to-day management of their business. These systems need to be set up, configured and maintained. As computers have become more powerful, the complexity of computer systems has increased, so there is a need for knowledgeable IT practitioners to undertake this work.

This unit will help you to learn about setting up, maintaining and tailoring computer systems to meet a user's needs. Computer equipment may need to be upgraded or new peripherals, such as printers or scanners, added. Operating systems and application software may need patching to fix a problem or to add an enhancement. Latest versions of security software may need to be installed. The areas covered by the unit will be of value to all, regardless of whether you intend to become a desktop support technician, programmer, network engineer or systems analyst.

IT practitioners may be asked to advise on the purchase of new computer systems. Modern software makes increasing demands of the hardware needed to run it. Therefore, practitioners need to keep up to date with the latest developments in both hardware and software. They also need to be aware of the tools available to protect systems and keep them secure.

In this unit, you will:

- 2.1** Understand the hardware components of computer systems page 43
- 2.2** Understand the software components of computer systems page 58
- 2.3** Be able to undertake routine computer maintenance page 63

So you want to be a...

Support Analyst

My name **James Stimpson**
Age **28**
Income **£24,000**



What does a support analyst do?

I support the company's desktop computers, laptops and mainframe computer

What are your day to day responsibilities?

I set up all the new desktop computers and laptops. I maintain them and I am responsible for fault-finding if they develop problems. I do some software support, particularly spreadsheets. I also run SQL queries on the mainframe.

What qualifications did you need?

After completing my GCSEs, I went to college to complete a BTEC National Diploma in IT Applications. I wanted to take a practical route into the industry because I like to be 'hands on'. Some of my colleagues have degrees but there are a lot of IT certifications that can be taken and a lot of different routes into the industry.

What training have you had?

I got my first computer when I was ten years old. I have always upgraded and maintained my own PC and I enjoy using new gadgets and technology. My first job was as a mainframe operator. I did that for six years, and then moved into PC support. I have been on a number of training courses, but the most important training has been 'on the job'.

What are the hours like?

I usually work from 9am to 6pm, but sometimes the company needs me to work later into the evening. Sometimes we need to work at the weekend, when the office is quiet and we don't

have to worry about taking the system down for a few hours. If I work extra hours I get paid overtime. It doesn't happen often but you have to be prepared to be flexible.

How good is the pay?

When I first started work, pay was fairly low; about £12,000, but it has gradually improved and I now earn double that amount. I could earn a lot more if I was prepared to work in London or work as a contractor, but I like the company and the people I work with so for now I am more than happy to stay where I am.

What qualities do you think are important for your job?

You need a lot of patience and good people skills. Obviously you need good technical knowledge as well as the ability to solve problems and prioritise your workload. It really helps to have an interest in new technologies, which luckily I do.

How do you see your career progressing?

I still have a lot to learn and with further training and after gaining some more on the job experience I would like to get more involved in the networking side of things.

“Problem-solving abilities and an interest in new technologies are important”

Grading criteria

The table below shows what you need to do to gain a pass, merit or distinction in this part of the qualification. Make sure you refer back to it when you are completing work so that you can judge whether you are meeting the criteria and what you need to do to fill in gaps in your knowledge or experience.

In this unit there are three evidence activities that give you an opportunity to demonstrate your achievement of the grading criteria:

page 58

P1, D1

page 63

P2, M2, P3, P4

page 71

P5, M3, M1, D2

To achieve a pass grade the evidence must show that the learner is able to...

P1 explain the function of the system unit components and how they communicate

P2 describe the purpose, features and functions of two different operating systems

P3 demonstrate the operation and explain the use of two different software utilities

P4 describe the range of available utility software

P5 undertake routine maintenance tasks in relation to a PC

To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to...

M1 explain and implement the installation and configuration of an additional or replacement device

M2 compare the features and functions of two different operating systems

M3 explain the effect of the software maintenance activities carried out on the performance of a computer system

To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to...

D1 evaluate at least three specifications for commercially available computer systems and justify the one most suitable for use in a given situation

D2 justify the considerations for selection in the upgrade of an existing computer system

2.1 Understand the hardware components of computer systems

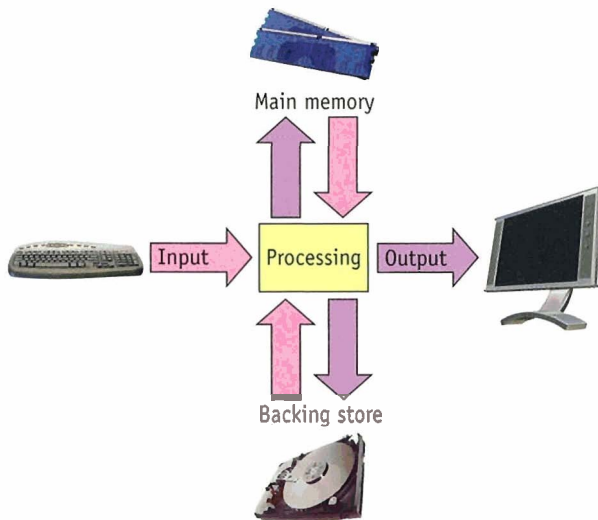


Figure 2.1 The components of a computer system

Regardless of their size, most computers perform similar basic functions:

- **Input** – data and instructions can be input into the computer using a number of different devices, such as a keyboard, mouse, scanner or microphone.
- **Main memory** – data and instructions are temporarily held in main memory before and after processing. This is sometimes referred to as 'temporary storage'.
- **Processing** – the central processing unit (CPU) takes the data and instructions from main memory and processes them in some way, for example, producing an image or a text document, generating a sound or opening a web browser.
- **Output** – once processing has taken place, data can be output, for example to a printer, as sound through speakers or to be viewed on a screen monitor.
- **Storage** – some information may need to be stored for use at a later date. This is sometimes referred to as 'auxiliary' storage. Common forms of storage include hard disks, USB memory sticks (sometimes known as pen drives) and CD-ROMs.

SYSTEM UNIT COMPONENTS

Processors and options

Computers contain a number of processors that perform different tasks, but the term 'processor' usually refers to the main processor, otherwise known as a microprocessor, CPU or chip.

The microprocessor is an **integrated circuit** (IC) that is located on the **motherboard**. It controls the activities of the computer by interacting with other components that are on or attached to the motherboard. The microprocessor executes a series of programmed instructions with four steps: fetch, decode, execute and write back. This process involves fetching program instructions and data from memory, decoding them, executing them and then writing the result back to memory. This process is covered in greater detail in Unit 9.

The speed of the processor is measured by a system clock as a number of operations or cycles per second. Modern processors normally operate at speeds measured in gigahertz (GHz). One gigahertz is 1,000,000,000 cycles per second!

Key words

Integrated circuit – a small electronic circuit

Motherboard – the central circuit board of a computer

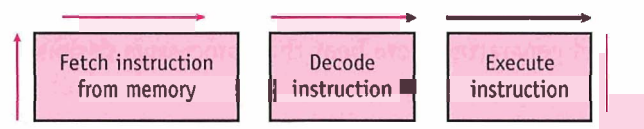


Figure 2.2 The fetch execute cycle

When building or upgrading a computer system, it is vital to ensure that the microprocessor is compatible with your motherboard.

Modern desktop processors

Two companies dominate the computer microchip market: Intel and AMD.

Table 2.1: Intel® and AMD microchips

Intel	AMD
Celeron® – this is a cost-effective processor using proven technology for home and small office applications.	Sempron™ – competes with Intel Celeron D.
Pentium® 4 – the series was launched in late 2000 and retired in 2006. It was the first major redesign since the launch of the Pentium Pro in 1995. It uses hyper-threading technology that allows the processor to operate more efficiently when multiple tasks are running.	Athlon™ 64 – competes with Intel Pentium 4.
Pentium® D – a series of chips was introduced in 2005 using two Pentium 4 processors on a single chip. This allows multiple tasks to be split across the two processors, giving improved performance over single processor chips.	Athlon™ 64 × 2 – first AMD dual-core processor .
Core™ 2 Duo – a new series of dual processors using several new technologies to save power and increase processor performance.	Athlon™ 64 FX – aimed at gamers. Dual-core from FX-60 onward.

Key words

Dual-core processor – a dual-core processor has two processors on the same chip handling data simultaneously, improving efficiency

Modern laptop processors

Some laptops contain desktop processors. These are likely to use more power, reducing battery life and generating more heat than processors designed specifically for laptop use.

Table 2.2 Laptop processors

Intel	AMD
Pentium® M	Mobile Athlon™ XP-M
Celeron® M	Mobile Athlon™ 64
Mobile Pentium® 4 and 4M	Mobile Sempron™
Core™ Duo and Core™ 2 Duo processors	Turion™ 64
	Turion™ 64 × 2 Duo Core

The system case

Most of the component parts of a computer system fit into a system case. There are a number of different styles of computer case available, including desktop, tower and mini-tower designs.

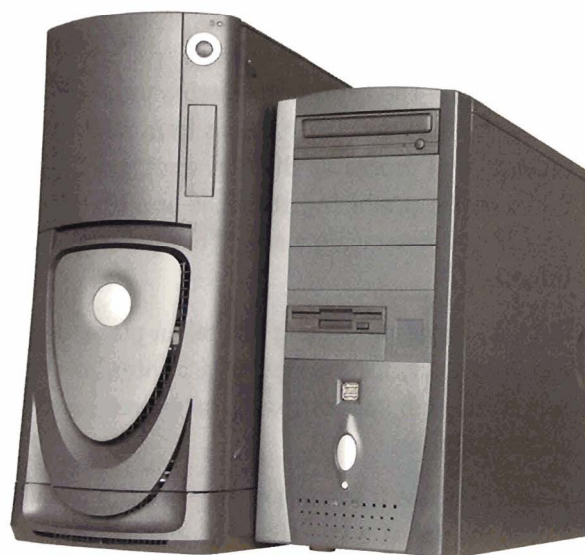


Figure 2.3 Different types of case – desktop and tower

It is important to consider the needs of the user when purchasing the case. Will the computer sit on a desk or under it? Some cases are designed to have a small 'footprint', meaning that they take up less space on a desk than a standard desktop computer. If you choose a small footprint case, you will need to consider carefully the **form factor** of the motherboard and ensure that all your components will fit in the case. The amount of equipment you need to house inside the case may determine the size of case you choose. It is also important to consider the position of the power button and the accessibility of USB connectors.

Key words

Form factor – the physical size and shape of a device. This term is frequently used in discussions about computer cases and motherboards

Cases are usually purchased with a power supply unit (PSU) and a pack of blanking plates, screws and mounts. The screws are used to hold devices, such as network cards or CR-ROM, drives in place. Mounts support the motherboard in the case. Blanking plates are used to cover holes in the rear of the case.

The motherboard

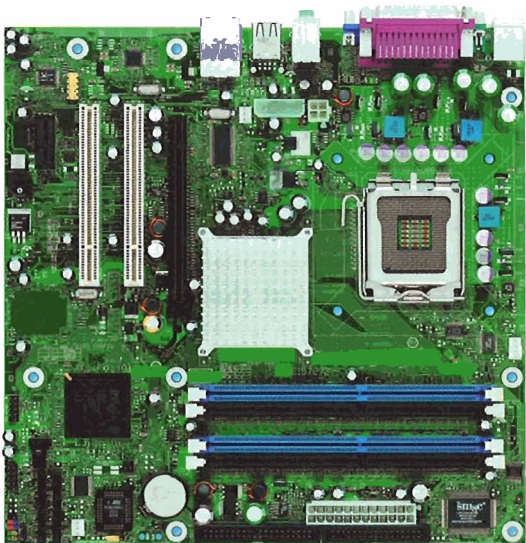


Figure 2.4 A motherboard

The motherboard (or system board) is situated within the computer case. All of the essential components that are involved in making a PC work correctly, including the processor, are either on

the motherboard or connected to it. It performs a number of functions:

- provides connectivity between the components and the microprocessor so that they can communicate with one another
- distributes power at the correct voltages from the power supply to all devices that require it
- provides connectors for external devices, such as keyboards and mice
- contains external ports for connecting video, printers, etc.
- contains expansion slots for attaching additional devices, such as network interface cards, modems, soundcards, etc.
- has slots for RAM and an area for plugging in hard drives, CD-ROMs, etc.

Currently the ATX form factor is the most common form factor for PC motherboards.

Research tip

There are a large number of other form factors for motherboards. Familiarise yourself with the form factors that are available and have been produced in the past. A useful starting point for this research is www.motherboards.org.

Choosing a motherboard

Replacing the motherboard is a common upgrade that can be made to a computer. However, a number of questions need to be answered before making a purchase.

- What will the computer be used for? Will it need to do heavy-duty processing, such as game playing, scientific calculations or video editing?
- Are the processor and memory (RAM) compatible with the motherboard? This can be checked by going to the motherboard manufacturer's website. The purchase of both motherboard and processor need to be considered together.

- What features are associated with the chipset (a component on the motherboard)? The chipset determines a number of essential features of the computer, such as the type and speed of the processor, the type and amount of memory that can be installed and additional features, such as whether integrated graphics and sound are included. Knowing these features may help to differentiate between otherwise similar motherboards.
- Is the computer to be used for multimedia applications? Many motherboards come with integrated sound. If it will be used for this purpose, it is important that the motherboard includes a PCI Express slot to take a graphics card.
- If you want to attach peripheral devices, how many USB2 ports are there? Do you need FireWire?
- Will the motherboard fit in your existing case?

BIOS

The BIOS (Basic Input and Output System) chip is situated on the motherboard of a PC and is vitally important to the computer's operation. It can usually be found by looking for a chip near to the processor with a sticker or text on it. It is usually a Flash memory chip (this means that the BIOS can be upgraded using software, rather than having to replace the chip).

The BIOS boots the computer. When the computer is switched on, its first action is to copy itself into memory. It always copies itself to the same location in memory. The processor then begins to run the BIOS instructions. This is known as the booting process. It completes a power-on test (POST) to ensure that all components are working. It checks to see that all the devices listed in CMOS are present and working. CMOS is a complementary metal-oxide semiconductor chip that contains a setup program that stores information about the date, time, hard drive and memory configuration. It has to be supplied with power constantly so that the information is not lost. A small CMOS battery (resembling a watch battery) is used. CMOS

provides a set of instructions that the processor executes until the operating system has loaded. It supplies routines that allow the operating system to interface with devices such as the keyboard, mouse and monitor. Once the operating system has loaded, peripherals use programs called device drivers to interface with the operating system.

Power supply

A computer needs a power supply to operate. The power supply unit (PSU) is usually, but not always, supplied when purchasing the computer case. The power supply unit converts AC current to the DC voltages needed to power a PC. The unit also contains a fan that is used to cool the inside of the case. The unit is able to regulate incoming power to reduce electrical noise and power surges. (Unfortunately the quality of the power we receive in our home, school and office varies.)

The external power supply can be subject to spikes or surges (higher than usual voltages), brownouts (lower than usual voltages), blackouts (sudden and entire loss of power), lightning strikes and electrical noise (when your computer shares its supply with other devices via an extension cable). Over time, any of these events may cause damage to your computer. Many organisations use surge protectors to protect their equipment and invest in uninterruptible power supplies (UPS) to avoid damage to computer systems and disruption to work in the event of a power blackout.

▲ **Under no circumstances should you ever attempt to open the power supply unit. It contains capacitors and transformers that can supply a deadly electrical shock. (Note that there are also capacitors within monitors, which should be treated with the same caution.)**

Research tip

Investigate the range of uninterruptible power supply solutions and power surge protectors that are available.

The power supply unit has a number of connectors so that power can be distributed to the components of the computer.



Figure 2.5 The power supply unit and connectors

Currently there are two standards for connecting power to the motherboard of desktop computers. Older motherboards have 20-pin AXT power connectors. Newer motherboards have 24-pin AXT power connectors. It is possible to attach a 24-pin

Table 2.3 Power Supply Connectors

20-pin connector (older motherboards)	
24-pin connector (newer motherboards)	
4-pin Molex connector (floppy drives, standard hard drives, CD-ROM drives, fans, etc)	
SATA connector (serial ATA hard drives)	

power supply to a 20-pin motherboard using an adapter, but you should not attempt to attach a 20-pin power supply to a 24-pin motherboard.

Fan and heat sink

Modern computer components, such as the microprocessor, graphics processors, the chipset and hard disks, can generate a build-up of heat. This heat must be reduced to within the range of safe operating temperatures. This is achieved through the use of fans and heat sinks.

Fans

Fans are used to disperse heated air, replacing it with cooler ambient air.

- PSU fan – this is a fan incorporated into the power supply unit, which blows cool air across the motherboard. If the power supply fan stops working, the power supply should be replaced immediately. It is important that the case is closed if this cooling is to be effective.
- CPU fan – a CPU cooling fan should be installed on any Pentium or higher microprocessor. It is attached either to the top of the processor or the top of the heat sink, depending on whether a heat sink is used. Most motherboards have a three-wire (power, earth and speed monitor) CPU fan connector. If the fan rotates too slowly, the processor could overheat and fail. The third wire on the connector allows the motherboard to monitor the speed. If it detects a problem, the computer will shut down or not boot, to protect the processor.
- Other fans – it may be necessary to add additional fans inside the case, particularly in tower cases where cards are mounted horizontally. Other components, such as graphics cards, may have their own fans to disperse heat.

Heat sinks

Heat sinks are machined blocks of metal, usually finned. The large surface area is used to disperse heat. An adhesive may be used to attach the heat sink to the top of the processor. Alternatively a clamp may be used, with a thermally conductive

pad or gel to ensure good conductivity. Fan-cooled heat sinks made of aluminium were common until recently, but now many heat sinks are made of copper or have copper bases. The fins on heat sinks may become coated with dust, reducing their efficiency.

Hard drive configuration and controllers

The hard disk drive stores data. Hard drives are contained in sealed units that contain one or more disks, **read-write heads** and control electronics. The disks are made of aluminium and coated in ferro-magnetic material or a mixture of nickel and cobalt. Each disk contains an upper and lower platter. Modern drives come in two main sizes: 2.5 inch and 3.5 inch. The smaller drives tend to be more expensive and are used in laptops.

Key words

Read-write heads – mechanisms that read data from or write data to disk drives



Figure 2.6 A hard disk

Hard drives are installed in the computer case and connect to the motherboard. When more than one hard drive is installed, one is designated as the controlling or master drive; the other is known as the slave.

External hard drives can also be purchased. These are standard hard drives that have been encased in a caddy. USB connectors are used to connect it to the computer. They are used for additional storage or to back up data held on the computer.

Research tip

Investigate the sizes and speeds of hard drives available today by looking at manufacturer websites such as:

- www.wdc.com
- www.hitachi.co.uk
- www.seagate.com.

The microprocessor communicates with other devices, such as hard disks, printers and monitors, through controllers. Sometimes the controller is built into the motherboard, but it can also be contained on a card that slots into the motherboard. It translates signals and protocols between the system and its I/O (input/output) devices. Several different types of controller are available.

IDE

IDE (Integrated Drive Electronics) drives (or ATA drives) are a **computer bus technology** used for data transmission from hard drives and optical drives. It uses 40 wire ribbon cables to connect a hard drive to the motherboard. The ribbon cable has two or three connectors attached to it: one to attach to the adapter and the others to connect to the drives. IDE has been used mostly as an internal computer device as the standard only allows for cables with a maximum length of 46 cm (although longer cables are possible). If two drives are connected to a cable, one is set up in the BIOS as the master drive. The second is known as the slave drive.

EIDE

EIDE (Enhanced Integrated Drive Electronics) offers higher performance than IDE, as it supports data transfer up to four times faster (up to 16.6Mbps) and can also support larger storage capacities. The technology can support other devices, such as CD-ROMs and CD Writers. A later development of EIDE, called Ultra-ATA, can support data transfer rates of 33Mbps.

Key words

Computer bus technology – a collection of wires through which data is transmitted from one part of a computer to another

SCSI (Small Computer System Interface)

The SCSI standard has been around since 1986, but further improvements have been made since then. It has traditionally been used for attaching multiple hard drives to high-end workstations and servers. It is also used because of the device's speed at transferring data.

An adapter card is used to connect the SCSI devices to the motherboard. An adapter can support up to fifteen devices. Each SCSI device has its own controller. These are intelligent and handle data transfer operations, freeing up other system resources, including processor time, that would otherwise be used for this purpose.

SCSI devices may be internal to the computer or external. If they are external, they use a thick shielded cable with Centronics-50 or DB-25 connectors to connect the devices. Multiple SCSI devices can be daisy-chained (wired) together. If the device is internal to the case, it uses a 50-pin ribbon cable. Other SCSI devices include printers, scanners, optical and tape drives.

SATA (Serial Advanced Technology Attachment)

SATA has been developed as a replacement for older ATA standard. Data can be transferred much faster using serial transmission. The connectors and cabling used are very different to ATA ribbon cables. Each drive has its own thin cable and it is possible to **hot-swap** drives, which was impossible to do using ATA. The connectors are grooved, ensuring that they can only be connected one way. SATA transfers data at speeds from 150Mbps and there are plans to increase this up to 600Mbps.

Key words

hot swap – the ability to remove and replace components while the computer is operating

Example

There is continued rising demand for small, high capacity hard drives. In January 2007, Fujitsu announced a breakthrough in magnetic storage technology that could enable storage capacities of a terabyte per square inch to become a reality.

Ports

Parallel and serial ports

A parallel port is a type of connector found on older PCs. They were mostly used to connect printers, zip drives and some scanners, but have been largely superseded by USB ports. Another form of connector found on older PCs is a serial port. These were used to connect mice, joysticks, keyboards and other peripherals to a PC. They have also mostly been superseded by devices using USB connectors.

USB (Universal Serial Bus)

USB is a connection technology that can be used to connect up to 127 devices to a computer. It is primarily intended for slow devices, such as keyboards, mice, joysticks and external hard drives. USB is designed to be Plug and Play: it should be possible to attach and detach USB devices while the computer is running. The standard specifies two types of connectors and receptacles: series-A and series-B. Series-A connectors are designed for devices such as mice and keyboards; series-B connectors are designed for scanners, and printers.

Think There are two standards for USB: USB1.1 and USB2.0. Find out what the differences are.

Firewire is a high-speed technology that allows data to be transferred between digital devices, such as digital camcorders and some digital cameras. It was developed by Apple, but is also used with PCs. Many new desktop computers and laptops come with Firewire ports built in, but Firewire cards can be purchased for older systems.

Peripherals

Peripherals are pieces of optional hardware that can be added externally to expand the functionality of the computer. Common peripherals include printers, scanners, plotters, webcams and digital cameras, and will be looked at in more detail in the following section.

Printers

Three main types of printer are available: dot matrix, inkjet and laser printers.

- Dot matrix printers – these have a print head that moves back and forth across a sheet of paper and print by striking an inked ribbon against the paper. The letters are formed from a matrix of dots. Some models can be very noisy and they vary greatly in quality of output, speed and price. Very fast dot matrix printers are often used when reports containing large amounts of data processing need to be printed quickly and regularly.
- Inkjet printers – these are very popular as they are relatively inexpensive to purchase, easy to use, quiet and produce good quality output. Most work by producing pulses of current which propel heated droplets of ink onto the page. The ink is water-based and can smudge if handled too quickly after printing or if exposed to water. They contain one or more disposable cartridges of ink, which hold only small amounts of ink and need to be replaced frequently, which can be expensive, particularly for colour printing. Print heads can clog with ink if the printer is not used regularly.
- Laser printers – these produce high-quality output. They used to be much more expensive than inkjet printers, but there are now many cheaper models developed for the home market. A laser printer temporarily saves print-job data to its own memory. Some models are able to make use of the memory within an attached computer. The printer contains a drum made of photoconductive material. The drum receives a positive electrical charge from either a corona wire or a charging roller. As the drum rotates, a laser passes across its surface, drawing (as a pattern of negative electrical charges) the letters

or images to be printed. Toner (a fine positively charged black powder) coats the drum, adhering to the negatively charged areas. A sheet of negatively charged paper rolls under the drum. The toner is transferred to the paper, which then passes between two hot rollers, known as the fuser. The toner melts and bonds with the paper. After the toner has been removed, the drum passes a discharge lamp. This removes the electrical charge from the drum, so that the process of printing the next page can begin.

Example

The development of new printer technologies tend to be evolutionary rather than revolutionary, involving improvements in existing types of printer. Ricoh have recently developed a range of gel-based printers. The gel dries instantly on contact with paper, reducing smearing and bleeding that can occur with inkjet printers. Revolutionary new products are less common. Xerox is presently developing an inkless printer that uses reusable paper.

Scanners

Scanners are devices that can analyse an image or text and save it as an image. The most commonly used type is a flatbed or desktop scanner, but hand-held and rotary scanners are also available. To scan a document, it is placed face down onto a glass plate. The scanning program needs to be opened and selected, such as the area to be scanned. When the scan is completed, the image is saved. When installing a scanner, accompanying software, including drivers, needs to be installed.

Plotters

A plotter is a device used to create line drawings by means of a pen or pencil attached to a mechanical arm. Plotters are frequently used in engineering and architecture to produce very precise drawings, which can be very large. The colour of pens can be changed to produce multi-coloured drawings. Many are being replaced with very large format inkjet and laser printers. In some plotters, other tools, such as cutters, can replace pens on the mechanical arm and vinyl can replace paper. Patterns can then be cut by the device.

Webcams

A webcam is a camera that is able to capture and send real-time images across the internet. The webcam is attached to a computer, usually facing the user so that images of the user can be sent to another computer. This will require additional software, some of which is freely available as a download. Webcams may also be used for other purposes, including security. Software is available that will activate and record sound and movement when it is detected. Webcams are often positioned over busy roads, allowing internet users to check road conditions before travelling. Webcams are also used to show the weather in different locations.

Digital cameras

Many digital cameras use flash memory cards to store the pictures taken. It is easy to transfer images taken by most modern digital cameras to a computer using a USB cable. Once saved on the computer, image manipulation software can be used to edit the images, if required, before printing. Alternatively, memory card readers can be purchased for PCs, removing the need to connect the camera to the PC via a cable. Some photo printers have memory card readers built in.

Internal memory

Computers need to be able to store data and instructions temporarily while processing takes place. In PCs, three types of memory need to be considered: RAM, ROM and cache.

RAM (random access memory)

This memory is situated on the motherboard, close to the processor. It consists of modules that are inserted into slots on the motherboard. They can be removed or replaced as necessary. At the time of writing, most PCs have 512MB or 1GB of RAM.



Figure 2.7 RAM module

Instructions and data are read from and written to RAM from the processor. RAM is sometimes known as 'primary or main memory' and is vital to the operation of a computer. It is volatile, meaning that when the computer loses power or is switched off, the data held in RAM is lost.

Data held in RAM can be accessed quickly using its memory address. This is much faster than serial access, such as from tape, or access from a hard-disk drive (which requires read/write heads to move to the location where the data is stored before it can be accessed). However, with the development of faster processors, the time taken to access data stored in RAM has become an issue: it has created a performance bottleneck.

At the time of writing, the most common types of RAM are DDR and DDR2 memory.

- DDR SDRAM (double data rate synchronous dynamic random access memory) – these memory modules operate at twice the speed of the earlier SDRAM. They had 168 pins and are not interchangeable with the newer DDR modules with 184 pins. DDR RAM cannot be installed on motherboards designed for SDRAM.
- DDR2 SDRAM – this is superseding DDR SDRAM. It operates in a similar fashion, but with higher bus speeds, reducing **system latency time**. It has lower power consumption and operates at a lower temperature than DDR SDRAM.

Key words

System latency time – the length of time between transmitting and receiving data

ROM (read-only memory)

ROM is a hardware chip used to store BIOS information. It is sometimes known as 'firmware'. ROM is non-volatile, so it maintains the information it holds, even when the computer is turned off. It consists of permanent instructions used when a computer is booted.

Cache

This is very fast RAM that operates in conjunction with the processor. It temporarily stores the most frequently accessed data and instructions. When the processor operates, it looks for data in the cache prior to looking in RAM. Cached data and instructions can be accessed more quickly than data and instructions that have to be fetched from main memory.

Memory caches built into the microprocessor are called Level 1 (L1) caches. They are usually 32KB in total, divided into two 16KB memory caches: one for data and one for instructions. (AMD K6 processors use 64KB of L1 cache). Many modern PCs also have a further cache, called Level 2 (L2). L2 cache is usually 256KB or 512KB, and is located on a separate chip. If the processor cannot find the data it is looking for in L1 cache, it will look in L2 and then in main memory.

Specialised cards

Cards (also known as expansion boards), are printed circuit boards that can be added to provide increased functionality.

Network interface cards (NICs)

Networks can now be found in many different locations, including the home. A network can range from two computers linked together to networks of large numbers of computers.

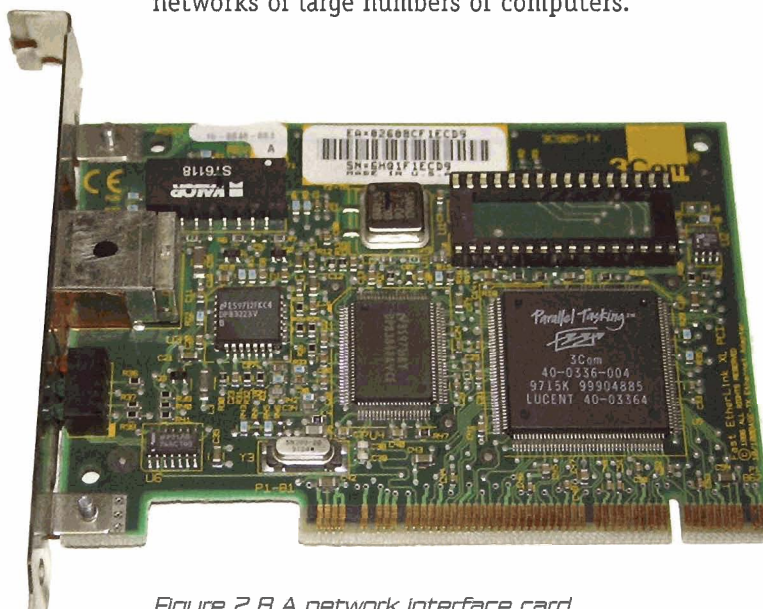


Figure 2.8 A network interface card

An NIC allows a computer to communicate with others on a network. It slots onto the motherboard, although some motherboards have NIC circuitry built in. An NIC converts the parallel data stream used by the computer to serial data packets used by a network. It comes with either PCI or ISA connectors, depending on the type of slot it is to be positioned in on the motherboard. It also comes with either BNC or RJ45 connectors, depending on the cabling being used. Software drivers need to be installed on the computer to complete the installation.

NICs can also be used to network printers. Without an NIC, if you want two or more computers to share a printer, one computer needs to act as a host. This computer would have to be switched on for the other to be able to use the printer. Some modern printers come with network capability (NICs) built in. These are slightly different from the NICs discussed above, as they have a processor built in to manage the tasks that the software drivers perform on a computer. The NICs tend to be proprietary (the property of a company) and are usually manufactured by the maker of the printer.

Graphics cards

For high-end gaming and processor-intensive 3D graphics rendering, separate graphics cards are usually required. A graphics card performs three main tasks: geometry, lighting and rendering images. Geometry involves the computation of shapes, lighting involves the creation of shadows, and so on, and rendering involves adding textures to surfaces.

There are two sorts of graphics cards – AGP or PCIe. AGP is slower and is being phased out. Motherboards come with either an AGP slot or PCIe slot(s). An AGP card cannot be installed in a PCIe slot, so it is essential that you check that you have a matching motherboard and graphics card. For high-end processing, it is possible, using PCIe slots, to install two different graphics cards in a PC. This allows complex processing to be shared across both cards. This also allows up to four monitors to be attached to a PC (an operating system that supports multi-monitors, such as Microsoft Windows® XP is also required).

Graphics cards have a number of components:

- A GPU (graphics processor unit) – this dedicated processor is designed to process complex graphics algorithms quickly. It therefore reduces pressure on the main processor.
- Memory – a graphics card has its own dedicated memory.
- RAMDAC – this is an additional chip found on graphics cards that converts digital signals from the GPU to analogue signal to be output to the monitor.

BACKING STORE

Different technologies have been used to develop devices that can store programs and data on a more permanent basis than the expensive and volatile main memory allows.

From the early days of computer systems, the use of magnetic storage systems, such as hard disks, floppy disks and tape, has been common. More recently, mainly due to the development of pen drives, most new computer systems have stopped shipping with floppy disk drives.

Types of backing store

Disks

A floppy disk is a portable storage device. It is a circle of Mylar, encased in a plastic rectangular sleeve. The most common version is the 3.5 inch floppy disk, which can store 1.44MB of data.

Most new desktop computers and laptops now ship without floppy-disk drives as many computer users now use much higher capacity USB pen drives to move files from one computer to another.

Pen drives

These devices, sometimes known as USB Flash Drives, have largely replaced floppy disks as the portable storage device of choice. At the time of writing, they can be purchased in a wide variety of sizes from 128MB to 8GB.

These devices use Flash memory. This is non-volatile, erasable and rewritable memory. It offers fairly quick access times and is more resilient to



Figure 2.9 A pen drive

knocks than disks. The number of times you can erase and then rewrite to the device is limited, however. Data is erased in blocks (blocks of data make up files). Most available Flash memory devices are guaranteed to last for at least one million rewrites. Chip firmware or system drivers spread the rewrites between sectors so that certain areas of the device do not wear out before others. This is called wear levelling. Bad blocks, ie corrupted data, are also removed from use.

Optical media

A CD-ROM (Compact Disk Read-Only Memory) is a disk composed of a polycarbonate, covered with one or more very thin layers of reflective metal, usually aluminium, which is then coated with lacquer. CD-ROMs are designed to store text, images and stereo sound. Data is encoded onto the CD starting at the centre and finishing at the outer edge. A CD can hold 650MB or 700MB of data.

The data held on a CD-ROM is read by a drive using laser light to read the pits and lands on the CD as it rotates. (Pits are etched onto the CD when it is produced. Lands are the areas on a CD between the pits). The reflection of the laser light away from the surface of the disk is detected by a sensor. The sensor converts the signal into digital signals that can be interpreted by the computer.

A DVD is another type of optical storage disk and can store between 4.7 and 17GB of data. The disks resemble CDs, but store data using a different format and at a much higher density. DVD drives are backwardly compatible with CD-ROMs.

There are a number of different recording standards and you need to ensure that you purchase disks that are compatible with your DVD drive and/or DVD player. The most commonly used formats are:

- DVD-R and DVD-RW – DVD-R was the first format (non-rewritable) that could be played on DVD

players. It is compatible with most, but not all DVD players and DVD-ROMs. DVD-RW is a rewritable format that can be played on slightly fewer DVD players and DVD-ROMs.

- DVD+R and DVD+RW – DVD+R was developed later and considered more reliable. Cheaper DVD players are more likely to play DVD-R disks. There are many hybrid DVD players on the market that will play both formats.

DATA TRANSMISSION

Buses

All of the main computer components communicate with each other via collections of wires called buses. There are a number of different types of bus to consider:

- Data Bus – this carries data between the processor, main memory and peripheral devices. When the processor wants to read or write data, an address is sent along the address bus and the data is transmitted.
- Address Bus – this carries addresses of memory locations between the processor and main memory. It is used when data needs to be read from or written to memory. The number of lines that make up the bus determine the number of memory locations that can be addressed.
- Control Bus – this carries commands from the processor to other devices and status signals from other devices to the processor. It coordinates the activities of the computer system.

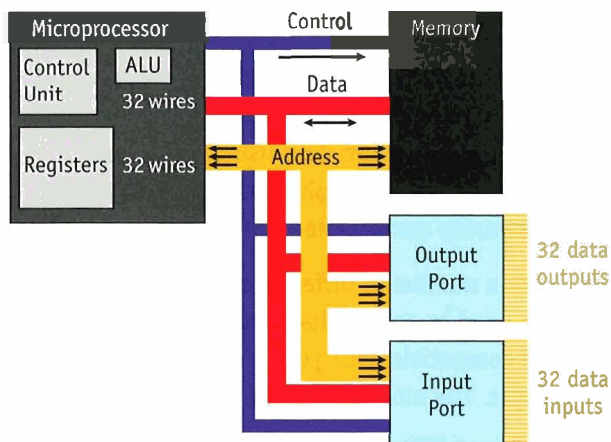


Figure 2.10 Bus system

Expansion Bus (I/O Bus)

- ISA (Industry Standard Architecture) – this is an obsolete, slow bus system used by early 8-bit and 16-bit PC systems. It appeared initially in 1981 and hung around for twenty years. It was used to connect peripheral devices, such as modems and sound cards. It could be difficult to configure the devices, eventually leading to the development of ISA PnP, otherwise known as Plug and Play.
- EISA (Extended Industry Standard Architecture) – this is a 32-bit version of the ISA bus architecture. It was introduced in 1988 as an alternative to IBM’s Micro Channel architecture. It is possible to plug an ISA card into an EISA slot.
- VESA Local Bus (Video Electronics Standards Association) – this was developed in the late 1980s from the need to have a bus that could keep up with faster processors. It was used mainly for video and sound cards. It had a 32-bit data path.
- AGP (Accelerated Graphics Port) – developed by Intel for the demands of 3D graphics. It creates a dedicated channel so that the graphics controller can access main memory directly.
- PCI (Peripheral Component Interconnect) – developed by Intel (1993). PCI supports both 32-bit and 64-bit systems. It also supports both ISA and EISA. It replaced the VESA Local Bus. It is common to see PCI expansion slots alongside the new PCI Express slots in modern motherboards.
- PCI Express – designed to replace PCI and AGP and still being developed and improved. It has its own expansion slot(s), different to the earlier PCI or PCI-X slot. It is far faster than previous bus architectures.

Research tip

Investigate the range of speeds of data transfer achieved by the different bus architectures described above. Wikipedia, processor or motherboard manufacturer websites are a good starting point.

Modems

Modems are used to connect a computer to the internet. A modem takes a digital data signal from a computer and turns it into an analogue signal (sound) so that the data can be transmitted along a telephone wire. When the signal reaches a recipient computer, its modem converts the analogue signal back to digital. Modems can be internal or external devices and most transfer data at 56Kbps. There may be a few older modems still in use that transfer data at 28.8 or 14.4Kbps.

ADSL (Asymmetric Digital Subscriber Line) allows data communication over telephone wires at a faster speed than that achieved using a standard modem. Both voice and data can be sent at the same time.

Cable modems are not strictly modems as they do not convert digital signals to analogue. They are used to provide a broadband service using spare capacity on a cable television network.

Example

The internet is playing an increasingly important role in business. In 2005, 70 per cent of UK businesses had a website, 31 per cent had an intranet, and 8 per cent an extranet. The proportion of businesses buying or selling products over the internet doubled between 2002 and 2005, from 7 to 15 per cent, whilst the value of internet sales in 2005 hit £103 billion.

Processor speed

It is possible to run a CPU at a higher speed than it was designed for by increasing the bus speed to a higher speed than recommended or by configuring the motherboard for a faster processor. This may result in a slight improvement in the processor's performance. However, it will certainly void your warranty and is not recommended by the major chip manufacturers.

CONSIDERATIONS FOR SELECTION

Cost

It is possible to purchase a general purpose computer for under £500. If the computer is going to be used to run the latest computer games or for video editing, a high-end computer with a very fast processor, lots of RAM, a dedicated video card with considerable on-board memory, and a large hard drive will be required. This may cost £1500 or more.

New computer systems come with a warranty and this should be looked at carefully, considering:

- how long it will last
- whether it covers both parts and labour
- whether the equipment needs to be returned to base
- who will pay for the postage?
- if on-site repair cover is a next day service.

User requirements

There are a number of considerations when making a decision about which computer to buy:

- What will the computer be used for? The specification required for a computer to be used for video editing will be very different to a computer to be used for browsing the Internet and running office applications.
- Is a maintenance contract required? These can be purchased from equipment manufacturers and third-party vendors. As with warranties, different types of contracts exist. The most expensive are 4 × 4 contracts for servers, which guarantee that an engineer will arrive within four hours and that a fix will be in place within four hours. If the equipment cannot be fixed within this time frame, the vendor will supply replacement equipment until yours is repaired.
- What other peripheral devices need to be purchased at the same time? If there are very specific requirements, such as a printer needing to print a certain number of pages per minute, then these need to be specified very carefully to ensure that they meet requirements.

- Does the system need to be compatible with other systems? For example, if it is to be used for video editing, the computer will need a FireWire port. You should also consider how many USB ports are needed and whether they are easily accessible.
- How much storage is needed and what type? Programs and data are normally stored on the hard disk, so this needs to be large enough to meet the needs of the user. Additional external hard drives can be purchased, but these tend to be more expensive and vulnerable than those installed internally. Is a DVD rewriter needed?

Accessibility for disabled users

A wide range of assistive devices and software is available to assist users with disabilities. These include:

- braille keyboards, large keyboards and keyboards with high contrast key-top stickers
- trackballs, head-mounted pointers and adaptive joysticks
- large monitors
- speech recognition software
- screen readers.

In addition, the Microsoft Windows® XP operating system has a number of accessibility options built in, such as:

- high contrast to improve the screen contrast using alternative colours and font sizes
- toggleKeys, which emit sound when pressing caps lock, scroll lock, and num lock
- soundSentry, which gives visual warnings for system sounds
- option to improve visibility of the mouse pointer
- magnifier
- narrator text to speech program
- on-screen keyboard.

Example

Examples of software to assist users with reading and writing difficulties includes Dragon Naturally Speaking, a voice recognition software; TextHELP Read & Write, where text can be spoken back as it is typed; Supernova, which combines speech reading with a magnifier; and CCTV, a magnifier.

Research tip

What computer devices have been developed to aid users with physical disabilities? A good starting point for your investigation is www.assist-it.org.uk.

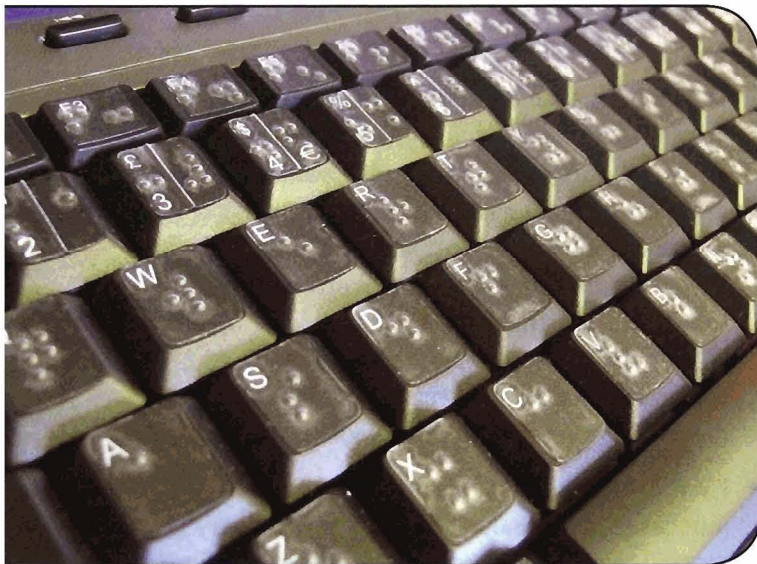


Figure 2.11 A braille keyboard

CASE STUDY: DATA-PRO LTD PART 1: HARDWARE RESPONSIBILITIES

Data-Pro is a multinational company involved in data processing at a number of different locations. At one particular location, the PC Support Team has three technicians and a team leader. They are responsible for supporting 250 users, 250 PCs, 40 laptops, 40 printers and 18 servers. The team has a wide variety of responsibilities, involving hardware, software and maintenance.

The technicians are frequently required to:

- upgrade hard drives, memory and graphics cards
- install and configure dual-screen video cards, scanners, local and network printers.

The organisation operates a help-desk system. Calls for IT-related problems are recorded centrally via a service desk team onto the company's help-desk software, TouchPaper®.

Calls are assigned a priority level between 1 and 5 and are then assigned to the appropriate resolver group: hardware support, network support, server support, mid-range support or mainframe support. There is some overlap of responsibility between these teams. The priority level is based on the severity of the problem:

- Level 1 is the highest priority. The team has 4 hours to resolve a Level 1 call. It usually involves a full outage affecting a significant number of users, who are unable to continue working until the problem is solved.
- A Level 3 call is an issue or problem. Three days are allowed to resolve this.
- A Level 5 call is a change request. It might be an installation of new software, procurement of new equipment or a machine move. Ten days are allowed to complete a task like this.



When the call has been completed, it is resolved with a resolution description typed into TouchPaper®. The call returns to Service Desk for final closure.

The hardware team:

- troubleshoot hardware problems
- repair hardware that is out of warranty
- manage repairs to hardware that is in warranty, ringing the manufacturer's service line, describing the problem, arranging an engineer visit and ensuring that the problem is fixed
- move computer equipment. The team liaise with the facilities department for floor-box moves or desk moves, the network team if additional networking is required and the communications officer if telephone connections need moving
- specify, procure, install and support servers.

Evidence activity

P1 – D1

You have been employed by a college to support their computer systems.

1. Your line manager has asked you to produce a presentation that explains the function of system unit components to new computing students. It is important that the use of jargon is kept to a minimum and that all terms are defined. The presentation could include diagrams with hotspots or hyperlinks to slides containing details and examples. You must ensure that you include details of how the components communicate. (P1)

2. The college has asked you to specify three different computer systems for the college:

- a computer to be used to run Office applications, web browser and email
- a computer to be used by the media studies department for video editing
- a computer to be used by the engineering department to run a CAD program.

Produce a report making three different recommendations for each of the computer systems required, with an appropriate output device also selected. Decide which system is most suitable for each situation, considering cost and technical requirements, and justify your choice. (D1)

2.2 Understand the software components of computer systems

OPERATING SYSTEM SOFTWARE

The operating system (OS) of a computer is a program, or suite of programs, that controls the operation of the computer. It acts as an interface between the hardware and software applications.

Operating system examples

There are a number of different operating systems available for computers. The most common are:

- Microsoft Windows® – this is a very widely used operating system. The latest version is Vista. Previous versions include XP Professional and Home, 2000, 98, NT, ME and 95. Microsoft Windows® is designed for use on home and business PCs and laptops. Historically, it was designed for use on single-user systems. Microsoft Windows® XP is a multi-tasking operating system developed from the earlier NT kernel. It incorporates both a graphic user interface (GUI) as well as a command line interface (cmd.exe). Microsoft Windows is thought to be easy to learn to use.
- UNIX® – Unix is a multi-tasking, **portable** multi-user operating system. It has been developed since the 1960s by many different corporations and individuals. It has a hierarchical directory structure. The operating system consists of a kernel that manages hardware and data access, schedules tasks and enforces security. It has a shell that supports custom environments for users and executes user commands. A large number of utilities are available for process, user, print and file management. Unix has traditionally been viewed as more difficult to learn to use than Windows, due to its command line interface. Many Internet servers are UNIX-based.

Key words

Portable – can be used on a computer system that is different from the one for which it was designed

- **Linux** – Linux is a multi-user OS that will run on a number of different computer architectures, including PCs. It is similar to UNIX, but requires less hardware resources to run. It is Open Source software, which means that anyone can have access to the source code. Examples include Red Hat and Fedora.
- **Mac OS** – This GUI OS was developed for use with Apple Macintosh computers. Early versions operated only with Motorola 68000 systems, but later versions were compatible with PowerPC. The latest versions are compatible with Intel x86 architecture.

Research tip

It is important that you become familiar with the fundamentals of UNIX and Windows. There are some good tutorials available online, including:

- www.ee.sun.ac.za/~teaching/unix/
- www.microsoft.com/windows/using/windowsxp/default.mspx

Command line and GUI operating systems

Command line interface

The command line interface is text-based and relies on users typing commands onto the screen from the keyboard. UNIX shells and DOS both use this type of interface.

It is possible to access the command line in Microsoft Windows® XP by clicking the Start button, clicking Run and typing **cmd**. This opens a window with the DOS prompt. To see a list of files and folders, type **dir** at the command prompt (where the cursor is flashing). If there are too many folders and files to fit on one screen, type in **dir/p**. This will allow you to view the first screen, and then press the spacebar to see the next screen until you have viewed all the files and folders. Alternatively, you could type in **dir/w** to see the files and folders using a wide format. At any point, you can go to the root of the C drive, by typing **cd**.

The command line interface is very quick to use when the correct commands are known, because the user does not have to work their way through menus or click through a number of selections with a mouse. It does not require Windows, uses less memory than a GUI and will run on a very basic PC and monochrome monitor. However, it relies heavily on a user's typing skills and knowledge of commands.

Batch files

It is possible to write multiple commands into a text file. This is very useful, particularly for procedures that need to be repeated frequently. The file is saved with a **.bat** extension. It can be scheduled to run at specific times of day, or when specific events occur, such as when a PC boots or shuts down.

Graphical user interfaces (GUIs)

This interface allows users to interact with the computer using windows, icons, menus and a pointing device (WIMP). Microsoft Windows®, Mac OS and X Windows (Linux) all use variations of this type of interface.

The interface consists of 'widgets' that allow the user to interact with the program, including windows, scroll bars, buttons and menus. Large widgets, such as windows, are containers for content. One of the features of a well-designed GUI is that the widgets are customisable, allowing the user to adjust the layout of the interface to suit their method of working. GUIs are described as intuitive or easy to use (although some might disagree!). Once a user can interact with the interface in one application, that knowledge can be applied in other applications designed using the same widgets.

Think List a number of GUI widgets that are customisable in a common application such as a word processor or spreadsheet.

Some GUIs are designed for very specific requirements, such as ATMs (Automated Telling Machines), self-service checkouts and touch-screen point-of-sale systems.

Operating system functions and services

The operating system performs a number of vital functions:

- File and disk management – the transfer of data and program instructions from a backing storage device to main memory and back again are functions of the OS. The OS also enables users to create folders and move, copy and delete files. It keeps a database of where all the files are stored so that they can be retrieved.
- Memory management – the OS manages the allocation of memory to programs, so that they can operate. Many operating systems can run several programs at once, enabling users to switch quickly from one program to another. When a computer is booted, part of the OS, called the kernel, is loaded into main memory. This sits in memory while the computer is turned on.
- User interface – the OS provides an interface for the user to interact with the operating system. For example, in the Microsoft Windows® OS, users can use Windows Explorer to move files. They can use the Control Panel to add and remove programs and printers, optimise and configure multimedia devices and much more.
- Scheduling and peripheral management – the OS assigns priorities for different operations involving processor time. It also manages input and output, using queues and buffers. Buffers are required to store data temporarily as many devices within the computer system operate at different speeds. For example, data can be sent to a printer faster than the printer can process it, so data is stored in a buffer allowing the printer to operate in the background and freeing computer resources to get on with other tasks.
- System tools – the operating system often contains a number of additional programs called utilities, which are used to monitor and maintain elements of the system. It is usually necessary to keep the operating system patched. A patch is a program that will fix a problem, such as a software bug or a security issue, or add extra features to improve usability or performance. They are usually small programs, but can in some cases be large. It is important to keep the OS patched to avoid viruses.

Operating system software also helps to guard against security issues:

- Logins and passwords – user IDs and passwords can be set on individual computers (a feature of the OS) or on networked computers (as part of the network OS). Network administrators can set a minimum password length, set complexity of the password and force users to change passwords at regular intervals. They can also control the areas of the network that users have access to and on what days and times the user can access the network. Rights to particular files can also be set, for example read-only access, read and write access, create new files and folders and delete files and folders.
- Encryption – this is the conversion of data into a cipher with the aim of stopping the data from being read by others. A 'key' is required to translate the data back into readable form. There are a great many different methods of encryption. To protect data from hackers, private and public key systems are sometimes used. These systems require two different keys to be used. One key is used to encrypt the data and another is used to decrypt it.
- Audit logs – these can be used to record information about activities on the network, for example about who accesses data and when they access it. Do they edit, copy, move or delete data? Logs can be useful to track down any unauthorised activity.

Device drivers

A device or software driver is a software program that allows operating systems and other programs to interact with a hardware device. One example is printers' drivers, which convert data to a format that printers can understand. Drivers are specific to certain operating systems and devices. If a device does not function correctly, it is worth going to the manufacturer's website to see if there are any newer drivers available for your model. Other devices that need drivers are modems, CD-ROMs, webcams and monitors.

SOFTWARE UTILITIES

Software utilities are programs that perform a task or tasks that help to manage a computer system. They are frequently, but not always, small programs that are bundled with the operating system.

Virus protection

It is important to protect computer systems from virus attacks. The installation of scanning software and a schedule of regular updating can reduce the risk of a successful virus attack occurring. A number of other actions can be taken by users to reduce the risk of infection, including not opening unsolicited email or attachments, avoiding pirated software and backing up data regularly.

System profilers

This software can provide information about a computer's configuration and properties. It can be used to display a list of all hardware and software, including version numbers, on a computer. It can also be used to assist in the detection of hardware and software problems.

Firewalls

A firewall is used to protect a network from unwanted internet traffic. It exists between your computer(s) and the internet. Some firewalls are software programs that are installed on your computer, others are built into hardware, such as a broadband router. The firewall allows you to access websites and download files while ensuring that hackers cannot access your computer resources.

Clean up tools

- **Cookies** and internet history – when web pages are visited, copies of these files are stored temporarily on the hard disk of your computer. It is possible to control the amount of disk space that is allocated to storing these files. A list of pages and sites visited is also stored and it is possible to set how many days this list is kept for.
- **Anti-spyware** – spyware is software that is able to collect personal information without the user's knowledge. It may do this by recording keystrokes made by the user, scanning documents on the computer or recording the Internet history. A number of software applications can be installed to prevent the use of spyware. Anti-spyware can also scan a system for the presence of spyware and remove it.
- **Defragmentation** – as files are saved to a hard drive, then edited, resaved, and deleted, parts of a file may be saved to several different physical locations on the hard disk. This fragmentation of files leads to longer times taken to read data into memory. Many operating systems have a defragmentation utility, which attempts to move files into contiguous sectors, thereby reducing data access time.

Key words

Cookie – a cookie is data that some internet sites download onto your computer. In some cases a cookie collects information about the websites you visit; in others, it may contain auto-login information that will enter your login and password automatically for a website you visit regularly

Drive formatting

IT practitioners are usually only required to perform high-level formatting of hard disks. The disk is low-formatted at the factory to prepare the surface of the disk for data and it is rare for this procedure to be repeated. High-level formatting might include:

- scanning the disk for problems and marking bad sectors
- creating magnetic tracks and 512-byte sectors
- creating areas between the sectors to keep error correction information
- creating a file allocation table to record the location of files stored on the disk.

On newer operating systems, such as Microsoft Windows® XP, the format commands are run as part of the OS setup procedure. On older operating systems such as Win95, the FORMAT command would be run prior to the installation of the operating system.

It should be noted that formatting a disk does not mean that the data is irretrievable, although the process of recovering it is complex. If you need to ensure that the data is gone forever, which you may need to if the information is confidential or financial, then you should either destroy the hard drive or use a utility that has been created specifically for that purpose.

CASE STUDY: DATA-PRO LTD PART 2: SOFTWARE RESPONSIBILITIES

Software is installed using imaging or cloning software to deploy standard builds. Different builds are required to meet the software needs of different departments and some departments require more than one build. Additionally, each different model of PC or laptop will require an individual image to maintain hardware and software compatibility, which means that bulk purchases of new PCs and laptops are preferred to reduce the need to create new images, which take two days to complete.

An image is created by installing all software and patches required onto a PC and then using a utility provided by Microsoft called Sysprep to remove the machine's unique identity. The imaging software is used to create a copy of this PC. On image restore, the Microsoft setup wizard automatically runs to recreate the PC's unique stripped (SID) identity. Once an image has been created, a final machine configuration can be completed in less than an hour. One-off custom builds and server builds are always done from scratch.

Quality control of work done is maintained using checklists.

Requested one-off installations of software are done manually.

A software licensing database is kept up to date. This is done automatically via auditing software. Reports are run manually every three months and compared against licensing records. Any unauthorised software found is removed. Spare licenses are identified for future allocation.

Patching of software from Microsoft is achieved automatically using Microsoft SUS server. Other patches may be deployed manually or via group policies.

Virus protection software is installed onto PCs via login scripts. They run an agent that looks to a central database on the network for updates. The central database updates from the vendor's site, thus minimising internet traffic.

Evidence activity

P2 – M2 – P3 – P4

1. Questions have been asked about what operating system should be used by the college. Create a table with two columns that describes the purpose, features and functions of two different operating systems, such as Mac OS, Unix® or Microsoft Windows®. (P2)
2. Identify the differences and similarities between the two operating systems and summarise each one's strengths and weaknesses in terms of their features and functions. (M2)
3. Your line manager has asked you to create a step-by-step guide to the use of two different software utilities. The guide should include screenshots of the steps taken to operate the software. (P3)
4. There have been arguments in the department about how to define a software utility. Describe four different software utilities, including one from each of the following categories: virus protection, firewall, clean up and drive formatting. (P4)

2.3 Be able to undertake routine computer maintenance

SOFTWARE MAINTENANCE

Upgrade software

It is worth checking manufacturers' websites for the latest device drivers for installed peripheral devices, such as graphics cards and printers. These sometimes include bug fixes or provide improved functionality.

It is vital to ensure that anti-virus protection software is kept up-to-date to protect computers from new viruses. It is usually possible to configure the virus protection software so that it automatically checks the anti-virus manufacturer's website every time the computer connects to the internet and automatically downloads the latest files.

Installation of patches

Many software companies release patches for their programs. Because software programs can contain millions of lines of code, it is almost inevitable that there will be some errors in it. These errors, or holes, can be exploited by rogue program writers. To correct the errors, the operating system or software manufacturer will issue a patch. Patches are also released to add additional features to a program. These can be downloaded from software manufacturers' websites. Microsoft Windows® XP can be configured to automatically check for and download updates. Instructions for the installation of updates are usually supplied in a text file or on the website.

Example

Microsoft has a number of different types of patches, to deal with different issues. These include 'critical updates', which provide fixes for issues in software; 'feature packs' which include additions to software programs; and 'driver updates', which update software that supports or controls hardware.

Scheduling of maintenance tasks

Some organisations maintain a schedule of preventative maintenance. This includes tasks to be completed daily, weekly, monthly, six monthly and annually, which might look like the example shown below.

Table 2.4 A maintenance schedule

Daily	<ul style="list-style-type: none"> • Backup data • Check computer case ventilation is not blocked.
Weekly	<ul style="list-style-type: none"> • Check power cables are in good condition • Wipe over the exterior of equipment with a damp cloth • Check that anti-virus software is updating correctly.
Monthly	<ul style="list-style-type: none"> • Clean inside the system case • Reseat any expansion cards that are working loose • Clean the keyboard and mouse.
Six monthly	<ul style="list-style-type: none"> • Use a diagnostic package to check system • Scan the disk • Defragment the hard drive.
Annually	<ul style="list-style-type: none"> • Check warranties, maintenance contracts and licensing.

Utility software aimed at users

Defragmentation

To defragment a disk in **Microsoft Windows® XP**:

- ▶ go to Start > All Programs > Accessories > Disk Defragmenter
- ▶ or: click My Computer, then right-click on the hard drive icon
- ▶ select Properties > Tools > Disk Defragmenter
- ▶ click the Defragment Now button.

Clean up

To clear temporary internet files, cookies and internet history on a computer, in IE7

- ▶ go to Tools > internet Options > Browser History > Settings
- ▶ choose the settings you require

To clear temporary internet files in IE7:

- ▶ go the Tools menu > internet Options > Browser History > Delete
- ▶ A number of options exist:
 - temporary internet files
 - cookies
 - history
 - form data
 - passwords.

System Profilers

To access system hardware and software information in **Microsoft Windows® XP**:

- ▶ go to Start > All Programs > Accessories > System Tools > System Information
- ▶ the right-hand pane of the Information window allows you to select the following information:
 - hardware resources
 - components
 - software environment
 - internet settings.

Other third-party utility software

Compression utilities

Compression software is used to reduce the size of files for storage, download or for sending as an email attachment. A popular format is .zip. A software program is required to compress the data and to uncompress it. A number of free compression utilities are available on the Internet, but **Microsoft Windows® XP** has its own compression utility.

To compress a file or folder in Microsoft Windows® XP:

- ▶ right-click on the file or folder and select Send to
- ▶ choose Compressed (zipped) folder from the fly out menu
- ▶ to unzip a file or folder in Windows XP, double-click the zip file.
- ▶ click Extract all files.

Spyware Removal

A number of free software utilities are available for download from the Internet. These can be configured to detect and prevent spyware from being downloaded onto your computer. Alternatively, a program called Microsoft Windows® Defender, a free download from Microsoft for Win2000 and XP, can be used. It is built into Vista.

To scan your computer:

- ▶ start > All programs > Windows Defender
- ▶ click the down arrow next to Scan
- ▶ select Full Scan.

Diagnostic tools

Many software tools, some of which are free, can be used to run a series of tests on your computer to aid in the diagnosis of problems. An internet search will find a number of these programs.

HARDWARE MAINTENANCE

It is usually preferable for computer equipment to be stored off the floor. Carpet and dust can reduce the flow of air around the computer case, which can lead to the temperature within the case being hotter than desirable, which will shorten the life of the computer.

The computer case should always be kept closed when in operation. The fans inside the case are designed and positioned to maximise cooling of the components.

Example

There are many companies that offer professional computer cleaning services.

Capital Computer Care offers cleaning services of equipment including desktops, laptops, printers and scanners. Their clients range from small businesses to major national organisations.

Think Why might some businesses choose to employ professional computer cleaning services?

Cleaning equipment

To avoid problems developing with a computer system, you should take preventative measures. This can be as simple as having a simple cleaning regime. Computer systems attract dust and dirt, which shorten their efficiency and life. It is important that the right products and methods are used when cleaning to avoid damage. A range of products will need to be used, including soft cloths, screen wipes, anti-static spray, a small paintbrush, compressed air (usually in an aerosol), a vacuum cleaner (special attachments such as fine crevice tools can be purchased), cotton swabs, flat-headed and Philips screwdrivers and a grounding strap.

⚠ Always check manufacturer's instructions for cleaning their equipment and ensure that the computer is unplugged before undertaking cleaning.

- Computer cases – use soapy water on a squeezed soft, clean cloth. Ensure that no excess moisture is able to penetrate into the case.
- Computer screens – avoid the use of solvents as they may cause discolouration. Screen wipes are useful for removing general dust and finger marks. Anti-static spray may be applied.

Keyboards – the keyboard should be unplugged, then turned upside down to shake out loose dust or crumbs. A vacuum can also be used.

To loosen a sticky key, use a flat-headed screwdriver to gently remove the key. Clean the key socket as well as possible (using computer cleaner or distilled water), then, when dry, snap the key back in place.

- Mouse – the inside can become clogged with dust. Unplug the mouse, remove the cover and release the mouse ball. A damp cloth can be used to clean the ball. Three rollers are located inside the mouse. Dust will need to be removed from them, using a pair of tweezers or your fingernails.
- Inside the computer case – only compressed air should be used to clear dust. It is extremely easy for static electricity to permanently damage the inside of a computer, so avoid touching any components in the process.
- Inkjet printers – these are prone to developing clogged nozzles, especially when the printer has not been used for some time and the ink dries. Most printers have an automatic cleaning program, which may need to be run a couple of times to clear the nozzle. Many manufacturers advise against manually cleaning the printer heads.
- Laser printers – general dust and bits of paper can cause poor print quality and paper jams. Check the printer manual and warranty before cleaning. Turn off the printer, unplug it and allow it to cool down first. Remove the toner cartridge and use compressed air to remove dust and general debris. Use a disposable soft cloth to remove residual toner from the inside of the printer.

Install and configure new peripherals

IT practitioners may be called upon to install new computer devices, particularly printers. Most new printers come with manuals and installer programs. If so, you should always read the documentation for any special instructions. You will probably need to install toner or ink-jet cartridges and you should follow the instructions on the packaging.

If instructions aren't available, the following procedures can be used:

USB printers


- ▶ if you have an installation program, install the printer drivers before you connect the printer to the computer. Follow the instructions given
- ▶ if you do not have an installation program, attach the USB cable to the computer and printer. The 'Add New Hardware' window should appear on your screen
- ▶ click next, then click 'Search for the best driver for your device'. Click Next again
- ▶ browse to locate your printer drivers, then click OK
- ▶ click Next a further two times and then click Finish
- ▶ turn on your printer and print a test page.

Parallel port Printers (Microsoft Windows® XP)

- ▶ go to Start > Printers and Faxes > Add Printer
- ▶ select Local printer OR Printer connected to this computer, then click Next
- ▶ select the LPT port and the make and model of printer
- ▶ otherwise, click Have disk, and browse to the location of the driver
- ▶ click Open, then OK
- ▶ select Yes to make the printer the default printer, then select Do not share this printer, then Next
- ▶ turn the printer on, then print a test page by selecting Yes. When the page has printed, click Finish.

Install and configure additional or replacement device

You need to be able to install or upgrade a hard drive, graphics card, optical drive or a network interface card.

 **Remember to always turn off the computer and unplug from the mains before opening the computer case. Use a grounding strap when touching components within the case.**

Replacing a hard drive

Hard drives are mechanical devices, and therefore may fail, necessitating a replacement. Alternatively, a user may find that the disk is no longer large enough to store all their programs or data in which case a new hard drive will be needed. Replacing a hard drive may be a way of extending the working life of a computer.

To replace an IDE drive:

- ▶ backup any data you will want to copy to your new disk
- ▶ turn off the computer. Unplug the power lead
- ▶ remove the old drive. Note where cables connect to power supply and the motherboard
- ▶ set the jumpers for master, slave or cable. Select the replacement hard drive. Check the original drive settings, and do the same
- ▶ install the drive in the mounting frame, reusing the screws from the previous drive
- ▶ attach the cables to the motherboard and to the power supply
- ▶ most modern BIOSs will auto-detect the new hard drive. If not, go into the BIOS to change the drive settings.

Installing a sound card

- ▶ install the card into a free slot. Avoid touching the components on the card. Ensure that the card seats itself firmly
- ▶ connect the cable from the CD/DVD drive to the soundcard
- ▶ screw the card in place, if a screw hole exists on the card
- ▶ close the case and reattach the keyboard, mouse, monitor, speakers, etc
- ▶ on startup, Microsoft Windows® should recognise the soundcard. Follow the onscreen instructions to install software drivers.

Upgrading a graphics card

- ▶ Uninstall existing card drivers.
- ▶ Remove card.
- ▶ Install new card.
- ▶ Install new drivers.
- ▶ Configure display settings.

Adding a CD/DVD drive

- ▶ remove the drive slot cover on the case.
- ▶ set the IDE drive mode to Master if it is the only device attached to the cable.
- ▶ install the drive in the case.
- ▶ attach the audio cable to the drive. The other end of the cable attaches to the motherboard or a PC audio card.
- ▶ attach the IDE cable into the motherboard and one of the other connectors of the cable into the CD/DVD drive.
- ▶ insert a **4-pin molex connector** from the power supply into the CD/DVD drive.

Key words

4-pin molex connector – a commonly used power connector for disk drives and other components

Adding and configuring a Network Interface Card

If you wish to attach your computer to a local area network (LAN), a network interface card (NIC) will need to be installed unless the computer already has onboard networking. The user manual that comes with the card contains vital information related to installing and configuring the NIC.

- ▶ Ensure that the card has connectors that are compatible with the cabling used by the network. Many Ethernet cards come with both BNC and RJ45 connectors so that they will work with both thin Ethernet and CAT5, CAT5e cabling.
- ▶ Check the User Manual to determine the required jumper settings
- ▶ Install the card into an expansion slot on the motherboard of the computer. Secure it to the back plate of the computer using a screw
- ▶ Microsoft Windows® XP should detect the card and load the drivers, otherwise install drivers when prompted. Install the NIC drivers onto your computer. This software allows the computer to manage communication between itself and the NIC

- ▶ some NICs have activity lights that can be used to help diagnose problems. See the user manual that came with the card
- ▶ attach the network cable to the connector on the NIC
- ▶ find out what protocols are being used (from the network administrator). Assuming it is TCP/IP, today's prevalent protocol, IP numbers will either be static or dynamically allocated by **DCHP**. In case of the former, contact your system administrator for the correct IP number, subnet mask, DNS setting, WINS settings, and domain suffix and gateway settings to be used
- ▶ go into Control Panel > Network Connections
- ▶ double-click on the TCP/IP protocol, then add the appropriate settings.

Key words

DCHP – Dynamic Host Configuration Protocol. A set of rules to allow a computer to request and obtain an IP address

Other hardware maintenance issues

Health and Safety

When working with computer equipment, there are a number of hazards to be aware of.

- Never open the power supply or VDU (monitor) units as there is the potential for receiving a life-threatening electric shock due to extremely high-level voltages.

Avoid working inside the computer case while it is plugged in and switched on.

- Keep food and drink away from computers. When cleaning around the computer with fluids, be very careful to avoid fluid dripping on or seeping into the equipment.

Regularly check that the insulation on power cables is in good condition and replace them if necessary. Ensure that power cables are not trapped under pieces of furniture or left where they can become trip hazards.

Unplug computer equipment during thunderstorms whenever possible, including modems.

- Ensure that cooling vents on computer cases are not blocked and unable to dissipate heat from the processor and other components.

Electrical computer equipment in the workplace needs to be PA (Portable Appliance) tested as part of statutory Health and Safety requirements. The frequency of testing is set by the Health and Safety Executive.

Care also needs to be taken when working with laser printers. There are a number of hazards to consider:

there are a number of high voltage areas within laser printers

- the light produced by the laser can damage eyesight

you should always unplug the printer and allow it to cool for a few minutes, due to high temperatures produced by the fuser unit

you should not attempt to bypass interlock switches inside a laser printer without expert training.

Disposal of Equipment

Computer equipment contains some environmentally hazardous materials, such as lead, arsenic, precious metals and plastics. The EC Directive on Waste Electrical and Electronic Equipment (WEEE) aims to minimise the impact of electrical and electronic items on the environment. From 1 July 2007, producers of any equipment bought after 13 August 2005, will be responsible for collecting and disposing of it. Where equipment was purchased prior to 13 August 2005, it is the responsibility of the business to pay for it to be recycled or disposed of.

FILE MANAGEMENT

Create folders

Learning to manage files is an important element of computer maintenance. It is frequently necessary to create folders, copy, move and delete files and there are a number of different ways of managing this. Microsoft Windows® XP uses File Explorer for this purpose.

If you are in school or college, you may not be able to access File Explorer, or its functionality may be reduced. This means that you may need to develop alternative strategies for managing your files and folders.

To open File Explorer

- ▶ right-mouse click on the Start button > Explore
- ▶ the File Explorer screen usually displays two panes. The left pane shows a list of drives and folders, while the right pane displays the contents of a selected folder. If a folder has a sub-folder within it, a plus or minus sign will appear next to it. Clicking on a plus causes the contents of the selected folder to display in the right pane
- ▶ to open a folder, click on it
- ▶ clicking on a minus causes the contents of the folder to be hidden. It closes the folder.

To create a folder

- ▶ in the left pane, click on the drive or folder in which you wish to create the folder
- ▶ go to the File menu > select New > Folder
- ▶ type in a name for the folder. Press Enter. You should not use any of the following characters when naming files or folders: * < > [] = + " \ ? , . ; :

To select a block of files

- ▶ display them in a list, click on the first file in the list, hold down the shift key, then click the last file in the list.

To select files that are not in a contiguous list

select the first file, hold down the Control key, select each of the required files.

To copy and move files

- ▶ with your file or files selected, Ctrl+C will copy the files into the Windows clipboard
- ▶ ctrl+X, will move files onto the clipboard
- ▶ browse to the required folder, then Ctrl+V to paste.

To delete files

- ▶ once they are selected, press the delete key.

Backup procedures

It is a common role for IT practitioners to be responsible for ensuring that valuable computer data is backed up regularly. If data is added or amended daily, it may be necessary to back this up daily. However, certain types of data may only be amended periodically and may not need backing up as often. For example, if payroll is processed monthly, it may only be necessary to back this data up once a month, after the payroll has been run.

A number of different devices may be used for backing up data, including floppy disks, CD-ROM, DVD, external or alternative hard drive, ZIP drive or tape drive. Some devices will be appropriate for small amounts of data; some systems may need to backup very large amounts of data.

There are three main types of backup procedures.

- Full backup – This backs up everything on the system.
- Incremental backup – This backs up only files that have changed since the last backup. The **archive attribute** is updated. This will be quicker and takes up less storage space than doing a full backup each day. It allows data produced or changed on a specific day to be restored. If a full restore is needed, and the last full backup was done three days ago, the backup followed by the three incremental backups would need to be used to restore the system. The files changed since the last incremental backup would be lost.

Key words

Archive attribute – the archive attribute indicates whether a file has been updated since the last backup. When a file is created or changed, the bit is turned on; when the file is backed up, the bit is turned off

CASE STUDY: DATA-PRO LTD PART 3: MAINTENANCE RESPONSIBILITIES

When a piece of equipment comes into the department for work it is given a surface and internal clean before being returned.

Backups are taken every night of all servers and data areas. A full backup is taken on a Friday night. This takes approximately 15 hours to complete and spans multiple tapes. These are autoloading using a robotic tape device. Incremental backups are taken on weekdays. These complete in eight hours. A 30-day cycle is used, with tapes being sent off site for storage every day.

The team is involved in a yearly BCP test (Business Continuity Plan). The company pays for floor space and hardware in a DR (disaster recovery) centre located in a different part of the country. Once a year, all systems, including desktops, servers, and network connectivity, are implemented according to the plan using only backups and pre-supplied machine images to emulate a loss of site. This process takes three days.

The team are responsible for day-to-day administration, such as setting up user accounts and logins, maintaining group memberships for email and security, granting of access to server areas, general maintenance of user details, password resets, account lockouts and account deletion. They are also responsible for the procurement and installation of printers, configuring network printers, user access to the printers and management of repair calls under warranty and post-warranty. Laser printers are not repaired by the team due to the hazardous nature of the equipment.

The team:

- is responsible for keeping an inventory of all PCs, laptops, printers, scanners and servers



- set up training and meeting rooms with any PC-connected equipment that is required
- is responsible for reporting IT-related risks to management. Identified risks are added to a risk database
- is responsible for the procurement or maintenance agreements on software and hardware where required
- supply a limited amount of user support for software. Generally, training is dealt with by the HR department
- maintain a knowledge base of unusual and reoccurring issues and procedures.

A third-party company comes in to clean the computer equipment. This is done overnight. The company use specialist cleaning materials.

Disposal of old and broken equipment is also handled by a third-party company.

- Differential backup – This creates a cumulative backup of modified files only. The archive attribute is not updated. This method is useful when only the latest version of an altered file is needed.

Example

There is a growing market for data storage. Sun Microsystems, a US-based software and computer server maker, bought a data storage firm called Storagetek for £2.3 billion in 2003. Whereas Sun produces primary data storage systems, Storagetek provides secondary storage services, e.g. data archiving and back-up systems. Sun's move into the market reflects a growing recognition by businesses of the potential threat posed by data loss, and the need to put in safeguards to minimise the risk.

Even though there is an increased awareness of the need to manage risk, computer failures can still cause massive disruption for businesses and other organisations. In July 2007, there were severe flight delays on US East Coast routes when the computer system that manages part of the air traffic control system failed. When the back up computer became overloaded, flight controllers were forced to enter information manually, resulting in lengthy delays.

Evidence activity

P5 – M3 – M1 – D2

1. Identify the maintenance activities that are needed for a PC. Produce a checklist (plan) for each activity. Carry out each maintenance task, take photographs as evidence and/or obtain signed observation sheets. (P5)
 2. Explain how the activities you carried out for P5 have improved the performance of the computer. (M3)
 3. Install and configure a printer and one of the following: a hard drive, graphics card, sound card, CD-ROM drive or a network interface card. Produce supporting notes, explaining the process you followed, to show understanding. (M1)
 4. In a short report, justify the considerations for selection of your upgrade. (D2)
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