

Unit 2: Computer systems

By the end of this unit you should be able to:

1. Understand the components of computer systems
2. Be able to recommend computer systems for a business purpose
3. Be able to set up and maintain computer systems

Whether you are in school or college, passing this unit will involve being assessed. As with most BTEC schemes, successful completion of various assessment criteria demonstrates your evidence of learning and the skills you have developed.

This unit has a mixture of pass, merit and distinction criteria. Generally you will find that merit and distinction criteria require a little more thought and evaluation before they can be completed.

The colour-coded grid below shows you the pass, merit and distinction criteria for this unit.

To achieve a pass grade you need to:	To achieve a merit grade you also need to:	To achieve a distinction grade you also need to:
P1 Explain the function of computer hardware components		
P2 Explain the purpose of operating systems	M1 Compare the features and functions of different operating systems	
P3 Explain the purpose of different software utilities		D1 Explain how software utilities can improve the performance of computer systems
P4 Recommend a computer system for a given business purpose	M2 Justify choice of computer system to meet a given business purpose	
P5 Set up a standalone computer system, installing hardware and software components		
P6 Configure a computer system to meet user needs		
P7 Test a configured computer system for functionality	M3 Evaluate the performance of a computer system	D2 Explain and justify improvements that could be made to a computer system
P8 Undertake routine maintenance tasks on a standalone computer system		

Introduction

Computer systems is a 10-credit unit which is designed to introduce you to the hardware components that exist inside a typical computer. In addition, it also helps you to learn about important software such as the **operating system**, and crucial utilities such **antivirus** suites and **firewalls**.

Practical tasks are also covered. As part of your studies you will be required to build computer systems, tackle hardware and software maintenance, and configure and test a computer system to ensure that it meets user needs.

This unit provides a critical platform for your success in other units.

How to read this chapter

This chapter is organised to match the content of the BTEC unit it represents. The following diagram shows the grading criteria that relate to each learning outcome.

You'll find colour-matching notes in each chapter about completing each grading criterion.

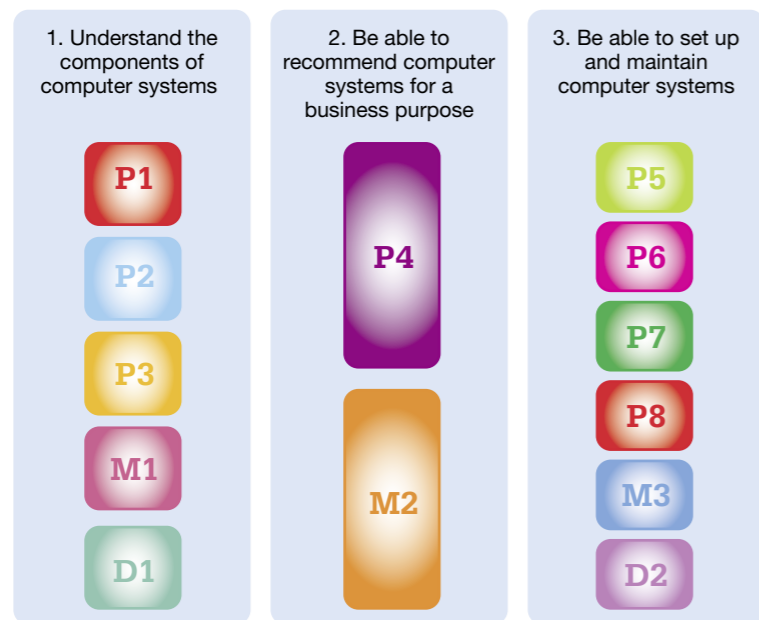


Figure 2.00

2.1 Understanding the components of computer systems

This section will cover the following grading criterion:

P1

Make the Grade **P1**

This criterion requires you to be able to explain the function of computer hardware components (that is, what they do). This will include all the internal components, the externally connected peripherals and backing storage devices. Typically, you may be asked to visually identify these or write about them during your assessment.

2.1.1 Internal system components

A typical computer system (Figure 2.01) consists of a base unit (or tower), monitor, keyboard and mouse.



Figure 2.01 A typical PC system (base unit, keyboard, mouse and monitor)

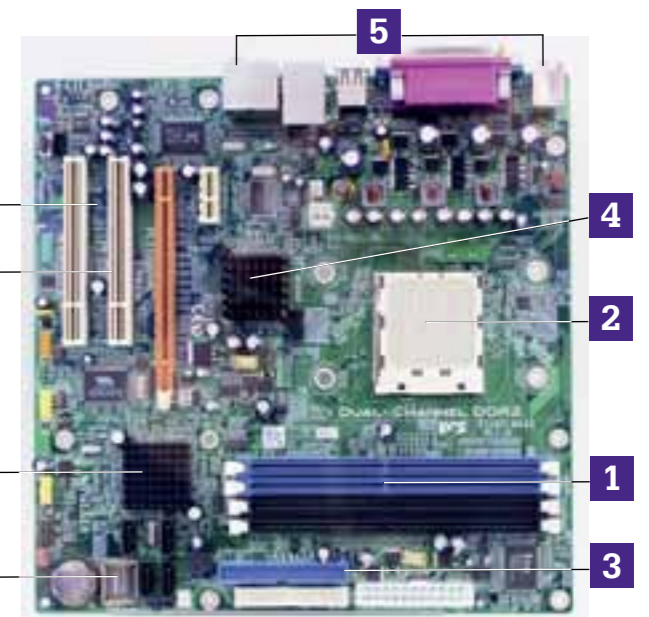


Figure 2.02 A typical ATX motherboard

Standardised components are used inside the base unit to create a number of different connected **subsystems**. Components and subsystems are built using industry-standard designs. This ensures that they are compatible and interoperable world-wide.

Motherboard

The **motherboard** is perhaps a computer's most important hardware component. It is located inside the computer system's case and other key components connect to it.

Most modern motherboards are based on a particular **form factor** (describing its dimensions and layout) called **Advanced Technology Extended (ATX)**. Standardised form factors ensure compatibility between different motherboards, cases and components.

A typical motherboard is shown in Figure 2.02 and the following explains the numbered components in the photograph.

- 1. Random Access Memory (RAM) slots**, where memory modules are fitted. Usually two or four slots.
- 2. Processor socket**, where the Central Processing Unit (CPU) chip is fitted. The socket has to have the same number of pin holes and pin configuration as the processor. Typically, a socket's name reflects the number of pins (for example, Socket 478, Socket 754 or Socket 939).

- 3. Primary and secondary Enhanced Integrated Drive Electronics (EIDE) connector**. This connects to a hard disk, CD-ROM, DVD and so on. In addition this board supports Serial Advanced Technology Attachment (SATA) drives (SATA is the most recent standard for hard disk connectivity).
- 4. Northbridge chip**, manages data traffic between the faster motherboard components (RAM, CPU and graphics subsystem).
- 5. Motherboard backplane**, for external connectivity.
- 6. Southbridge chip**, manages data traffic between slower components on the motherboard.
- 7. Peripheral Component Interconnect (PCI) Express expansion slots** the most recent standard for specialised cards (for example, graphic cards).
- 8. PCI expansion slots**.
- 9. Basic Input Output System, (BIOS) chip**.

The motherboard chipset is the combination of the Northbridge and Southbridge processors. Some chipsets are more popular with system builders because they are more reliable or perform quicker in benchmarked tests. A Southbridge chip may not be present on all motherboards; some manufacturers prefer to delegate its role to separate subprocessors.

Basic Input Output System

The **Basic Input Output System (BIOS)** is a small collection of programs that are stored in **Read-Only Memory (ROM)**, **Programmable Read-Only**

Memory (**PROM**), Erasable Programmable Read-Only Memory (**EPROM**) or (most commonly these days) **Flash** memory. Existing as a small chip, the BIOS is fitted onto the motherboard of a typical PC system (Figure 2.03).



Figure 2.03 A typical BIOS chip

Typically, the BIOS chip contains all the code required to control the keyboard, display, disk drives, serial communications and other critical functions. It can also monitor hardware (temperature, hard drive status etc.) and take action (that is, shut down the PC) to prevent any damage occurring to the hardware.

In addition, it has a BIOS set-up program (typically accessed by pressing a designated key on power-up, usually F2 or the Delete key), which lets the user configure the basic operation of the hardware.



Figure 2.04 A typical BIOS set-up screen

Another function of the BIOS is the **Power On Self Test (POST)** procedure that checks to see that all connected peripherals (keyboard) and components (CMOS, BIOS, RAM and the Input/Output controller) are functioning correctly.

Malfunctioning devices are often reported via short on-screen messages (Figure 2.05) or, quite commonly, as a series of beep codes. Unfortunately, beep codes tend to be specific to different BIOS manufacturers.

An unsuccessful POST will usually cause the computer system to halt.



Figure 2.05 A typical BIOS POST screen

It is possible to update BIOS code by downloading new images over the internet. The process of updating the BIOS is called **flashing**. It is possible that flashing can go wrong and this can often kill the BIOS chip permanently, effectively rendering the motherboard useless.

BIOS updates are often used to add new functionality or fix existing bugs (problems) with the original BIOS firmware. Checking the motherboard manufacturer's website is usually the best way of finding out if new BIOS updates are available.

The final job of the BIOS is to seek an operating system on an available drive (floppy, hard disk or CD/DVD, USB pen drive) or via a network connection. Once found, the operating control is passed to the operating system as it is loaded into RAM. This is called the **boot process** (from the expression 'pulling oneself up by one's own bootstraps'). If the BIOS is unable to find an operating system, the boot process will halt.

Activity 1

Accessing the BIOS

Using an available PC, switch it on and access its BIOS using the designated key (usually the F1, F2 or DEL key).

Explore its menu system using the cursor keys and Enter.

Make a list that details:

- the name of the company that produced the BIOS;
- the BIOS version number;
- the 'top row' menu options;
- the types of hardware monitoring the BIOS can perform.

A motherboard may have a number of jumpers that change its performance or function. The CMOS jumper is often coloured differently (usually red, Figure 2.07) to emphasise its importance.

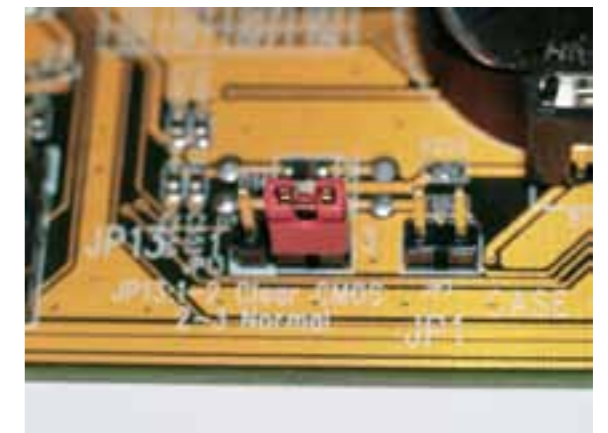


Figure 2.07 A 'clear CMOS' jumper

CMOS

Complementary Metal Oxide Semiconductor (**CMOS**) is a particular structure used in integrated circuit transistor manufacture. It is used to make memory chips that store the settings made by the BIOS set-up program. A 3 V lithium battery (Figure 2.06) is used to provide power to the memory circuit, ensuring that the information stored on it is retained when the mains power is switched off.



Figure 2.06 A CMOS memory back-up battery

Central Processing Unit

In simple terms, the **Central Processing Unit (CPU)** or simply 'the processor' is the brain of the computer system. The CPU processes data and instructions. It is also responsible for coordinating system resources and performing arithmetic and logical operations.

The instructions are specific to the CPU in question and written in **machine code**. Machine code for one type of processor will not work on another unless they belong to the same family (in which case they are said to be **code compatible**).

For many years, Intel® have developed an x86 family of processors that included the 486, Pentium®, Pentium® 2, Pentium® 3, Pentium® 4 etc. Each later developed processor was **backwardly compatible** with earlier processors (which means that code written for an earlier processor would work on a later version, even if all the functionality of the later version could not be used). Other manufacturers, such as Advanced Micro Designs (AMD), created processors that were machine code compatible with Intel's. These processors included the K5™, K6™, Athlon™, Duron™, Sempron™ etc. Figure 2.08 on the next page shows an AMD Phenom™ processor.

Processor speed and architecture

Processor speed is measured in megahertz (MHz) or gigahertz (GHz).

The speed is actually the clock frequency of the processor and generally it is accepted that a faster

processor will execute a program's instructions more rapidly (for example, a 3 GHz processor is faster at executing instructions than a 2.4 GHz processor), however, this isn't necessarily true because a lot depends on the processor's architecture (that is, its design).

Some processors have more efficient designs or have multiple cores, for example dual core (two processor units) or quad core (four processor units), within the same package. In addition, processors either handle 32-bit or 64-bit 'chunks' of data; at the same clock speed, a processor that can digest 64-bit 'chunks' of data would do so more efficiently.

The only downside to processor innovations is that software has to be written to take advantage of their efficient architecture. For example, a 64-bit processor would require a 64-bit operating system; Windows® Vista® and Windows® 7 are available in both 32-bit and 64-bit implementations.

Processor bus

The **processor bus** is also called the **Front Side Bus (FSB)**. It is the bidirectional link between the motherboard and the processor itself. Like the processor it operates at a certain clock speed, usually measured in megahertz.

Bus multiplier

A **bus multiplier** is a value used to calculate the maximum processor speed. The general equation for working this out is

$$\text{maximum processor speed} = \text{processor bus speed} \times \text{maximum multiplier}$$

For example, 1992 MHz (2 GHz) = 166 MHz × 12

Overclocking and underclocking

Overclocking is the act of running a processor beyond its maximum rated performance.

In theory, if a processor can be kept cool (and other components, for example, RAM can run at the higher frequency), then it can be pushed beyond its rated speed limit by manipulation of the multiplier. Overclocking has the reputation of shortening the lifespan of a processor. Some processors are locked (they have their speeds fixed) by their manufacturers.

Underclocking is the opposite of overclocking in that the clock rate is reduced to keep a processor cool. This results in more reliable performance and it saves electrical power. Servers often have the ability to be underclocked when they are idle.

Power supply unit

A **Power Supply Unit (PSU)** (Figure 2.09) converts the incoming mains alternating current (AC) voltage (240 V in the UK) into the different direct current (DC) voltages used by the computer's internal components (for example, 12 V to power a DVD-ROM drive).



Figure 2.08 A typical ATX PSU

A power supply's power output is measured in watts (W). 450 W is a typical PSU power output in 2010. Most PSUs come already fitted inside the computer system's case, but they may be purchased separately when a replacement is needed. They contain lethal voltages, so they should never, **under any circumstances**, be dismantled, **even after** the power has been removed.

Help

Modern PC PSUs – what you need to know

The most common PSU types are:

- AT – used in older PCs
- ATX – most commonly used today
- ATX-2 – a recently introduced standard.

ATX PSUs introduced software-based power management (including standby mode) and the lower 3.3V supply needed for newer processors.

A number of PSU connectors are commonly found:

- **Floppy Drive (FD) connector:** This is also known as a Four-pin Berg Connector (Figure 2.09).

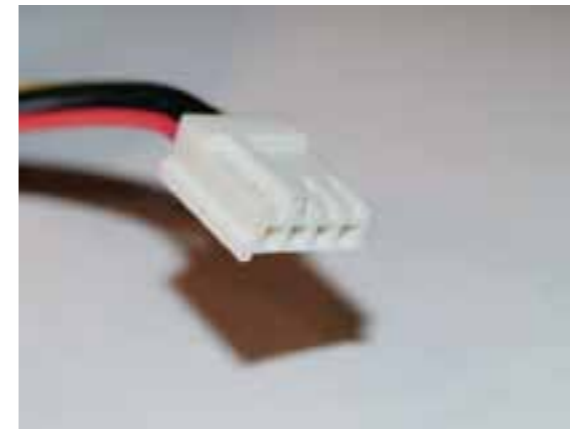


Figure 2.09 Floppy drive connector

This is used to connect the PSU to small form factor devices, such as 3.5-inch floppy drives, or even supply supplementary power to a graphics card. They may also be used to power additional USB hubs.

They are often used on AT, ATX and ATX-2 PSUs.

- **Four-pin Molex connector** (Figure 2.10)



Figure 2.10 Four-pin Molex connector

This is used to power various components, including hard drives, optical drives and system fans. Molex is actually the name of the company that created this type of plastic in the 1930s.

They are often used on AT, ATX & ATX-2 PSUs.

- **20-pin ATX power connector** (Figure 2.11)



Figure 2.11 20-pin ATX power connector

This is used to provide the main power to the motherboard in ATX systems. ATX power supplies can be controlled by the BIOS and the operating system.

They are often used on the ATX PSU. (The ATX-2 PSU has 24 pins.)

- **4-pin auxiliary 12 V power connector** (Figure 2.12)



Figure 2.12 4-pin auxiliary 12V power connector

These are very common on Pentium® 4 processor motherboards.

They are often used on ATX PSUs. (They are integrated into the power connector on ATX-2 PSUs, hence 24 pins.)

- **6-pin auxiliary connector** (Figure 2.13)