UNIT 23: OPERATING SYSTEMS & SYSTEMS ARCHITECTURE (ADVANCED)

ABOUT THIS UNIT

In this unit you will learn:

- how to configure the software for a computer
- about some different types of operating system
- what occurs in a computer when the operating system is running
- to understand the internal structure of the microprocessor system which controls the computer
- about the way a computer system links its different parts.

You will produce a report which compares different systems architectures and different operating systems.

This unit builds on Unit 4: System installation & configuration (Advanced). It links well with Unit 16: The human-computer interface (Advanced) and Unit 18: User support (Advanced).

This unit will be assessed only through an external assessment. **The grade you achieve in this assessment will be your grade for the unit**.

WHAT YOU NEED TO LEARN

The topics are:

- systems architecture
- operating systems
- evaluation
- standard ways of working.

Systems architecture

Systems architecture covers how similar parts of a computer fit together to offer different facilities, eg a bungalow and a flat have similar components but different capabilities. In a similar way, systems architecture can differ, depending on the needs users have for their computer systems.

Particular aspects of systems architecture that you need to learn are:

- components of the microprocessor
- the way a microprocessor works
- data handling and representation within the computer.

You need to know that at the heart of every computer is a microprocessor which comprises three main parts, the main store, the control unit (CU) and the arithmetic-logic unit (ALU), which together form the central processing unit (CPU). You will meet new technical terms in each of these topics and you will need to learn how people use these terms, and then to use them correctly yourself.

You will learn that the main store is sometimes called main memory or immediate access store. Its chief job is to hold programs and data, which it does in binary digits (bits). The main store is split into units called locations, with each location being the same size measured in bits, as in a '32-bit' computer system, and with each location having a unique address.

The location may store either a program instruction or data. Programs are the instructions to the computer which tell it to do something and data is the material that these instructions act on. Because of the restriction in the size of a location, the microprocessor may have to store a single instruction or a single piece of data in more than one location.

Locations may be in either random access memory (RAM) or read-only memory (ROM). Reading memory means finding a specific location and seeing what is held there; writing to a location means altering its content. RAM can be changed (read from and written to) while ROM cannot be written to. Access to both ROM and RAM takes place at very high speeds, with operations occurring at more than a million times a second, without any mechanical movement. You must learn why the different types of memory exist and their typical uses.

Instructions are located and read from memory, and passed to the control unit, whose job is to interpret (decode) and execute instructions very rapidly in a specific order as part of a Fetch-Decode-Execute cycle (fetch-execute cycle). After decoding comes the execution of each instruction which may result in production of a new piece of data or a signal to operate a peripheral.

You will learn that the arithmetic-logic unit receives data for calculations (such as +, –) or logical operation (such as AND, OR) and comparisons (< = >). It sends results to the main store and then possibly to a new component that lies outside the microprocessor, the backing store.

You will be familiar with the purpose of the backing store, but you must also understand why different computer systems require different types and sizes of backing store. The same applies to the remaining building blocks of a computer system, devices for input and output.

None of the instructions in a computer will pass anywhere without lines of communication and inside the computer these are called the bus. There are several different bus systems and you must learn to compare them.

The millions of operations that occur every second follow a sequence, the fetch-execute cycle. A clock circuit uses a pulse to time changes in the cycle from one state to the next, and clock speed can be a significant factor in choosing a microprocessor for a computer system.

Essentially, the fetch-execute cycle consists of fetching an instruction from main store, then decoding and executing the instruction, something which will take several operations if instructions and data are in several locations. There are some special locations in the CPU that you must learn about, called registers. In the control unit, there is a program counter (sometimes called sequence control register or SCR, which gives a better idea of its job). The SCR holds the address of the next instruction the control unit needs, and with each instruction or part instruction, the number in the SCR increases (increments) by one. When the program branches to another part, the number in the SCR becomes the address of the new instruction.

The current instruction register also sits in the control unit. It holds the code of an instruction from main store while it is being decoded and executed. You must be able to draw diagrams showing the relationship between the current instruction register, the main store and the SCR.

You must also learn about special registers in the arithmetic-logic unit, known as accumulators. Accumulators store values of data that are the subject of arithmetic or logical operation or transfer.

You will learn to write simple instructions to illustrate your understanding of registers and locations.

Descriptions of computers refer to many technical pieces of information. You must understand the importance of those that affect systems architecture, such as buffer, cache, processor type (RISC, CISC) and the work of co-processors.

Operating systems

The operating system of a computer provides a layer of services which manage the hardware and allow the user to drive the computer. An ideal operating system is unobtrusive to the extent that the average user hardly realises it exists, or notices it at work, except for the interface which it provides.

Operating systems work with systems architecture to manage the input, output, storage and processing activities of a computer system. They provide an interface between user and hardware because they are the means of:

- informing users what is happening
- allowing users to intervene.

An operating system consists of a complex set of programs and is most definitely software. Some of the software is held permanently in ROM to allow the computer to start operating when users switch it on. You may sometimes see the term 'firmware' used to describe this. Much of the software is held in RAM where it is loaded only when it is needed by the system or by the user, for example, when you need to alter the time or date.

The work of an operating system on a microcomputer system deals with situations such as:

- handling the instructions you give to load, save, delete, rename, copy files
- informing you of errors and what to do next
- background control of different programs so that they appear to be working at the same time
- giving guidance in a clear and consistent way (through a standard graphical user interface, for example)
- managing peripherals such as printers so that they work correctly through drivers
- installing new hardware and software easily
- making the best use, without bothering users, of the demands they make on processing, memory and peripherals
- controlling items such as disc drives, sound and video apparatus
- checking for viruses.

You must be aware of some of the major operating systems that are available and their strengths and weaknesses. You must also understand the different types of user interface used by these operating systems and you must know how to use and optimise the different interfaces. For instance, in Windows you can work in web style, classic style or custom style; you should understand the differences between these styles and be able to configure the system to use each. You would also need to learn how to customise your desktop to include only those items which you use regularly.

You must understand the use and function of the various operating system files. These will include some, or all, of the following, or their equivalents, depending on the operating system used:

- ROM (eg BIOS)
- object files (eg IO.SYS, MSDOS.SYS)
- system files (eg CONFIG.SYS, KEYBOARD.SYS)
- batch files (eg AUTOEXEC.BAT, BOOTDISK.BAT, SETRAMD.BAT for MSDOS)
- configuration settings (eg WIN.INI, TELEPHON.INI, SYSTEM.INI for Windows 98).

You must understand the way the operating system stores and manages files, in particular file-naming conventions and the use of directories or folders, and should be aware of the differences between some common file systems (eg FAT16 and FAT32) and the limitations of each.

You should understand the security arrangements that the operating system allows.

Evaluation

You will have to learn to evaluate different operating systems, looking for similarities for which you can make direct comparisons, and differences for which you may be able to compare things such as purpose or ease of use.

You need to include consideration of a number of the following points in your evaluation for operating systems:

- identify the reasons for the different types
- compare similar facilities between different types
- identify and comment on differences
- comment on the different facilities
- identify good and bad points
- compare ease of use
- identify limitations
- identify possible improvements
- compare process of installation
- compare the degree by which each may be 'tailored' to your use.

You will also need to be able to comment on systems architecture, for instance, evaluating the impact of things like co-processors.

Standard ways of working

Note

What you need to know and be able to do to implement standard ways of working is described in detail in Unit 1: Presenting information (Advanced). The following is a shortened version of these requirements. They are written to apply specifically to this unit. The way you manage your work during the investigation, analysis and report production is very important.

You need to learn to:

- plan your work to produce what is required to given deadlines
- save work regularly
- use file names that are sensible and that help to remind you of the contents
- store files where you can easily find them in the directory/folder structure
- keep a log of any ICT problems you encounter and how you solve them
- keep information secure (eg protection from theft, loss, viruses, fire)
- protect confidentiality (eg prevention of illegal access to medical or criminal records)
- observe copyright laws (eg not using the work of others without permission)
- keep dated backup copies of files on another disk and in another location
- evaluate your work and suggest how it might be improved
- proof-read your products (on screen) to ensure accuracy and economic use of material.

ASSESSMENT EVIDENCE

You need to produce evidence in the external examination of your understanding of:

- comprehensive descriptions of systems architecture
- an evaluation of contemporary operating systems
- evidence that you know how to install and modify the configuration of a computer operating system.

To achieve a grade E your work must show:	To achieve a grade C your work must show:	To achieve a grade A your work must show:
E1 accurate descriptions of the operation of the main store, CU, ALU, program counter and the clock in a fetch-execute cycle E2 detailed comments on one specific type of systems architecture identifying any individual characteristics of the architecture E3 a clear description of the characteristics of contemporary operating systems E4 a brief comparison of the features of contemporary operating systems E5 description of the correct installation of an operating system into a computer system which then operates normally E6 description of correct modifications to the ROM-BIOS and batch or configuration files of an operating system E7 a clear statement of what such modifications are designed to do.	C1 an evaluation of features with respect to their specific purpose and instructions for simple operations using registers C2 a detailed evaluation of operating systems including major comparisons of the way that they work, the features they include, the human computer interface and the installation process C3 evidence that your knowledge of installation and modification includes effective planning and testing C4 that you can work independently to produce your work to agreed deadlines.	A1 use of selected up to date information to produce statements, comments and criticisms relevant to contemporary practice A2 understanding of the reasons for the different operating systems, including their benefits and disadvantages, the improvements which modifications may make to the use of an operating system, and some potential improvements that you have identified which could be made to operating systems A3 fluent use of technical language, explaining technical terms where required, and production of clear, coherent works that have been checked and proof-read to remove most spelling and grammatical errors. Your work will be illustrated with accurate, appropriate images (diagrams, pictures, drawings, etc).

ESSENTIAL INFORMATION FOR TEACHERS

Teaching strategies

The theoretical knowledge outlined in 'What you need to learn' can easily become very dry. It should, wherever possible, be backed up with practical examples using microprocessor trainers.

Students might find it helpful if teachers focus separately on the following components of the central processing unit:

- arithmetic logic unit
- control unit
- memory registers or locations
- timer
- program counter
- bus.

Students must attempt to understand one operating system in detail and then examine a second, so that they can make detailed comparisons.

Teachers may find it helpful to provide a scenario, or a range of scenarios, against which hardware can be evaluated, and for which the operating system can be customised.

Examples could be:

- a simplified system for use by primary school-age children
- a system configured to maximise speed of internet access
- a system used primarily for technical graphics.

The student may test and use a hardware system which is available within the centre, or the student may research and detail a potential system. Either approach is of equal value, however the installation and modification of an operating system configuration are best taught by practical exercise to back up theory.

Comparison of operating systems may in the simplest instance, and for the lowest grades, be straightforward comparisons of different versions of Windows. At higher grades it is expected that students would look at different systems from different suppliers, for example Windows and Mac OS.

Research may take many forms, but the internet may be a valuable source of information.

Assessment strategies

This unit is externally assessed. Sample assessment materials for the unit may be obtained from Edexcel. Students should be encouraged to use these materials to assist them in preparing for the external assessment.

The result of the external assessment of student evidence is an overall mark for the unit. This is then used to generate a unit grade. It also contributes to the total mark for the qualification which in turn is used to generate a qualification grade.

The mark awarded will take into account the extent to which the evidence matches both the unit pass standards, represented by the set of criteria in the grade E column of the grid, and the grading standards, represented progressively by the criteria in the grade C and grade A columns. Thus the overall mark determined for a particular student is based on best-fit judgements of the evidence against successive sets of criteria presented as cumulative grade descriptions for grades E, C and A.

When grading student evidence you should consider the following general qualities that distinguish between the three grades:

- increasing depth and breadth of understanding
- increasing coherence, evaluation and analysis
- increasing independence and originality
- increasing objectivity and critical understanding.

Grade E

To achieve an E grade, the evidence should provide coverage of all the requirements stated in the E grade criteria of the assessment grid. It may be, however, that a student has demonstrated considerable effort and skill in some areas at the expense of precise detail in another. Professional judgement should be used to decide what is a reasonable expectation of the student and whether the stated quality and sufficiency requirements have, on balance, been met.

The student will have provided accurate descriptions of general points of systems architecture and detailed comments on one specific type of systems architecture. It is envisaged that CU, ALU, registers, main store and accumulators will, as a minimum, all be described.

The description of operating systems should cover, as a minimum, user interface, directories, range of systems on which it is supported and the range of peripherals supported by the operating system. The description should lead into comparisons of these features.

Knowledge of installation of an operating system and subsequent modification will be tested and the student will be expected to give details of what modifications are expected to accomplish.

Grade C

To achieve a C grade, the descriptions of system architecture will be comprehensive, well presented and show good understanding of the technical features involved. Each of the features reviewed will be related to a specific purpose and it is envisaged that each will be reviewed in greater depth. For instance, there should be descriptions of specific registers, of clock speed, of the fetch-execute cycle, etc. The work should include instructions for simple operations using registers.

The evaluation of operating systems should give consideration to systems from different suppliers. The evaluation, and especially the comparison, will give detailed consideration to the workings and features of each, together with ease of installation and ease of configuration. There will be more examples of detail with things like directory organisation, communications capability and virus checking. It is anticipated that the student will be able to describe more than two examples relating to each topic.

There should be evidence that the student knows how to install and modify an operating system and test the result of the modification.

Students should take an independent approach to solving these problems.

Grade A

To achieve an A grade, the descriptions of system architecture and operating systems should contain comprehensive and up-to-date information. The description of the features of early versions of MSDOS will **not** be acceptable in the assessment of different operating systems. The same applies to systems architecture. There is a great deal of up-to-date evidence on the internet which may be utilised for advanced-level work.

The evaluation of the operating systems should be a polished piece of work which addresses limitations discovered, or researched, by the student. Students should know of at least two benefits and two disadvantages of each operating system and should have a view on improvements they would like to see built into the systems. The potential improvements do not have to be feasible at this stage of the operating system's development, rather we are looking for the student recognising limitations which they would like to see removed.

There should be a high level of understanding of the various factors involved and reports should make appropriate and wide use of technical language, where necessary explaining the terms used. All spelling mistakes and obvious grammatical errors should have been removed from the documents.

Key skills

This guidance highlights the most relevant key skills opportunities in this unit. It contains suggestions only. You will need to check that students have produced all the evidence required to meet part A **and** part B of the key skills specifications. Students may need to develop additional evidence elsewhere to meet fully the requirements of the key skills specifications.

Guidance is referenced in two ways:

K – keys to attainment

These are key skills or aspects of key skills which students should achieve as they meet the vocational requirements of the units. Only part B of the key skill is highlighted – you will need to check that students achieve part A.

S – signposting

These are opportunities that can be incorporated naturally into the learning programme.

COMMUNICATION, LEVEL 3		**Key skills reference**
When students are:	**They should be able to develop the following key skills evidence:**	
• researching certain topics in advance of the external assessment, as required by the pre-released material	C3.2 Read and synthesise information from **two** extended documents about a complex subject. One of these documents should include at least **one** image.	S