Unit 6: Systems Architecture

Unit code: M/601/3503

QCF Level 2: BTEC Specialist

Credit value: 6

Guided learning hours: 50

Aim and purpose

This unit introduces how information is represented in a computer and an awareness of communication processes in networks and distributed systems. It also involves knowledge and use of an operating environment.

Unit introduction

All computer systems share the same underlying computer architecture principles. This unit examines these principles and explores the fundamentals of how computer systems work.

Learners will explore how various types of data can be represented and then stored within computer systems. This is followed by a study of the low-level system components. It includes the processor, buses and memory incorporating an analysis of how these components interact to manipulate data using the fetch-execute cycle.

Learners will then look at how operating systems, including network versions, are used to interact with and control computer systems.

Finally, learners will examine the operation of distributed operating systems and computer networks, learning how communications are established and maintained between in distributed systems.

Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

On completion of this unit a learner should:

Learning outcomes	Assessment criteria
1 Know the representation of information within a computer	1.1 outline how number systems and data representation are used to store information in a computer
	1.2 identify the role of input, output and storage devices
	1.3 list the characteristics of CPU components and outline the operation of the Fetch Execute Cycle
	1.4 outline the operation of a peripheral device
2 Know and use an operating environment	2.1 use operating system interfaces and functions
	2.2 identify the role of process management and concurrent processes in computer operating systems
	2.3 identify how operating system features can contribute to data and system security
3 Be aware of the communication process in distributed operating systems and computer networks	3.1 state the function and operation of distributed operating systems
	3.2 state the functions of data communications systems in enabling network and distributed systems

Unit content

1 Know the representation of information within a computer

Types of data: representing bit patterns for different types of data eg numbers, text, graphics, video, audio and other data; graphics eg bitmap (resolution, colour depth, file calculations), vector (objects, properties); sound (compression, sampling resolution, sampling rate, streaming audio, quality); video (compression, encoding, streaming, quality); analogue data; digital data; analogue signals; digital signals; data conversion eg analogue to digital; file formats eg mp3, mp4, wav, avi

Number systems: conversions between different representations of data; representing integer numbers in different number bases; converting between number bases using integer numbers eg denary to binary, denary to hexadecimal, binary to hexadecimal

Input, output, and storage devices, functions of and interactions with peripherals: input devices eg tracker ball, joysticks, graphics tablet, scanner, digital camera, touch screen, OMR, OCR, bar code scanner, biometric scanner, sensors (light, temperature, pressure, inductance loops) magnetic stripe reader, microphone (spoken commands); output devices eg valves, heaters, coolers, motors, monitors (CRT, LCD, plasma, flat screen), printers (dot matrix, laser and ink jet), plotters, speakers (voice simulation, sounds); storage devices eg hard disks, zip drives, CDs, DVDs, flash memory devices, magnetic tapes

The CPU and the Fetch–Execute cycle: CPU components and functions, control unit, arithmetic logic unit, registers eg general purpose, accumulator, program counter; the fetch-execute cycle (fetch, decode, execute, store)

2 Know and use an operating environment

Key functions of an operating system: input/output control eg handshaking, interrupts, peripheral management; file management eg copy, create, delete, edit, move, open, rename, save, attributes, properties, permissions, search/find; resource allocation eg RAM, disc space, CPU time, file or data access; error or exception handling eg hardware errors, interrupts, software errors, exception handler; command interpreting eg device drivers, user interface

Types of operating systems: characteristics and uses of graphical user interfaces, menu driven and command line systems

Process management: multi-tasking, multi-programming eg multi-threading, pre-emptive and co-operative time-sharing; process management models eg 2, 3, and 5 state models; scheduling methods eg FIFO, round robin, shortest first

The role of an operating system in data and system security: security policies, authentication, passwords, access levels, encryption, file attributes, backup and restore

3   Be aware of the communication process in distributed operating systems and computer networks

Additional functions of a network operating system: network management and security, remote access, directory services, handling network communication

Network data communication: channels, simplex, half-duplex, duplex; serial and parallel communications; bit rate; parity and checksums; routing, connectionless (packet switching) and connection-orientated (circuit switching) modes

Additional functions and operations of distributed operating systems: single system image, process migration, process checkpoints, network file system, communications between processes

Essential guidance for tutors

Delivery

Simulation software could be used extensively in this unit, eg to develop learners' understanding of the operation of a range of peripherals, to give experience of different operating systems or to investigate network security issues.

Learning outcome 1 could be delivered using a series of worksheets relating devices to the data types that they generate or use. Practical experience of the devices, or virtual versions of them, would be desirable.

Simulation software will also be useful in explaining CPU structure and the fetch–execute cycle.

For learning outcome 2 the learner should experience more than one operating system eg Microsoft Windows Vista/Microsoft Windows 7/Microsoft Server 2008, Linux Ubuntu, Linux Fedora , Linux Red Hat, and FreeBSD. These operating systems could be run on virtual machines so that learners can investigate the facilities without risking data or system damage.

For learning outcome 3 the learner should experience more than one network operating system, these could be the same as those looked at in learning outcome 2. A virtual network would be suitable for this. Learners must also look at a distributed operating system, eg Amoeba, Kerrighed or LINUXPMI.

Simulations are available to demonstrate aspects of data communication, although a series of worksheets might also be appropriate.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments. The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
Know the representation of information within a computer: • whole-class exercise – tutor presentation on data types, followed by directed research into data types and file formats • whole-class exercise – tutor presentation on number systems, followed by individual mathematical exercises • whole-class exercise – tutor presentation on input, output and storage devices, followed by directed research into selected devices and their associated data types • whole-class exercise – tutor presentation on the fetch–execute cycle, followed by directed research
Assignment 1 - Making and using data **Assignment 2** - Processing in the CPU
Know and use an operating environment: • whole-class exercise – tutor presentation on operating systems, followed by practical exercises • whole-class exercise – tutor presentation on operating systems security functions, followed by practical exercises • whole-class exercise – tutor presentation on process management, followed by directed research
Assignment 3 - Process management made simple
• Be aware of the communication process in distributed operating systems and computer networks: • whole-class exercise – tutor presentation on network operating systems, followed by practical exercises • whole-class exercise – tutor presentation on distributed operating systems, followed by practical exercises • whole-class exercise – tutor presentation on network data communication, followed by directed research.
Assignment 4 - The user guide **Assignment 5** - Getting the message through

Assessment

It is suggested that this unit is assessed using five assignments as summarised in the *Programme of suggested assignments* table.

Finding a scenario which covers all aspects of all criteria is difficult, but the one suggested in the programme of suggested assignments table is acceptable. Some of the evidence required to complete the assignments could be naturally occurring within learners' work for other units within the qualification, or for other courses they are undertaking, and tutors are encouraged to use such evidence.

For 1.1 to 1.4 learners should produce material for technical audiences specified either by learners or the tutor. The material could be presented in a number of different formats and learners should be encouraged to use more than one. 1.1, number systems, could be assessed by means of a set of mathematical tasks produced by the tutor.

2.1 to 2.3 are probably best assessed in a similar manner to the learning outcome 1 criteria. Once again, learners should try to use a variety of methods to demonstrate their knowledge of the material. These can be selected by learners or the tutor.

For 3.1, learners need to describe a network operating system, this may fit naturally into the material they produce for learning outcome 2 and could form an extension to that work. 3.2 could be regarded as an extension of 1.2 and 1.4 and learners might be able to add to that work in order to include this criterion.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass criteria in the outcomes and assessment grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
1.1, 1.2, 1.4	Making and using data	A company requests information on a range of input, storage and output devices. In the context of using these devices, you must explain how numbers, text, graphics, video, audio and at least one other data type is generated, stored and used. Your explanation must include a section on how integers are represented in binary and hexadecimal and how to convert these representations to and from denary.	Web pages. Presentation. Posters. Booklet.
1.3	Processing in the CPU	The company requests some training material to illustrate how the fetch–execute cycle works.	Poster. Web page.
2.1, 2.3, 3.1	The user guide	You are asked to write a user guide for a network operating system. Chapter 1 is to be a tour of the interface and basic functions. Chapter 2 is to look at the security	Web pages. Presentation. Booklet.

Criteria covered	Assignment title	Scenario	Assessment method
		features that are available.	
2.2	Process management made simple	The operating system features multi-tasking. You are asked to produce training material to explain how this works in simple language.	Web pages. Presentation. Poster.
3.2	Getting the message through	The company wants you to expand on the information that you gave about input, storage and output devices. You are asked to explain the data communication methods that the devices employ when they are used over a network by a distributed operating system.	Web pages. Presentation. Posters. Booklet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in IT sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
	Computer Systems	Systems Architecture
	Setting up an IT Network	Computer Systems
		Computer Networks

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 2 National Occupational Standards for IT (ProCom):

4.1   Systems Architecture

Essential resources

Learners must have access to practical resources and suitable technology. They can also use simulators or multimedia tools if available to gain experience before handling 'live resources'.

Employer engagement and vocational contexts

Any contact with employers to discuss their views on the content of this unit would be useful for tutors and learners.

There is a range of organisations that may be able help centres to engage and involve local employers in the delivery of this unit, for example:

- Learning and Skills Network – www.vocationallearning.org.uk

- Local, regional business links – www.businesslink.gov.uk

- National Education and Business Partnership Network – www.nebpn.org

- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk

- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

- Work experience/workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei

Indicative reading for learners

Textbooks

Gaura E, Hibbs D and Newman R – *Computer Systems Architecture* (Lexden, 2008) ISBN-10: 1904995098 ISBN-13: 978-1904995098

Dollimore J, Kindberg T, Coulouris G – *Distributed Systems: Concepts and Design - International Computer Science Series 4th edition* (Addison Wesley, 2005) ISBN-10: 0321263545, ISBN-13: 978-0321263544

Websites

cs.vu.nl/pub/amoeba

www.distributedcomputing.info

www.freecomputerbooks.com/compscArchitectureBooks.html

homepages.feis.herts.ac.uk/~msc_ice/fe2/practicalinstructions/notes.htm

www.nsnam.org

phillips.rmc.ca/courses/milis-2005/resources/RSCPU

www.virtualbox.org

Functional Skills — Level 2

Skill	When learners are …
ICT - Using ICT	
select, interact with and use ICT systems safely and securely for a complex task in non-routine and unfamiliar contexts	investigating security features of a network operating system
ICT - Finding and selecting information	
use appropriate search techniques to locate and select relevant information	finding information on a range of input, storage and output devices
select information from a variety of sources to meet requirements of a complex task	finding information on a range of input, storage and output devices
ICT - Developing, presenting and communicating information	
combine and present information in ways that are fit for purpose and audience	creating a user guide