Pearson BTEC
National Level 3

Information Technology: Unit 1

endorsed for BTEC

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A

LEARNING AIM A

Digital devices in IT Systems

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Chapter 1
Digital devices

Objectives

- Describe digital devices that form part or all of IT systems:
  - multifunctional devices
  - personal computers
  - mobile devices
  - servers
  - entertainment systems
  - digital cameras – still, video
  - navigation systems
  - data capture and collection systems
  - communication devices and systems

An information technology system

An **IT system** refers to all the hardware and software used for a particular purpose. A small business may have a single IT system comprising several networked PCs, a server, and several software packages for carrying out the various tasks that the business performs to keep everything running smoothly. A large organisation may have hundreds of computing devices linked in a network, and several sub-systems each designed to carry out different functions.

Q1 **Describe some of the hardware and software making up the IT system at your school or college. List the different categories of users; for example, teaching staff and students. Do some departments have specialised IT equipment and software?**

This chapter is a short overview of some of the digital devices that are used in different ways by organisations and individuals.

Multifunctional devices

Multifunctional devices, as the name suggests, are used for a multitude of different functions. In an office or school environment, for example, most deskwork will be done using a desktop computer, which would typically be either a PC or Apple iMac. Many people working at home or while travelling to and from work use a laptop.

Virtual memory

Memory is not limitless, so as more and more jobs (called **processes**) are loaded into memory, the operating system may swap pages of temporarily inactive processes out to disk, using secondary storage as an extension of memory to make room for the next process which needs a share of processor time.

As memory fills up, you may notice a deterioration in performance as sections or **pages** of programs and data files are swapped in and out of RAM, to the point where the operating system is spending most of its time swapping pages in and out, so-called 'thrashing', and performance slows right down.

Q2 **Suppose a PC that you have used for a number of years has become very slow. Suggest actions that you could take that may help to improve its speed.**

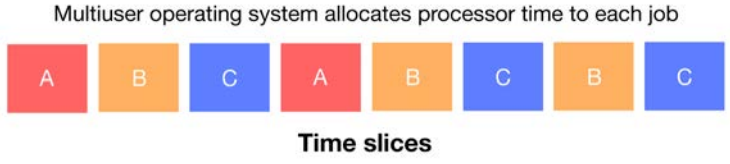
Interrupts

An **interrupt** is a signal from a software program, hardware device or internal clock to the CPU. A software interrupt occurs when an application program terminates or requests certain services from the operating system. A hardware interrupt may occur, for example, when an I/O operation is complete or an error such as `Printer out of paper' occurs.

Interrupts are also triggered regularly by a timer, to indicate that it is the turn of the next process to have processor time. It is because a processor can be interrupted that multi-tasking can take place.

Managing multi-tasking

Although there may be many processes running apparently simultaneously in a computer, they are not actually running at the same time. The OS allocates each one in turn a tiny slice of processor time. If, for example, a user is writing a document and pauses to think what to write next, the OS will allocate the next task to the processor. If a long program is executing, it will only be allowed a few microseconds at a time (a time slice) before the processor is allocated to the next process.



Q3 **Suggest reasons why Process A only has two time slices in the above diagram.**

Device drivers

A **device driver** is a computer program that provides a software interface to a particular hardware device. This enables operating systems to access hardware functions without needing to know details of the hardware being used. When you attach a new printer to your computer, for example, you will have to install the device driver program that comes with it before it will work. Sometimes the OS will do this automatically if it detects that the printer is one for which it already has a driver. Drivers are **hardware dependent** and **operating system specific**.

The device driver communicates with the device, issuing commands to carry out the required task. When a signal is received from a device, for example "out of paper" or "job complete", the device driver communicates with the OS. This causes an interrupt and the next process in the queue is allocated processor time.

The **size** or **resolution** of an image is expressed directly as the width in pixels by height in pixels, e.g. 600 x 400. If the size of a picture is increased, then more pixels will need to be stored. This increases the size of the image file. This is a **bitmap** image. The file will be stored as a collection of pixels as a **.bmp** or **.jpg** file.

100 x 67 pixels

1000 x 670 pixels

Videos

As with images, there are several different formats for video files. The AVI format, developed by Microsoft, is one of the oldest video formats. AVI files can run on a number of different operating systems like Windows, Mac and Linux, and are also supported by popular web browsers. MPEG4 is used for HTML5 videos and the files usually have the extension .mp4. They can be played on Macs, PCs and all iPhones.

File compression

Data compression techniques are covered in Learning Aim B, Chapter 13. Image and video files are commonly compressed to create smaller files. With lossy compression, unnecessary information is removed from the file. Lossless compression retains all the information so that the original file can be recreated exactly.

The following table shows some file types and file extensions for different file formats.

Type	File Extension	Compression Type	Explanation
Bitmap	.bmp	-	Uncompressed still image file
Portable Network Graphic	.png	Lossless	16.7 million different colours. Enables a transparent background
JPEG	.jpg	Lossy	Good for photographs. 16.7 million different colours
Graphics Interchange Format	.gif	Lossless	Colour depth = 8 bits (only 256 colours) Good for images with large areas of solid colour. Ideal for web graphics
MPEG 4	.mpg	Lossy	Video files: Suitable for small low-resolution sequences
MOV	.mov	Lossy	Developed by Apple for playing back movies with sound, also commonly used in Windows

Case Studies

Every case will be different, and every case will require different factors to be taken into account. The examples which follow are designed to help you answer questions on this topic.

For each case study, go through the list of factors listed in this chapter. You would do well to memorise this list. Which factors are relevant in the given scenario? For every two marks allocated to the question, you need **one** factor with an explanation of **why** it is important. Try and answer the questions before turning to the end of the chapter for a possible answer.

Example 1

A 2018 study in the US found that serious, non-fatal workplace injuries in the US resulted in $60 billion being paid out in workers compensation costs.

A large construction company is planning to use technology to improve the safety of workers. They are focussing on:

- **Purchasing new hardware to protect workers from danger.** They are considering equipping each construction worker with **smartboots** that will issue automatic alerts for unsafe environmental conditions and hazards using sensors that can detect temperature, motion and location.

Wearable technology for construction workers

The company is also considering introducing drones to limit the amount of work that their employees have to do in unsafe areas.

B

LEARNING AIM B

Transmitting data

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(*Note: Cable television, provided by Virgin Media and BT, is a system of delivering TV programmes to consumers via radio frequency (RF) signals transmitted through coaxial or fibre-optic cables. Satellite TV, such as Sky, uses a communications satellite to transmit TV signals.*)

Q2 **Explain what happens to transmission speed when many users are downloading multimedia files simultaneously.**

Sometimes small private companies lay fibre-optic cable in rural areas to provide superfast broadband.

Tove Valley Broadband is an example of a not-for profit company that engaged an installation company to lay fibre-optic cable in Northamptonshire.

Laying broadband cable in Tove Valley

Exercises

1. (a) Describe what is meant by **Bluetooth** technology. [4]
   (b) Describe **two** applications of Bluetooth technology. [4]
2. Four computers are to be connected in a small local area network.
   (a) Describe **three** methods which could be used to connect the computers. [6]
   (b) State **two** hardware devices that would be needed to enable the computers in the network to access the Internet. [2]
   (c) Draw a labelled diagram, showing devices and connections, of a small network to which different computing devices can be attached. [4]

Q1 **Redraw the diagram using boxes instead of icons. Assume the email is sent from a PC rather than a mobile phone.**

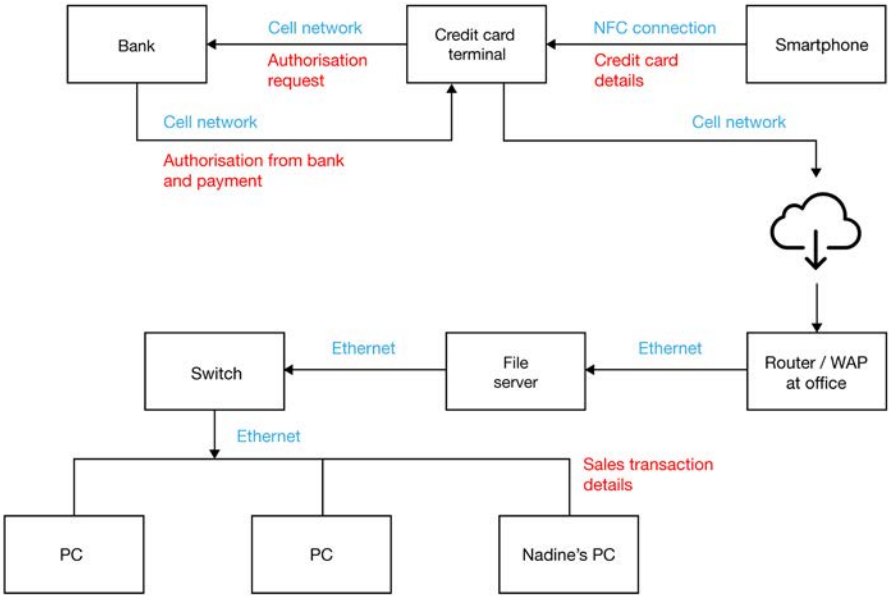
Example 2

Mishal is at a music festival. She uses her smartphone, tapping it on the food seller's NFC (near-field communication) credit card terminal to establish a wireless connection, (creating an ad hoc network) to pay for food using her credit card. The NFC-powered terminal sends an authorisation request to Mishal's bank, which authorises the payment. A record of the transaction is sent using the mobile/cell network to the LAN at the main office. It is downloaded by the sales clerk, Nadine, to her PC.

Using NFC and mobile payment

Draw an annotated diagram showing the devices to be connected and the connection types.

Solution



Example 2 – System diagram

Q2 **Complete the labelling of the data flows through the system.**

This technology enables an organisation to outsource the technical IT support occasionally needed both by employees working in the office and those working at home or at a remote location.

Using this type of software, it is possible to:

- display the remote computer screen on your own screen in real time
- use your own keyboard and mouse to control the remote screen
- allow a remote user, for example a technical support worker, complete access to and control over your computer
- connect either via an internal network or IP address

Case study: RemoteConnekt

Reviews of remote desktop software can be found online. Here is a typical summary of such software:

RemoteConnekt

4.5 ☆☆☆☆☆ (739)

RemoteConnekt software provides easy-to-use, scalable, and secure software to connect to and monitor any device, anywhere in the world. From desktop-to-desktop, desktop-to-mobile, mobile-to-mobile, or to unattended devices like servers and IoT devices, RemoteConnekt allows you to service and support the widest array of platforms and technologies.

One review of the software included these points:

"What I like about this application is the simple way that it allows me to connect with others with a single click… it is super intuitive… it is a vital tool when working with complex systems and there are no experts or advisers available who can provide face-to-face assistance…"

"Sometimes the connection goes down or it becomes very slow during communication … it requires a very good Internet connection."

"I currently use an administrative system and our advisors and experts do not work in our office, so I connect with them through RemoteConnekt . They have managed to solve various urgent problems in record time."

A second reviewer wrote:

"I use RemoteConnekt personally to connect to my computers remotely. This allows me to have access to the computer and the network at home while I am at work."

"In our company we all use RemoteConnekt to connect from home to the work computer and vice versa. I also use it from time to time to access the network while I'm away and to transfer files between computers. I've used it several times to connect remotely from home, access my work computer and solve programming problems for co-workers."

"It has an easy-to-use interface and a very good connection to the server."

Q1

(a) Summarise the ways in which the two different reviewers use remote access technology software.

(b) One reviewer mentions a problem which the second reviewer does not have. Suggest a reason for this, and a solution to the problem.

Case study: A Level Maths paper leaked

In June 2018, questions from an A Level Maths paper due to be sat the following day were leaked online. Students reported seeing the paper on sale for £200, with sellers offering the first question free to prove they had it. Around 50,000 students took the exam the following morning, and the Exam Board issued a statement to assure students that they had established processes in place to ensure no students would be disadvantaged.

Students who sat the exam were angry at the Board for allowing such a leak to take place, and concerned that they would have to resit the exam.

Q3

Suggest three ways in which such an occurrence could have happened. Describe the likely impact on the Exam Board, and on the students sitting the exam.

Software problems

Problems with software systems can have very negative effects for both organisations and users, as shown by the case study below.

Case study: TSB upgrade

On Friday 20 April 2018 at 4pm TSB began a long-planned upgrade to their computer system, involving the transfer of records and accounts of its 5.2 million customers to a new system. TSB warned its customers that some services such as online banking would not be available until 6pm on Sunday.

On Sunday, when some customers attempted to log in after 6pm, it became apparent that there were 'issues'. Some people reported that their accounts showed incorrect balances, and others could see accounts belonging to other customers. On Monday, TSB's parent company wrongly published a statement on its website stating that the upgrade had been successfully completed. Customers were posting in large numbers on Twitter that they could not access their accounts. By Tuesday, customers trying to contact the telephone banking team were left on hold for more than an hour.

A week later, many customers were still unable to access their accounts or make payments. TSB announced it would waive £10m in overdraft fees and pay extra interest on current accounts as it attempted to prevent thousands of customers leaving.

The chaos continued for several weeks and by the end of July, issues still remained; 26,000 customers had

Chapter 22
Encryption, protocols and digital certificates

Objectives

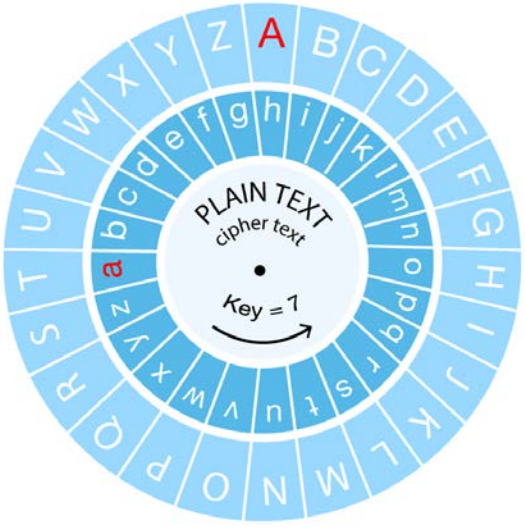
- Describe the features, applications and implications of encryption methods used to protect:
  - data during transmission
  - stored data
- Describe the processes and techniques of protecting data and systems:
  - digital certificates
  - protocols

Encryption

Encryption is the encoding of data so that it cannot be read directly.

- Plaintext: the original message to be encrypted
- Ciphertext: the encrypted message
- Encryption: the process of converting plaintext into ciphertext
- Key: a piece of information or a random string of bits used for scrambling and unscrambling data
- Encryption algorithm: the formula for encrypting the plaintext

The Caesar cipher, said to have been used by Julius Caesar in Ancient Roman times, is a very simple encryption method, called a substitution cipher, in which each letter is replaced by another letter further along the alphabet.



A Caesar cipher wheel

Q1

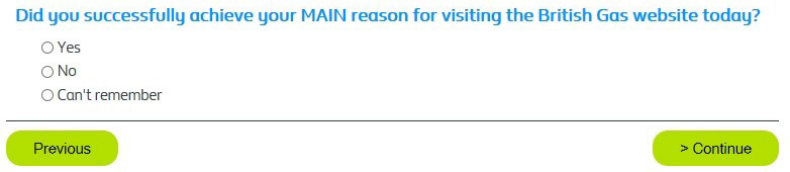
(a) Using a key of 3, use the cipher to encrypt the name KEN.

(b) Using a key of 7, decrypt the word flz.

A researcher may be asked to look for common reasons for dissatisfaction, thus helping the organisation to understand how their product or service could be improved. They may also want to pick up on trends and discover opportunities.

Q1 **The questionnaire above asks the user to give a reason for their answer. How will this be analysed? Why does British Gas ask this question?**

Q2 **Suppose that an existing customer has logged in to the British Gas website. They complete a questionnaire regarding their experience with the website. What action could British Gas take if the customer answers "No" to the question below?**



Focus groups

Focus groups are groups of people invited to come together to discuss a particular issue, planned strategy or product. Typically a focus group includes between eight and 12 participants, and a moderator to guide the discussion.

Selecting people for a focus group

- Define the purpose of the group: identify the goal of the discussion. For example, if the goal of the focus group is to test a new product, you will want to identify participants who have used similar products or are interested in similar products.
- Screen the participants: Choose members that are either past, current or prospective users of the product or service under investigation. Customer lists are a good source, and advertising on social media is another way to recruit participants. It may be necessary to offer an incentive to participate.

The people making up the focus group need to be selected with care so that they are a realistic representation of the likely customer base. It may be necessary to hold several meetings with different focus groups in different locations.

Chapter 31
Global and environmental issues

Objectives

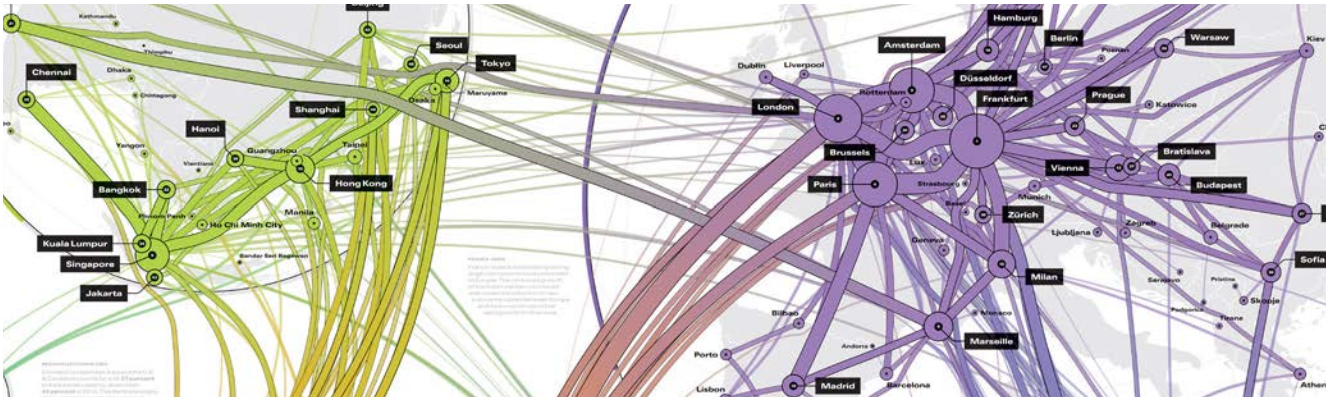
- Describe the moral and ethical factors relating to the use of information technology:
  - globalisation
  - unequal access to information technology
  - environmental effects

Globalisation

Globalisation implies interaction between the people, organisations and governments of different nations. Nothing in history has had a greater impact on communication and collaboration across the globe than the invention of the Internet in the early 1980s and the World Wide Web in 1989.

Advances in communication technology, the concepts of cloud storage and cloud computing, and the use of IT in almost every profession and sphere of life, has enabled the exchange of skills and information between people and organisations regardless of geographic location.

Email, social media sites, Skype and other Internet-based communication systems have made it easy and inexpensive to communicate and collaborate with others across the globe.



Global communication via the Internet

Q1 **What are the downsides of the ease of global communication in terms of security and privacy?**

Winners and losers in globalisation

Improved technology makes it easy to communicate and share information. Large, global organisations including IBM, Shell, banks and insurance companies have call centres located in countries such as the Philippines or India. Around 600,000 Filipinos are employed in outsourcing, generating billions of dollars for their country's economy.

More specialised and lucrative outsourcing opportunities exist in accounting, animation and gaming, and many of these are outsourced to India and other countries.

World Wide Web Consortium

Known as W3C, this organisation was established in 1994 by the creator of the Web, Sir Tim Berners-Lee. Its stated mission is "to lead the World Wide Web to its full potential by developing protocols and guidelines that ensure the long-term growth of the Web".

Sir Tim Berners-Lee, founder of the World Wide Web, Orlando Florida January 2018

British Standards Institute

The British Standards Institute (BSI) is a service organisation that produces standards across a wide variety of industry sectors. It publishes Codes of Practice for Web accessibility, similar to those shown on page 181 for WCAG 2.1.

Exercises

1. (a) Describe what is meant by **accessibility** in the context of information technology. [2]

   (b) Ray is colour blind.

   Describe **one** way that a website designer can ensure that no text is unreadable by him. [2]

   (c) Rihanna is blind.

   Describe **two** specialised hardware devices that Rihanna may need in order to use IT effectively. [4]

2. (a) Describe the purpose of the Open Accessibility Framework (OAF). [2]

   (b) Describe **two** steps in the framework designed to help achieve its purpose. [4]

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Pat Heathcote is a well-known and successful author of Computer Science and Information Technology textbooks. She spent many years as a teacher of these subjects at various levels, including BTEC Information Technology and Advanced Level Computer Science, and has significant examining experience. She has also worked as a programmer and systems analyst and was Managing Director of Payne-Gallway Publishers until 2005.

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ISBN 978 1 910523 15 5