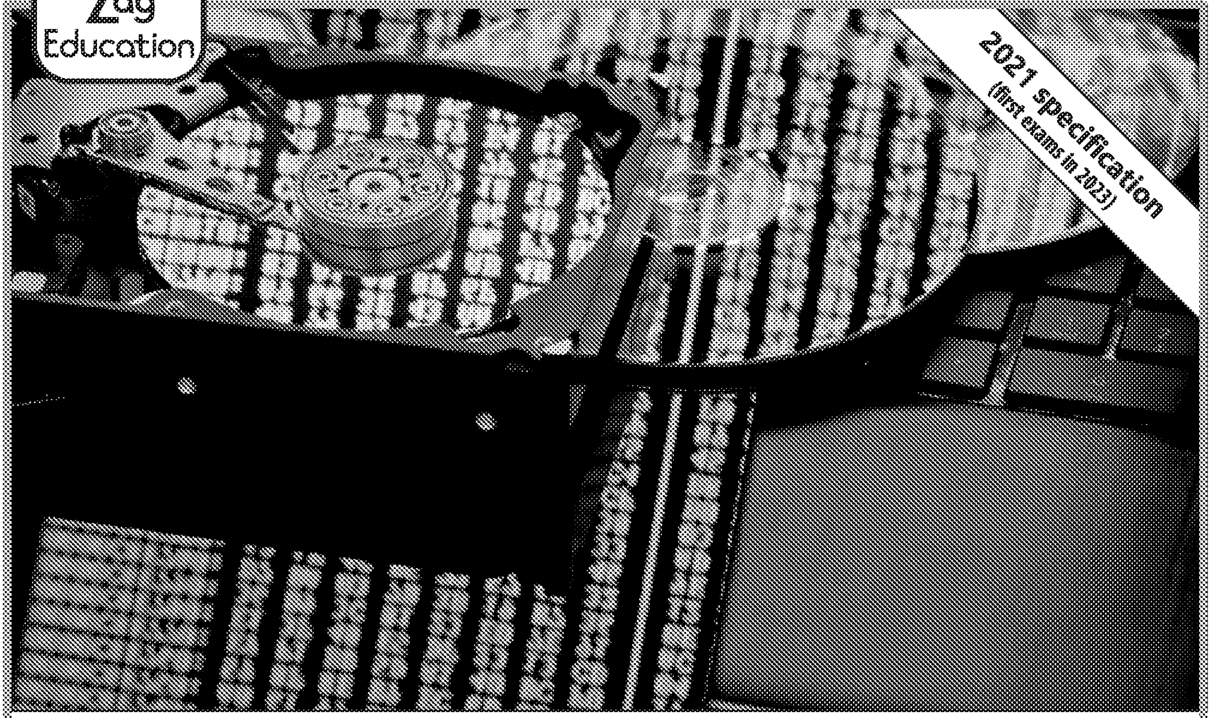
Zig Zag Education **Digital Technology** GCSE | WJEC | C00/4040/5



Course Companion

for WJEC GCSE Digital Technology Unit 1: The Digital World

Update v1.1, December 2023

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Contents

Teacher's Introduction

This course companion has been written specifically for the WJEC GCSE Digital Technology qualification (first teaching from September 2021 and first award from 2023). The theory notes and practice questions cover the essential knowledge and understanding prescribed in Unit 1 of the specification, *the digital world*.

Each of the six *areas of content* (1–6) is given its own section in the resource. These are as follows:

① Data
② Digital technology systems
③ Digital communications
④ Impact of digital systems on organisations and individuals
⑤ Securing data and systems
⑥ Changing digital technologies

Remember!

Always check the exam board website for new information, including changes to the specification and sample assessment material.

Within each section there are student notes covering the specification content and structure. These notes include descriptions of theory, supported with examples, diagrams and images where appropriate. Discussion points for learners are also interspersed throughout the resource.

Questions are interspersed throughout the guide to test and develop understanding. Suggested answers* are included at the back of the resource.

* *The intention of these is to save the teacher time, rather than to offer a comprehensive set of definitive answers. In some cases, there are equally valid alternative answers to those that have been given.*

A Roberts, October 2023

Update v1.1, December 2023
Page 11: Corrected the definitions of storage units to the binary system (1,024), in line with the mark scheme for the 2023 exam.
Page 14: Corrected question 13 from "1,000" to "1,024".
Page 23: Paragraph 4, changed "1,000" to "1,024".

Chapter 1: Data

In this chapter you will learn:

- What is analogue data and what is digital data
- How data is stored
- Why digital data has advantages and disadvantages
- How digital data is stored, compressed and sampled
- The storage units for digital data
- The storage media used to store data

What is analogue and digital data?

Analogue data and **digital** data can be tricky to define, but it's easier to think of a data as the physical world around us, while digital data can be stored and used b computer devices. Your eyes and ears take in analogue data, and you speak in analogue. Your computer or smartphone only processes digital data – information stored as digits, just ones and zeros – but outputs analogue data for you to see and hear. We'll later see how we can convert between the two.

Analogue: D
allowing fo
possible val

Digital: Dat

For example:

- The movement of your hand and fingers is analogue. You use your hands to on your smartphone, which uses a digitiser to convert the movement into a knows where you pressed or swiped, and maybe how hard you pressed.
- A printed paper photograph or a handwritten note is analogue, but you can digital copy to your computer.

You won't be surprised that a 35 mm film camera or old movie footage on film is camera was sensitive to the light that it was briefly exposed to, and the image w plastic film. Nowadays, we mostly use digital cameras with electronic photosens image as a file made of ones and zeros.

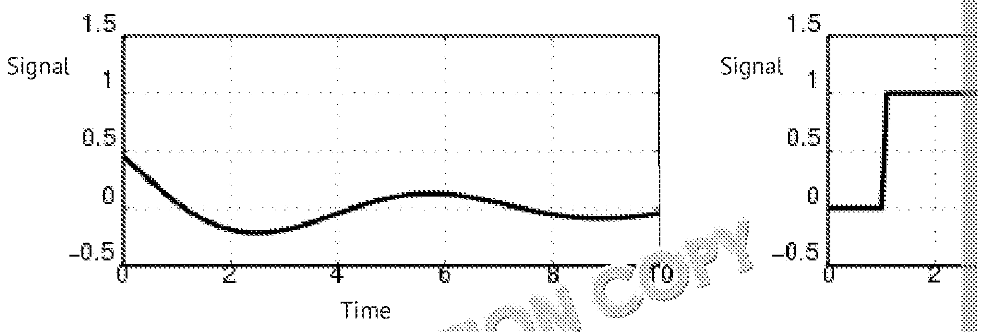
However, you might be surprised that older electrical signals and standards were a digital radio and television were developed, all of the signals were transmitted as a listen to analogue radio, but all of the analogue TV broadcasts have been switched technically analogue, and so too are older video standards such as the old VGA mo network for a voice call is also analogue, but the same line can also carry the digit

Analogue data

So, analogue data is any input that we see, hear or smell. It can also be stored ph paper, film, plastic (e.g. vinyl records) and in older recording media (i.e. pre-digit be transmitted over copper wires, or broadcast over the air as a radio waveform.

Digital data

By contrast, digital data must be stored and transmitted as a stream of binary dat one (1) meaning 'on' and a zero (0) meaning 'off'. Digital data can be sent through and fibre cables, and transmitted through the air digitally, at different frequencie a square waveform, unlike the [illegible] waveform of analogue. All of the files store computer are digital and are stored on hard drives and flash memory.



Analogue vs digital waveforms

Devices that use analogue and digital data

Here's a quick summary of some of the devices that use analogue and digital da

Analogue	
• Film cameras and older camcorders • Cassette and record players • Old radios and TVs, VCR • Landline telephones • Keyboards, mice, game controllers, scanners and touchscreens take in analogue signals and digitise them • Old monitors that use analogue video input, e.g. VGA, DVI-A	• Digital cameras a • CD and DVD playe • Digital TV and rad • Digital telephone • Smartphones and • PCs and laptops, g • Internet routing e • Modern monitors HDMI, DisplayPor

The relationship between analogue and digital data

Analogue data can cover an infinite range of values. For example, if you look ou buildings and sky can take on an unlimited (continuous) range of colours and br perceive all of them. Digital data may limit the number of colours and amount o discontinuous values). Think of a clock. An analogue clock has hands that go a need to interpret the time from their position. A digital clock displays the exact,

Analogue data can be richer than digital data but takes up more storage space – paper or stored on 12" vinyl records. Audiophiles tend to prefer the richer sound can be lost in the sampling process, reducing the precision of the data (samplin would much rather watch high-definition digital video than standard definition purchased digital download of a movie takes up much less physical space. On th lose quality – we'll talk about resolution later on, but if you scan in an image at dots per inch), there is a lot of quality missing from the original image.

One of the benefits of digital data is that it is much easier to change, modify an record, there are very limited options available on my record player – I can perh that's all. That device has only one function – to play audio. But a digital compu can be used for many more functions and interpret lots of data types. I can scan and use software to enhance it – for example, I can bring back the faded colour change the contrast and brightness, crop and resize it at the touch of a button. to others, or upload it in seconds to social media.

Another benefit is that digital copies of data are exact and perfect. Quality does unlike with analogue data. Your teacher may have occasionally photocopied a back to the original – you might notice that text becomes bolder, wavy with jag to become blurry with too much contrast.

Wales led the UK in turning off its analogue signals in 2010. Do you know w

Analogue to digital conversion

In the last few decades, we have transformed our lives to fit the new digital wor produced before the 2000s were recorded on film or analogue video tape. This m worth of analogue media is being digitised, both as a way of making it easily acc Billions of pages of records have been digitised and uploaded to government sit websites; millions of old books, newspapers and magazines have been scanned; were recorded on film, and old audio recordings, have also been digitised and ma

Large businesses may have their own specialist conversion team – for example, letters and paperwork and link the scanned documents to the clients' correspon the paper is too bulky to store, it will be shredded and/or recycled.

The UK government embarked on an ambitious project to digitise every birth, de produced since 1837 – mainly from rolls of microfilm (tiny postage-stamp-sized clear film).

A wide range of digitising equipment is used to convert the analogue material to d – there have been hundreds of media formats and types over the years, so a wide

For example:

- Audio, image and video capture devices (including flatbed, sheet, film, slide, negative and microfilm and microfiche scanners, using digital cameras, and image and audio capture from many obscure and proprietary formats)
- Document scanners (with automatic sheet feed and special sheets to separate individual documents into separate files)
- Books are scanned using a camera mounted above the pages so that the pages don't need to be removed from the binding (pictured). Page turning may be done by hand, and a glass sheet may be placed on top of the pages

Of course, we also need to convert digital back to analogue. You need to be ab media on your display and through your speakers, using your analogue eyes and If you print out a digital document, the copy made of paper and ink is, of course

Recording

Sound is recorded using a **microphone**. A microphone is a transducer – a device electrical energy which can then be transmitted, amplified or recorded. Microph constructed to be used in different situations and locations, and for different pu

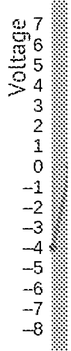
Images are recorded by cameras. A **camera** is an optical device that is used to re measure of light intensity that can be used to interpret the colours seen within t then be recorded or transmitted for other use.

Microphone inputting sou

Camera: A and moving

Sampling (signal processing)

Sound is created when an object vibrates and creates sound waves. These sound waves are longitudinal, which means that the waves travel in the same direction as transmission, as opposed to transverse waves that travel up and down.



Sampling is the process of digitising the analogue audio.

- **Sampling rate** (frequency) – During the recording process, through the use of a microphone, the analogue signal is converted into a digital signal. Sampling rate describes how frequently the voltage level of an analogue signal is measured with the aim of gaining an accurate representation of the analogue signal once it's converted into digital.
- When the sampling rate is too low, the conversion process creates what is known as an 'alias signal' – this means that the signal is unrepresentative of the original signal.
- **Bit depth** – Just as the sampling rate states the number of samples taken during the conversion process, bit depth describes the number of levels available for samples to be taken. This allows for a more accurate representation of the signal. It should also be mentioned that a higher sampling rate and bit depth result in higher sound quality.

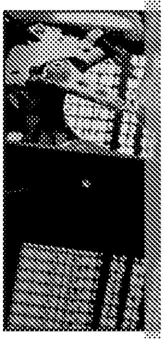
Sampling: Cre
representation

Sampling rate
analogue soun

Bit depth: The
samples to be

Storage

Audio can be stored in many different formats; for example compressed formats (e.g. MP3) and lossless formats (e.g. FLAC) (covered later). Nowadays, digital audio is stored on a computer's hard drive if recorded directly, or on a flash memory card in dedicated recording devices. The file size is determined by factors such as the audio quality (e.g. high sampling rate and bit depth), whether compression has been enabled, and the length of the recording. The largest files are those of high quality, uncompressed long recordings.



Many *images* and photographs are stored as a **bitmap** (**raster**) image, made up of colour. The more pixels, the larger the file size, and image files can be very larg a reasonable digital camera, or perhaps 3 MB or less from a cheap smartphone. parts of the images, the individual dots become larger and the quality cannot be editing software to change the colour of each pixel.

High-end cameras can save a 'RAW' image file, which records the exact input to the photosensor as well as a compressed version. Most consumer cameras will only record the smaller compressed file (e.g. JPEG) – covered later. The images are usually stored on a flash memory card.

Bitmap: A mat

Raster: A type
dot matrix stru

What storage formats do you use?

Advantages and disadvantages of storing data dig

The table below shows some of the advantages and disadvantages of digital sto potential problems with storing data on paper, and digital storage has a lot of a digital storage has drawbacks too – no system is perfect.

	Advantages	
Data retrieval	✓ Instant retrieval for online systems. ✓ Data stored in 'the cloud' (see page [illegible]) may be accessible worldwide. ✓ Data retrieval from solid state media is very fast. ✓ Onsite data is always available, even if the internet connection is lost.	× Offline storag drives) still ne centralised st × Locally stored accessible off × Cloud storage connection fa × Old media ma equipment ma mechanical d media, degau × The applicatio become obsol support older converted wh
Efficiency	✓ Quick to search for and sort data when properly indexed. ✓ Can set up a robust storage policy and implement a robust file naming and workflow policy.	× Non-indexed stored as ima × Users might a wrong place. × Data created compatible w
Security	✓ Can be password protected and encrypted, rendering data useless if intercepted or stolen. ✓ Can set access restrictions to specific users or groups of people. ✓ Data may be safer when stored in the cloud compared to locally on mobile devices.	× Possibility of modified or o × Very easy for without perm × Need to caref when obsolet × Expensive to level of secur
Accessibility	✓ Searchable, digitised text can be read by a computer (using OCR – optical character recognition). ✓ Computers can read text aloud, and can change the text size and font to increase readability.	× File or drive p meaning that provide manu
Scalability	✓ Cloud storage is easy to increase and decrease as required. ✓ Local storage media (e.g. portable hard drives and flash drives) can be easy to purchase.	× Upgrading loc space can be × Some storage some flash dr many disks a
Loss of quality (sampling)	✓ Makes files smaller so they are faster to load across a network and take up less storage space. ✓ Lossless compression means that storage space is saved, but the original quality is maintained.	× Reduces the q then the origi

	Advantages	
	✓ Digital storage can be very cheap and long-lasting, prices are falling. ✓ Discounts for cloud storage may be available.	× Can be time-co data to new st optical media × Data retrieval very expensive × Fast access to expensive Inte
Management	✓ Using cloud storage offloads the day-to-day running and management onto the host provider.	× Needs lots of store, backup sometimes fro

Storing digital images

In this topic, we discuss how still and moving images are stored, and factors tha

Pixels

The term '**pixel**' can mean several things. For example:

1. The number of squares that a screen can display horizontally and vertically. Old monitors used to display 640 × 480, later 800 × 600. Modern HD (high definition) displays and televisions are 1920 × 1080 (1080p), and UHD (ultra-high definition) 4K televisions are 3840 × 2160. Running a monitor at the wrong image resolution can create a blurry display, i.e. it is scaled up.
2. The size of an actual image or photo. If you open an old image that us 640 × 480), it will look very small on a large, modern display.
3. The number of pixels per inch (PPI) of an image on the screen – the higher

Pixel: The smallest ele image, normally arra two-dimensional grid.

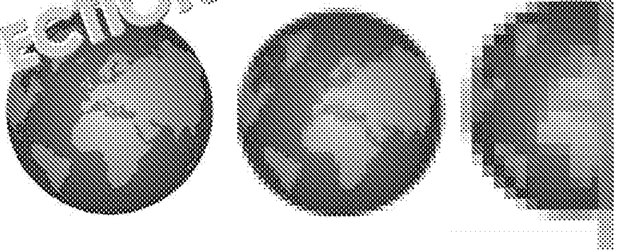
When we a[illegible] print an image, we refer to the quality as DPI –dots per inch. laser printers are produced by printing tiny dots on the page. Where there is soli are so close together they appear solid.

Resolution

Resolution describes the total number of pixels that make up an image; the mor the image appears. Resolution is usually expressed in pixels as height by width.

A megapixel is one million pixels and is used as a measure of quality for digital megapixel camera will take an image made up of roughly six million pixels. How although the megapixel count of camera devices is always stated – particularly it is not the only meaningful measure of quality; the lens of the camera, the sens important features. The higher the resolution, the higher the quality of the imag zoomed in further without significant quality loss. But the higher the resolution, file sizes mean more storage space, slower load and processing times, and slowe

The sequence of images to the right represents an image at a number of different resolutions to demonstrate its impact on image quality.



64 × 64 32 × 32 16 × 1

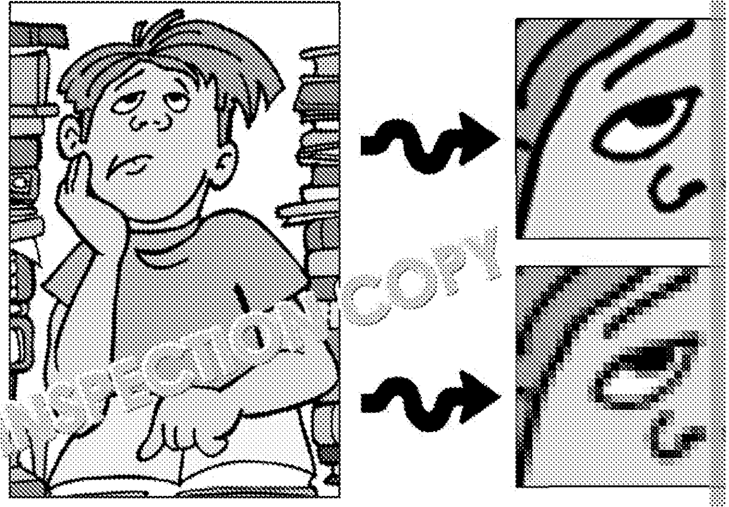
Vector and bitmap graphics

Vector describes an image that is arranged by using a mathematical formula to objects such as circles and polygons to create the complete image. The main dif and bitmap images is that vector images can be edited by manipulating the curv image; when it is resized, the resultant image is identical to the original. File siz bitmap images.

Bitmap images are created by a series of tiny squares called **pixels**; each pixel is arranged in a grid to form the desired image. When you zoom into a bitmap ima individual coloured pixels, and altering the colour of or deleting individual pixels the overall image.

When a bitmap image is enlarged it seems to become distorted, as each individu also enlarged and becomes clearly visible. This process is called pixelation and be pixelated.

By studying the image below, we can see the distinction between enlarging a ve bitmap image.



There are two file formats used within digital photography that are used for diff

- *JPEG* – Joint Photographic Experts Group (JPEG) is a file type that was speci photographic images and uses **lossy** compression. It is commonly used for s and displaying images over the Internet due to its low file size and relative
- *RAW* – a RAW file is a **lossless**, direct reading of an image from the camera se files is that they contain all of the original image data, whereas JPEG and oth this colour information, which can lead to visible compression artefacts whe converted into JPEG files if desired.
  There are, however, a number of disadvantages associated with RAW files. Firstly, they are extremely large files, which means that fewer files can be stored on a memory card and the writing process also takes longer. They can also take longer to open on a computer and may need to be converted or compressed before transferring.

Lossy: Compres discards data a

Lossless: Reduc quality, e.g. TIFF

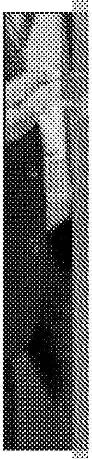
Compression: T a file, in order t transmission time

Digital cameras also have a quality setting that, when shooting images in the JP
of **compression** used when saving the image.

Higher quality means that there is a lower amount of compression, which in turn
with greater colour information.

While it is possible to enlarge an image safely, rescaling beyond a certain point w
in quality and could show evidence of pixelation, where **pixel** 'blocks' are visib
when enlarging low-resolution images.

Moving image files



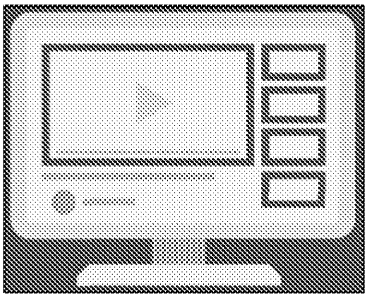
A number of different video formats are used across the Internet to allow users to watch video content. The format used usually depends on a range of factors such as the type of video, viewing platform and expectation of quality.

- *AVI* – Audio Video Interleave (AVI) is a container format developed by Microsoft to play both video and audio. Advantages include its compatibility across a wide range of devices and Internet browsers, eliminating the need for specialist hardware or software for playback.

  Additionally, it produces high audio fidelity and supports audio and video streaming.
- *MPEG4* – Moving Picture Experts Group 4 (MPEG4) is a widely used format on the Internet that's designed to transmit audiovisual data, and can
  graphics and animation layers.

  One of the main advantages of using MPEG4 is that it produces high-quality
  widely supported across websites and Internet applications, leading it to be
  used for sharing and uploading video footage over the Web.
- *WMV* – Windows Media Video (WMV) is a video compression format original
  the Internet. Its main advantages are that it supports the compression of la
  loss of quality, and also results in small file sizes.

  However, it does have compatibility issues with other computer platforms su
- *MOV* – Apple QuickTime Movie (MOV) is a high-quality video format that's c
  and Apple platforms. It can be used to store audio, video, effects and text (s



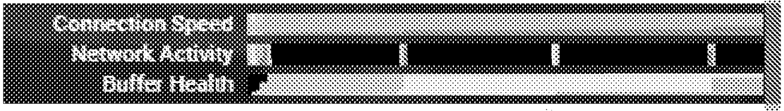
Streaming refers to the ability to listen to music
time without it being downloaded onto the com
or listening to music from an online source. An e
viewed on YouTube through a web browser, or a
smart TV. The type of connection and performan
will affect the watching quality.

Streaming happens in real time and can be quic
downloaded onto the device before the user starts playing it, but it requires a fa
pauses and interruptions in video transmissions. The data is downloaded in the b
'buffer', which may contain several seconds to several minutes of downloaded vi
Internet speed is very slow or cuts out, the video will pause when the end of the
reached. We call this pause 'buffering'. The video will resume either when the data connection is restored or when several more seconds of video have been loaded into the buffer.

Streaming: Star
before the whole
from the Internet

Downloading: S
before playback

Next time you are on YouTube, right-click the video and click 'stats for nerds'. You will be able to see details about the network speed, network activity and the amount of buffer remaining. Here y connection is not regular, but that the video is downloaded in small sections.

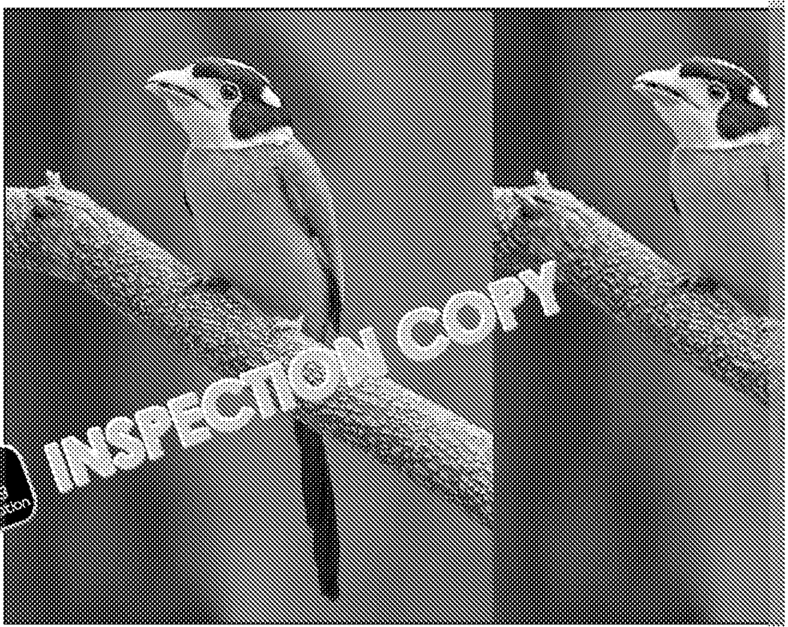


Downloading means creating a physical copy of the file so that it can be viewed might download a digital copy of a movie from an online store, or download cat mobile device for viewing offline when you are out travelling.

Compression techniques (lossy vs lossless)

Compression describes the process of gaining an accurate representation of data the image to an acceptable level. The reduction in file size allows more files t required for images to be sent or downloaded over a network connection.

Lossy compression removes data, and quality is often reduced. **Lossless** compres size without any loss of quality.



You can see the effects of lossy compression in the image on

There are a number of different file formats used for storing image data depend supported by a computer can vary depending on the software installed on it.

Some of the most common image file formats are described below:

- *TIFF* – Tagged Image File Format (TIFF) is commonly used within the printi typically results in large file sizes. Multiple layered images can be stored in **lossless** compression method.
- *JPEG* – Joint Photographic Experts Group (JPEG) is a file type that was speci photographic images and uses a **lossy** compression. It is commonly used fo cameras and displaying images on the internet.
- *GIF* – Graphics Interchange Format (GIF) is widely supported online and is c animation. However, GIF only supports up to 256 distinct colours and uses outside the palette.
- *PNG* – Portable Network Graphics (PNG) was originally developed to replac channels, full transparency and **lossless** compression, although, unlike GIF,

Why do we still use both lossy and lossless compression?

Measuring and storing data

Binary units

All data is stored in binary as strings of 1s and 0s
Computers can only process binary digits too – e.g. used in the proce

We use various encodings and file formats to be able to turn those 'bits' into the audio that the device can display for us to see and hear.

For example, we can encode text as ASCII or Unicode, and we can store images a

Binary storage data units

In binary, data is stored as 'bits' (1s and 0s), and sets of 1s and 0s of a particular size are given names as follows:

Bit	A single 1 or 0
Nibble	4 bits (e.g. 1001); i.e. half a byte
Byte	8 bits (e.g. 100100100) i.e. one character

The powers of 2 (or base 2) binary system is important to represent storage size.

The most commonly used units are listed in the table below (there are names for larger units too):

Kilobyte (KB)	1,024 bytes
Megabyte (MB)	1,024 KB
Gigabyte (GB)	1,024 MB
Terabyte (TB)	1,024 GB
Petabyte (PB)	1,024 TB

Note: While Microsoft Wi (where a kilo direction is t Hard drive m base 10 syste TB hard drive about 935 GB each megaby system.

Note that w base 2 binar abbreviation for kibibyte (1,024 kibib

However, th megabyte, e exam is the

Storage mediums and their applications

Below are the common types of storage media that are still in use.

Magnetic storage

Magnetic storage uses a metallic oxide media such as iron, which may be 'doped cobalt. A magnetic write head aligns crystals of the oxide coating depending on can then read back the recorded data.

There are two modern uses of magnetic media:

1. **Mechanical hard drives** – use aluminium (or sometimes glass or ceramic) disks coated with the oxide. The read–write head hovers just above (but doesn't touch) the surface. Cheaper consumer computers still use mechanical drives because they are cheaper than solid-state drives, and many servers still use large mechanical drives for their cheapness and large capacity (they spin much faster than the ones in your home computer). Drives in desktops are larger (3.5") while l You can also purchase external drives, e.g. housed in a plastic case and plu

2. **Tape** – computers used to use reels of plastic tape coated with the oxide fo tape is housed inside cartridges, and only used for backups. Although hard d have reduced the need for tape, tape is still used and new tapes are still be capacity and faster speeds in the same small cartridges. Unlike disks, the he the heads occasionally require cleaning to remove a build-up of oxide parti

Optical storage

These include the shiny silver plastic disks such as CDs (compact disks), DVDs (digital versatile disks) and Blu-ray (BD). Each was released at a different time, for a different purpose.

The disks are read by a laser – hence the name 'optical'. Their use has rapidly declined in recent years (replaced with digital downloads and streaming), and most consumer computers and laptops no longer have an optical drive fitted as standard.

Most commercially produced disks are printed at a factory and are called ROMs
contents cannot be changed.

Home users can purchase writable (and rewritable) media such as CR-R and DVD
different ways that the data can be written to by the laser for DVDs, but most dr
types of disk). These disks are typically less durable than factory-printed version

Each type has a different capacity:

- CD – up to 700 MB or 80 minutes audio
- DVD (single layer) – 4.7 GB / (dual layer) – 8.5 GB (often called DVD 9)
- Blu-ray (single layer) – 25 GB / (dual layer) – 50 GB

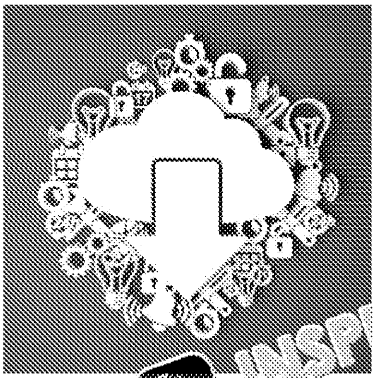
A DVD drive can typically read CDs, and a Blu-ray drive can typically read DVDs a
only read CDs and a DVD drive cannot read Blu-ray.

Each type also has different uses:

- **Commercial PC software and games** were once sold mostly on **CDs** (and late
  became larger and DVD drives became common), but now they are mostly s
- **Computer games for consoles** are still purchased on disk (used to be **CDs**
  ray) in addition to digital downloads from each 'store' set up by the manufa
- **Music** was typically sold on **CD** since the 1990s (when CDs replaced vinyl a
  music is streamed or downloaded.
- **Movies** and **TV series** were typically sold on **DVD** starting in the late 1990s
  2006), and later **Blu-ray** for high-definition versions.

Over the years, individuals have sometimes used optical media to perform backu
largely been replaced with hard disk or cloud-based alternatives.

Cloud storage



Cloud storage is data that is stored on a server s to access via the Internet. Server farms, also cal large companies such as Google, Microsoft, App

You need to create an account and set up a use the data. Providers usually give each user a sma of storage for free, e.g. 15 GB, and if you wan space, you need to pay a monthly or an annual fee which you can change as needed. Your data and files can usually be viewed in a web browser, or 'synched' through a folder on your computer. Anything that you add to that folder gets uploaded automatically to the cloud, and anything added in the cloud is downloaded to that folder.

Cloud storage: D where data is sto accessed from the

Solid-state storag memory; no movin

Flash memory: M drives and memo can be electricall

Cloud storage is great for:

- Backups
- Sharing files with friends and family
- Working offline with automatic synching when you reconnect

Solid-state storage

High-end modern devices, and many portable devices, use **flash memory** – there 'solid state'. This memory retains the data when switched off (non-volatile) and mechanical drive.

There are many modern uses of flash memory:

1. Hard drives – a much faster replacement for mechanical drives
2. Storage in portable devices (phones and tablets), and devices such as the R – either built-in or using a removable card (e.g. SD or microSD card)
3. Storage in cameras and other monitoring equipment (e.g. SD and other sim
4. USB flash drives (pen drives or thumb drives) – used for data transfer or sha

As you can see, there are lots of potential uses for these types of storage in ever

- Using mechanical or solid-state hard drives as the main primary storage in
- Backing up data to tape or to the cloud (businesses), or to an external drive
- Using an external drive to store large files, such as many years' worth of dig
- Sharing files with your family using the cloud
- Saving your school work on the cloud, or transferring home using a USB fla
- Using an SD card or a microSD card in your camera or smartphone
- Watching a film on a DVD or Blu-ray disk

What types of hard drive or storage are installed on your devices?

Practice Questions

1. Give one way that digital data differs from analogue data.
2. Describe why we convert analogue data to digital data.
3. What is meant by the term 'sampling'?
4. What is the main advantage of using a high sampling rate?
5. Give a disadvantage of using a high sampling rate.
6. Describe two disadvantages of digital storage.
7. An image or video resolution of 1920 × 1080 is usually called what?
8. Give an advantage of a vector graphic over a bitmap.
9. Describe why some people prefer lossless compression over lossy compress
10. What is 'streaming'?
11. Does a JPEG file use lossy or lossless compression?
12. A bit is a single 1 or 0. How many bits are in a nibble, and a byte?
13. What do we call 1,024 gigabytes?
14. Describe why optical media has rapidly fallen out of use.
15. Give one advantage and one disadvantage of cloud storage.

Chapter 2: Digital technology s

In this chapter you will learn:

- How we interact with devices
- How the Internet works and how we get online
- The role of the operating system, and the different types of human–compu
- The different types of software and their purposes
- How and why we back up data and prepare for disasters
- How and why we use the cloud
- The six steps of the systems development life cycle

Interaction with digital devices

We interact with devices in many different ways. The common ones are noted be

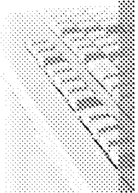
Speech

Because everyone talks differently, computers have had a very hard time understanding us, especially if we have a strong regional accent. Nowadays, a lot of the voice interaction with machines is done through smartphones (e.g. Siri and Google), tablets and smart speakers (e.g. Amazon's Alexa). We can ask our device a simple question and it will either search the Internet to find an answer, or access apps and services we have installed. We can ask devices to add appointments to a calendar, set alarms and reminders, order a product online, or start playing music, etc. For example, I can ask my phone what the weather will be like today – it will use my location and use an online weather service to find out. Using a computer voice, the answer will be read out to me. All of this can be done hands-free.

Even though the technology has advanced and some services may use the comp recognition can still be hit and miss. Even if the software can input every word you what the meaning i

Over the years, new games have also implemented voice control in order to co using a headset connected to the game controller. You can issue a set of comma

Keyboard and mouse



A keyboard is one of the main ways of inputting data into a computer, phone or tablet. It is either a device with rows of buttons called keys, or it shows up on screen when you tap into a data entry box. Keyboards include the letters A–Z, the numbers 0–9, various symbols (!"£$%^&*-_=+'@#~/?.>,<`¬) and arrow keys. Pressing the Shift or Caps Lock key gives capital letters and activates the top symbol on number and symbol keys. Turning on Num Lock activates the separate number keypad to the right (if present), and some keyboards, especially short versions and those on laptops, include a function key that activates a virtual number pad.

Additional symbols not found on a standard keyboard can still be inserted into d insert symbol feature in software or by typing in a special combination of numbe Accessing symbols on a phone or tablet can be trickier – with less space on the s menus used to access them.

The arrow keys can be used to navigate through the screen (and Tab can select a using the mouse. This is a quicker way of using a computer because there is less hand movement. If you're a PC gamer, you will be familiar with the WASD as a basic arrow system which is a fairly recent diversion from the arrow keys. Most operating systems and applications also have built-in shortcut keys – you're probably familiar with some of them: Ctrl + C to copy, Ctrl + V to paste, etc. You can see some common ones on the right. Pressing Alt will often show a different range of shortcuts in Microsoft Office. If an application has a line under one of the letters in each menu bar after pressing Alt, that will be the letter to press on the keyboard. Try this: open Notepad and press Alt: the menu will change to File, Edit, Format, etc. (Note that 'o' is underlined in Format because File took the 'F' first.) If you press F, you see each of the commands in that menu also have one letter underlined. Shortcuts are best when they are system-wide. Some bespoke programs have th different context. For example, a program might use Ctrl + C to close it rather th the case, users will keep closing the program by accident until they learn not to

Our computers in the UK use the standard QWERTY layout by default, largely in However, the layout can be changed within the operating system, either to a for familiar with a different layout, or to a different layout, such as Dvorak, which is putting frequently used keys together.

Laptops usually have a bank of extra function keys at the top that can be used to the screen brightness and volume, turn on airplane mode and activate external

Input is only as fast as you can type (and much slower than speaking), which can not learned to touch-type. For example, typing speeds might range from 30 to 12 job roles expect employees to be fast, proficient typists (at least 50 or 60 wpm) have included a typing test to screen the speed and accuracy of the potential ca – pressing the wrong keys by accident – which takes time to correct. My favouri Alt + F7, which is the same as right-clicking a word with a red zigzag below it.

A mouse is a pointing device. Moving the m your hand, wrist and arm corresponds with (such as a small arrow or I-beam cursor) on space on your desk, you can pick up the mo else, but the pointer stays in the same plac types of mouse have a left and right (altern swapped in the OS if you're left-handed), a through pages and documents.

A single click of the left mouse button selects whatever the cursor is hovered ove application, and holding down the button while dragging can select things; holdi objects moves (drags) them from one place to another. The right button may brin mouse doesn't have a second button, the right-click can be simulated by holding

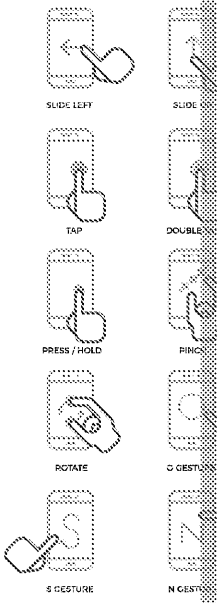
Keyboards and mice are used to control the operating system and every applicat

Some people with hand mobility and dexterity issues can have a hard time usi Specialist ergonomic equipment is available, such as split keyboards, sideways m

Gesture

Gesture: Specific swi
for input into a touch

There are a lot of different 'gestures' that we can use, which may be specific to a certain device. Gestures can be specific hand movements on a touchscreen or trackpad – such as pinching to resize or zoom, or using combinations of fingers, or holding or swiping from certain areas such as the top/bottom or corners. Gestures can be used as shortcuts and to perform more complex tasks. While gestures can take some time to learn, they can really save a lot of time overall.



On my Android phone, I can swipe down from the top to access a menu, swipe from the bottom right corner to bring up the camera, and even shake the phone to turn on the torch. Common gestures (and touch) can be seen on the diagram (right).

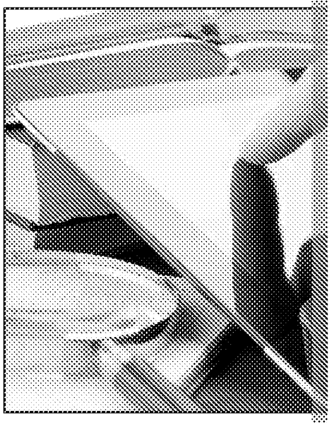
Some gesture input may also use a specific glove, sensor or camera to track hand or facial movement.

Apple is a big fan of gestures – Apple supports many multitouch gestures on its devices, including its touchpads and even on the top of its mice.

Did you know?

Microsoft introduced gestures called 'charms' into its Windows 8 operating syste
was poorly received by customers. The tablet–desktop hybrid operating system
work well, and Windows 10 was very similar to Windows 7 for desktop systems.

Touch



The screens on phones, tablets, smartwatches and some laptops are touchscreens (they are both input and output devices). You can press buttons and swipe and scroll with your fingertip or sometimes a stylus. Touchscreens use a membrane, often built into the glass, which turns the movement of your finger into a digital signal. Some are resistive displays, which feel like plastic. They are less sensitive but can be used with gloved hands and often many styluses, making them useful in industrial settings. Many screens are capacitive screens, which are made of glass, but you need to touch them directly with your finger – the type most common in your smartphone.

Apps must be specifically designed for use with small touchscreens. They often
their desktop counterparts, using a [illegible] and simple design with big button
suite for tablets and phones [illegible] familiar with the desktop version, but uses a m
designed for smartphones and tablets must use a range of techniques to use tou
or mouse. This application can be difficult for daily use by power users.

Virtual reality (VR)

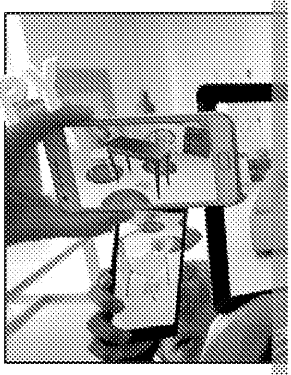
Since the 1990s, there have been several attempts made to bring **virtual reality (VR)** to the mass market; for example, Nintendo's Virtual Boy, released in 1995. The simplest and cheapest form is to use a smartphone mounted inside a cardboard or plastic head mount that uses lenses to focus your vision on the screen and uses little more than the movement of your head for control. Over the last decade, more advanced offerings have been developed, such as the Oculus Rift, the HTC Vive and the PlayStation VR, which use a powerful computer or games console for the image processing, and usually some sort of handheld control in addition to motion and head tracking.

You are probably more familiar with the social and gaming uses of VR; you may on YouTube designed to be watched on VR headsets.

VR is starting to be used in many industrial applications, such as training (e.g. m battlefield simulations, or by surgeons to practise operations in a safe environm themselves or others), in health treatments, sports training, and teaching.

One of the drawbacks of VR is the high cost – for both the headset and the cont gaming PC needed to drive it.

Augmented reality (AR)



Augmented reality (AR) is taking a live image of the real word and overlaying digital objects on top of it. For example, you could use the camera on a smartphone or tablet to create the image, and then add digital elements on top. One of the most famous uses is in the game Pokémon Go. Retailers have also produced AR apps – for example, IKEA has an app that allows you to place virtual furniture into your home to help you decide what would look good – and some clothing and cosmetic companies have developed apps that allow you to see how you look wearing different clothes and make-up. Othe and colouring books. It is also possible to use AR for promotion, such as providi playing in place of the image.

Other AR systems project words and images onto a see-through helmet, visor or 'heads-up display' view used in many video games). This second concept has see (Google Glass), and other companies have developed or are developing applicati for fighter pilots, for the battlefield, and consumer uses such as ski goggles.

We have only just scratched the surface of VR and AR here – the future possibilities seem almost limitless and many new ideas will evolve as the technology further develops.

Virtual reality (VR): and special controls electronic world – ga industrial applicatio

Augmented reality (an image of the rea gaming and shoppin

Biometrics: Authenti physical traits such a pattern, etc.

Biometrics

Biometrics uses parts of our body to identify ourselves to a system (for authentic e.g. for use with smartphones, tablets, computers and specialist systems such as locks. As we are all unique (different fingerprints, facial structure, iris/retina patt the device or computer can compare us to its database and gives us access if we Biometrics can be used instead of a username and password, or to complement form of identification. When several different forms of ID – for example, someth know (a username and password), something we have (e.g. a smartcard), or who (biometrics) – are used in combination, the security is increased because it's diff hackers to have access to physical objects and, of course, other people.

Examples of biometrics include:

- A fingerprint reader or swipe reader on laptops and smartphones, often inte 'home' button
- Facial recognition using a 3D camera, e.g. Windows Hello
- A retina or iris scanner attached to a door locking system

Which types of interaction do you find easiest? Why?

The Internet

What is the Internet?

The **Internet** is a network of interconnected computers which communicate globally with each other via an IP (Internet Protocol) address. You may hear of the Internet as a 'network of networks', giving a wide range of access for both public and private networks, and commercial, academic, personal and gove connect their local networks in different countries via the Internet. Accessing th access the World Wide Web (WWW) and other protocols which use the Internet f Wide Web is a collection of websites which are available on the Internet.

Internet: A worl of computer net

The Internet is very useful in the home, at school or at work, allowing the user t and easily. [illegible] use the Internet for school research projects. The Internet is important in every aspect of our personal lives, from banking to dating, while th for routine but important tasks such as issuing passports, to major communicati of the Prime Minister addressing the nation during a crisis.

The Internet can be used to:

- **Communicate** – emails, chat rooms, social networks, etc.
- **Entertain** – downloading/streaming music and video, online gaming, etc.
- **Inform** – wikis, articles, blogs, etc.
- **Shop** – for goods (e.g. clothes) and services (e.g. car hire)

Computers are networked together globally using telephone network technolog phone line in the form of analogue and digital signals. Analogue is the standard in varying waves. This makes analogue slower than digital and more prone to co ones and zeroes and is constant. Digital data is transmitted faster than analogue

The infrastructure of the Internet

The public Internet is made up of combinations of different devices, all with specific f around between the Internet service providers (ISPs) and various types of server and DNS servers which translate your request for a website into the IP address o around the world as 'packets', through fibre-optic and copper cables that run alo underground trenches.

Here are some examples of the networking equipment that is used on the Intern homes and businesses.

- **Gateways** (sometimes called routers on home networks) – connect your pri network – LAN) to the public Internet (a WAN – wide area network) which u a system called NAT (network address translation) to convert the addresses public address provided by your ISP.
- **Bridges** – connect two networks with the same protocols.
- **Switches** – either managed switches or unmanaged switches send data to s using the MAC address of each device. Switches form the backbone of the n
- **Hubs** – similar function to switches but they send the same data to every d throughput. They have been largely replaced by switches because of this li 'Hub' with the routers that are provided by ISPs such as BT and Virgin; they
- **Wireless access points** – [illegible] network access to many devices over the a
- **Clients and servers** – Clients are the computers on the network that receive up the [illegible]. For example a client PC is the computer that you sit at and req web pages and files. A server is locked away elsewhere in the building or is the stored files and pages to the client when requested. Clients process and server for storage, such as a completed web form, a new or edited documen also host applications that are viewed by the client through a web browser.

The role of the ISP (Internet service provider)

An ISP (Internet service provider) provides an Internet connection for a monthly fe cabling into your home if you're not using the existing phone line (e.g. fibre or coa a router. There are many ISPs available, such as BT, Virgin Media, TalkTalk and ma connectivity services at different prices and speeds. Where you live can influence t available based on the local infrastructure. Some remote communities have chose effectively becoming a small, independent ISP for a village or hamlet. An ISP prov

- Internet access
- Online support

They may also offer:

- Email addresses and web space
- Firewall protection, content filtering (e.g. parental control) and sometimes f antivirus software

Search engines

Search engines maintain indexes of web pages (using a process called crawling) user to search for information on the World Wide Web using search criteria, or ke the user types in the search criteria or keywords, the engine searches its vast da those words and produces a list of links to likely websites; the most relevant site usually at the top. Many websites also contain a local search facility which enab the user to locate information within the site.

Popular search engines include:

Google	**www.google.com**
Bing	**www.bing.com**
Yahoo	**www.yahoo.com**

You can change the search engine by entering the URL (uniform resource locato preference in your web browser. Each search engine holds a vast database of inf keywords that help to find a website. The meta tags should be keywords from crawlers, such as Google, will pick up meta tags from the page content, not just t

The World Wide Web (WWW)

World Wid
interlinked
accessed vi

URL: Addr
for exampl

The **World Wide Web** (WWW) is part of the Internet and forms a network of websites. Web pages on the Internet are programmed using **HTML** (Hypertext Mark-up Language). Every website is hosted on a server and has a unique URL – see below. Websites and individual pages can be linked together by hypertext, usually called 'hyperlinks' – clicking the link takes you to that page.

Web servers

A web server hosts web pages which are supplied to clients (browsers). A web se
pages with which an end user can interact. Search engine servers and online for

Uniform resource locators (URLs)

To find information on the WWW you can either enter the **URL (universal (or unif**
specific website address, or use a **search engine** (a database-driven website that s
information) and then follow **hyperlinks** to find the relevant page (a hyperlink, or
that, when selected, will take you to another page). All website addresses start wi
automatically entered at the front of the address and means **Hypertext Transfer P**
means language). HTTPS indicates that a website is secure and has largely replac
website address is **www.** followed by the **domain name** – usually the company na
domain – **.co.uk**, **.ac.uk**, **.edu**, **.com**, **.org**, **.net**, **.gov** – which indicates the type of o
profit, government or education), or the location of the server. An example of a w

https://www.microsoft.com/

Hyper Text Transfer Protocol Secure (**scheme**)://World Wide Web.**domain name.g**
(top level domain)

The last two characters in the domain name show the country of origin – for e
organisation type.

Some sites also use subdomains and subdirectories.

In this example **https://docs.microsoft.com/en-gb/documentation/** 'docs' is the s
domain, 'microsoft.com' is the top level domain (for 'commercial'), and 'documen

Web browsers

A web browser allows you to view and interact with the World Wide Web. The first page that is displayed when you open a web browser is called the home page and is the default start page for a set of web pages. The home page will contain hyperlinks to other pages and other sites. A web browser requests a page, downloads it, and displays all components of the requested page on the user's computer (e.g. text, images, animations, videos, links, etc.) by interpreting the HTML code. Different browsers use a variety of 'engines' to interpret the code, and support varying levels of advanced features such as CSS and HTML5 – that's why websites sometimes look slightly different or might not work fully in unsupported or older browsers. Web developers will usually test that their websites function correctly in the most popular browsers.

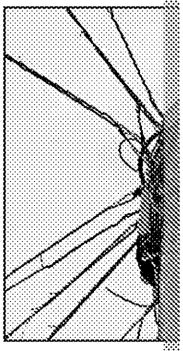
The World Wide Web can be viewed (or surfed) using a web browser such as th

Popular browsers

- Google Chrome
- Mozilla Firefox
- Microsoft® Edge
- Apple Safari
- Microsoft® Internet Explorer
- Opera

How much do you rely on the World Wide Web?

How we connect to the Internet



There are many technologies that we use to connect to the Internet. The most common methods are described below.

Broadband

Broadband uses high-frequency wavelengths to transmit the data (outside of the voice frequency), which means that phone calls can be made over the same cable at the same time. You may see a small box called an 'ADSL filter' hanging from your phone line right next to the wall socket. One cable goes to the phone, and the other to the router. This filters out the different wavelengths used by the phone and router, so that the two devices don't interfe

To represent Internet on a copper phone line, think of a pipe with a small amou bottom – that water represents the voice frequency. But there's a lot more room the possible flow of broadband Internet.

The amount of data (technically the frequency range) that a cable can transmit i larger the bandwidth, the more data that can be transmitted in a second. We ref (Mbps) or 'gigabits per second' (Gbps) – the number of bits carried in a second. A a megabit. Remember that if your Internet service provider promises up to 20 m only download at a maximum of 2.5 megabytes per second – as there are 8 bits

Where the Internet access to your home, school or business uses an existing pho digital subscriber line) is the most common– 'asymmetric' means that the down the upload speed; for example, 20 Mbps download and 1 Mbps upload – OK for uploading video, online gaming or having lots of people online at once. If your l upgraded to use fibre, you'll get faster speeds, [illegible] Mbps download, but yo

Broadband: Gener high-speed Interne data transfers) pro or fibre.

Bandwidth: The an transferred through period (measured i

ADSL: Internet conn speed is much faste

SDSL: Internet conn and upload speeds

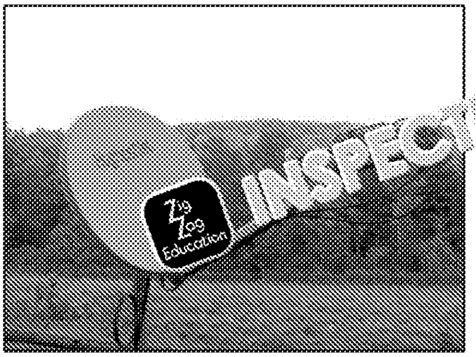
Some ISPs offer **SDSL** (symmetric digital subscriber line) connections where both download and upload speeds are the same. These lines are slow (if using copper), expensive and rarely used today, but they are sometimes still used where extremely reliable connections are required. Some business-grade fibre connections are symmetric.

Broadband enables the user to have permanent connection to the Internet without losing access to the phone line or fax (as happens with dial-up connection).

When connecting to the Internet within your building, wired networking is gene more fixed. Typically, wired networking uses an Ethernet cable with an RJ45 cor fast – they may be upwards of 10 Gbps.

In businesses, networking will run in the walls or in trays near or above the ceili installed in the walls, trunking or floor, all leading to switches and patch panels is likely to be built into new buildings, and has been 'retrofitted' (after being buil many offices are wired with copper cable, large sites may use fibre-optic cable t infrastructure together. This is because copper cable typically can't be run for st as the signal degrades. Once installed, the network devices such as PCs, laptops a nearby socket with a short cable.

In your home, you'll connect with Ethernet cables to your router if you want a be (faster speed, lower latency) – great if your devices are in the same room, not sc of the house. Some modern houses can be pre-wired with Ethernet for an extra c retrofitted their homes with Ethernet cables that run through the loft or under th powerline network adapters which plug into existing electrical sockets and use t the plug sockets to transmit the data. Some powerline adapters also add an extr home network.



Satellite

If you live in a very remote area where th isn't a reliable mobile network, you might

You are probably familiar with, or have a attached to houses to receive TV. Satelli to receive Internet access, but unlike TV able to send as well as receive data. Sate geostationary orbit satellites – they rota meaning that they always stay in the sa

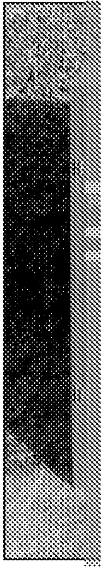
Advantages and disadvantages of satellite

- ✓ Gives access to the Internet where previously there was none
- ✓ Can be quickly connected (once the satellites are in place) as cables do not home (where they aren't already in place)

- × Very expensive compared to conventional Internet connections – perhaps £
- × Typically slow (max ADSL speed or slower)
- × Often have limits on how much you can download – perhaps a few gigabyt
- × High latency – so poorly suited to some uses such as VoIP and online gami

However, this could all change very soon. SpaceX's Starlink project has already l into space which will vastly improve the service provided by satellite Internet, a

Fibre



The fastest and most reliable connection is full **fibre**, delivered directly to your home or apartment block, which could offer you several hundred megabits per second to a gigabit per second download. You may get your Internet delivered through a coaxial cable (thick copper core) from an exchange that uses fibre. Coaxial cables allow more data than a phone line – you might have a cable TV service where the cable splits in two (one to your TV box, the other to your router), which may also support VoIP phones. Fibre connections are typically more expensive, and are not available in all areas.

The modern global Internet relies on glass fibre for its main infrastructure. This includes many of the undersea cables that connect countries together. You occasionally see in the news that one of these cables has been accidentally cut by a ship, meaning that some countries' Internet connection has slowed down until the cable has been repaired.

Glass fibre uses pulses of light (e.g. a laser or LED – hence 'optic') to transmit da light. This allows for a very high bandwidth, with thousands of connections over

Over time, the core copper network in the UK is being replaced with fibre – an e trenches must be dug to lay the expensive cable.

There are two ways that customers benefit:

1. **Fibre to the cabinet (FTTC)** – the copper cable between the phone exchange and the street cabinet is replaced with fibre. You still use the same copper phone line from the cabinet to your house (the 'last leg'), but as there is less copper, the speed is much faster than ADSL – up to around 80 megabits download. Because you are still using copper, the speed varies due to distance as for ADSL – copper is definitely the weak point. Some co thicker copper cable (coaxial cable) can provide faster speeds than are possib
2. **Fibre to the home (FTTH)** (also called fibre to the premises (FTTP) – your h fibre network. As there is no copper, speeds are much faster (including uplo and pay for different speeds that the provider offers – a single person may 50 megabits but a large family might pay extra for several hundred megab

Fibre to th
Internet de
but uses co
to the cab

Fibre to th
delivered

Fibre rollout now covers much of the UK. It is expected that, over time, more ho

Advantages and disadvantages of fibre

- ✓ Very fast and low latency
- ✓ Much higher upload speeds – good for uploading files to cloud storage, or
- ✓ Tiered pricing allows you to choose a package to suit you
- ✓ FTTH allows you to stop using a copper phone line and paying line rental if phone (and your router might allow you to connect a VoIP phone)
- ✓ Speed on FTTH doesn't slow down with distance from the exchange, unlike

- × Can be more expensive than ADSL
- × FTTH is not yet available everywhere
- × Maximum speed for FTTC is still reliant on the distance of your home from your phone cable

Mobile (4G/5G)

Internet access either through your smartphone or through a dedicated router th accesses the 3G (legacy), 4G or 5G network. Most of the time, you will access the connection on the phone directly on the phone itself. Sometimes you might also 'tet to another device which shares your phone's data connection with other wireles devices such as a laptop, or through the USB connection.

You are limited to the monthly data allowance that is set in your phone contract you might use the data very quickly if this is your only source of Internet access. are also limited by the network signal strength where you live, which could be p in rural areas, or even in densely packed cities.

4G (fourth generation) is the current standard for mobile Internet used in smartp provided by cell towers used by telephone providers. Over the coming years, it w generation) which will offer greater coverage and much faster speeds (up to 10 less interference in urban areas because of the higher-frequency signals. But yo to get on to the 5G network, and the service is initially limited to larger towns a

However:

- 4G signal can be patchy in rural and mountainous areas, and indoors as wal signals. You'll have found this out when holidaying in the countryside.
- Calls and data connections can drop out or time out.
- 4G routers are available which use a SIM card in the same way as a mobile phone (mobile service). The data is then fed into your home's Wi-Fi network (and more recently some BT home routers) also have a 4G connection whic switches over to if the normal cable Internet stops working, e.g. a fault on t

In the future, 5G routers could be a serious competitor to fixed home broadband the Internet of Things (IoT).

Wi-Fi (802.11 standards)

There are several different wireless technologies that use the 802.11 standards.

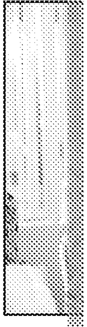
Wi-Fi takes the incoming cable Internet (copper, coax or fibre) into the home or business, and broadcasts a wireless signal that you can connect your devices to. There are many devices that you can connect to Wi-Fi – phones, tablets, laptops, some desktops (all if you include a wireless card or a USB adapter), TVs and a whole range of IoT devices, including colour-adjustable light bulbs.

You might be surprised to learn that the name 'Wi-Fi' is not an abbreviation, just a catchy brand name – some people incorrectly think that it stands for wireless fidelity.

Wi-Fi: Techn
to other dev

In your home, Wi-Fi is probably built into the router provided by your Internet pr
use your own Wi-Fi transmitter and booster equipment, and add repeater device
access points may be installed to ensure that the complete building has coverag
building, your device automatically disconnects and reconnects to the next acce
many public areas, including cafés, allowing greater work flexibility – from wor
appointments, to informal meetings in the café itself.

Over time, Wi-Fi has improved in terms of speed and range. Most modern device
technologies. Some networks can offer both frequencies in the 2.4 GHz and 5 G
However, Wi-Fi networks can perform poorly, especially when the router is surr
there are competing networks that overlap on the same 'channel'. You may noti
certain parts of your home.



Wi-Fi is great because it allows a lot of flexibility on where you work – very valuable in businesses where you can move around the building and attend meetings. Your device may even be switched to the different access points. But Wi-Fi isn't as reliable or usually as fast as a wired connection. Wi-Fi can also pose a security risk because it is accessible from outside the building, so make sure that you have changed the network and router's login password! Some companies don't allow staff to use or connect company devices for business use via public Wi-Fi over security concerns.

	Advantages	Disad
Wired	- Fewer interruptions to signal - More secure - No health concerns about exposure to radio waves - Fibre-optic cables provide faster broadband speeds where available	- Wires are messy and pr connecting multiple de rooms in a household, u - Unshielded cables are s interference in some ins instead if that's an issue
Wireless	- Ease of use, no wires - Devices identify and connect to each other without needing physical attachment - Mobility and outdoor use: can connect to the Internet via public Wi-Fi hotspots	- Possibility of a break in interruptions in service games) - Less secure, limited ran - Using higher-consumpt and most but not all de - Other wireless devices - There are health conce wireless radio waves ar

Bluetooth

Bluetooth uses radio frequency to connect or 'pair' devices together and to transfer files over a short distance (several metres). Bluetooth is built into most smartphones, tablets and laptops. You can add Bluetooth to a d inexpensive USB device.

Bluetooth: A technology th over short dis

Compared to other technologies such as Wi-Fi, Ethernet and USB, Bluetooth is ver 25 Mbps). We don't often use it for file transfers or for sharing your phone's Intern possible to set up. But Bluetooth excels at connecting to wireless peripherals such and mice, game pads, printers etc. We can also use Bluetooth to connect to our ca making hands-free calls, to access security devices, and for connecting devices tog

GIS (Geographic Information System)

A **Geographic Information System** is a powerful mapping tool used for storage, a Geographic Information Systems are especially useful for showing layers of data businesses.

For example, you could add a base map such as a Google map or an Ordnance Survey map, or an aerial photo. On top, you add other layers, including data that you have collected, or data that has been provided by others. You can then see where the data overlaps, to draw out trends, anomalies and a wealth of useful information.

GIS (Geograp System): Soft of informatio patterns and

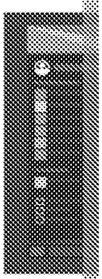
It would be useful for a supermarket business to see the areas where there are h existing nearby shops. In GIS, one layer could be a plot of all of the nearby shops show income.

If you're interested in GIS, have a look at Google Earth – it's essentially a form o different layers that are overlaid on the base aerial photograph.

A GIS may also refer to using GPS or other technologies to pinpoint your current installed app and the GPS receiver built into the device.

How is your home Internet provided? What speed do you get?

The features of operating systems



Today the most common **operating system** (OS) on desktop/laptop computers by far is Windows 10, followed by macOS. There's no doubt that you will be familiar with using either or both of these. By the time you read this, Windows 11 will have been launched.

Linux is a free alternative and has a good following with computer enthusiasts. While modern versions are designed to be accessible to consumers with a graphical user interface (GUI), Linux has a reputation of being harder to use with its frequent use of the terminal. If you're interested in trying out Linux, you could first try installing a popular distribution (distro) such as Mint or Ubuntu, either as a virtual machine or as a live boot (a live boot doesn't install to your hard drive) – both can be booted in a virtual machine manager such as VirtualBox. If you've got a Raspberry Pi, you'll probably be using a version of Linux.

Operating syst manages a syste resources as wel

On the phone and tablet side, Android (from Google) and iOS/iPadOS (Apple) are

There is significant overlap in the design and core feature sets between competi there have been lawsuits over these similarities. If you are familiar with using on fairly quickly.

A key difference between these systems is the type of software. Software is typic operating system and is then ported over to another. Some software or apps may especially if the software is written either by Apple or Microsoft, or by a very sma

The purpose and functions of operating systems

The operating system is one of the most important parts of a computer – it interacts with hardware and software, and provides the interface.

Managing resources

The operating system manages the resources available to your computer, such as the RAM, network adapters and processor. The OS also manages files and storage space.

Managing peripherals (input and output)

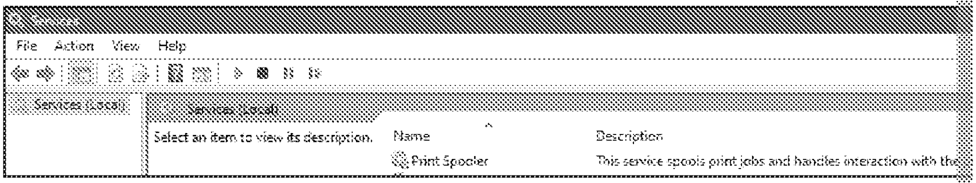
All peripherals (keyboard, mouse, game controller, printer, scanner, webcam, speakers, displays, external drives, etc.) are manged by the operating system; for example, the recording and storing of input and providing it to the appropriate program, or sending the necessary output to the monitor, printer, etc.

Each device uses a special piece of software called a driver to allow it to work with the operating system. Some drivers are built into the OS, others are provide party such as a printer manufacturer.

Spooling (printing)

Spooling (p managing p files to the p

Spooling is used when documents are printed to manage the 'print queue'. It is usually built into the operating system, and launched when a user logs in or the system starts. When you press print, the operating system uses the print driver to create a printer-specific fi files are temporarily stored on the hard drive and sent to the printer in the order t are printing several documents at once. Without spooling, it would only be possib

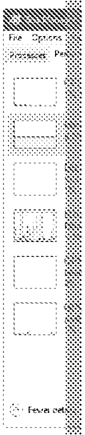


Select an item to view its description.

Name	Description
Print Spooler	This service spools print jobs and handles interaction with the

You can check that the spooler is running using the services menu in Windows.

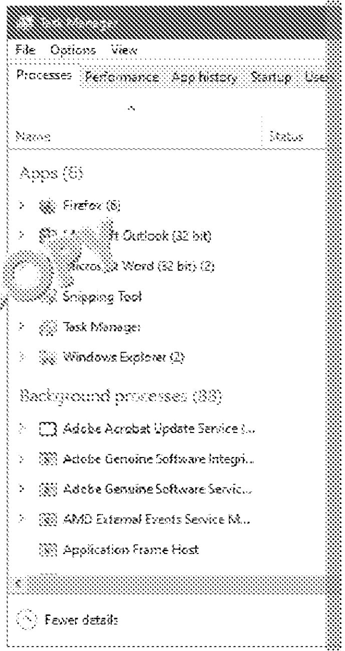
Managing memory



Operating systems manage the content of the system memory (RAM). When the RAM becomes full, hard disk space is borrowed and used in place of RAM. This is called 'virtual memory', and the memory contents are 'swapped' between the RAM and hard drive using a 'swap file'. Virtual memory is much slower than RAM because of the high read–write time to disk, especially if slower mechanical drives are used, causing the system to run slowly.

In Windows you can use the 'Performance' tab in task manager to see how much RAM is currently in use.

Managing processes

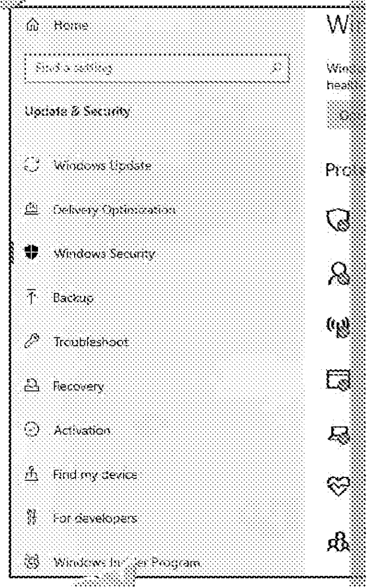

Task Manager
File Options View
Processes Performance App history Startup Users
Name Status
Apps (6)
Firefox (6)
Microsoft Outlook (32 bit)
Microsoft Word (32 bit) (2)
Snipping Tool
Task Manager
Windows Explorer (2)
Background processes (88)
Adobe Acrobat Update Service (...
Adobe Genuine Software Integri...
Adobe Genuine Software Servic...
AMD External Events Service M...
Application Frame Host
Fewer details

Operating systems run lots of different processes at once in order to function. Running these processes at the same time is called multitasking – each of the processes gets a short time using the processor, before control is released to give another process a turn – this is decided by the operating system. In the early days of computing the release was initiated by the application rather than the OS, meaning that if one application didn't release control, the whole system would crash. Nowadays, crashes usually affect only the single process or application.

You will be aware of all of the running applications, like web browsers and office applications, because they show up in the taskbar or dock. If you open Task Manager in Windows, you can see all of the running applications, but also the background services and pro services are essential for running processes provided by the OS such as the print connection, and third-party processes such as antivirus and software updaters. B automatically scheduled to run at start-up or login.

Other processes include file compression (to reduce disk space) and disk defragm drive to speed up access time). Solid-state drives are not defragmented as often on the drive. Instead, a TRIM utility is used to free up deleted file space to balan

Managing security



Our devices contain lots of data that hackers want to steal, and are targets for malware. Therefore it is essential that they are protected.

Most operating systems include a firewall (usually incoming) to block intrusions. Some also have built in antivirus software, such as Windows Defender Antivirus. Both firewalls and antivirus are covered in a later section.

The operating system is also capable of managing the permissions of files and drives – the network administrator will be able to allow or deny access to certain files or folders to different users, and decide whether users can edit and delete files, or just view their contents.

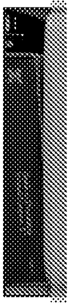
Providing the user interface

The operating system provides the space in which we run our programs and acc example, the OS provides the start menu or applications folder, the taskbar or d The OS also defines the look of some applications. We look at the types of user i

Which operating system(s) are you most familiar with?

Human-computer interfaces (HCI)

There are several different interfaces that we use to interact with computers and devices.



The command line interface (CLI)

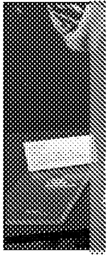
Many early computers used a basic command line interface. Instead of pictures and icons, only text is displayed on the screen, mainly because of the hardware limitations of early devices. Some of the earliest devices had no screen at all – the text output was printed on paper one line at a time.

The user had to learn and remember many different commands to perform basic
folders (often called directories) and copying them. If one letter was typed incor
rejected. Each command is typed at a prompt, e.g. "C:".

While most consumers no longer use a CLI, they are still widely used by comput
powerful and quick way of performing tasks (you just type a few words rather th
windows and buttons) and for network administration. Additional letters after th
to perform extra functions (called switches). If you're interested in taking a look
in the command followed by /? and you'll see a detailed help file with all of the
both PowerShell and the older Command Prompt).

You can access a CLI in Windows (PowerShell and Command Prompt) and through

The graphical user interface (GUI)



The GUI is what we mainly use today on PCs and laptops. Both Windows and macOS have been GUI-based since they were first developed in the 1980s. However, early versions of Windows required you to boot into the command line called DOS before you could open the Windows graphical shell. GUIs need much more computing resources than a CLI – faster processors, more RAM, and more powerful graphics cards.

The photograph shows the Xerox Alto computer, one of the first GUIs developed

We are all familiar with the desktop metaphor – the early designers of the GUI l
decided to digitise what they saw. What's in an office? Well, there's your desk th
on paper – so we got the desktop where you could store files and see open appl
Then there's a waste paper bin – so we got the recycle bin. There are filing cabi
etc. Some early desktops even had in trays and out trays, from where you would send and receive mail!

GUIs are designed to be navigated using a keyboard and mouse (although modern laptops may have a touchscreen as well). They employ an interface called WIMP – Windows, Icons, Menus and Pointers. They are much more intuitive and
(just click on a picture (an icon) and press buttons rather than typing commands)
paste data between applications.

Command line interface (CLI): In this i
types a command as input to the compu

Graphical user interface (GUI): Typical
allows navigation using menus, options a

Touch-sensitive interface (TSI): Type o
and stylus used mainly on the screen

Touch-sensitive interface (TSI)

TSIs are used in smartphones, tablets and other industrial applications such as point of sale and customer ordering systems. Touch and gestures are used to navigate the OS, so the designs are simple and easy to use with a finger. Sometimes styluses are used for extra precision.

Menu-driven interface

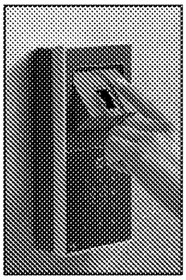
Menu driven interfaces use a series of branching menus to navigate the system. These systems are used in cashpoints and older phones, iPods and MP3 players. The options can be selected by buttons, scroll wheels or touch, etc.

Menu-driven in
options on an in
cashpoints, some

Voice-driven in
controlled throu
speakers and sm

Biometrics

Biometrics uses simple readers to identify a user; for example, a fingerprint reader, an iris scanner or facial recognition software, etc.



Voice-driven interface

Devices can process our voice or voice patterns in order to interpret commands or for authentication, asking us for responses. In the home we use voice control for smart speakers, smartphones and some appliances. Companies also use voice-driven interfaces on some incoming customer phone lines so that
right department and give our name, reference number and address to the syste

Have you ever used a CLI? If you did, was it difficult?

Application s
used to perfo
computer, e.g
graphics-editi

Bespoke soft
for a specific
task for the co

Software types

After we have installed the operating system, we install extra software in order to use the device for its intended purposes.

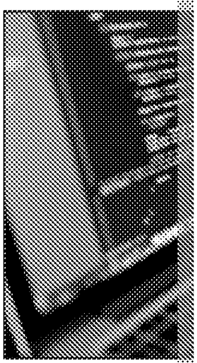
Application software

Application software is any standardised software that we run on a daily basis to
our computer. The software is usually purchased or downloaded from the Intern
either paid for (proprietary) or free (open source).

Examples include the Microsoft Office suite, or a free office suite, and web brow

Bespoke software

Bespoke software is software written by a software house for a single customer. The process is lengthy and expensive – the software can't be bought off the shelf; a team of programmers may spend weeks or months writing and testing it. Large companies may commission bespoke management or stock control systems that are tailored to their business processes.



Some companies may have a small internal programming team to create and maintain software developed in-house.

Process control

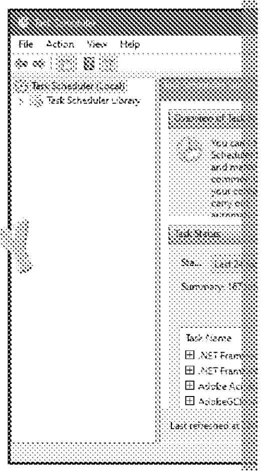
Process control software is used in industrial settings to control complex inputs
production process.

Utility software

Utility software is a generic term for software that maintains your computer and
(optimisation). These tasks generally run in the background. While their function
system, third-party versions are usually available. Examples include disk clean u
formatters and compression tools, backup software, disk repair and security soft

Task scheduling

Operating systems also use a task scheduler to perform tasks at specific times or when certain conditions or triggers are met; for example, running updates every day, or weekly backups, etc. You can set up tasks to run at specific times on certain days, such as the first Monday of each month. A task scheduler is built into Windows.



Antivirus

Antivirus software scans and monitors a system for known threats such as viruses. When it finds malware, it will remove it or move it to a 'quarantine' area which stops the malware from running. Antivirus often scans downloads and memory contents, and can sometimes block malicious downloads. Some antivirus software can monitor files for signs of suspicious activity even if the threat is not in its database (we call the tell-tale signs of each malware its signature). Antivirus must be kept up to date (usually updated daily) so that it can identify the hundreds of new malwares that are created every day.

Process control: A
systems including

Utility software:
designed to help
maintain a comp

Task scheduling:
automatically at

What application and utility software do you use?

Backing up data

We need to keep copies of our important data in case the original copy is lost or corrupted. Backup is the process of copying those files to external storage media

Most companies will back up their most important data every day, some even se times a day. Without data, the company wouldn't be able to function effectively a could even close.

We can back up:

- An individual PC or Mac using a backup utility built into Windows or macOS third-party tool
- A server or many servers at once using built-in server backup utility or third remote machines are copied across the network
- A single file or folder, or the whole machine

There are several types of backup that are used:

Full backup: Typ
all files are back
they have been m

Incremental back
only the data mo
weekly backup is

Differential back
since the last full
each day.

Full backup

A full backup includes all files that are to be backed up. This takes the longest to run and takes up the most storage space. It is the fastest type of backup to restore from.

A full backup might include all of the following:

- User profiles and user data
- Shared drives and sh[illegible]
- Databases (us[illegible]es, etc.)
- Email a[illegible]es

You may hear the term 'system image' backup. This is an exact clone of a hard d operating system, applications and all data. Restoring this backup will restore th

Incremental backup

Backs up only the files and folders that have been modified or created since the if the first incremental backup, or since the last incremental backup). Incrementa create because only the data that's changed is backed up. But they take the long backup must be restored, and then each incremental backup is required in the o

Differential backup

Differential backup is slightly different. Like an incremental backup, a full backu differential backup copies all of the data that has changed or was created since since the last differential backup). So if a full backup was performed on Monday backup would include Tuesday's files. Wednesday's would include both Tuesday The backup size will increase each day, but restoration is faster than increment latest incremental backup is required following the full backup restoration.

Grandfather – Father – Son (GFS) methodology

Companies will implement different backup methodologies, and often keep cop deposit box in case the office building is destroyed or there is a break-in to the methodology is GFS:

- Grandfather – full monthly backup or full system image (stored off-site)
- Father – full weekly backup (stored on-site)
- Son – differential or incremental backups (performed daily or even more fr

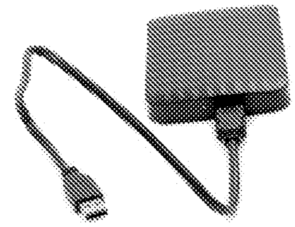
Have you, or has someone you know, ever lost data? How?

Choosing suitable backup media

Large corporations will back up most of their data using a combination of hard d as an individual should keep at least two copies of all important data, on differe

USB flash drives

Small USB flash drives that you might use to transfer a few files between home school. They are good at temporarily storing and transferring a few files but are limited by their small storage size, perhaps 16 or 32 GB. They are small and very cheap, so they're easy to store and carry, but equally easy to lose!

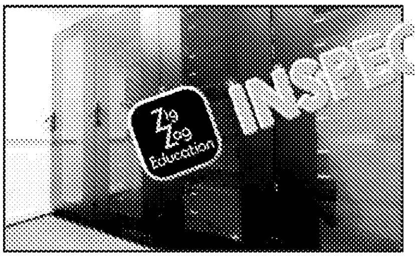


External hard drives

Usually a 2.5" drive in an external enclosure that co solution – they are fairly cheap, have fairly fast rea have USB3 ports), have high capacity (e.g. 2 TB) and can be damaged more easily than internal drives, a

Solid-state media

Drives use flash memory which makes them more durable than mechanical drive extremely fast storage. However, they are more expensive than mechanical offer lower capacity. Flash memory has a limited number of writes before the memory as 3,000.



Cloud storage

Cloud storage is just storage space on an off-s and accessed through the Internet. Unlike a o might last many years, you pay a monthly fee more you pay. Your data is protected from loc and accessible from everywhere, which can be the data could be lost or stolen, and the uploa hours for large backups if you have a slow Int

When did you last back up your dat

Disaster recovery plans

A disaster recovery plan enables a business to recover quickly after its servers have been affected by:

- A cyberattack, such as data deletion or modification, or a ransomware attack
- Physical theft of drives or servers
- A fire in the building that has destroyed the serv
- A flood or other natural disaster
- Hardware failure – e.g. too many failed drives or a failed server
- Data corruption
- Accidental deletion by a member of staff
- Power cut – in the UK it is very rare to lose power for more than a few hou can occasionally experience a day or more without power (e.g. Texas in 202

Disaster recovery from backup and following a cybe

If the data is hosted in the cloud, the owner of the remote server will be respons disaster management plan. The IT department in a business that uses on-premis maintaining and implementing the plan.

The plan will rely on data being restored from backup media. Backups are usuall to another server once or twice a day, or to a tape cartridge or disk. Some syster cartridges automatically.

At least one set of backups is kept off-site in case the whole site is destroyed. Th taken, the less data is lost. The faster the business gets up and running again, th of long-term damage.

Some components of the plan will include:

- The frequency and storage location of backups
- The physical and logical security of the system
- Who is responsible for updating and implementing the plan
- The actions that staff should take after a disaster to get the data restored aga

Of course, a data recovery plan is never idle or forgotten about, gathering dust i remain up to date at all times with updated job roles (rather than specific staff n and are replaced over time), and include any new risks, mitigations and updates be a daily occurrence. Regular testing of the backup system is necessary.

The disaster recovery plan will include:

- What everyone will be doing to ensure that no steps are missed, the work is don't perform the same task.
- What staff should and shouldn't do – everyone in the company might be inv on paper temporarily and not reporting news of a breach to the media.
- Who is responsible for making sure that the backup is running successfully, re when and how data is backed up, which drives or tapes each day, off-site stora
- Timeline for disaster recovery – which data and equipment will be restored fi infrastructure needed by the company to run successfully), and which is l
- What will need to be done if the office location needs to move either perma location (if the office is destroyed in a fire or becomes uninhabitable due to the policy will specify what network infrastructure, servers, hardware and s purchased for the move, and how the data will be restored at the new locati cover the loss of staff, for example, if the office is located in a hazardous ar

Cloud services

In recent years, businesses and consumers have started a shift away from physical h storage and cloud computing. You have probably used cloud storage at some point; account comes with 5 GB of free OneDrive space. Operating systems and apps can b providing access from anywhere in the world. There are many advantages and disad

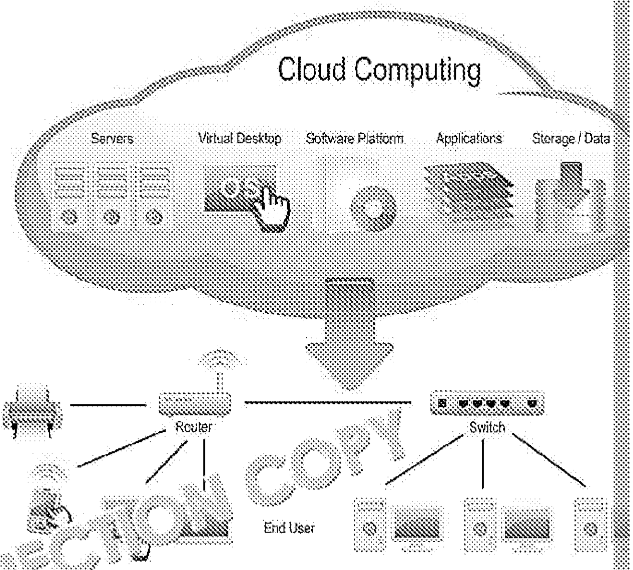
Cloud computing vs cloud storage

Cloud computing is a term used for virtual computing services such as hosted applications and online data storage or a combination of both.

A hosted application is a software application that is hosted over the Internet and not on a user's computer.

Cloud computing: Pro running applications o the interface and outp

Cloud storage: Data s is stored on remote se



A hosted application is a software application that is hosted over the Internet a benefits are:

- **Low cost** – it can be shared across a network of computers, and some vend per user, unlike traditional software licences
- **Low maintenance** – the vendor rather than the client deals with issues
- **Mobility** – the client can access the software from anywhere
- **Instant availability** – because the software is not installed physically onto a software is immediately available to the client
- **Automatic backup** – files are automatically backed up onto online storage

An example of online software is Microsoft Office 365, which provides the newe Office programs, such as Word, Excel and Access, to multiple PCs or mobile devi flexible way of using and sharing resources and can be utilised in the home, in s and in schools and universities. An annual or a monthly subscription fee is incur the latest versions of online software; this typically allows usage on several PCs flexibility of online storage and cloud computing. Hosted software enables users using templates, drop online media content into documents and share documen

An advantage of hosted software over stand-alone software packages, such as M to create, edit and share documents on a variety of PCs or mobile devices using Gaining access to the newest versions of software provides greater functionality ability to share and store documents online, helps to increase productivity and c

Remote backup services, also referred to as digital vaults, are provided by Interne Internet connection for a fee, providing convenient access to files over the Interne with friends, family or colleagues via a password. It also allows a user to protect fi

What is cloud storage?

Instead of having on-premises servers (the traditional method of storage), many files on 'cloud' servers. The term 'cloud' just represents the idea that there are m connected to the Internet.

These servers are located in special buildings called 'data centres' that house tho between their clients. These buildings have fast Internet connections and consume a lo and for air conditioning – those servers pump out a lot of heat. They are kept ve

Setting up a cloud storage account is very easy – usually you just apply through amount of storage that you need. Some companies will give you a small amount personal account you just need to use the password you choose. In a business s own login and may only be able to access certain files.

Synchronisation

Sometimes you have a copy of files both on your device (e.g. laptop) and in the cloud. If one copy of the files changes, then that change gets copied to the other location.

For example:

- You can work on your laptop – when you save or modify the file, the new version is copied to the cloud.
- If you work on the file online, or someone else with shared access works on the file, the modified file is copied over to your device from the cloud.

This service needs an active Internet connection. Synchronisation can be very useful if y without a connection – just work on the local copy and it will be copied back to Internet access.

You can share files with other people by providing an appropriate link. They can edit documents and add files to a folder – this is great when people are working with the same files and always need access to the latest copy. This stops people from working on different versions – which wastes time and means that their input can be lost.

Synchronisati duplication an client and a se

Scalability: Be users or instan computing cap

Cloud storage can be accessed from anywhere in the world providing there is an restrictions are set, the files are accessible 24/7/365.

Scalability

Imagine that a company has an on-premises server that is getting full. They can

- Buy larger disks to install in their server – this requires lengthy copying of new disks (perhaps several days), and a trained technician to set it up
- Purchase a second server that could cost thousands of pounds as a one-off (requiring a technician to set it up)
- Migrate to a cloud server and switch off their on-premises server

On-premises servers have ongoing maintenance costs and a constant supply o This is included in the price for cloud storage.

With cloud storage, the amount of storage can be varied – by paying more to in storage, and by paying less if less storage is needed. This is scalability. Instead o upfront investment in hardware, a monthly or an annual fee is paid that is appro to the current needs of the business.

We can also run software in the cloud. Instead of a program installed on your co software on a remote server, and just access it on your device – often through a

Cloud computing makes the software much easier to administer:

- Just select and pay for the software that you need (just like cloud storage) a users. Increase and decrease as the number of staff changes (scalability).
- No lengthy installations on thousands of machines throughout an office bui
- Everyone is using the same version of the software – no incompatibility be versions installed or licensing issues.
- No need to push out security updates or upgrades – this is all handled behi software company.
- You can use less powerful – and, therefore, cheaper – hardware in the offic needed to act as a screen, provide keyboard and mouse input, and dis the processing is completed on the powerful server.

But there are drawbacks such as:

- Some online versions of software have fewer features than the desktop vers
- Needs a stable and fast Internet connection – otherwise the application wi
- If the Internet connection is lost or down, then the software is not accessibl coupled with on-premises servers, there is much less potential for downtim

Advantages and disadvantages of cloud services

Below is a summary of the key advantages and disadvantages of cloud computi

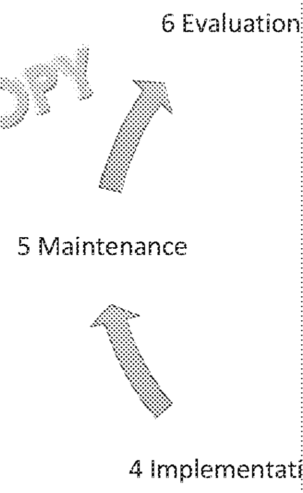
Cloud computing (online applications)	
Advantages	**Di**
• Cost-effective – it can be shared across a network of computers and some vendors charge for usage (including per hour) rather than per user, unlike traditional software licences • Low maintenance – the vendor rather than the client fixes issues and provides updates • Mobility – the client can access the software from anywhere • Instant availability – the software is not installed physically onto a server or computer(s), but is made immediately available to the client via download • Space-saving – no physical storage space is required • Accessible 24/7 from anywhere with an Internet connection • Allows for flexible staffing and working from home	Connection – and latency. If down you lose bandwidth wil (upload speed download spe • Lack of contro settings/defau • Security – not measures, suc software; the s • Limited – the remote server including all t software

Cloud storage (online files)	
Advantages	**Di**
• Ability to share files with other users • Ability to access files wherever you are and from a variety of mobile devices (laptop, smartphone, etc.) • [illegible] use encryption to protect data • Frees up storage space on your computer • Not affected by the corruption of physical storage media	• Confidenti from hacke • Data not p measures (software) • Data not b • Need an In access the

Do you ever use cloud storage? What are the pros and cons if you do?

The systems development life cycle (6 steps)

When we design and implement a system, there is a set of stages that we need to g stages to various contexts; for example, designing new software or setting up an e very important that this process is done correctly – change can be very expensive to implement, users may need new training and everyone needs to be on board with the change for it to be a success. The people actually using the systems are the ultimate judges over whether the new system is a success. In large companies, a change management team might be involved in the process and sign off the changes providing they can see the benefits.



The stages are outlined below, starting with the investigation.

You may come across other similar life cycles and models if you take a look online, but this is the one that you need to focus on for this course.

1. System investigation

In order to produce a better system, we must first be familiar with the existing o a look at:

- *What the current system covers* – its size and complexity, essentially the 'sco
- *The full range of hardware and software that is in use* – this may cover clients mobile devices, and physical infrastructure of the network, the operating sy utility software.
- *Issues with the old system* – what didn't work properly, what inconvenienced
- *The requirements from users of the new system* – the new system should incl need, along with added enhancements. Users will probably need access to t system, meaning that all of the data should be compatible with the new sys start using the new system.
- *Costs and benefit analysis* – for the new system to be worth implementing, t costs. This is calculated using a method called cost–benefit analysis.

2. System analysis

In order to fully understand the system, it's important to analyse how it works. F at all of the existing documentation of the system, talk to staff and managers ab use the system, and work out the exact goals and values of the company as a wh some of the following to do this:

- **Interviews** –it can be difficult to determine just from documentation how th needs to be used for. Managers may know the history of why certain data is way, or what it is needed for; staff may be able to quickly identify the frustr system or getting it out again in a way that is useful to them.
- **Observation** – the analyst may watch the system being used to see where t it is processed and where it needs to go.
- **Questionnaires** – particularly in large organisations, or for organisations wi most practical approach might be a questionnaire. This would have to be ca information about how the system is used.

The same process is applied to the new system – once the problems with the o must analyse the potential new system to check that the problems have been ad In order to fully analyse a system, systems analysts may use several tools such a

- **Data flow diagrams** – visual representations of how data flows through a sy to understand.
- **Decision tables** – grids that show varying outcomes depending on a range o
- **Data dictionaries** – big collections of information about something. We call

3. System design

When we design the new system, there is a lot to think about. For example:

- *Hardware* – how much of the hardware will be retained? Will new hardware will also need to choose the new hardware and infrastructure, and know th we might specify the processor or the amount of RAM needed in client mac servers, or the speed and cabling types used in the network set-up.
- *Software* – will the new software run on the existing operating system, or will operating system is upgraded? Will the software be switched over to the cloud written, a lot of time will be spent ensuring that all of the needs are met, and
- *Network* – whether the existing network or Internet connection can handle cloud storage and computing, whether it needs to be replaced or upgraded cabling, whether there are enough wireless access points, and whether the around the building, etc.
- *Staff issues* – some staff may be reluctant to change, and all staff and mana asked for their opinions because it's vital that they agree with the changes, willing to change. If the new system is very different from the old one, they possibly by the software company. There is a chance that a few staff may ev
- *Security procedures* – no system will be totally secure. The IT team needs to secure as possible and meets all of the company's security policies and stan even invite hackers to attempt to hack into their systems in order to find an called penetration testing, or pen testing for short.

4. System implementation

In this stage, the new system is actually installed providing that it has gained ap expected requirements.

Depending on the chosen approach, the system may be installed gradually (**pilot** department to try out and report any issues. Or the system might be installed alo that the old system is still available in case there are problems. Or the system m such as one department at a time (**phased**). Or the whole system might be install weekend (**direct**). While a direct approach is the fastest, it has the most potentia

5. System maintenance

Maintenance is the process of ensuring that the system is running as intended; f devices and components, installing security updates, fixing bugs, troubleshootin support requests from users.

As part of the system maintenance, *user guides* and *technical manuals* of how to u must be created and updated. These can range from PDF or printed documents, information accessible through the company intranet.

6. System evaluation

In this stage, the system is tested and checked to ensure that it meets all of its i doesn't then additional hardware or software might be needed, or bespoke softw staff and users may be interviewed at this stage to gather feedback.

Practice Questions

1. Give a limitation of speech to interact with a computer.
2. How can the keyboard be used to rapidly control a computer?
3. Identify a type of device that uses gestures.
4. Describe an advantage of using biometrics over traditional authentication m
5. Briefly describe the Internet.
6. Why are switches preferred over hubs?
7. Name the type of organisation that connects us to the Internet (not a specifi such as BT, Virgin, Sky etc.).
8. What language are web pages written in?
9. Which types of Internet connection are the fastest, and why? Give two.
10. Why does 5G have the power to replace fixed Internet?
11. Describe an environment where Ethernet would be better than Wi-Fi.
12. Give two resources that are managed by the operating system.
13. Who mainly uses the CLI today?
14. Why are GUIs more intuitive than the CLI?
15. How does application and utility software differ?
16. Why is bespoke software more expensive than most application software?
17. In the Grandfather – Father – Son methodology, which is the backup that is
18. Give a type of solid-state backup media with a low storage capacity.
19. Describe why businesses create and implement disaster recovery plans.
20. How does cloud storage differ from cloud computing?
21. Place the following stages of the systems development life cycle in order: A Implementation, Design, Evaluation, Investigation and Maintenance.
22. Identify a thing that we might look at when investigating a system.
23. What is a data flow diagram?
24. Which is the fastest way of implementing a new system?
25. Why are systems evaluated?

Chapter 3: Digital communicati

In this chapter you will learn:

- How we communicate digitally for both social and business purposes
- Why we need to be careful when using online information, and how to check t
- What the advantages and disadvantages are of social media, and who owns

The range of digital communications methods

Advantages and disadvantages of digital communications methods

We have never been so connected as we are now. Most of us carry a smartphone to the Internet at all times, allowing seemingly anyone to contact us at any time

I don't mind a call or message from a friend, but the number of spam calls and t sometimes. A seemingly unending stream of criminals on the other side of the w bank account by telling me that I need to pay for a parcel redelivery, or that I've Some people report getting work messages out of hours, blurring the work–hom that keeping up with work email is a full-time job in itself.

The revolution in technology has transformed our lives in connectivity, flexibilit in some cases, where we live. But some people are finding this overwhelming a example, by deleting social media accounts. We'll take a look at some of the co

Barriers to communication

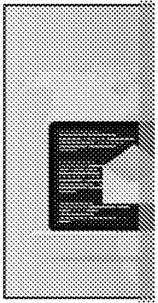
The key barrier is the digital divide – between those who have access to techno who don't are cut off from the many benefits and conveniences, such as online s Barriers could include:

- Age – some of our elderly population don't know how to use modern techn never learn to.
- Wealth – some people can't afford the cost of devices and ongoing fee phone contract
- Location – some countries still have fairly undeveloped communications n

Do you know anyone who is cut off from digital communications?

Personal and social communications methods

Emailing



Email, which stands for *electronic mail*, enables worldwide communication between users via computers or mobile devices.

With email you can send, receive, reply and forward mail to one or more recipients (a recipient is someone who *receives*). To have access to email you need a telephone line, a modem, computer and an Interne (Internet service provider). You may also need a router if connected to a netw

Email: T
employe
certain e

You can choose to access your email via webmail, e.g. through Google Mail or Hotmail, or through an email software program, such as Outlook.

An email address is made up of a **username** and a **domain name**, separated by th called the '**at**' symbol). The **username** is the name of the mailbox, and the **doma** the company or server and the location. For example the following email addres made up of the username **j.smith**, separated by @ and followed by the domain n company/server and the location). Geographical location may be indicated by th email address (for example, uk = United Kingdom and ie = Ireland) unless a .com

Email enables a user to send, reply and forward mail to other users, with or with is a file or files that is/are attached to an email message. This is a convenient wa photographs, to other users.

Be careful not to use bad language or bullying tactics in emails – this is referred knocked out of forums and chat rooms, or send bulk mail to a recipient as thi use capital letters in email as the text as this is considered **SHOUTING**! Also, d smileys or emoticons when it would be inappropriate to do so, e.g. in a professional spelling and grammar too, especially professionally and when communicating w Collectively, this is called **netiquette** (net etiquette).

Email can improve communication in large organisations, enabling staff to keep with up-to-date information. Files, such as minutes of meetings, agendas, audio attached to emails and distributed.

Advantages	
☒ Can transmit data quickly and cheaply to multiple addresses ☒ Can send attached files, such as photographs or audio files ☒ Formatting options enable you to change background, font, size and colour ☒ Can enable people to keep in touch all over the world ☒ Can be used to facilitate learning in CBT (computer-based training) ☒ Flexible – if using a web-based email account, you can access your mailbox and keep in touch from different locations using a computer, smartphone or tablet with an Internet connection. This is very convenient when travelling. This is also true of email client software if accessed from a laptop computer.	☒ Attach into yo ☒ Spam (scam ☒ Can be ☒ Relies an ele ☒ Size/s what y ☒ Attach and re

Instant messaging (IM)

Instant messaging is immediate and enables users to identify whether another user is online; it is a low-cost means of instant communication between two or more users. Instant messaging also allows users to communicate for free over the Internet and use webcams to transmit real-time images and transfer files. IM is a great way of communicating via simultaneous conversations, providing speedy communication and ease of use. The benefits of instant messaging are:

- Conversation is immediate and performed in 'real time' (unlike email)
- The environment is controlled (users need an email address or an IM address to take part)
- Pictures, photos and files can be exchanged
- It is cheap and easy to use

Instant messag of short comme two or more pe

IM can be processed via peer-to-peer (P2P) transmission or via a server/client ne retransmits the message to the recipient). Most modern IM services use strong e private. In some cases, not even the messaging provider can decrypt the messag

There are a wide number of instant messaging clients and apps available on sm You are probably very familiar with services such as Facebook Messenger, Whats

Blogs

Blogs are diary-style journal entries posted onto a website such as WordPress, or smaller sites for niche or specialist interests. They usually form a series of entries, with the most recent at the top; they comprise of text along with photographs, and sometimes drawings and video frames.

Blogs: Online d
or journal entri

Video confere
short notice, co
no travelling a

People may be willing to share details about their lives, opinions, experiences a

- A travel diary for a once-in-a-lifetime trip so that friends and family can rea
- A day-to-day diary for followers or fans
- To document and review purchases, lifestyle / health and fitness change
- To showcase interests such as photography
- To discuss opinions, news and events

Businesses may also set up blogs to generate consumer interest and provide det developments, or upcoming product launches.

Video conferencing

VoIP (Voice over Internet Protocol) enables calls to be made over the Internet, v software such as Teams, Zoom and Skype. Voice signals are converted from analogue to digital format. VoIP is cheap or free to other users of the software.

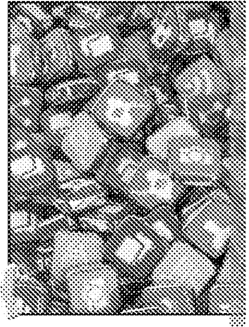
In addition to Internet access and appropriate software, a user needs the following hardware:

- Microphone
- Speakers
- Webcam (required for streaming video)

VoIP enables real-time communication over the Internet, using speech and live v conjunction with web meeting and conferencing software in order to create web people can meet at a specific time.

VoIP allows hundreds of people around the world to attend virtual conferenc events, or when the speaker is talking, you will not be expected to have your mi The host may be able to turn off everyone's microphones when people join the c lot of unwanted noise, such as coughs, bumps, feedback or echo, and allows the speaker's video and audio stream.

Social networking (web versions and apps)



There are many social networking sites, such as Facebook, Twitter, LinkedIn, Snapchat, Instagram, Threads and TikTok. These types of site provide features such as forums, instant messaging and file sharing which allow you to post information about yourself and communicate with other users.

Social netw
online platf
news, posts,

Social networking has impacted on how people socialise. It is now possible to communicate and share information with people from different backgrounds, cultures and countries without ever meeting face to face. This can become an issue when unscrupulous people try to form friendships with other users by creating a misleading online personality (profile), such as using a false Users can gather friends or followers and share information, video, audio, photo via their personal space. It is important to keep your profile private and only visi prevent fraudsters or unscrupulous people from accessing your personal informa

Friends that are gathered via social networking differ from the usual definition o number of them may be true friends. It is important to recognise the difference. A used to communicate and share information that cannot be used to identify you.

Participants can comment on their friends' profiles on a Comment space, Wall o visible to other users who have access to that profile.

- Be careful what you write about other people.
- Be careful what information you give away about yourself.

Information that you post on a social network space will be visible to other user this before you add anything you may later regret, e.g. photos of a night out tha potential employer!

Information can also be copied and pasted into other areas, so you never know w end up. Embarrassing photos or videos could turn up on YouTube to haunt you!

Social networking sites enable others to see what you are doing and where you are

What are your favourite forms of communication?

Business communications methods (internal and external)

Businesses use a variety of communications methods for staff to communicate with each other, and to

communications are outlined below.

Type	Example	Use	Advantages
Video conferencing and VoIP	Instead of using a traditional phone line, a VoIP (Voice over Internet Protocol) service allows for voice calls and virtual meetings through a desktop or a mobile app, or using a special VoIP phone.	• Internal and external communication with suppliers and customers • Help desk, customer service and sales roles • Project and team meetings • Online events and conferences	• Very cheap (often free) fo communication • Excellent option for inte • Can have conference cal of staff at once, across m locations • Easy to record for future • Easy to combine with vi • Cuts down on travel cos • Participants can be loca the world (with an Inter • Easier to organise appointments/meetings • Participants have access resources in their physic
Teleworking (collaboration tools)	Remote working uses remote-access technologies and collaboration tools. But teams may be located in different offices rather than at home, e.g. document sharing, instant messaging, video conferencing, e.g. Slack,	• Platforms designed to allow teams to work in the office, with other offices, or remotely, to share ideas, communicat[illegible] share files, set tasks and visualise project milestones	• All workers use the same work and share documen doesn't matter where th • Can replace more tradit such as email and on-pr sharing with instant me voice communications; s several people work on good for version control • Can set tasks and action been achieved and whe are being met

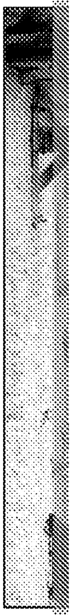
Type	Example	Use	Advantages
Teleworking (cloud services)	Each company or person who wants to use cloud services sets up a user account with a cloud provider which gives access to software, file storage, email, etc.	• File storage and sharing • Email hosting • Running software on a server rather than on the client machine	• Great for collaboration t and for working on docu same time, which can be on-premises options • Available 24/7 globally world teams • Easily scalable (just pay need, when you need it) • Everyone uses the same issues with compatibility
Email	[illegible]mpany will [illegible] series of mailboxes, sometimes publicly available, such as an address to receive customer queries, job applications, etc. They are accessed through a desktop client (e.g. Outlook) or a web browser. Each member of staff is likely to have a personal address, but staff in some departments will have access to shared and public mailboxes for a department or group use, e.g. customerservices or adminteam so that everyone in the team receives a copy of the message.	• Staff and managers send internal communication about projects, staffing and team or department email updates and company news • As a way of communicating with customers, e.g. helpdesk setting • Sending email marketing and new product launches • Sending updates to customers, e.g. new opening times, upcoming events and special offers and discount codes	• Good for communicatio and external recipients of purposes • Can perform the same f letters, but cheap to ser • Can attach documents a / HTML content, etc.

Type	Example	Use	Advantages
Promotion, advertising and marketing: social media	A company sets up business pages on popular social networking sites such as Facebook and X/Twitter. The company posts news and service updates and responds to messages from customers. Internal messaging systems are replacing email in some businesses as part of workflow software, e.g. Slack.	• To promote their brand to a targeted audience (including advertising) • To drive traffic to their website • To provide marketing, news and updates • As a way of customer feedback or point of contact • Email replacement	• Very fast communicatio and to external custome stakeholders • Quick replies and respo email, often fewer word • Real-time communicati wait for email response
Promotion, advertising and marketing: video	A wide variety of services that provide a combination of text, audio, video and images, etc. Usually two or more shown on the same page at once.	• Provide a rich experience, better than just text; for example, images in a blog, video instructions inserted into a tutorial page, etc.	• More engaging for the a interest and can use vid point or demonstrate a effectively than just tex • Appeals to a wider audi • Easier to understand • Provides alternatives fo disabilities (e.g. someon impaired can listen to a description, alt-text and

Type	Example	Use	Advantages
Promotion, advertising and marketing: leaflets	Leaflets and flyers for tourist attractions, takeaways, and other services.	• Provided at stands in tourist areas and information centres (attractions), often posted through letterboxes, left at local businesses, etc., in order to promote the business	• Good at grabbing attent of paper has to be dealt in a drawer for future us • May help direct website tourist attractions) • Can send through the po organising local deliver
Promotion, advertising and marketing: audio	Radio commercials	• Short (30 seconds or 1 minute) commercials to make potential customers aware of your company and brand, and increase sales	• Radio has a wide audien the day; some people lis while driving, while in th cooking, etc. • Reasonably cheap for lo • Can advertise on local s for smaller businesses • Good opportunity for no adverts • Radio can be listened to number of devices, and online and on TV

Type	Example	Use	Advantages
Websites	Companies set up a customer-facing website on the public Internet that anyone can access. Note that organisations may set up an internal website called an intranet – for staff to access information and tools.	• Often a first point of contact • To make customers aware about products and services, and to provide information and reviews • For articles, blogs and updates • For online sales platforms • For contact forms and live-chat sessions, e.g. with technical support and other helpdesk tasks • Company intranets (internal information systems)	• Publicly accessible from world 24/7/365 (even w [illegible]ed). Customers expe have a website! • Can contain a lot of info links to other pages, site and video • Able to create a series o available from menu ba • Wide variety of purpose corporate) • Easy to create (e.g. onlin • Easy to update
Apps	Businesses program apps to work on smartphones and tablets. They are then made available on the App store, Google Play, etc. Sone are free, others are paid for. Many desktop programs are also available as a cut-down mobile app, s[illegible] sui[illegible]er a [illegible]t interface [illegible]ed to work on smaller screens.	• Some apps replace a website – for example, shopping, banking apps, social media – or replace online applications • Others are designed to be stand-alone applications, e.g. games, satnav • [illegible] installed on mobile devices, such as email clients, calculator, torch, clock, etc.	• Provide easy-to-use, co contained platforms at t icon – no typing web ad • Add more functionality through a web browser • Each app can be given d permissions on the reso • Can easily switch betwe

The reliability of online sources



Take a simple quiz question such as 'What is the most common pub name in the UK?'. That seems like a very easy fact to check – just find every pub on a map, and tally them up in a spreadsheet (until you realise just how many there are!). If you search the Internet, the common consensus is that it's the Red Lion, but one site says that there are 547 Red Lions, another 543 (close!), but one says just 384 (nowhere near!). Some sites tell you that the Royal Oak is the second most popular name, while others say it's the Crown.

So why is there so much variation even for such a simple question?

Accuracy

We don't know who compiled the data behind those statistics. It could have been an official body, such as a government official keeping track of landlord's licences, or it could have been anyone on the Internet who accidentally forgot to include a few here and there.

Always be wary about where information has come from – for example, from an
can modify, personal opinion presented as fact, or someone misunderstanding or
they read elsewhere. If you look at online technical support pages, you'll see all s
work, are bad advice, or are entirely wrong. Or perhaps they didn't understand th
they thought was right, or what sounded right to them, or used a certain word in

Bias

Maybe the person didn't like a particular town or city and chose to exclude it from the list of pub names, or increased the number of the name they liked – a bit extreme, but you get the picture.
Bias is where you project your views and preferences into your writing. Perhaps you're writing a blog and you prefer one political party over another. You might only write positive things about the one you prefer, choosing to omit their failings, or maybe you don't write anything positive at all about the ones you don't like. Biased writing is unbalanced or one-sided. Or maybe you're writing a review and don't mention the negatives.
A manufacturer won't tell you about the bad things about their product because they want you to buy it. We find out about those parts on the review sites.

Accura
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Bias: C
story, c

Out-of
that is
longer

Out-of-date information

Information can become old and unreliable very quickly. Perhaps some of the in
was compiled 20 years ago. During that time, pubs will have closed and opened,
their names.

Have you ever been dubious about facts and information that you saw on

Verifying online information

So how do we make sure that the information that we find online is accurate, impartial (unbiased) and recent?

Checking multiple sources

While this can be time-consuming, it's best to take a look at a variety of different sources in order to check that they are similar. It's good to also check the sources for that page or individual fact (for example, on Wikipedia). Be wary sometimes even full phrases or paragraphs from each other. Sometimes there m last updated or the publication date – if it's more than a year or two ago, you sh recent. Search engines use a date range feature to help with this.

Ensuring websites are trustworthy

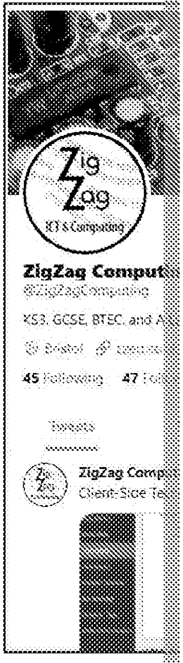
We need to know who wrote and published the information. There's usually an ' and work out who owns the site – is there a parent company? What is their agen Generally, you should consider a website trustworthy if it is owned by a reputab agency, or government, etc. because they will have checked the accuracy prior t for technical details about a computer component, go directly to the manufactu information that you find online. If you are reading something written by anyone review sites, etc. or on Wikipedia, you should try to verify that information elsew

Do you always fact-check material you use in school projects?

Social networking practices and ownership

Can you imagine a world without social media? If you wanted to talk to someone, you could phone them up, send them a text message, or write it down on paper and drop it into the post box for the price of a stamp.

There are so many different platforms that all compete with each other for our attention (and advertising revenue). Some become popular, and others don't and quickly disappear. They all have slightly different aims and audiences, and are targeted at varying demographics.



How social networking sites work

The broad uses of social media are:

- Chatting to friends
- Sharing photos and videos
- Joining groups of like-minded people
- Following public figures and news events
- Selling (e.g. Facebook marketplace)
- Connecting with businesses (following or online support)

With so many options to choose from, all of your friends need to be on the same using the same ones – otherwise your chats become fragmented.

The benefits and drawbacks of social media

Social media can bring us closer together with our friends and family, allowing u information to emotions. It can allow users to share their location in an emerge family know you are safe when you're in the area of a natural disaster, for exam way to raise awareness of and money for a charity cause, or promote your busin like-minded individuals to find each other to share their experiences of a hobby professionals in their area of work.

There are also many downsides to using social media, such as the following:

- Time! Social media is addictive – before you know it, 10 or 20 minutes hav down your newsfeed.
- Mental health – remember that people only post online what they want yo apartment, their achievements, their latest purchases, their trips out and pa everything is plain sailing. Don't feel jealous just because someone else is h
- Bullying and harassment – social media can be a channel for cyberbullying, stalking and other forms of harassment.
- Public profiles – check your settings to make sure they are set to private to identity or using your photos without permission. For example, scammers w websites using photos of random people's social media accounts. They th and ask for money – they often pretend to be in the military posted overse excuses why they can't meet in person.
- Misinformation can spread quickly, and often spreads more widely than the

These are just generic benefits and drawbacks of social media – each platform h

Platform	Audience	What can you use it for?	
Facebook	• The largest in the world – over 2.5 billion monthly users • Slightly male-dominated (around 56%) • Slightly older demographic, including many over 40 years old	• Posting photos and video (including stories) • Following news and businesses • Joining groups • Setting up events • Fundraising • Shopping (marketplace sales, similar to eBay) • Instant messaging	• •
Twitter (now 'X')	• Approximately [illegible] million monthly users • Significantly older demographic – over 60% of users are 35–65 years old • Male-dominated (two thirds)	• Microblogging – up to 280 characters (paid users can make longer posts) • Following famous people and celebrities • Retweets (reposts) and hashtags (which link your post to others on the same topic)	• • •
Threads	• Launched by Meta (the company that owns Facebook) as a direct competitor to Twitter when the latter rebranded to 'X' • Gained 30 million users on its first day launch in July 2023, mainly from Meta app Instagram	• Microblogging – up to 500 characters • Video up to 5 minutes long	• • •
Snapchat	• Widely used by younger people • Female-dominated (70%)	• Sending and receiving photos that auto-delete after a few seconds	• •
TikTok	• One of the 'new kids on the block' that has rapidly gained a large following (bigger than Twitter/X and Snapchat) • Users are mostly young – a large number are aged 16–24, with slightly more male users (same number as Facebook)	• Uploading and watching short videos (1–3 minutes in length (started at just 15 seconds!)	• •

Social networking and the ownership of media

When using social media, it is important to consider **copyright** and **libel**.
Copyright is the protection of yours and other people's creative works (e.g. text, images and video) from being copied and used by somebody else. Everything tha you create is typically protected until 70 years after your death (although it's slig different for material created for or by a business). If you find out that somebody has reproduced your work, such as copied paragraphs of text from your book int theirs, you can sue for breach of copyright. If people want to use your work, they must ask you for permission first, and you can charge a licensing fee. Some peo freely give away material, either by revoking their copyright claims and releasin material into the 'public domain' or through licensing it through the Creative Commons or similar scheme.

Similarly, if you uploaded photos and video to social media, you would be pretty and added it to their profile or website. You must be very careful what you post o from printed material, websites and posts are usually under copyright. For examp button to add a link to your profile, rather than taking a screenshot and re-uploa for the copyright logo, © – many people and businesses will add it to the corner

It's also worth taking a look at the terms of use of the social media accounts tha probably skipped through and said that you read...). For example, Facebook **https://www.facebook.com/terms.php** tells you about how they deal with your p you post may end up on your friends' newsfeeds, so be careful what you post.

Libel is where you post something negative about another living person or activ reputation. Libel can go beyond simple cases of cyberbullying. You can be sued responsibility is on you to prove that the other person or company has done wha post anything nasty about others online – there are many other reasons why; fo good 'netiquette' – net etiquette. Examples of libel would include you saying 'M tunes from Musician Y, and is a terrible person for doing that', or 'Company X ma slave labour in Country [illegible] without having actual proof that either is true.

Have you ever read about copyright before?

Practice Questions

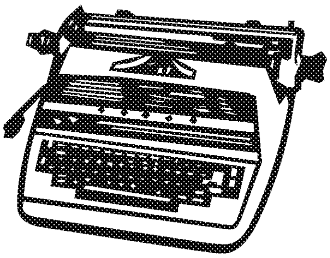
1. Give two advantages of digital communications.
2. Identify two causes of the digital divide.
3. What is 'spam'?
4. How has instant messaging changed communication?
5. Describe why video conferencing has risen in popularity.
6. Are there more advantages than disadvantages of using social media?
7. Describe two ways that businesses use digital communications to reach cus
8. Describe two ways that businesses use digital communications internally.
9. Describe why information obtained from the Internet is not always reliable.
10. Describe [illegible] verify whether online information is likely to be accur

Chapter 4: Impact of digital sy organisations and individuals

In this chapter you will learn:

- Why digital systems make business and individuals more efficient and are b
- Each of the ways that businesses implement digital systems
- How changing working practices have changed our culture and society
- How relationships have changed between us, the consumers, producers, ma terms of goods and digital content
- How businesses are increasingly monetising content

Efficiencies, benefits and drawbacks of digital syst



Here's a fun task for you – ask an older person who w growing up or working their first job with no access t computers or the Internet, or using horrendously obs standards. I have grandparents who were typists who letters and orders on manual typewriters. One or two corrected by a special type of correction fluid or shee mistakes, they'd have to retype the whole letter on s

New technologies have the power to scare people, making them fearful that the machine. We still see news articles to this day, and you've probably noticed a fe such as self-service checkouts in supermarkets and in libraries. During the 1970 real fear that the UK was losing its competitive edge and modernisation was vit government led by Margaret Thatcher sought to address these issues – ICT was Computer Literacy Project was introduced with a series of educational TV progra go with it – the famous BBC Micro, or 'Beeb' as it's affectionately known. Many c be watched online for free if you're interested. As a result, a new generation of h programmers was born, many starting programming in their bedrooms. (UK prog abroad to this day.) The UK has largely transitioned its economy away from man and knowledge industries, helped by advances in technology.

Office-based digital systems used within an organisation

Most offices have fully computerised, with employees spending nearly their enti looking at a screen (often two or even three screens!). Computers have helped w changes were harder to make – agreeing a contract with a client could take mo manually retyped and agreed upon, sometimes cutting up documents with actua paragraphs and pages together (that's why we still use the phrase 'cut and paste be typed straight into the document, which can be emailed back and forth. Emai fax machine, which was a brilliant invention in its day.

Uses and benefits:

- ✓ All word processing, documents, information systems and messaging syste Templates can be used for frequently used documents, and paragraphs of te between documents rather than retyping.
- ✓ Mistakes and typos can be easily corrected.
- ✓ Planning, diary sharing and scheduling can be centrally managed and shar meetings can be easier to schedule.
- ✓ Information can be shared freely and cheaply, including email and VoIP.
- ✓ IM systems can be faster than email, and now several people can work on the s
- ✓ Data such as contacts, calendar and email can be synched to mobile device
- ✓ Cheap communications with customers – less printing and reduced postag

Disadvantages:

- × The whole office can be ground to a halt by a power cut, loss of server or In updates, data loss or corruption, or malware/ransomware attacks.
- × Some staff will complain of repetitive strain injuries (RSI) and eyesight dete equipment and staring at a screen for hours at a time.
- × Computer equipment can cost a company thousands – if not millions – of p especially large enterprises with thousands of PCs to manage and upgrade
- × Data storage devices and mobile devices can get lost or misplaced, and dat encrypted or remote wipe can't be implemented.
- × Sometimes there is too much information – users in large companies may n emails each day but many won't be relevant to them.

Consumer-centric digital systems for individuals

Consumers (i.e. home users) use technologies slightly differently (although there example, consumers are far more likely to use tablet computers, and less likely t more likely to run macOS and different versions of Windows (Home and 'S' rathe Enterprise versions).

Consumers will use social media and online video platforms, browse the web and sh degree than in businesses. Overlap includes the use of smartphones and VoIP to co families, and the use of basic office suites for word processing (letters, CVs, etc.) and finances and planning. Consumer versions of office suites typically have fewer apps Most consumers will use email but are more likely to use webmail or smartphone a

What apps do you have installed at home that are not installed on your c

Implementing digital systems

When an organisation chooses a new system (ranging from new software to entir are several methods that they can use, depending on the amount of acceptable

Pilot method

The pilot method is the slowest but more cautious approach. This is where the n initially rolled out to only a few users; for example, to a single department or su location if there are multiple offices. This gives the opportunity for issues to be f system can be tweaked to optimise the performance. If the pilot testing goes we system can be rolled out to all users with a high confidence of success.

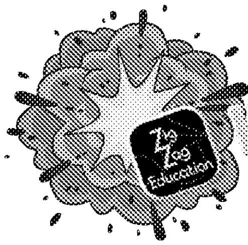
Parallel method

In the parallel method, the new system is set up before the old one is taken away. This means that if there are problems with the new system for all or some tasks, the users can switch back to the old one temporarily. There are also advantages such as training, which can take place at a slower, more comfortable rate.

Pilot method: A sma among specific staf

Parallel method: S keeping the old sys

Big Bang method: at once.



Big Bang method

With the Big Bang method, the old system is removed a at once, usually over the weekend or during a holiday o can save money, but can be the riskiest approach as the fall back to the old system. Staff must learn and adapt t could be a challenge if the new system is radically diffe

Which approach would YOU take?

Changing working practices

The impact on culture and society

During 2020, millions of people across the world had to work from home for the with their colleagues using VoIP such as Zoom and Teams. They accessed compa as remote desktops and through VPNs. They accessed email through webmail, a applications like never before. Companies which had previously stopped employ security concerns (or had used that as an excuse to not allow homeworking) wer their networks to off-site access within a couple of weeks. While tight data secu risk to human life was more important. Even large events and meetings went ah time – in both business and leisure settings.

Some people even think that we'll never go back to working in offices to the people have moved out of cities into rural areas for a better way of life with people are very happy to work from home full-time, while others would prefer a site working. Of course, there will always be some who prefer working in an offic their working and home lives, and for the social element. The technology that we many of us have fast Internet connections in our homes, makes this a viable set-u entirely dependent on the demands of the bosses and company CEOs – when bo the office in 2021, the bosses were faced with threats of mass resignations in so policy shifts. Workers had become used to working from home for the many bene

There are certainly some benefits of working from an office for some of the time need the hands-on help to understand the company culture, training and social scope for in-person collaboration – always friendlier face to face. Watch this spa

But it's important to remember that these technologies weren't entirely new. Su their existing products in 2020; for example, by adding new features or improvi tracking to add a background on Zoom. Many had to rapidly increase their capab load – Zoom went from 10 million to 300 million daily users throughout the yea

Take a look at these two offices from the 1950s and 1980s. We can see lots of re computer t[illegible] back, meaning that the office from the 1980s has been completely [illegible]e there are still typewriters in use. This is a big contrast to the

Many companies had embraced these technologies before 2020, which allows fo

- **World teams**
  - Members of the team are located in different countries
  - This allows recruitment from a much larger talent pool
  - Multinational companies can share resources and workload between their offices
  - A diverse workforce allows for a rich melting pot of ideas and creativity, making products more innovative

- **Multiculturalism**
  - Teams include a wide range of backgrounds, cultures and religions
  - Barriers are broken down between race, gender, age and sex, etc.
  - Very insightful, allowing the team first-hand experience of launching products across different markets – they know what is accepted and what is taboo across different cultures, how the product could be tailored to different markets, allowing the right products to be delivered in the right places

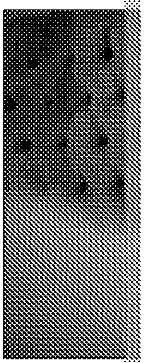
- **Inclusivity**
  - Modern tools, such as methods of input into computers, and the use of users access the technologies if they have disabilities

- **24/7/365**
  - By having access to teams around the world, the different time zones c used to provide a much longer service. This is an advantage; for examp
    - Customer service and online support chat can be carried out in dif areas of the world to maintain 24/7 support – helped by the Inter cheap global telecommunication. Countries that don't celebrate U festivals or public holidays are able to carry on receiving calls if a contact centre is closed for the day.
    - Projects can be completed more quickly if one team finishes for th country is able to pick up where they left off – modern communic to leave messages for the next one.
    - Allows shift work and more flexible working hours
    - Websites and order forms are available for customers to purchase warehouse is closed

- **Flexibility**
  - Much greater flexibility for off-site and on-site work, and hot-desking, casual, temporary and permanent staff. A laptop and VPN set-up would staff to work in shared meeting rooms, or work at other sites and office temporarily – while still connected to their base office.
  - Staff are not limited to working from a specific country – a UK worker temporarily work from a holiday home in France or Spain, etc.
  - Greater use of part-time staff, and experts and individuals (could be self employed) can be contracted for a specific project on an hourly or daily

Let's look at the following effects of modern technology on people – those using t smartphone with us at all times – constant notifications and messages are at our fi people can phone us up at all times. We are addicted to our phones and other tech glued to screens, sometimes at the expense of going outside and getting some fres do go out, we use headphones to block out the outside world, preferring to listen t

Now work can begin on the commute with email and phone calls, or go into the evening – some workers even respond to emails from their beds. There's a saying that when phones were connected to the wall, people were free, and there's a lot of truth in that. There wasn't an option to do any work until you arrived at the office! But smartphones are still incredibly useful – how many times have you used yours to get directions when you're in a new city, find attractions to visit, and contact your friends or family if there's a problem?



Mental well-being – technologies have the ability to help our mental well-being

For example:

- Depression, loneliness and lack of self-confidence – for example, when working remotely for long periods without social engagement, becoming addicted to an online technology or game at the expense of a normal social life with poor performance at school or work. Some people become victim t online bullying or harassment (cyberbullying), which can lead to a great dea of stress and increased mental health disorders.
- Separation from a stressful environment – so you had a bad day at school o work, or you're having problems in your personal life? Games, media and virtual reality can provide a means of escape and could, therefore, benefit som people. It is important that people don't use technology to hide from the problems rather than dealing with the cause.
- Feeling in control – flexibility with working times, location and schedule ca and boost self-confidence. They may use an electronic diary to update their colleagues so that others know when they are available.
- Family needs – working from home or working more flexible hours allows p dependents such as young children and elderly parents. However, the emplo working arrangement.
- Less commuting – working from home can save people several hours a day to and from the office. The time saved can be used for leisure and hobbies, bed, which means that staff are less stressed and tired and, therefore, are m benefits from less traffic and fewer CO_2 emissions, but this can be offset by hundreds of homes rather than a single office building.

New job roles

- The number of jobs in technology has exploded, along with increasingly nic programmers are required for specific new languages, and cybersecurity i unfilled vacancies.
- Even 50 years ago, most of these jobs didn't exist; however, traditional jobs
- Employees must stay up to date – those in more traditional roles may need systems and processes. If their jobs are completely replaced, they need to r another industry. Even those working in technology need to retrain when fu methods and programming languages emerge. To stay competitive in the jo on additional qualifications, and/or take exams and training to 'upskill', and webinars to stay sharp – often called CPD (continuing professional develop
- Some jobs are under threat from automation by robots and algorithms, but oversee them; for example, a warehouse where orders are picked by machin should things go wrong!

The digital divide

- Those who do not have access to technology, or those who refuse to retrain cut off from the benefits of digital services, communications and the moder

Do you think that technology has improved the way that we work?

Changing relationships between producers, manuf and consumers

With the advent of digital technologies, data has now become a valuable comm have become serious threats or competitors for the traditional 'bricks and morta

Business-to-business selling (B2B) and electronic data interchange

Business-to-business sales are when goods are sold to other businesses rather tha was physical objects; for example, a construction company needs to buy sand, cen builders' merchant, or an office needs to buy paper, stationery and furniture from ordered from paper catalogues either over the phone or by mail order. Nowadays,

However, data is an increasingly valuable commodity that is bought and sold by such as customer research and the results of surveys. To allow the data to be ex sent in standardised formats that can be read and opened by standard applicati

While the Microsoft Office suite is one of the standards for sharing individual fil (electronic data interchange) also includes formats such as CSV (comma-separat Object Notation) which are excellent for exchanging data. PDF (Portable Docum sending exact copies of documents because they will always display perfectly n viewed on, and have powerful features including digital signing and signatures.

Online shopping

Online shopping has really taken off since its development in the 1990s. Amazon started in 1994 as an online bookseller and has become the biggest online retail selling just about anything. In 1994, not many of us even had Internet access in 2020, $197.3 billion passed through Amazon's online stores. This doesn't cover th that Amazon took in from its online web hosting service (AWS) and other services streaming (Prime Video), smart speaker market (Alexa) and eBooks platform (Kind

Nowadays, most physical stores include an online counterpart in order to stay co for a lot of customers who can order online 24/7/365 at a time that suits them. because it's cheaper to operate warehouses than high-street stores, and shoppin bricks-and-mortar stores are closed. With online shopping, orders can be sent ou via courier and parcel delivery services, click and collect from the closest store, depot, convenience store, Argos (for eBay) or other participating store.

In 2020 and 2021, we learned to rely even more on online shopping during periods when non-essential shops were closed by the government, people chose not to go to the shops to reduce the risk of catching COVID, and people testing positive for COVID were forced to self-isolate and, therefore, were not allowed to leave their homes. Food delivery slots from supermarkets were snapped up weeks in advance. Many people tried online shopping for the first time ever, and that trend is likely to stay in place for the time being.

Business-to-busin companies, e.g. m

Online shopping: delivery to your h

Business-to-cons to the public.

Marketplace: A s sellers, such as eB Amazon, etc.

Where businesses sell to the consumer, we call this **B2C (business to consumer)**.

Online marketplaces which process third-party business-to-consum consumer (C2C) sales

Sometimes, as is often the case with smaller companies, or sellers who are locat established online **marketplace** for their selling platform.

For example, Amazon offers a third-party marketplace and charges fees for usin party seller can hold and ship the items from the sellers' premises, or sellers car in a warehouse belonging to Amazon, and the products will be shipped by Amaz from Amazon, you will see the name of the seller and the shipping details. If the Amazon', it's likely that the product is stored in an Amazon warehouse. Amazon products itself, so sellers must compete with Amazon's own prices.

Online selling platforms are also set up for third-party use; for example, busines account with eBay and pay listing fees, along with a percentage of the final sale their own goods, and can set up an online shopfront, allowing customers to see for sale. eBay is a very general selling platform, but specialist platforms are also AbeBooks, and music, e.g. Discogs. Some people have set up entire businesses b for example, buying up pallets of returned items, selling items bought at charity

Many of these selling platforms are and sell items. These are C2C (**cons** case, the sellers and items are loca time an item is sold, the seller is re (not always to the highest standard to collect the item, or drop the item point or a parcel shop / counter. So collection from their homes; for he sometimes the only option. This ty eBay and Facebook marketplace. M collectables through Etsy, as well a

What does your household buy online?

Services that monetise content

Data and advertising can be big business. There are thousands of organisations set up to help deliver advertising, marketing and data collection and analysis services.

Marketing to prospective and existing customers (including via email, social media and other methods)

Email marketing works exactly as it sounds – email sent to existing customers to sell new products, services and events. Generally, the emails are sent as HTM formatting including fonts, layout and images, often set up in frames or tables. T a pixel that can be used to track whether the emails have been opened, helping the marking campaign has been (based on the number of opens, and any increas email clients such as Outlook automatically block images from downloading.

Email marketing can be very cheap (compared to postal marketing, for instance), and emails can be sent to thousands of recipients at once. Businesses can either send out the email from their own servers, or set up accounts with marketing companies such as MailChimp, SendGrid and other providers for a fee, but with a lower chance of the emails being flagged as spam by the recipient's email provider.

Consumer-to-c between memb eBay, Faceboo

Email marketi communications offering new p

Businesses need to set up their mailing lists based on customer opt-ins and cura expired addresses and honouring unsubscribe requests. The biggest shake-up to requirements, which are discussed later.

Social media adverts are displayed within the newsfeed of users of sites such as celebrities (governments, even). Social media can deliver highly targeted ads ba status and what you've interacted with (commented on, liked, visited, etc.). The a and can be effective. During 2020–2021, the UK government targeted social me messages concerning social distancing and vaccination.

There are many other forms of advertising, such as [illegible]ed and telephone m large number of non-addressed flyers and brochures appear on the doormat (and paper recycling bin).

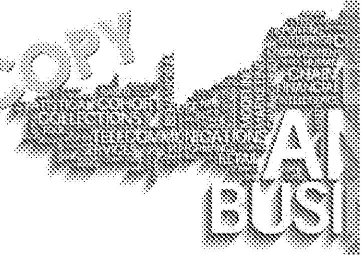
Website advertising

Many websites partially or fully fund themselves through advertising the produc They often make use of cookies, the small text files stored on your computer wh why you often see adverts for the items that you've looked at on other sites. Adv across the page or down the sides. The most obnoxious adverts play videos and text, or sometimes fill the page entirely until you remove them. Because this is a browser extensions called ad blockers to stop the adverts displaying. Because th sites refuse to load until you have disabled the ad blocker for that page. Some o the tabloid-style and local news sites.

Adverts also play before and during many online videos, including YouTube – a monetise their work. You can often skip these adverts after a few seconds, depe Sometimes these adverts are fairly specific to the genre of the video.

Data mining and analytics

Businesses and retailers build up huge sets of data about their customers in huge databases. They can run queries to analyse the data using powerful computers – called **data mining**. Large shops and supermarkets have decades' worth of sales data. Where customers have loyalty cards, even greater profiles can be built up, and vouchers and rewards can be sent out, including money-off vouchers. Retailers will create profiles for each type of customer based on their demographics, lifestyle choices and income. For example, some customers are very loyal to a brand, others shop around for the best deals, and others value convenience over a specific brand.



Data mining: S and patterns fr

Analytics: Dra hypotheses fro

These data sets are analysed **(analytics)** and used to spot emerging patterns and order extra stock, or decrease orders for lines that aren't selling well. Retailers o data such as long-range weather forecasts to work out when to order extra salad temperature that people want BBQs can very around the country!). They will als specific events such as football matches, and festivals such as Christmas to ensu demand and satisfaction.

Do you try to ignore online [illegible]

Practice Questions

1. Describe two dangers of being overly reliant on digital systems in the workp
2. Give two differences in the way that businesses and consumers use digital
3. Give an advantage of the pilot method used when businesses implement a
4. Describe two ways that offices have changed over the last 50 years.
5. Give an example of business-to-business (B2B) selling.
6. Describe how businesses have responded to changing shopping habits from
7. What is the difference between items sold by a company such as Amazon co
   products sold on a marketplace (such as Amazon's marketplace)?
8. Give an example of a platform where goods are sold directly by consumers,
9. Describe how companies use social media to advertise to consumers.
10. What is the purpose of data mining?

Chapter 5: Securing data and s

In this chapter you will learn:

- Why threats to data are either accidental or deliberate
- How to protect data and increase resilience
- What digital footprints are, and their impacts
- How data and privacy are legally protected through legislation
- The ethical impacts of data, privacy and use

The threats to data stored on local computer syste

There are many ways that data can be lost both accidentally and deliberately. Th device, storage media or server within the building, or stored on a cloud server o

Accidental damage/destruction

People sometimes make mistakes and data is lost – for example, they might delete the wrong file, overwrite a newer version with an older one, cut text from a document without pasting it again somewhere else, or overtype information by mistake. They might also throw away the only copy of information by accident, e.g. by discarding a handwritten form or note, or by leaving a USB drive or laptop containing the only copy on a train. The data is permanently lost, not just a copy of it.

Hopefully, the losses are only minor (affecting single files or there are only a few lines to retype), or there is a recent backup in place to help prevent data loss, such as a digital recycle bin.

Large-scale data losses make the news – for example, a government departm thousands of important records.

Sometimes the data loss is because of a hardware failure – a drive or even a corruption of magnetic storage media when in contact with a strong magnetic fi data, or someone could accidentally drop or knock over a drive or computer whi

Data can also be lost or corrupted by natural disasters such as a flash flood, an e from a burst pipe or a building fire can also be a cause. To prevent this, server fa protection built in (including no servers near the floor), and fire-suppression sys that don't damage electronic equipment.

Malicious/deliberate damage

Tampering means changing some of the data, but not necessarily deleting the file notice than deleting – someone will quickly notice if a file is missing, but not if a changed. An employee could tamper with a file in order to cause harm to the busi decisions as a result, or a hacker or a rogue government could modify the data an

Systems are attacked for a variety of reasons, such as:

- **Fun/challenge** – while the hackers don't intend to cause disruption or finan much access to a system they can gain, they may gain a reputation and kud dark web. However, starting this way could lead to darker activities, as was
- **Industrial espionage** – attempts to steal valuable electronic property (intell secrets such as formulas and recipes. For example, hackers (who may have b steal the secrets about the COVID-19 vaccine from companies such as Pfi
- **Financial gain** – hackers attempt to breach company and government serve to sell. A growing trend is to also infect a business with ransomware – data retrieved from a backup or by paying the hacker the ransom, extorting mon
- **Personal attack** – for example, an attack on a previous employer by a disgru acquaintance or partner who they hold a grudge against.

Malware (malicious software)

Cyberattacks and theft of data are carried out by black-hat hackers. They are often started by targeting weaknesses in software, through malicious downloads and booby-trapped adverts, or through malicious links in email. The easiest way to defend against attacks is by using caution – ensuring that you have a good antivirus package installed, and being very careful when downloading files and viewing emails from unknown senders.

Hackers have the following tools at their disposal:

- **Malware** (malicious software) – they take the following forms, each with a specific purpose:
  - **Adware** – shows advertisements in order to make money for the creato example, through software, and often injected into a web browser).
  - **Botnet** – a network of infected 'zombie' computers across the Internet sent by the hacker to do things like perform a DDoS attack or send out
  - **Ransomware** – malware that encrypts some or all of the files on a com cryptocurrency such as Bitcoin to decrypt the files. After a few days, th unavailable or the fee increases. However, if the user has a recent back user can just reformat the hard drive and load on the OS and files, avo
  - **Spyware** – software that 'spies' on the user; for example, it could steal log into your online bank. It could also inject fake adverts or pop-ups i the browser to redirect to other sites.
  - **Trojan horse** – malware that pretends to function as a useful applicati product. Once installed by the user, it can deliver a viral payload such open up a back door so that more malware can be installed on the syst
  - **Virus** – attached to a file that runs, thereby spreading the virus to oth opened. It may delete or overwrite files and cause the system to be co be sent as an email attachment.
  - **Worm** – a program that self-replicates and opens many copies of itself it. A worm slows down the computer and network as it uses up the RAM computers. Worms can have other malicious tasks too, such as rebooti equipment. Worms could infect any vulnerable computer on a n scanning for vulnerabilities and open ports.

Social engineering

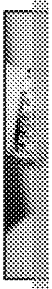
In the 1980s, not many people were familiar with the concept of social engineering. Hackers used to phone up IT departments or reception desks pretending to be employees at the company and asking for their passwords. Nowadays, passwords are much more secure and this tactic won't work. But social engineeri widely used in different ways.

Social engin the users of c data or gain

Social engineering tries to take advantage of human behaviour and people's mis order to obtain information. Examples of social engineering include:

- **Baiting** – cybercriminals attempt to obtain information such as login details promise of free goods such as movie downloads (that also contain malware the bait is physical – for example, a virus-ridden USB flash drive left in a pu that will automatically install the malware as soon as it is inserted into a co Never rise to the bait, or ever insert an unknown flash drive into your comp
- **Phishing** (fishing for information) attempts are emails, texts and phone calls to be from someone or an organisation that the victim may be familiar with phishing is highly personalised, i.e. a specific victim is targeted.) Some of th look really sophisticated due to the complexity of the scam. The aim is to link, divulge your password or banking details, or to steal money.
- **Pretexting** – the scammer tries to get your personal details by asking for th to be from an organisation that you trust and asking for your name, date of sure that you are actually talking with someone from the real organisation, back using their official phone number.

- **Scareware** – fake programs, such as fake antivirus packages, send lots of m is infected by a virus to falsely scare the user into action. The user might th using their debit card to download even more fake or malicious software to believing that the software is legitimate. Always remove scareware by uninstalling it, and run a scan with legitimate antimalware software.
- **Shoulder surfing (aka shouldering)** – watching someone type in their password (looking over their shoulder) or PIN at a cashpoint. Usually done at close range, but could be done through binoculars. This is why you should always shield the keypad at a cashpoint or card reader when you type in your PIN.



Brute force attacks

A **brute force attack** is where a computer program tries to crack a password or other login using millions of different combinations of letters and numbers, e.g. AAAAAAAA, AAAAAAAB, AAAAAABB, etc. Because this is very time-consuming, the program might be set up to use a dictionary attack of commonly used usernames and passwords. This attack can be thwarted by setting policies to lock out the account after three or five failed login attempts. The account may be blocked permanently, until a technician manually unlocks it, or until a timeout period is reached, e.g. 30 minutes. If set to 30-minute lockout after three failed attempts, then only six pa four-digit PIN is much easier and faster to crack (only 10,000 possible combinat

Brute force at that tries ever succession.

Denial of ser website or ne deliberate att

Denial of service (DoS) to authorised others

The website or a server in the company is taken down (legitimate users are deni company through lost sales and damaged reputation. A botnet is used to send re connection that exceeds the capacity of the Internet connection so that the legi (or there may not be a [illegible] address). The attacker might have a grudge of the service they provide, or be trying to extort money from / blackmail the c could damage equipment so that it has to be reinstalled or replaced if the firmw

- Sometimes websites are taken offline by thousands of people trying to acce 2020 when a new tier system was announced for COVID-19 restrictions, the as people tried to access it to find out which tier they would be in.
- A server may be taken offline by the attack, or switched off while analysis t corrupted or modified, then the data has to be restored from backup. While be restored first, there could still be several days before all of the systems a

Hackers could try to stop a business from operating normally, causing it to lose virus to infect machines and delete files, by slowing down the network with a w server (e.g. web server) or Internet connection offline using a DDoS (distributed flooding a network with dummy requests from a series of controlled computers.

Data manipulation

There are so many ways that data could be altered by an attacker. For example, a website or social media account could be defaced by hackers (or 'hacktivists' – a slander the business or party. Such attacks are usually discovered quickly becau course, a hacker or malicious insider could also alter data in a company-owned s attacks might not be discovered for months. An employee could alter company f decisions could be made as a result.

Data modification

Data modification is similar, but may be financially motivated for personal gain. Fo example, an employee could alter their timesheet if there's a bug, allowing them to paid extra, or an attacker could try to change bank balances and move out the mon

Data theft (in transit and at rest)

Data can be intercepted and stolen (unauthorised) when:

- It is being transferred across a network or the Internet. Unencrypted data co encrypted information can be unencrypted. However, most of our network t strong encryption to keep the contents safe, even if intercepted.
- If a drive or device is stolen (such as a flash drive, a hard drive or a laptop), access by hackers and/or competitors, and, in some cases, this could be a

Which types of threats are the most dangerous?

Protection of networks, systems and data in storag transmission

Just like the fact that there are many types of threats, there are many ways of sto

Encryption

Encryption – data storage

Encryption: Sc it can only be appropriate 'k

Encryption is where normal text (plaintext) is converted to cipher text using an algorithm and one or more 'keys' which are often very long numbers. This means that if an encrypted file is intercepted, then it is very hard to read it without the key(s) needed to dec encryption (asymmetric or end-to-end) is much more secure than using one key

We can encrypt individual files, databases and whole drives using a password or when taking data off-site – losing a USB flash drive is less of a problem if it's stron encrypt sensitive data or password files – theft of unencrypted data or drives f constitute a data breach and large fines can be imposed.

In Windows, drives can be encrypted using BitLocker. Individual files can be enc system), and individual applications such as Word and Adobe Acrobat can set pa

Encryption – data transmission

We can also encrypt data as it is sent across a network and the Internet using en somebody intercepts the data (e.g. a man-in-the-middle attack), it is harder for th a lot of different methods of encrypting data. For example:

- We set Wi-Fi passwords that encrypt the connection to the router
- We use HTTPS when sending data across the Internet (including online banking, shopping and email, and social media) – look for the padlock icon the browser, and some browsers can be set to warn you when a site only us HTTP. Browsers used to display green padlocks in browsers but have since removed the green because it's now so common to use HTTPS.
- We use VPNs to form an encrypted network tunnel across public networks
- We use encrypted communication platforms such as WhatsApp and Signal
- We use apps that encrypt all of their network traffic

Firewalls

Firewall: Hardwa security which con network traffic be

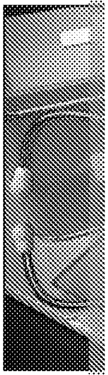
A **firewall** simply allows some network traffic to pass through, but blocks other traffic. This allows us to specify which traffic is legitimate, and helps block hackers from gaining access to the system by blocking the ports (doors) that can be exploited. We determine what traffic is allowed to pass through and w 'rules'. We can block or allow certain ports, IP addresses and domains, etc. Firewa pre-defined rules, but network admins can change (configure) these rules to mee

Firewalls nearly always filter incoming traffic – this is to help prevent hackers from accessing the internal network. Some, but not all, filter outgoing traffic generated within the internal network. This is useful because the firewall can sometimes be used to stop a malware program from 'phoning home', or uploading files to the remote hacker. Firewalls that filter both incoming and outgoing traffic are 'two-way' firewalls.

There are two types of firewall:

1. Hardware firewall – a physical device that plugs into the entrance of the ne between the public Internet and the private LAN. All network traffic passes the network infrastructure is located behind it. Hardware firewalls can be co a web interface. They are expensive and purchased with several years' wort renewed. After several years, the device may no longer be supported and th hardware, sometimes with an upgrade discount.
2. Software firewall – this can either be built into the operating system, be pa suite, or be a stand-alone application. The software firewall is a second line firewall, but it also helps to prevent a compromised computer on the intern malware across the system.

Antivirus software



Antivirus software stops the installation and running of viruses and other malware, including spyware and, more recently, ransomware. The software also detects malware that is already installed on the system, through regular scans and constant monitoring. In the past, this could slow down a computer, but nowadays, the performance drop is minimal.

Antivirus detects by looking for the characteristics of the files, their behaviour and processes on the system against a set of known malware signatures or definitions. If a file is infected, it may attempt to remove the infection (disinfect), delete the file, or stop the file from running by placing it in a protected 'quarantine' area. Antivirus software is essential for laptops and desktops, and strongly recommended for smartphones and tablets.

Antivirus: Softwar files and applicatio arises quarantines harm your system.

This means that the antivirus must constantly update its definition of known thr manufacturer by downloading the files from the server several times a day; for e MacAfee, Sophos and Microsoft. Each time a new malware sample is provided to made. Because this set of definitions can be very large, some antivirus software Internet connection when running for best results. It can make checks against a the downloaded version might contain only common and recent definitions.

But as there are thousands of malwares created each day, there is often a d created. Therefore, antivirus software tries to detect unknown threats based on replication and CPU usage.

Antivirus is often preinstalled with the operating system (Microsoft Defender), a (e.g. Avast and AVG) or paid for (e.g. Norton, MacAfee and Sophos). Paid-for vers subscription fee which must be paid to ensure that the product keeps working a

Good practice... points to remember!

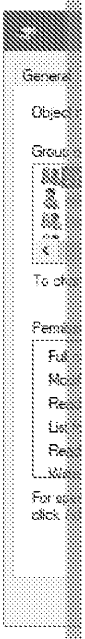
☑ Install antivirus and antispyware software
☑ Regularly update antivirus software
☑ Scan the system regularly for threats
☑ Scan any removable storage device for viruses before opening files
☑ Only download from Internet sites that you know and trust

Hierarchical access levels

Access lev
networked
can open,

Access levels – you have probably seen in the movies that employees in some companies or government agencies carry access cards that can be used to access specific parts of a building (usually with a villain attempting to access the parts that they shouldn't). This is true of many organisations – only a few trusted IT staff will have access to the server room, while a regular employe to the front door. They may have a card that allows them to enter the building o and new starters may not be given the door code for several months until they a

You may find this when you go to college or university – for example, your access card may only allow you to enter your department building, specific libraries, or your own hall of residence. Unless you've been granted 24/7 access, your card may only work until, say, 6pm.



Access can also be restricted to computer system resources such as drives, files and printers. For example:

- Payroll and HR may be the only departments with access to salary and highly personal information (e.g. on a shared drive) – see the screenshot (right)
- Only IT administrators will have access to company servers
- Only network admins would be able to make substantial changes to the website infrastructure
- A regular employee might only be given read access to some shared [illegible]
- System functions could be disabled entirely such as new software installations, access to the control panel or command prompt, etc.

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These settings can be implemented in various ways. For example:

- Giving only certain staff admin accounts that allow them to access servers or more shared drives
- Selecting access to specific usernames only
- Setting appropriate file permissions (based on username or members of policy groups, for example)
- Setting group policy on the server to automatically block certain activity

Cybersecurity – staying resilient and in control

Resilience – preparing for, responding to, and surviving a cyberatta

A system could be breached by an outside hacker directly targeting the organisation, or indirectly. An insider could steal or leak data or create a security hole. Once data is leaked and sold on to others, there is no knowing how many copies there are or where the data is held.

Data can be either copied, deleted or modified slightly so that it is no longer valid. The intrusion may not be detected for months or even years, depending on the level of security of the system.

However they've been breached, there are many financial repercussions for the business. In some cases, the business may even be forced to close if it cannot financially recover.

In order to survive, businesses need a good plan to deal with an attack. The best first place by having good defensive measures in place. Don't think that it's just attacked, although they're generally the ones you hear about in the news. Many medium-sized businesses because they've generally got the smallest budgets fo experienced IT managers in charge, and may be forced to pay ransoms.

Temporary or permanent loss of data and information

- **Data loss** – any data that has been deleted (or encrypted by ransomware) s could be lost forever, including customer orders. The company would have was important, if they could. This is a cost because staff have spent their ti to go through the whole process of creating it again.
- **Downtime** – a server might be taken offline by the attack, or might be swit place. If data is deleted, corrupted or modified, then the data has to be rest important data might be restored first, there could still be several days befo back online.

Damaged or corrupted software

Malware can damage specific software, meaning that it must be reinstalled follo of the system. Productivity software used on a daily basis would have a major im spyware can hijack web browsers, changing the home page, the DNS settings and Some malware will also target specific files, such as deleting files used by Micros

Websites taken offline

Denial of service is exactly what it sounds like – denying (stopping) legitimate u service such as a website or server. Typically this is achieved by flooding a serve network connection becomes too busy to support legitimate users, or the server amount of traffic directed to a server might be several terabits per second, sent controlled by the hacker (a botnet). However, you could also say that taking a sy outbreak or worm, or encrypting data through a ransomware attack, is a denial o to be taken offline by the IT admins while the attacks are being investigated and

Denying a service is designed to cause financial damage to a business through:

- Bringing down public platforms and lost sales opportunities
- Reputational damage
- Lost staff productivity as internal systems are disrupted

Denial of service attacks are often aimed at large corporations as punishment fo the hackers oppose. Attacks may also be political; an attempt to take down the s you oppose.

Denial of service attacks can be difficult to stop because all of the requests are s and it's difficult to know which requests are malicious.

Loss of reputation

- **Public image** – when personal data is breached, the company may be requi their data was stolen. In large breaches for well-known companies, news of national news channels and in newspapers and online news. Affected custo company, and new potential customers might be put off from joining the co telecoms company TalkTalk – its breach in 2015 made national news when 157,000 customers were stolen. Around 100,000 moved to a different provi millions of customers who stayed. The share price of TalkTalk dropped by 1

Loss of competitive advantage and financial loss

- **Competitive advantage** – companies which have suffered large financial los their competitive edge over the competition; for example, they may lose cu as valuable databases.
- **Financial loss** – it was thought that the TalkTalk breach could have cost up financial costs of a breach can include fines, forensic analysis, purchasing n provision and loss of staff productivity and customers. In some cases the bu temporarily and staff still need to be paid.
- **Reduced productivity** – if staff don't have access to servers, files, intranets a their job, they will have to work offline temporarily, possibly on paper or on their work may take longer, and they have to manually add in the data once
- **Legal action** – under the Data Protection Act 1998, companies could be fin Under this Act, TalkTalk was fined £400,000 for its data breach. In the UK, t Information Commissioner's Office (ICO) – this was the largest fine that it h details see **zzed.uk/12330-cyber**

However, TalkTalk was probably lucky. Had the breach occurred a few years late the Data Protection Act 2018, which significantly upped the ante in terms of the dished out. For the most serious breaches, there is now a maximum fine of £17.5 from the previous year, whichever is greater.

In 2020, the ICO fined British Airways £20 million after the theft of details conce The hotel chain Marriott International was fined £18.4 million after hundreds of accessed six years previously, and occurred before Marriott even acquired the co the breach. The fines could have been a lot worse – they were initially set at £9 £183 million for British Airways!

Do you know of any companies that have been hacked?

Preventing a cyberattack

Prevention is the best strategy. Here are ways that cyberattacks can be prevente system will ever be totally secure.

Boundary firewall and Internet gateway

Boundary device ins network to stop entry

As a minimum, every system should be protected by a firewall, an IPS (intrusion prevention system) or a UTM (unified threat management system) at the entrance (the entrance is called the gateway). At home, you probably have some sort of firewall or security built into your router.

If a company has its own servers, such as email, web or file (FTP), then there sh These servers are placed between the two firewalls in an area called a DMZ – d firewall routes traffic through to the servers based on the necessary protocols. T internal network.

Secure system administration – admin accounts, audit trails, accoun

Admin accounts – unlike the typical user of a computer, who gets only limited a (they can't change major settings or install new software), admin (administrator) system. Only a handful of staff within the organisation will be given admin acce passwords which are hard to crack. When an administrator leaves the company, immediately disabled (this is true for any employee, but especially true for admi malware (e.g. rootkits) attempt to get admin access (also known as root access)

Audit trails –an audit trail is a log of what has changed within a system. Audit tr reviewed if necessary, such as in the event of a suspected malware infection or the operating system and in individual applications; for example, you can take a lo Windows (go to Windows Logs > Security) to see who has logged into the systen are any failed login attempts from hackers or port scanners. When logs are creat they can be sent to a centralised server automatically for storage. You can also g network in real time and alerts staff to any potential problems, such as a sudden mean that there is a malware outbreak.

Account management – when an employee joins a company, they are given a us to log on, they'll first need to read the 'acceptable use policy' – the list of rules s use the computer for. Generally, companies work on the basis of 'least privilege' least amount of access and control over the system while still allowing them to

When admins set up an account for a new user, they will create the account but the new starter joins. They will use the company policy to automatically set pas how often the password must be changed. In very secure environments, passwo weeks. In a normal office setting, this might be reduced to six or 12 months, but A temporary or contracted employee may be given an account with an expiratio the users to the groups created for each team or department, depending on thei

Access restriction and control of sensitive/valuable data

Access levels are the levels of access provided by user IDs – these must be mon that only certain personnel have access to particular areas on the system. For ins have access, giving them the rights to make changes on the network. Some or permit access to specific parts of a network system. Authorised users are allowe using their password (referred to as **access rights**) and this helps to keep confide from unauthorised users.

Sensitive and confidential information is at risk of unauthorised access if the correct security procedures are not followed. The best way to ensure security of data is to use a login and password to access a computer system. Types of information that can be at risk of unauthorised access are financial information, personal details, health records and social security details.

Admin accou administrator the system – s

Audit trail: A activities that

Account man permissions a

File permissions

File permissions refer to security controls which a user can set to secure files from or formatting.

A file that can be shared and edited by more than one user is a read–write file, whic accessed and read and can also have data written to it (for example, when the file is

You can change the attributes by making the file read-only. Selecting the read-o from being overwritten or amended. The file can be opened and read but change existing file name. If you want to make changes to a read-only document you w the read-only check box.

Password protection

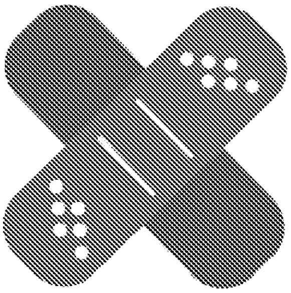
Some documents are confidential or contain sensitive information which should only be seen by specified users. Document passwords are added to make sure that unauthorised users cannot access or make changes to a document.

When a character is typed into the password box, it is displayed as either an asterisk (*) or a dot (•). This is to ensure the privacy and security of the password.

Installing antimalware protection

Every machine must have antimalware installed to reduce the threat of malware outbreaks, and scan downloaded files and removable drives, etc. Some package only include antivirus; others come bundled with firewall and other tools. On a large network, the antimalware may be known as 'endpoint protection'.

Using patch management to ensure all machines are up to date



Companies such as Microsoft release updates for Windows, Office and other software usually once a month (on the second Tuesday in Microsoft's case – aka 'Patch Tuesday'). These updates close security holes, fix bugs and errors, and sometimes add new features. If Microsoft releases an emergency patch, to fix a major bug or a security issue that's being actively exploited by hackers, they call it an 'out-of-band' update.

Your home computer will check for updates directly from Microsoft's servers about once a day and will automatically download and install necessary updates.

Patch man
that pushes
the network

But a large business with thousands of PCs won't want direct updates for two reaso

1. Windows cumulative updates are large – maybe 300 MB to 1 GB, and mayb takes up a lot of Internet bandwidth and can slow the Internet speed to a c
2. Updates can sometimes break a system, software or drivers, or cause printi the provider will remove an update from their download site after a few da

Instead, the business will use a patch management system such as WSUS (Wind release necessary updates at a set time. Generally, the updates are downloaded are stored on a local server. This allows the administrators to:

- Test updates first on a limited number of machines to ensure that they still
- Block updates that break the machines
- Remove specified updates
- Update the machines in batches to reduce strain on network bandwidth

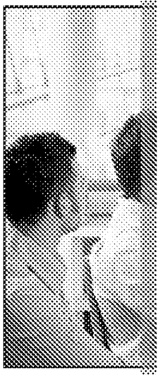
There are also systems designed to patch mobile devices such as phones and ta management (MDM). These systems [illegible] so much more functionality, such backups and wipes if the device is stolen.

Ensuring applications are updated and known vulnerabilities are pa

Just like operating systems, application software can be vulnerable to attack (yo 'increased attack surface' with more apps). It's important to ensure that the apps versions possible. Any unnecessary applications should be uninstalled; for exam computers like HP or Dell often bundle lots of extra software with their machine

Sometimes software companies will issue warnings about security issues with th
Exchange software (email server) was found to be vulnerable, and hackers were
placing web shells into thousands of servers (web shells are back doors that can
server; for example, to steal data or to launch malware). It is vitally important th
soon as possible by applying patches and other fixes. You may have heard about
that hackers are aware of the bug but there is no fix available yet.

Training staff to protect data



There are several ways that a company can teach staff how to protect data as they go about their day-to-day jobs. Some of this is taught to the employee through an induction on their first day, via annual refresher training, and by reading through policy handbooks.

An **acceptable use policy** (AUP) sets out how people may and may not use a network, i.e. which uses are acceptable. AUPs mostly focus on what you can't do, so as long as your use is legal, doesn't harm others and isn't specifically mentioned, it's probably OK.

Acceptable
which gove
a computer

AUPs protect the network from attack, abuse, illegal activity and legal liability, and protect the other people who use it. You will normally accept the agreement by clicking a box to accept (e.g. signing up to a website), or you may be asked to manually or electronically sign an agreement (e.g. on your first day of a new job).

You may agree to be bound by acceptable use policies in lots of different scenar
- using your school, college or university network
- using a computer system at work
- using a public Wi-Fi connection in a café or holiday home, or on the bus or
- purchasing a subscription to a home broadband connection
- signing up to a social media site
- downloading apps
- accessing or signing up to general websites, including forums

Each AUP varies depending on the specific scenario. Some common don'ts in an
- No downloading or uploading of illegal material (e.g. indecent images of ch
  material) or copyright infringing content
- No hacking or malware distribution
- No activity that degrades the network performance for others (e.g. 24/7 file
- No spamming or sending unsolicited email (especially if you've been asked
- No online bullying, defamatory or racist messages
- Don't let someone else log into the system as you, or log in as someone els
- No copying the content of the website

There are different sections within the AUP. For example, the sections cover:
- *Scope* – who and what the policy applies to, e.g. staff and students at the col
- *Assets* – what the policy covers, including files and information.
- *Acceptable* – anything that is allowed (if specified) or anything that users ar
- *Unacceptable* – anything that is not allowed
- *Monitoring* – how compliance is monitored, e.g. logs, web filtering, tracking
- *Sanctions* – the processes to investigate and the potential penalties for bre
- *Agreement* – how you will accept the policy – tick box, (electronic) signatur

Acceptable software

Companies assess and test the software that they expect their staff to use. For e software is properly licensed (which may limit the number of installations), is co doesn't crash or cause the whole machine to crash, and doesn't contain known s

To ensure that the software meets the business needs, the IT departments spen of pounds on software licences to use proprietary packages such as Office suites (computer-aided design) and project management software. The IT department w out updates and patches as required, alongside the monthly updates to the operati technicians are able to 'deploy' (install) new software and remove software as re tools installed on the company servers. In many organisations, normal staff acco have sufficient privileges to install new software.

The IT department may also allow the use of some open source or free software extra checks to ensure that it's not a Trojan and can be run in commercial applic

Large businesses may have an approved list of software available for staff to ins software, they will need to submit a request so that it can be approved and teste why the extra software is necessary.

Without these rigorous checks, staff could unknowingly infect the system with m widespread disruption to the whole network. They could also cause legal reperc ever performed and non-commercial, pirated, illegal or licence-exceeding softw the software policy, they could be disciplined or fired.

What is your school's network policy?

Recovering from a cyberattack

Disaster recovery policy

In the event of a fire, flood, data breach, malware outbreak, data corruption, or a server failure, the disaster recovery policy must be implemented as quickly as possible to minimise the damage and get the company operating again as soon as possible. The longer the system is not working, the more disruption and loss of income occurs, increasing the chance of the business failing.

Of course, a data recovery policy should never be idle or forgotten about as an unopened file on the network. It should remain up to date at all times with updated job roles (rather than staff names) and include any new risks, mitigatio backing up will be a daily occurrence. Regular testing of the backup system is ne

The disaster recovery policy will include:

- What everyone will be doing to ensure that no steps are missed, the work is don't perform the same task.
- What staff should and shouldn't do – everyone in the company might be in on paper temporarily and not reporting news of a breach to the media.
- Who is responsible for making sure that the backup is running successfully, re when and how data is backed up, which drives or tapes each day, off-site stor
- Timeline for disaster recovery (which data and equipment will be restored fi infrastructure is needed by the company for it to run successfully), and which is
- What will need to be done if the office location needs to move either perma location (if the office is destroyed in a fire or becomes uninhabitable due to the policy will specify what network infrastructure, servers, hardware and s purchased for the move, and how the data will be restored at the new locat

Actions to take after an attack

After a system has been compromised, such as a malware outbreak, or an outsid data, the following steps should be taken. Note that some of these may overlap s example, as soon as the breach is discovered the server might be taken offline b

1. Investigate – find out what happened (e.g. hacker or malware), when it happ is based on the potential for personal data to have been lost, and which serv were involved.

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2. Respond – let stakeholders (e.g. customers, employees and investors) and Information Commissioner's Office) know about the compromise – in some cas within 72 hours (three days) of discovery. If personal data including passwords people need to be told that they should change any passwords that they use e and be on the lookout for fraud and impersonati

↓

3. Manage – contain the threat by taking the affected equipment offline or p hacker by removing or disabling the compromised account or by blocking th firewall.

↓

4. Recover – implement the disaster recovery plan in order to remove the malw example, this might include running a tool to remove the malware, reinsta purchasing new equipment or replacing equipment and software. This

↓

5. Analyse – find out why the event occurred and how it could have been prev work out how successful the remediation was. As a result, policies and proced the company more robust in the future.

Alternative premises, communication methods and facilities

Alternative premises – if the regular office has been damaged but will be operational again within a few weeks, the business may ask staff to work from home, rent flexible space, or move some staff to another branch office temporarily. If the building has been destroyed, it will need rebuilding, or the company will need to find other premises nearby.

Alternativ and warm can use if e.g. throug

Some companies will have entire disaster recovery buildings – fully functional o from in emergencies and practice days. The buildings may also house servers wh office, with new data copied between sites each day. This is an expensive propo disruption – imagine a company with 1,000 employees and a single office locati backup site.

Cold backups don't have any real infrastructure set up so are the slowest to some infrastructure.

Communications – if the main office becomes unavailable, then alternative com needed. The main phone number for customers can usually be ported temporari may need to set up temporary VoIP or other messaging services.

What-if scenarios

As part of disaster planning and business continuity plans, many different 'what-if' scenarios will be discussed and planned for. The business must be able to find fixes and alternative provision.

What-if scen
scenario to d
continue doin

Example scenarios could include:

- Malware outbreaks, including ransomware
- Failure of the backup system (can't create new backups, or restore from existing backups)
- Loss of Internet, cloud storage or cloud computing, or internal networking
- Software failures
- Hardware failures
- Loss of electric power
- Staff sickness and lateness (e.g. disease outbreaks, natural disaster, major traffic incidents)

Backing up data every day

Backing up and recovering data – If you've ever lost an important or irreplaceab to the device, it's crashed, it's been hacked or it has fallen victim to ransomware importance of backups. A backup is just a copy of the data that can be restored f deleted or damaged. Most backup systems are automated – they are set to run o need to do each day is to insert a new tape (there are also robots that can do thi

Businesses pay meticulous care and attention to their backups and spend thousa Most businesses rely on having access to data, so would temporarily be brought easily fail if their data was permanently lost. Imagine if you owned a business a to arrive to work without access to any of the files, documents, databases and c need to do their jobs...

There are lots of different ways of backing up data. For example:

- to cloud storage
- to local hard drive or tape
- manually copying data to a drive or removable device

If backups are made to local media (e.g. hard drives) they will usually be stored two copies of each week will also be stored off-site. This is just in case the buildin copies are destroyed in a natural disaster, or stolen.

A business will have a set schedule of how data will be backed up and restored, full exact copy every day or week, or just the data that's changed since the last b important files might be backed up more than once a day, and would be the firs system failure or breach.

Full backups take longer each day (physically copying the data to physical medi are much easier to restore from than incremental backups.

When you delete items from the hard drive they will be sent to the Recycle Bin, deleted, or restored if required. Files and folders deleted from the A drive or flas the option of being restored. For this reason, you should be very careful when de flash drive or other removable drive.

The Recycle Bin (in Windows; Trash on Macs) icon is situated on the deskt depending on whether the Recycle Bin is empty or contains deleted files.

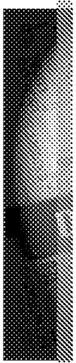
The following items cannot be restored from the Recycle Bin:

- Files/folders deleted from network locations
- Files/folders deleted from removable storage media, such as memory sticks
- Files/folders which are larger than the storage capacity of the Recycle Bin

The Recycle Bin gives you the option of restoring deleted files and folders (reme USB drive will be deleted permanently and cannot be restored from the Recycle

Digital footprints

Everything we do using a computer leaves a mark somewhere, whether we intend to or not. Digital footprints can be used by the police to investigate crimes.



Passive footprints

Passive footprints are the ones that we're not aware that we're leaving. For example:

- Logs on the device we're using, including all applications that you open, settings you change and browser history
- Logs on remote servers – when you visit a website, the server will log your IP address, browser details, screen size, etc. Logs will be stored on the central servers on a corporate network.
- Login times and location – every time you log into Facebook, for example, i based on your Geo-IP.
- Your mobile phone network provider knows where you are, based on which ce
- Logs print jobs stored on printers (document names, usernames, page coun

Passive footpr
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the result of m

Cookies – your browsing habits are tracked by your web browser and cookies (sm stored on your device. These cookies are useful in the functionality of websites (cookies), but can be used to track your online history (third-party cookies that ar by the owner of the site you are on). Third-party cookies are sometimes called tr cookies. They can be blocked using browser settings.

Remember that in Europe, each website that uses cookies must ask for and be gr on your computer. In theory there should be a 'single' button to reject all, but som buttons to turn off. In the past, we had less knowledge of – and certainly less cont placed on our computers, so they were truly passive. You could only instruct your remove them, but not where cookies are needed for the site to function corre

Take a look at the permissions that you are agreeing to – you might be surprise vendors might be able to view your data. Online newspapers often have a lot of

Active footprints

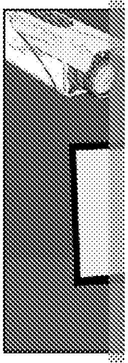
By contrast, an **active footprint** is anything that we knowingly do or type into a computer or device. For example:

- Post messages on social media, blogs, forums, review sites, comment threads, etc.
- Upload videos to sharing sites
- Search the web
- Use smart appliances, smart speakers, etc.
- Create new websites
- Send email
- Create and save documents
- Use online shopping sites

Active footp
created by a
media or a p

Monitoring employees (and potential employees)

Like it or not, if using a computer owned by your employer, you should expect z designed to be used exclusively for business use, unless the acceptable use policy a lunchtime or after office hours. The employers have the right to monitor its use (the you are working and adhering to the acceptable use policy and other rules set by th material that violates copyright, or viewing indecent images that could land the co



Audit trails are usually kept, including a log of the websites you visit. Some companies go further and install software that monitors use and even takes screenshots every 15 minutes or so, or upon certain triggers, such as when specified websites are visited. Many companies also set up CCTV in corridors and offices to ensure compliance with policies. Whatever the policy, the employer should make their employees aware of the monitoring process.

These boundaries are blurred slightly when companies allow a 'bring your own device' or provide devices that can be used personally as well.

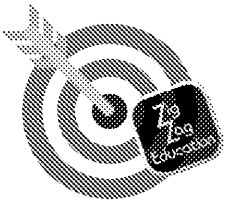
Sometimes employers will screen candidates' social media or search online for
reason why it's important to protect your social media accounts and delete anyt
about other people or companies. It's also a reason why people sometimes ask G
that link to damaging articles that are untrue.

Security services (information gathering)

Various security agencies routinely collect information about us, and have the pow
request the monitoring of our online communications and online digital footprints
find criminals and foil terrorist plots. Each time new legislation is passed, such as
Investigatory Powers Act (discussed later), governments are criticised by privacy a

There have been many leaks over the years of the techniques that governments
their citizens, such as the information provided by Edward Snowden. Generally,
services disapprove of the strong encryption of messaging systems because they
decrypt messages easily.

Targeting potential customers



Businesses target potential customers in many ways, includin
cookies. Collected data can be used to create an advertising pro
picture of you by working out your age, interests and ho
a read of this article to see what sorts of things companies tr
zzed.uk/12330-data.

What have you added to your digital footprint over the last week?

Legal responsibilities over the protection, storage

Here we cover the legislation and look at how it impacts our privacy and trust.

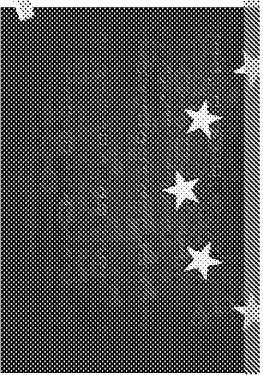
The Data Protection Act 2018 and the General Data Protection Regu

If you read books about IT from perhaps 40 years ago, they would say that your
handful of computer systems. That's probably hundreds today – and now those
to the Internet, potentially allowing hackers access to that data. The more place
greater the chance of a breach.

Your personal data is valuable because it can be sold on the dark web to cybercrin
identity theft and other fraud. Identity theft is particularly problematic because cri
and loans in your name. It can be very difficult and time-consuming to convin
you didn't set up the account. At best, you could receive more scam calls, junk ma

Because of the danger of hacking, and the importance of keeping personal data
place to help protect it – for example, the Data Protection Act 2018 and Genera
(GDPR) in the UK. These regulations protect how data can be collected, stored, u

The new legislation was stricter than the old, and gave citizens greater rights on data held on them, consenting to the use of their data, and having their data ren the new legislation came into force in 2018, everyone received emails from doze signed up to over the past decade or more, asking for permission to retain the d allowed pre-ticked boxes to sign up to receive marketing emails, for example.



The penalties for non-compliance and for failure to protect data (e.g. breaches) became much more severe. GDPR set the bar high – the maximum penalty was the larger of either €20 million or 4% of global turnover in the past year. In the UK, the euro price was converted to £17.5 million. All fines are handed out by the Information Commissioner's Office (ICO).

Below are the general principles of the Data Protection Act 2018 / GDPR (which replaced the previous Act of 1998). The UK was still in the EU when GDPR came into force, so it became law in the UK as well.

Lawful processing

The person who is in overall charge of the data and sets how it is processed is th who use the data on a day-to-day basis are the data processors. They must ensu (processed) only as instructed by the data controller. The controller must ensure 'legitimate interest' to the business, and that the person who the data is about (t consent for their data to be used.

Collection for a specific purpose

The data collected must only be used for the purpose that it was collected for – chooses to collect data, it must decide what data to collect, and why that data is to use that data for a different purpose, it may need to ask for consent again.

Only necessary collection

The minimum amount of data should be collected – only what is absolutely nec relevant for the study. If you are a volunteer taste testing a new bar of chocolate company would need to know your mother's maiden name or your National Insu legitimately want to know your age and your gender because that information w for marketing if a bar of chocolate was particularly well-received by a certain de

Accuracy

The real world is complicated and changes frequently. For example, we move ho (and may change surnames), have children, etc. The data might be accurate (cor collected, but after a few months, or years, it might be inaccurate.

This could allow inaccurate, misleading or incorrect decisions to be made based legislation, businesses should be very clear on where the data was collected fro make checks on the accuracy if necessary. If the data is discovered to be incorre corrected (or deleted) as soon as possible.

Only kept as long as necessary

In most business settings, except for archiving and statistical analysis, it is unlik keep your personal data indefinitely. If you've bought something online, keeping your last purchase probably isn't necessary. In that case, the company should an its data is still relevant, and delete or anonymise anything that's no longer nece have a standard data retention policy, informing the data subject how long their

Data subject rights

Remember that the data subject is the person who the data is about. The data su rights to (be):

- Informed – about how and why their data is being collected, the privacy an
- Access – anyone can request to see a copy of the data that is held about th a month of the request.
- Rectified – any incorrect data to be corrected, and any incomplete data com
- Erasure – in some cases, you may request that a company deletes certain da the data is inaccurate, used only for marketing, is being used for a different
- Restrict processing – stop the data being used for some purposes (a substitu
- Portability – take a copy of your data to another service (previously discuss
- Object to the data being processed in certain circumstances, e.g. marke
- Automated decision-making/processing – e.g. important decisions made by personal circumstances into account. The data subject may be able to ask a made and potentially overturn it.

Protected

All of the personal data must be adequately protected from hackers, data breach the business must have sufficient equipment (e.g. firewalls), antivirus software, e in place to prevent breaches and ensure that the data is safe. After the data and necessary, the data must be destroyed, e.g. by shredding paper and tapes, magn

Companies risk large fines if their systems are breached or if their protection me ICO of the breach within 72 hours of discovery, as previously mentioned.

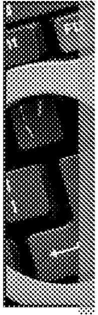
Not transferred to countries with less protection

Not all countries have the strict protection laws afforded by the Data Protection flows of data are essential to our modern lives.

This is why when you try to access some websites – for example, where the site they are blocked from [illegible]. Companies that operate across the world might ha countries and transfer that data to others. In 2020, a judge in Ireland (where centre) ordered Facebook to stop transferring any data about EU citizens to the U

While companies may reach agreements that any data transferred will be treated U.S. Privacy Shield is no longer valid at the time of writing, meaning that this is no data to the USA. Does this mean that using Google Analytics, for example, is not c

The Computer Misuse Act 1990



In the very early days of computing, there were no laws against hacking, meaning that it was difficult to prosecute hackers using the existing laws – sentences were typically light, if charges were possible. However, the law has since caught up with hackers and criminals.

The first laws were introduced in 1990 in England and Wales with the Computer Misuse Act 1990, with separate provisions in Scotland. This law made three things illegal, punishable through fines and prison time:

1. Unauthorised access to a computer system
2. Unauthorised access to a computer system with the intention to commit f
3. Unauthorised modification of files

Since 1990, the offences have changed slightly and the penalties have become m has been introduced – now up to 10 years in prison and larger fines. These chan Act 2006 and the Serious Crime Act 2015.

Under these amended Acts, the following are now crimes:

1. Unauthorised access into a computer system (finding weaknesses into the con
2. Unauthorised impairment of a computer system (including modifying or delet to crash)
3. Making, supplying or obtaining materials to use in acts of computer misuse hacking tools and malware)

Fighting cybercrime is difficult – many crimes committed go unpunished becaus locate. They may not be located in the UK, so prosecutors need to partner with a

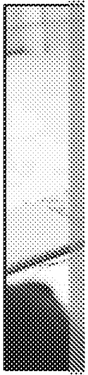
The Investigatory Powers Act 2016

The **Investigatory Powers Act 2016** amended a previous act called RIPA. While t law enforcement to operate, it has received severe backlash online from privacy surveillance aspect has led to it being branded as the 'Snoopers' Charter'. For th started to use virtual private networks (VPNs) and apps such as WhatsApp (stron means that the business who creates the app (Facebook) cannot read the messa

From a data holder point of view, ISPs must retain records of the sites visited by comply with the requests to hand over personal information.

The ethical impacts on the wide-scale use of data a

Individual privacy



Throughout the world, people are becoming increasingly concerned over companies and governments watching their online footprint – the web pages they view, the messages they send, and who they send them to. This is the reason why people use VPNs to hide their web surfing, and encrypted messaging services such as WhatsApp. However, governments and law enforcement are becoming increasingly concerned because encryption also helps hide criminal activity. Encryption isn't a bad thing – it's essential for safe online shopping and banking – it's just that if two criminals are conspiring to commit a crime, the police can't act as easily.

In isolation, a single piece of information isn't too much of a concern. However, to build up a detailed profile of a person. Your cookie data may be collected and buried in the small print that you often agree to without reading!). They may tra devices. For example, shopping patterns, location, cookies, and identifiable info work out where someone lives, their age, their sex and gender identity, any hea in debt, their hobbies and interests and whether they are married, etc.

Ethical use of shared data is essentially saying that even if the use or collection of that data is legal, is it right to collect or use it in that way? Ethics are a lot looser than laws, but professional bodies may discuss and agree on sets of rules or codes th gets around the issue that each person has a slightly different set of morals (wh ethical considerations may govern the impact of building up such a detailed pro

Ethics: Term use moral principles

Wider society

In general, governments have been gaining powers to monitor citizens, reducing individual **privacy**. For example, number plate recognition cameras are installed along motorways, and installed in police cars. In the future, real-time facial recognition software could and when they visit certain shops and locations, or commit minor offences. Faci be used to identify race, and be used to control behaviour, as this article explain

Privacy: Increa and the rise of concerns relati

Do you allow or reject cookies?

Practice Questions

1. Give two ways that data is accidentally destroyed.
2. Give two ways that data is deliberately destroyed.
3. Give two examples of malware.
4. Describe how social engineering works.
5. How can passwords be breached?
6. What type of attack is designed to take a server offline?
7. Describe the purpose of encrypting data.
8. How do firewalls and antivirus differ in what they block?
9. How would a network administrator restrict access to network file shares to e
10. Why do businesses need to plan to defend against cyberattacks?
11. Give a consequence of server or website downtime.
12. Give two examples of financial loss a business may face because of a cyber
13. Why is patch management crucial for businesses?
14. Why do staff need to be trained to protect data?
15. Why is an acceptable software policy necessary?
16. Why is a hot backup site the most expensive to implement?
17. Is posting on social media an example of an active or a passive digital footp
18. Give one way that an employer could digitally monitor the activity of an em
19. Give an example of an Act that considers your rights to how your personal d
20. Give an example of how you can help to protect your privacy online.

Chapter 6: Changing digital te

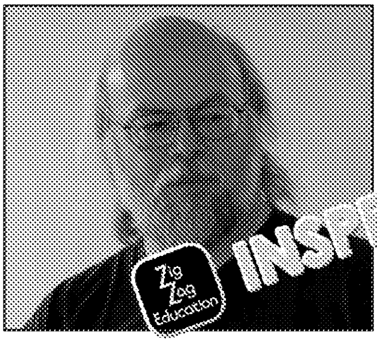
In this chapter you will learn:

- The key moments and people involved in the development of communicati digital devices
- How technology has affected society, the economy and culture

Key milestones and people involved with the devel communications, computing systems and digital d

Lady Ada Lovelace, 1815–1852, London, England (first programmer)

Lovelace was a mathematician who first realised that machines could be programmed to run an algorithm; she translated others' work from Italian and wrote extensive notes on the subject. She worked with Charles Babbage, who designed but never built a mechanical calculator called the 'difference engine', and she worked on a new concept from Babbage called the 'analytical engine'. The difference engine was not built until the 2000s – you can see it at the Science Museum in London. Government funding dried up for Babbage in the 1800s!



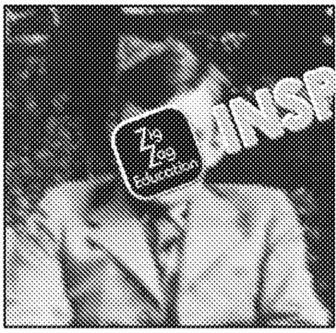
James Gosling, b. 1955, Calgary, Albert programming language)

Gosling worked for Sun Microsystems and deve programming language with two other authors first released in 1995 as a Beta version. Billions including all Android devices, and many routers computers run it. Because Java runs inside its o portable. Java is now owned by Oracle, which b

Admiral Grace Hopper, 1906–1992, born in New York, USA (first commercial electronic computer)

Hopper was in the US navy and helped program one of the first computers, the Harvard Mark 1, which was used towards the end of World War II and created between IBM and Harvard University. She created the underlying programming theories that were used to create the programming language COBOL, released i 1959. While Hopper didn't actually design COBOL herself, the language she insp is still in use today in legacy systems – there are still new programmers learnin language to maintain code, and will need to do so for decades to come!

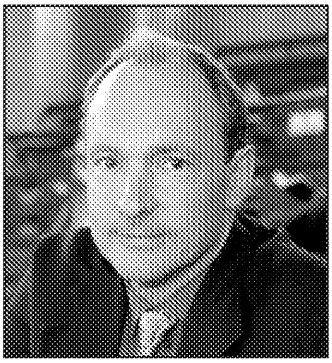
Alan Turing, 1912–1954, born in London, England (computational th



Turing is best known for his work in Hut 8 at Ble helped with deciphering German Enigma code deciphering device called the 'Bombe'. He was o computing theory, algorithms and artificial intel 'Turing test' to work out whether a computer ca machine is a human. Turing was convicted of be offence at the time) and chose hormone therapy believed to have committed suicide as a result, b accidental. He has since received a pardon from online petition, and now appears on the £50 not

Steve Jobs, 1955–2011, born San Francisco, California, USA (commoditised computing; smartphones)

So much has been written about Jobs over the last few decades! Jobs founded A
Computer (now Apple Inc.) with Steve Wozniak ('Woz') and Ronald Wayne in 197
was a fantastic salesman for the computers Woz designed – initially the Apple I,
followed by the Apple II in 1977. Apple was highly successful by producing a rel
cheap computer with a keyboard – the Apple II came fully assembled, which dif
from the kits that were available at the time. Combined with an early spreadshe
package, the Apple II was highly successful: six million were sold during its 16
production run! Jobs was also instrumental in overseeing the building of the Ma
computer, released in 1984 which was one of the first affordable computers to
a GUI. Jobs was later ousted from Apple; he set up his own computer company
and funded NeXT. In the mid 1990s, Apple was in financial difficulties, so Jobs w
became CEO. Apple had purchased NeXT, and the technology was incorporated
return, Jobs discontinued several projects, and brought out the iconic colourful i
his team, developed the iPhone, which launched in 2007, a product that merged
and is one of the first consumer smartphones. Jobs was also well known for his l
launches during the 2000s, including a mock funeral for the legacy MacOS 9 in 2



Sir Tim Berners-Lee, b. 1955, London, Engl

Berners-Lee is the inventor of the World Wide Web
as the Internet). He created the Web to be a series
working at CERN in Switzerland (the scientific cen
Hadron Collider). The first web page went live in D
and hosted on a NeXT computer (that Steve Jobs d
Berners-Lee has worked as a consultant for the UK
several foundations, calling for a free and open W
campaigner. You might have noticed Berners-Lee
2012 London Olympics sitting at a NeXT compute
everyone. He was knighted by Queen Elizabeth II
that the Web is barely 30 years old!

Research other computer scientists such as Donald Davies, Katherine Johns

Impacts of society, economy and culture

It's hard to believe how much technology has impacted and transformed our everyday lives, from the way we work, communicate and entertain ourselves, to our economies. The first computers only started to come into homes and businesses during the 1980s, and even the Internet didn't take off in homes until the late 1990s. The Internet has become pervasive. Social media and video-sharing sites have given us vast insights into other cultures. Want to try a recipe from somewhere else? Sure, and at least we can find out how much flour is in a cup, or the weight of a 'stick' of butter.

Here are some inventions that have, or will dramatically change the world.

Industrial robots

The first industrial robot was the 'Unimate', unveiled in 1961 by General Motors,
to transport hot metal, and it was very basic compared to the sophisticated
robots are great for carrying out dangerous and dirty jobs, including within hot a
robotic arm in the photograph is welding metal.

Industrial robots: Robots th
repetitive jobs in car manuf

Autonomous robots

Autonomous robots: R
think and adapt to their

Unlike industrial robots which just repeat set instructions over and over, automatous robots have a degree of intelligence, are able to detect changes in their environment and ofte themselves around, and may sense people and objects and move out of their pa used in industrial settings where the product differs slightly, such as picking ite cleaning (e.g. robotic vacuum cleaners), in space and in military applications suc

Autonomous vehicles

Self-driving cars have been the stuff o they are now a reality. You've been te different shapes for a while – how ma completed where it asks you to identi traffic lights and even palm trees? De have been proposed since the 1920s, controlled or run on special tracks. Th the Carnegie Mellon University. Since started developing commercial produ now most car manufacturers are developing such vehicles, with increasing amou in recent years. Testing self-driving cars has been legalised in a few specific sta there is a human on board who can immediately take over if there's a problem. have human control at times; a truly automatous vehicle wouldn't even have a s

There are lots of ethical and moral questions over the use of driverless cars, wh respond to accidents (potentially who to kill), attempts by hackers to break into population that has never learned to drive.

Virtual reality (VR)

We have already discussed the development in VR and its uses in gaming, industr

Augmented reality (AR)

We have already discussed the development of AR in a variety of commercial and social settings.

Artificial intelligence (AI)

Artificial intelligence:
'think' for themselves c
machine learning and

Artificial intelligence is an attempt to mimic thinking, problem-solving and decision-making by a computer as if it were a human. The AI is given a large data set in order to process decisions. Early examples of AI include simple chatbots and AI when talking to smart speakers, getting recommendations from Spotify, and websites – they look online or at a database to come up with the best answers.

There are lots of advantages and disadvantages of AI. Advantages include takin from people (automation) which can save businesses money. They can also wor available in all time zones. AI is often paired with robots taking away dangerou used in medical applications, such as screening for cancers and diseases with a helped give Stephen Hawking a voice.

However, disadvantages include a loss of human jobs, even in the creative indu the jobs at risk from automation. When humans are replaced with AI, the p Also, AI can have a very high development cost. Hawking often spoke about the perhaps some of the horror sci-fi films of AI taking over humans are a bit far-fet regulate and control future AI applications.

Machine learning (ML)

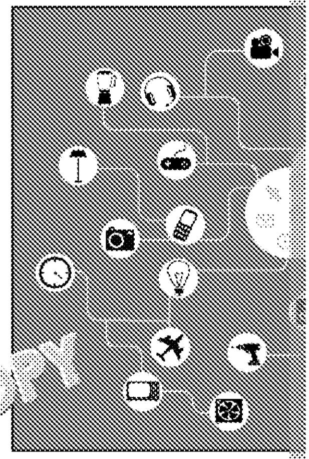
Machine learning (ML): Ability intelligence systems to improve

Machine learning (ML) is essentially a subset of AI. ML uses algorithms (sets of instructions) to get better at recognising and 'learning' new patterns in data. We give the algorit (think of all those pictures of traffic lights and trees we train driverless cars with algorithm gets better at recognising them. This way the algorithm is capable of stopping at them, avoiding pedestrians and trees, etc.

Another example of machine learning is the YouTube algorithm – its goal is to in videos that it thinks we want to watch, promoting certain channels and indiv learn to recognise human speech and learn which emails are spam in order to se

One step further is deep learning, which uses neural networks – connections tha the human brain.

Internet-enabled hardware and the Internet of Things (IoT)



The **Internet of Things** (IoT) has grown rapidly in recent years. The definition of IoT is very broad – it includes a very wide range of smart devices that are connected to, and accessible over, the Internet, and can often be controlled through a smartphone app. The number of IoT devices is likely to skyrocket with the advent of the 5G mobile network. Devices are often wirelessly connected to home Wi-Fi or by other wireless methods, and include many devices such as kitchen appliances, smart speakers, doorbells and locks, baby monitors, electricity meters, colour-changing light bulbs, medical devices, smoke alarms, motion-activated cameras, and smart watches and fitness trackers, etc.

Internet of Things: The devices that send data controlled remotely.

There are many benefits to smart devices; for example, convenience, time-saving and ease of use. You can pull into your driveway, open the garage door, unlock the front door to your home and turn on the lights before even leaving the car. If yo or later than expected, you can turn on or off the heating remotely. If someone d out, you can speak to the delivery driver and tell them where to leave it, and you home if they detect movement when nobody is supposed to be in.

Some of the major problems are security and lack of privacy – many of these de security and are a target for hackers (it has been shown that some cameras and b and can show hackers a live video feed of strangers' houses, and listen to childre are trying to implement standards to improve safety, but this is a challenge beca located abroad, and end users can simply buy online and have goods shipped di China. Many of the devices send data 'home' to the parent company, which coul the world. People simply walking down the street may be seen and recorded by into smart doorbells. These devices can be tricky to set up securely, and many us as setting up IoT on a guest network or regularly updating the firmware.

Are you for or against the development of AI? Would you buy a driverles

Noteworthy research

Technology is a fast-evolving field. New technologies emerge, while others face longer supported. New software and OS versions get released, along with new h desktops and all-in-ones, and IoT devices, new generations of processors and ne Major milestones in 2021 (just in desktop computing) include the new line of Ap announcement and later release of Windows 11.

Each year there are exhibitions and trade fairs around the world where brands sh inventions. Perhaps the most famous (to the public, at least) are CES (C which runs in Las Vegas every January and E3 (Electronic Entertainment Expo) f which takes place in Los Angeles each June.

Now it's over to you! Use the rest of this page to jot down notes about the miles technologies that have been released since you started this course (and also kee exam). You could do this once per month.

Practice Questions

1. Give an example of where industrial robots are used.
2. How do autonomous robots differ from industrial robots?
3. Describe one challenge of autonomous vehicles.
4. How are artificial intelligence (AI) and machine learning (ML) related?
5. Give one example of a challenge with the Internet of Things (IoT) that needs

Answers

Chapter 1

1. Any suitable way, e.g. stored as 1s and 0s, transmitted wirelessly as a square waveform
2. Any suitable reason with explanation, e.g. to make the information more accessible by s it to the Internet, or to reduce the volume of storage space required, e.g. by scanning in information digitally in the cloud
3. Converting analogue audio to digital audio
4. The quality of the audio is higher
5. Any suitable point, e.g. requires more storage space
6. Any two explained disadvantages, e.g. corruption or failure of old media could m online systems can be vulnerable to hacking, resulting in data corruption, or the initial a electricity costs required to purchase and run servers / monthly fees to cloud providers t
7. 1080p
8. Any suitable advantage, e.g. vectors can be scaled up without loss of image quality, or s
9. Any suitable reason with explanation, e.g. high-quality images used by professionals wh there is no loss in image quality, meaning there is less pixelation when printing large in
10. Playing a video through an application or a web browser, where the file is distributed fr (rather than local storage)
11. Lossy
12. Nibble = 4 bits, byte = 8 bits
13. Terabyte (TB)
14. Optical media such as CDs and DVDs because they have been replaced by downloads an no longer come with optical drives as standard.
15. Any advantage and disadvantage of cloud storage, e.g. accessible worldwide and scalab stable Internet connection, releases some control over the storage to a third party (disa

Chapter 2

1. Any suitable limitation, e.g. may not understand the input/accent, requires a private spa
2. Use of shortcut keys
3. Any suitable device, e.g. smartphone or tablet, or a laptop or desktop with a touchscree
4. More secure due to the uniqueness of each individual / hard to steal or hack into rem
5. A network of networks carrying TCP/OT traffic / connecting networks together
6. A switch recognises the intended destination, which is more efficient than a hub (1), which
7. Internet service provider (ISP)
8. HTML
9. Broadband has higher bandwidth than other forms of Internet access, such as dial-up an (the best is FTTH) for most or all of the way, with just a small amount of copper (if at all
10. 5G is very fast with speeds in excess of many existing Internet connections – it offers a will be widespread over the coming years
11. A large space where lots of boosters and wireless access points would be needed, or wh as microwaves that would cause the Wi-Fi signal to degrade
12. Any two resources, e.g. RAM, processor, printers and peripherals, input and output devic
13. Computer and network admins (NOT home users or general employees)
14. Any two suitable reasons, e.g. icons/graphics and selectable menus and buttons aid me commands with complex syntax and switches or typing errors
15. Applications are the main applications operated by the user to perform main functional programs that perform maintenance tasks on the device
16. Bespoke software must be written specifically for one customer with high programming software is bought 'off the shelf' and is intended for thousands or millions of customers
17. Grandfather
18. USB flash drive
19. In case of a cyberattack, destruction of data, natural disaster, hardware failure, etc.
20. Storage is simply files stored on a remote server; computing uses the server to run and p
21. Investigation, Analysis, Design, Implementation, Maintenance, Evaluation
22. Any suitable part of the system investigation, e.g. coverage, scope, issues, requirements,
23. An easy to understand representation of data flow through a system
24. Direct (Big Bang)
25. To ensure that the system works as intended / as it's meant to

Chapter 3

1. Any two advantages, e.g. quicker and cheaper than using the post, very flexible, uses les
2. Any two, e.g. age, wealth and location (rural, developing world)
3. Unsolicited bulk email
4. Many short messages in real time rather than longer email communication; convenient
5. Any two reasons, e.g. cheap, no travel required, more personal and engaging than just a

6. Allow a discussion of the advantages and disadvantages of social media. Advantages, e.g. Disadvantages, e.g. can be addictive, takes up a lot of time.
7. Any two methods, e.g. direct email marketing, media and social media to customers to i special offers, email and VoIP for everyday communications. Also accept external websit
8. Any two methods, e.g. internal VoIP, instant messaging and online collaboration to chea communication, manage projects and share and collaborate on documents
9. Any explanation of inaccurate information (written by a non-expert or someone with a p (omitting facts or information, or one-sided) or out-of-date information (no longer accur
10. Any explained method, e.g. checking whether the same fact or information can be found copies of each other), checking who created the data (i.e. whether the organisation is re information / last page update or publication date to work out how old the data is

Chapter 4

1. Any two explained risks, e.g. major disruption if systems go offline, including power damage or data breaches
2. Any two differences, e.g. consumers use digital technologies more socially (social m use more specialist software tools, and use technology for corporate uses instead of soc
3. Allows problems to be discovered and fixed before a large-scale rollout
4. Allow any two explained reasons, primarily focused on the advantages of computerisati some or all team members to work off-site and collaborate with staff in other offices or
5. Any suitable example, e.g. office supplies and furniture, materials for manufacturing
6. Any suitable description of the rise of online shopping with direct courier to the consum collect from a depot
7. Items sold directly by Amazon are all purchased from and shipped directly through Ama third party and just use Amazon's site as a selling platform. Some will send the goods o goods in Amazon's warehouse and Amazon will do the shipping.
8. Any suitable platform, e.g. eBay, Etsy
9. Any suitable description of advertising through social media, such as targeted ads to sp are called 'sponsored' messages.
10. Analysing very large data sets to identify trends and patterns

Chapter 5

1. Any two suitable ways, e.g. accidental deletion, damage, natural disaster
2. Any two suitable ways, e.g. disgruntled employee, hacker, using malware
3. Any two suitable forms of malware, e.g. virus, worm, spyware, Trojan horse, ransomware
4. Tricking a human into giving away information or allowing access through false pretenc
5. Any suitable method, e.g. brute force, or obtained from social engineering (phishing em in-the-middle attack
6. Denial of Service (DoS). Allow DDoS (Distributed).
7. To stop data from being read if it is intercepted (either in transit, or the storage device o
8. Firewalls block malicious network traffic and intrusions (and block ports) while antivirus
9. Any two, e.g. by not allowing access to drives that they don't need access to / by adding group(s), setting file permissions (read, read and write, etc.)
10. They need to be safe from any risk of data theft or breach of confidentiality if the syste commercial data safe from an attack
11. Any disadvantage, e.g. loss of staff productivity, customer-facing services may be inoper
12. Any two losses, e.g. direct cost from staff productivity loss, data and system recovery co
13. To keep system software up to date / reduce the threat of attack or malware outbreaks
14. Any two suitable reasons, e.g. humans are the weakest link in security and make mistak may choose to deviate from company policy, or may be oblivious to threats
15. Allow any suitable reason, e.g. might be from an unofficial source and contain malware, might not be licensed for commercial use
16. Requires a fully kitted-out office with servers and computers and Internet access for reg full building rent
17. Active
18. Any suitable method – monitor logs, use monitoring software, CCTV, etc.
19. The Data Protection Act, or GDPR
20. Any suitable method, e.g. rejecting cookies, using a VPN, using strong encryption when

Chapter 6

1. Any suitable example, e.g. car factories, foundries, or allow reference to dangerous cond
2. Any key difference, e.g. ability to 'think', awareness of surroundings
3. Any explained challenge, such as trusting a machine to make life-and-death decisions w technological challenges such as being able to recognise and avoid external obstacles i
4. ML is a subset of AI
5. Data security to protect highly sensitive data. Any other example of privacy, such as enc