

GCSE Computing

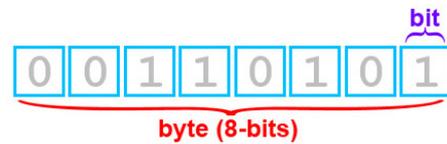
A451 Revision



Binary Logic

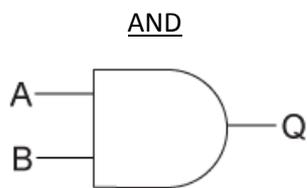
- Explain why data is represented in computer systems in binary form

Binary is a number system of two numbers, namely 0 and 1. Each binary number is a bit, and 8 bits make a byte. It is known as the base 2 system, and is measured by the output voltage of a circuit to determine whether a component is on or off.



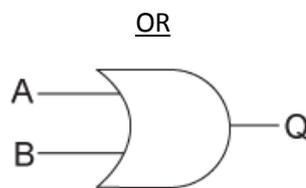
Computers use binary because it is faster to determine whether a component is on or off, rather than measuring some analogue value or property. This is why digital computing is faster.

- Understand and produce simple logic diagrams using the operations NOT, AND and OR



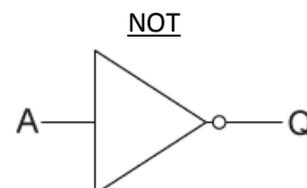
True if both inputs are true

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1



True if either input is true

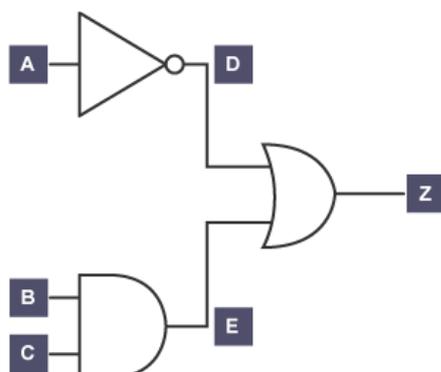
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1



Reverses the input

A	Q
0	1
1	0

- Produce a truth table from a given logic diagram



$$Z = (\text{NOT } A) \text{ OR } (B \text{ AND } C)$$

A	B	C	D = NOT A	E = B AND C	Z = D OR E
0	0	0	1	0	1
1	0	0	0	0	0
0	1	0	1	0	1
0	0	1	1	0	1
1	1	0	0	0	0
1	0	1	0	0	0
0	1	1	1	1	1
1	1	1	0	1	1

Secondary Storage

- Explain the need for secondary storage

Secondary storage is additional storage for data and programs. It is needed so that the data does not get deleted when a computer is switched off. Therefore, it is permanent and can be changed.

- Describe common storage technologies, such as optical, magnetic and solid state



Optical storage uses light from lasers to change the colour of the surface of the data area, which is read from and written to. e.g CDs and DVDs

Magnetic storage consists of disks coated in a magnetic material and a read-write head that moves to read or write the data. e.g Hard Drives, Floppy Disks, Zip Disks



Solid State storage has slower access times than RAM, but faster than magnetic storage. It has no moving parts (durable), but the constant writing of data can cause deterioration - eventually failure. e.g USB flash drives, Memory Cards

- Select suitable storage devices and storage media for a given application and justify their choice using characteristics such as capacity, speed, durability, reliability and portability

Capacity - How much data can be stored on the device

Portability - How easy a device is to carry around

Reliability - How likely it is for the device to fail

Durability - Is the device resistant against temperature, pressure or damage

Speed - How fast the data can be read or written to the device

	Optical	Magnetic	Solid State
Capacity	Small	Very Large	Medium
Portability	Yes	No	Yes
Reliability	Worst	Best	Medium
Durability	No - easily scratched	No - damage if drop	Yes - no moving parts
Speed	Slowest	Medium	Fastest

Input & Output Devices

- Understand the need for input and output devices

Input device is used to enter data into the computer.

Output device is used to present the result of processing data to the user.



Input and output devices are vital so that users can interact with the computer system.

- Describe suitable input devices for a wide range of computer controlled situations



Mouse



Keyboard



Scanner



Microphone



Webcam

- Describe suitable output devices for a wide range of computer controlled situations



Monitor



Speakers



Printer



Projector



Plotter

- Discuss input and output devices for users with specific needs

Concept Keyboards have larger keys spaced further apart for people with limited mobility or vision.

Tracker Ball is an upside down mouse, so that people with limited arm and hand movements can move the ball with the flat of the hand.

Suck and Puff Switches control the cursor by inhaling or exhaling air through a tube; this is useful for people who have no hand movement.

Eye Gaze Devices allow users to navigate and control computer with their eyes, no muscles required.

Braille Keyboards allow visually impaired users to enter data into the computer.

Screen Magnifiers are placed over a screen to assist visually impaired users.

Screen Readers convert text to speech and read out what is on the screen, benefit visually impaired.

Braille Printers can be used to output hard copies of documents in Braille format.

Instructions and Data

- Define the terms bit, nibble, byte, kilobyte, megabyte, gigabyte, terabyte

Bit 1 binary digit	Nibble 4 bits	Byte 8 bits or 2 nibbles	Kilobyte 1024 bytes	Megabyte 1024 kilobytes	Gigabyte 1024 megabytes	Terabyte 1024 gigabytes
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- Understand that data needs to be converted into binary to be processed by a computer



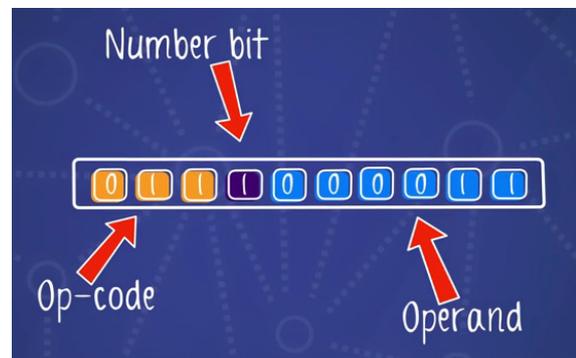
Computers use the flow of electrons to represent information. They are digital so do not measure the size of the voltage, but whether there is a voltage or not. Therefore, there are only two states - true and false. So binary code represents data in a computer, as it only has two digits - 1 and 0.

- Explain how instructions are coded as bit patterns

Instructions from a programming language are converted into machine code as binary instructions. Machine code is a system of binary instructions carried out directly by the computer's CPU.

These bit patterns are made up of:

- **Op-Code**, which sets the operation to be performed. Mnemonics represent op-codes, when written in assembly language.
e.g Op-Code 011 stands for instruction ADD, 001 stands for LOAD, 010 stands for STORE
- **Number Bit**, which tells the computer whether the operand is either a value or an address.
e.g 1 stands for value, 0 means address
- **Operand**, which contains either data or the address to be processed.



Instruction above is ADD value 3

- Explain how the computer distinguishes between instructions and data

The CPU will always attempt to process the first three digits of a bit pattern as an Op-Code instruction, so if this is given incorrectly an error will occur. The computer cannot distinguish between the instruction and data that it is given.

Representing Characters

- Explain the use of binary codes to represent characters

Each character is given a numeric code, stored in binary. This allows the user to input characters into the computer i.e via a keyboard, and view characters outputted by the computer i.e on a monitor.



- Explain the term character set

A defined list of characters which are recognised by the computer system.

- Describe with examples the relationship between the number of bits per character in a character set and the number of characters which can be represented

Character	ASCII (8-bit)	Unicode (16-bit)
C	0100 0011	0000 0000 0100 0011
A	0100 0001	0000 0000 0100 0001
S	0101 0011	0000 0000 0101 0011
I	0100 1001	0000 0000 0100 1001

In the ASCII character set, each specific character is given an 8-bit binary code. Therefore, only 256 characters can be represented in this system.

In the Unicode character set, each specific character is given a 16-bit binary code. As a result of this, more characters can be represented using this system.

Basically, the more bits used to represent each character in a character set, the larger the character set can be i.e it can recognise more characters.

Software

- Explain the need for specific functions of an operating system

An Operating System is a set of programs that control how a user interacts with the hardware and software of a computer. Examples are Windows 7 and Mac OS X.

User Interface	<ul style="list-style-type: none">• OS provides a link between the user and computer• Graphical User Interface - menus, icons, windows• Command Line Interface - user types in commands
Memory Management	<ul style="list-style-type: none">• Manages amount of memory used by each application• Without OS, applications wouldn't run, as not enough space
Peripheral Management	<ul style="list-style-type: none">• Co-ordinates the basic input and output systems• Device Driver Software allows hardware to be used by OS
Multi-Tasking	<ul style="list-style-type: none">• OS allocates each program a slice of the CPU's time• Also determines priority in which programs should use CPU• Enables several programs to run on computer at once
Security	<ul style="list-style-type: none">• Prevents unauthorised access through usernames, passwords• Protects files from being read or written by other users

- Describe the purpose and use of common utility programs



Computer Security:

Anti Virus - scans and removes malicious files which could cause harm e.g viruses
Firewalls - filter information coming through internet connection onto computer
Spyware Protection - scans and removes malicious software which can display irritating advertising messages or collect personal data



Disk Organisation:

Disk Formatting - sets up hard disk ready for use by splitting into drives e.g C:, E:
File Transfer - allows files to be created, moved, renamed, copied and deleted
Defragmentation - reorganise the structure of files so that related data is stored near each other; this frees up space on hard drive, so the computer runs faster



System Maintenance:

Cleanup Tools - search for and remove files no longer needed e.g installation files
Automatic Updating - ensures most recent security patches, device drivers etc
System Information - provides useful details of the system e.g version number
System Diagnostics - identify issues and problems with system e.g task manager

- Discuss the relative merits of different types of software



Off the Shelf:

Application software produced by a company for many users, it can be bought in a shop or downloaded from the internet. e.g Solid Works

- + Easily available and installed
- + Tested by many users, so bugs solved
- + Requires no training to use
- + Producer provides updates
- + Large user base for help/forums
- May not meet exact need of the user
- Pay for features that may never be used



Custom Written:

A software solution specially designed, written and implemented by a professional developer, to meet the user's exact requirements.

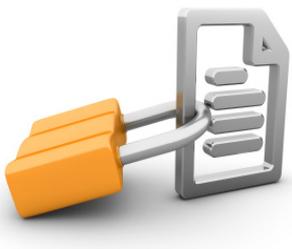
- + User is able to influence the development of the software
- + Won't pay for unnecessary features
- + Contains all features that user requires
- Expensive
- Need training to use it
- Take time to develop
- No other users for help and support



Open Source:

Software whose source code is available for modification and enhancement by anyone. e.g Android, Linux, Firefox

- + Usually free of charge
- + Constant upgrades available
- + Can be adapted to specific needs
- + Community of developers who provide help and support
- May need specialist knowledge to develop
- May not be as professional or user-friendly



Proprietary:

Software whose source code is kept closed by the developers, as they have control and thus charge to make a profit e.g Microsoft Office

- + May be guaranteed by vendor
- + Provide good system support
- + Vendors limit number of licenses, so to keep close control
- Support and updates may be expensive
- May not meet exact needs of user

Memory

- Describe the difference between RAM and ROM

RAM	ROM
<ul style="list-style-type: none">• Random Access Memory• Volatile, loses data when computer is switched off• Read & Write, user can change the data stored	<ul style="list-style-type: none">• Read Only Memory• Non-Volatile, data remains even when computer switched off• Read-Only, data cannot be changed by the user

- Explain the need for ROM in a computer system

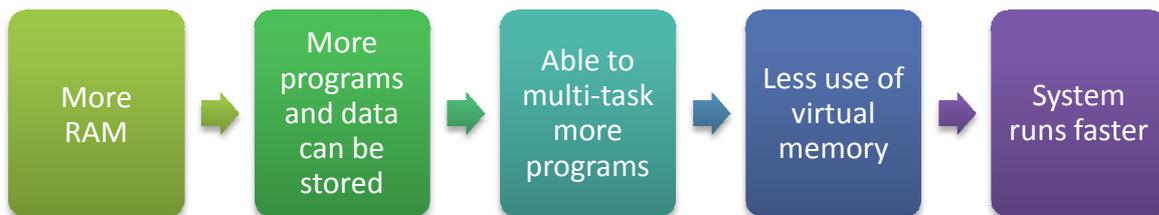
Read Only Memory is needed to permanently store the programs and data to boot the system, because without it the computer would not be able to turn on itself.

- Describe the purpose of RAM in a computer system

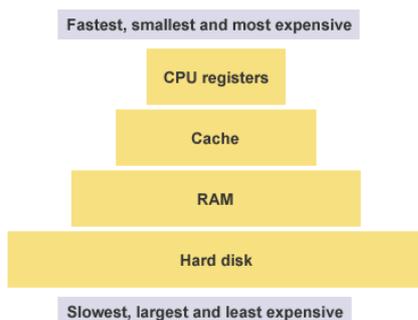
Random Access Memory provides a temporary storage area for data and programs that are being used by the computer. It allows the CPU to retrieve them quickly when they are required, whereas storing this on a secondary storage device such as hard disk or CD would take longer to retrieve, so slowing down the processing speed of the CPU.



- Explain how the amount of RAM in a personal computer affects its performance



- Explain the need for virtual memory



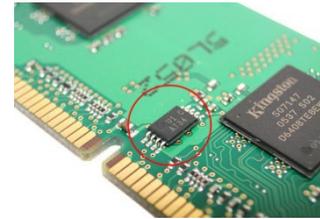
Virtual Memory is sections of the hard disk used to store items of the RAM which are not currently being used. It is needed to allow more programs and data to be loaded when the RAM is insufficient, has become full. However, this is a lot slower.

- Describe cache memory

Cache memory is located between the CPU and RAM, it stores data recently used or likely to be frequently used again. This allows the CPU to check the cache memory first (faster) then the main memory after (slower).

- Describe flash memory

Flash memory is a type of storage media device, whose contents can be electrically erased or programmed. It is non-volatile, so keep its data when the computer is turned off, and quick to read and write to. Also it has no moving parts so requires little power, but it is quite expensive, so used in smaller amounts.

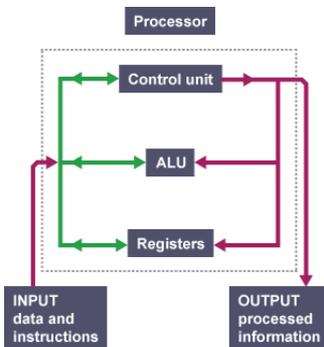


- Discuss how changes in memory technologies are leading to innovative computer designs

Flash memory allows storage in a very small form, so has influenced the design of thin laptops, smart phones and MP3 players.

The CPU

- State the purpose of the CPU



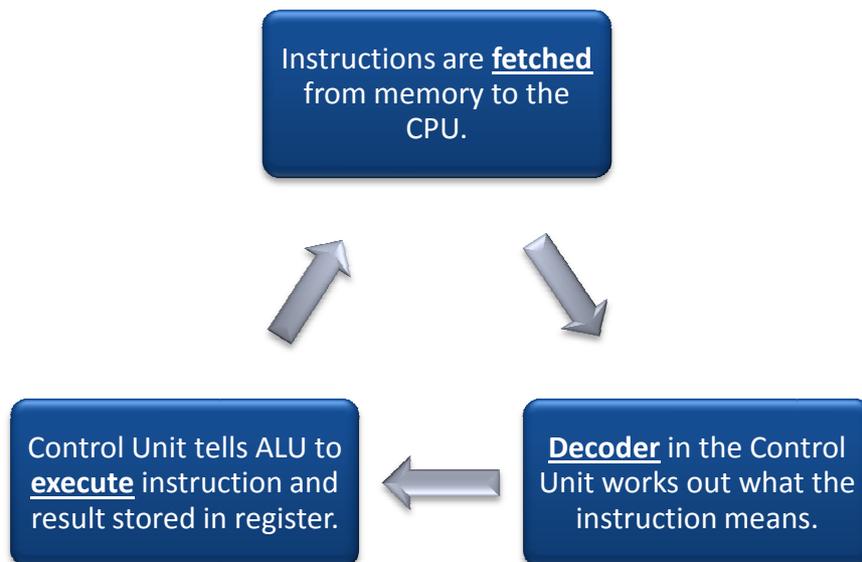
The Central Processing Unit processes data using three main parts:

Control Unit: Controls the operation of the rest of the CPU, by issuing control signals to other parts of CPU, instructing them on what to perform next.

Arithmetic/Logic Unit: Carries out mathematical and logical computations.

Registers: Memory locations within the CPU that store data and instructions to be processed.

- Describe the functions of the CPU as fetching and executing instructions stored in memory



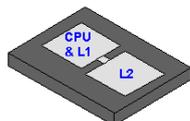
- Explain how common characteristics of CPUs affect their performance



Clock Speed is measured in Hertz and 1 Hz would mean 1 instruction is carried out by the CPU each second. As you increase the clock speed, the CPU works faster, but overclocking the computer (making it faster than the manufacturer specified) can result in the computer crashing or overheating.



Number of CPU Cores in the processor can be increased to allow the system to work together on the same program or work on different programs at the same time.



Cache Size can be increased, to make the computer run faster, because more data can be stored locally, so accessed quicker from the CPU.

- Describe common tools and facilities available in an IDE

An Integrated Development Environment provides facilities for computer programmers to develop software applications.



Source Code Editor

Text editor designed for writing and editing source code of programs

- **Syntax Highlighting** - displays source code in different colour according to the category of terms (strings, functions) to improve readability.
- **Autocomplete** - source code editor predicts a word or phrase the user wants to type without the user typing it in completely.
- **Bracket Matching** - highlight matching sets of delimiters to help spot omissions.
- **Auto Indentation** - Automatically indent next line when return key is pressed.

Debugger

Test code to highlight and remove programming errors

- **Breakpoints** - Intentional stopping of the program at a specific place so that the programmer can see if the code is functioning correctly up to that point.
- **Single Stepping** - Allows code to be run and inspected one line at a time, so that the effect of the instruction can be evaluated in isolation.
- **Variable Tracing** - View the values of variables at any stage in the running of the program, to check if their values are as expected.

Auto-Documentation

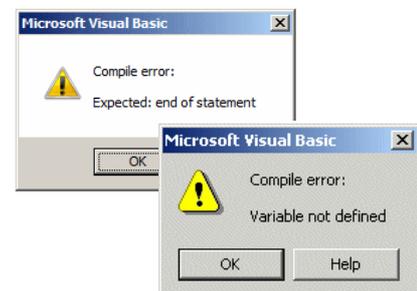
Documents all variables and modules used in text or XML file

- Describe and identify syntax errors in a program

Syntax Errors occur when the source code does not conform to the syntax of the programming language - a set of rules for how declarations, functions, commands and other statements should be arranged.

Examples:

- Spelling mistakes
- Missing out brackets or quote marks
- Using the wrong case characters for key words
- Missing out a semicolon (EOL character) at end of statement
- Using tokens in the wrong order



- Describe and identify logic errors in a program

Logic errors are mistakes in the source code of a program, resulting in incorrect or unexpected behaviour. This type of runtime error may simply produce the wrong output or cause a program to crash whilst running.

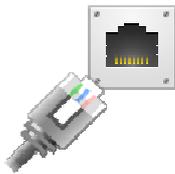
The Internet

- Describe the nature of the internet

The internet is a worldwide collection of computer networks.



- Describe the hardware needed to connect to the internet



Network Adaptor

Enables your computer to connect a network - it may be built in like an ethernet port on a PC or an add-on like a Wi-Fi dongle.



Router

Allows many devices to communicate with each other and share resources i.e internet connection.



Modem

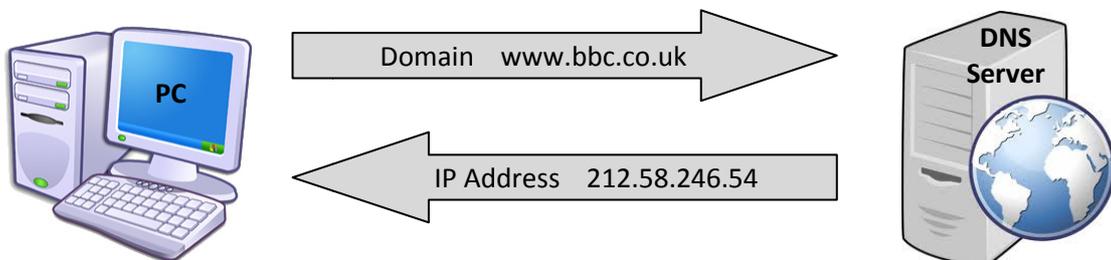
Converts between digital sound produced by computer and analogue signals sent over telephone network. It connects to your Internet Service Provider.

- Explain the need for IP addressing of resources on the internet



An IP address is a unique identifier for every computer accessing the internet. Static IP addresses do not change, as they are required by users accessing the web. Whereas, dynamic IP addresses occasionally change, for example personal computers.

Domain names identify IP addresses; they are easier to remember than four 8-bit numbers.



Domain Name Service translates domain names into corresponding IP addresses.

- Explain the importance of HTML



Hyper Text Markup Language is used for the creation of web pages. It is a text file containing tags, which indicate how the text and content of web page should be displayed. It also contains pictures, hyperlinks and other elements to include on the web page.

It is important that web pages use HTML, because it is an open accepted standard for all web browsers to interpret and display data correctly.

- Describe common file standards associated with the internet



JPEG:
Stores complex images in a relatively small file size, by using lossy compression.



PNG:
Stores high colour images in a relatively larger file size, by using lossless compression.



PDF:
Stores documents for sharing, all you need is a PDF reader. It is a lossless file format.



GIF:
Stores simple images with limited colour e.g icons, by using lossless compression.



MP3:
Stores audio files, using lossy compression to reduce file size, widely used for music.



MPEG:
Most widely used on the internet to store videos in a lossy format.

- Explain the importance of compressing files that are transmitted via the internet

By compressing, the size of the file that needs to be transmitted is reduced. This shortens the download time and reduces internet traffic.



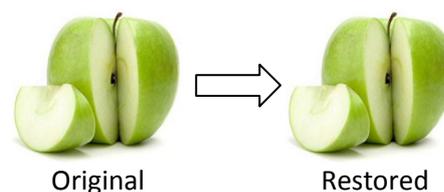
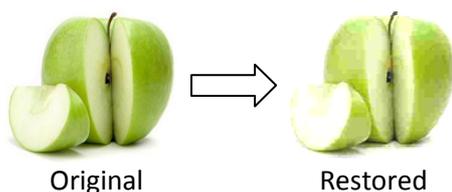
- Describe the differences between lossy and lossless compression

Lossy

- When data is uncompressed it is not exactly same as the original, but the difference is so small it cannot be noticed.
- e.g Music Files (mp3)

Lossless

- When data is uncompressed it is restored completely to the original file. Redundant data is removed, so that it only contains it once.
- e.g Text Files



Networks

- Explain the advantages of networking stand-alone computers into a Local Area Network

Sharing Peripherals - saves money as only one printer is needed for many computers

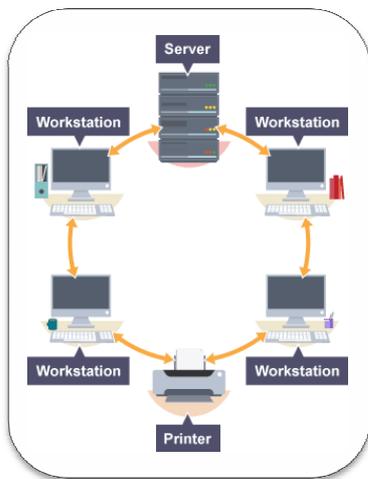
Communication - users can work more efficiently, by sending emails over a network

Sharing Information - files can be easily shared between computers on a network

Sharing Software - purchasing a "site license" makes it cheaper to install on many computers

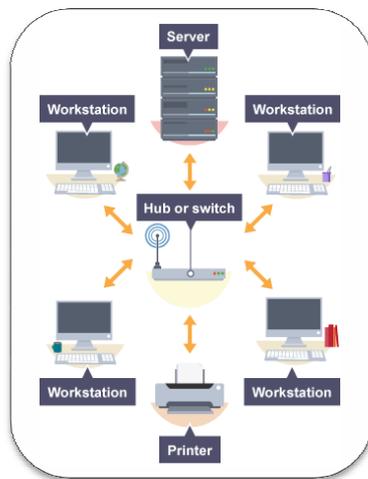
Roaming - users can access information from anywhere, not fixed to one computer

- Describe the ring, bus and star network topologies



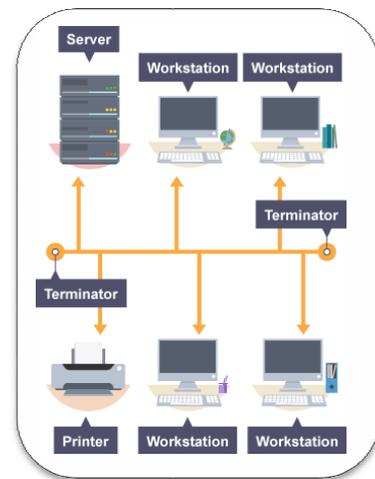
Ring

Each computer is connected to the ones either side of it. Data is sent in one direction, no reliance on central server, but if any connection breaks the whole network is disrupted.



Star

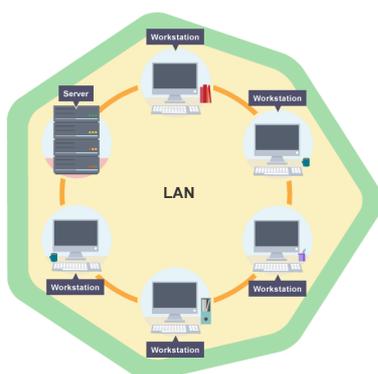
Each computer is connected to a central device, which co-ordinates all traffic. If a connection fails, the whole network is not affected. It is also easy to add new computers to the network.



Bus

Each computer is connected to a single cable and data can travel in both directions like a bus route. It is easy to set up, simple to add more computers, but if the central cable fails the whole network fails.

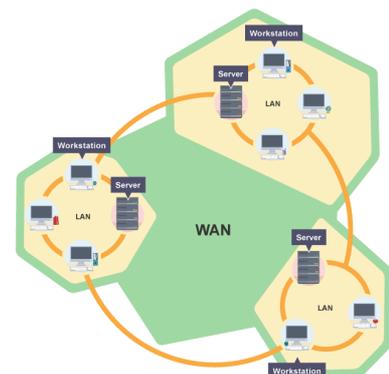
- Describe the differences between a Local Area Network and a Wide Area Network



Local Area Networks cover a small geographical area e.g a building.

Wide Area Networks cover a large geographical area e.g across many different countries.

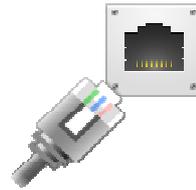
Data is more secure in a LAN than a WAN, such as the internet.



- Describe the hardware needed to connect stand-alone computers into a network



Network Hub cannot send and receive information at the same time. When a message is received from one computer, the hub transmits it to all other computers, which leads to unnecessary network traffic.



Network Adaptor or Network Interface Card connects a computer to a network e.g ethernet port. It formats data sent from computer according to the network protocols (rules).

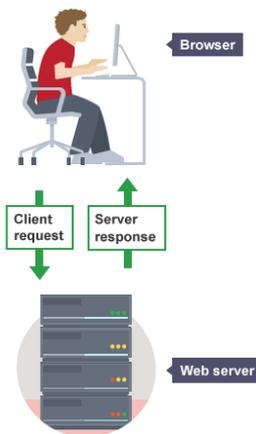


Network Switch reads messages to find the destination and sends it only to the computers intended to receive it. Switches send and receive information at the same time, so are faster than hubs, and cut down on unnecessary network traffic.

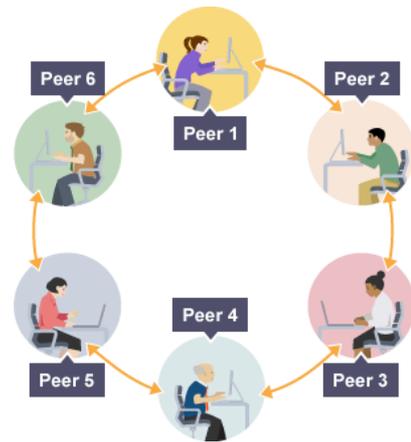


Wireless Access Point allows wireless devices to connect to a network using WiFi. It converts data received through cables into a wireless signal.

- Explain the different roles of computers in a client-server and peer-to-peer network



Client-Server networks have two types of computers: client machines on which the users work, and servers which store files and control access to the network. Users must log in to the central server.



Peer-to-Peer networks have no central computer. They connect directly to each other, in order to share information and get files.

- Explain the terms IP addressing, MAC addressing, packet and protocols



An IP address is a unique identifier for every computer accessing the internet, consisting of 4 8-bit binary numbers. A private IP address is valid on a Local Area Network e.g school, used to communicate with other computers on network. A public IP address is used by any server or computer connected to the Internet for communicating with Internet services.

A MAC address is the permanent hardware number “burned” into the Network Interface Card in every computer.

A Packet is one unit of binary data capable of being routed through a computer network.



A Protocol is a set of rules that specify how computers interact with each other on a network. The most common is TCP/IP, which ensures data packets are sent from the computer, transmitted over the cables and are delivered to the right computer.

- Describe and justify network policies

Acceptable Use



- Set of conditions a network user must agree to comply with before they are allowed to use the network

Disaster Recovery



- Set of procedures an organisation will follow to restore normal network operations if there is a natural or man-made disaster

Failover



- Implemented to allow a system (e.g server) to automatically transfer control to a duplicate system when it detects a fault

Backup



- The copying of programs and data stored on the network to safeguard them in case of natural or man-made disasters

Archiving



- The storage of data not currently used but may have to be kept for legal reasons or possibly for future access

- Explain the need for security measures in networks

Networks are at risk of illegal access by unauthorised users, so measures must be taken:

User Access Levels control who can access all the folders and files on a network server. Different groups of users can be assigned different rights, for example some may only be able to read files, while others can edit or delete them.



Strong Passwords ensure each user's account remains secure. They should be changed regularly and have different passwords for different sites. It should contain upper and lower case letters, numbers and characters, but not user identifiable items e.g date of birth, phone number.

Encryption converts data into a form that cannot be understood by unauthorised users. The message is encrypted with recipient's public key. The recipient decrypts it with their own private key.

