Computer System

Embedded Computers

- A small device that contains all the components of a computer e.g. ROM, RAM, CPU
- E.g. Microwave, Washing machine, Satnav, camera etc

Reasons to use Embedded Systems

- Physically small, less space is needed
- Use less power, cheaper to run
- Less power, no overheating
- One task in mind, very efficient
- Built on a single printed circuit, easy to replace

Data Buses

- ***Data Bus*** – Carries actual, binary data around computer
- ***Address Bus*** – Carries address of memory locations used to store data
- ***Control Bus*** – Sends and receives signals that controls components & CPU

CPU

The CPU

- CPU fetches memory from RAM; Decodes instructions and executes them
- Its purpose is to process data

The Control Unit

- Controls way data moves around CPU
- Controls and monitors flow of data between CPU and input/output devices
- Executes instructions provided by program

The ALU

- Performs Arithmetic Operations
- Logic Operations/ Comparisons
- Shift operations

Registers

- Type of memory inside CPU
- Temporarily holds data while a software's running
- Registers are faster than RAM and Cache

Von Neumann Architecture

Von Neumann Architecture

- Both data and software that are currently being used are stored in RAM
- With this architecture, a task can be changed by simply loading a different program into memory
- Also known as 'Stored Program' computers

Features of a VN Layout

- RAM has enough memory for both data and Programs, thus easy to load a different program
- Control Unit handles movement of data and instructions
- Info and instructions are carried by buses
- ALU responsible for Arithmetic and Logic Operations
- Way of inputting and outputting data

MAR and MDR

- **MAR**
  - In the RAM, every instruction/data is located in a specific location
  - This location has a unique address
  - The address of instruction/data being accessed is temporarily stored in the Memory Address Register
  - This address is passed to RAM via Address Bus

- ***MDR***
    - For data to be fetched from RAM, the CPU has to temporarily store it in the Memory Data Register
    - Unlike Instructions, only data can travel both ways
    - It can be fetched from RAM to be decoded by the CPU
    - After processing, it can be sent back to RAM to be temporarily stored
    - All data must pass through MDR via Data bus

More Registers

- ***Program Counter***
    - Points to instruction currently being executed
    - As each instruction's processed, PC is updated with address of next instruction to fetch
    - PC copies info to MAR and increments
- ***Accumulator***
    - Temporarily stores ALU's results
    - Makes it simpler to write software that handles data
    - Program runs faster, as registers are faster than RAM

Fetch, Decode, Execute Cycle

Fetch, Decode, Execute Cycle

1) Address in PC (305) is copied to MAR

2) Address in MAR is passed onto Address Bus and Control Unit sends a signal to RAM to read this address

3) Instruction at 305 is sent across Data Bus and copied into MDR, then the MDR is copied into the Instruction Register. The PC is then incremented

4) Instruction's decoded by Control Unit so CPU knows what to do and various parts of the CPU is prepared for the next stage

5) The decoded instructions performed and the PC is already pointing to the next instruction, so cycle can start again

CPU performance factors

CPU performance factors

- ***Clock Speed*** – Tiny quartz crystal inside CPU, which performs an instruction each 'tick'. Faster frequency, more instructions executed
- ***Multi Core*** – Adds another processing unit, multiplies frequency
- ***Cache***
    - A small block of very fast memory
    - Acts as a buffer between CPU and RAM
    - Stores data most used frequently by the CPU
    - Larger Cache, more data held but slower than smaller cache

Memory

Memory Types

Main Memory

- ***Two types of Memory*** – Main Memory and Secondary Storage
- Registers aren't Main Memory as they reside in the CPU
- RAM holds more than one program, so CPU can swap between tasks quicker, opening program quicker
- Secondary Storage holds large amount of data for long term use, but is accessed very slowly

Volatile Memory

- It's cleared when power supply is lost
- Volatile Memory includes RAM, Cache, Registers
- Secondary Storage is always Non-Volatile
- Programs held there are meant to be kept long term

RAM

- Used as Main Memory, accessed by CPU directly
- It's volatile
- RAM hold billions of storage locations, each with unique address
- Accessed non-sequentially, aka Random-Access Memory
- Programs in RAM run very quickly as CPU accesses any location any time

DRAM and SRAM

- Dynamic Random-Access Memory is used as RAM
- It's used as RAM because it's cheap
- DRAM constantly needs a 'Refresh Signal' to keep capacitors charged, else it'll lose its current data
- Static Random-Access Memory, is used as Cache
- SRAM is faster than DRAM but more expensive
- Both are volatile

ROM

- Read Only Memory is a type of Main Memory because it's accessed by the CPU
- ROM can't be accessed in a random order
- ROM can't be changed, overwritten or removed
- Used in BIOS and MAC Address

Virtual Memory

- When RAM's full, the Operating System marks sections of Secondary Storage for CPU to store data on
- It's still Main Memory because it's accessed by the CPU
- Virtual Memory is Volatile
- It's also slower than RAM
- When the CPU needs the data from the VM, the OS loads the needed data into the much faster RAM, swapping it with a currently unused program

Secondary Storage

Magnetic Storage

- Uses minute magnetic particles or 'domains' to store data
- Contains several platters on a spindle spinning at high speeds, with read/write head just above surface
- Includes HDD and Magnetic tape cartridge

- Huge Capacity, up to several Terabytes
- Low cost
- HDD has high read/write speeds
- HDD allows random access to data

- Not very portable
- Mechanical parts, less durable than SSD
- When HDD's near a strong Magnetic field, Data's lost

Optical Storage

- Includes CD, DVD and Blu Ray
- A laser beam burns tiny dark pits onto disk's surface
- If pit's present, resembles 1, if pit's not present, resembles 0

- Cheap
- Very portable, Lightweight
- Compact
- Immune to Magnetic fields
- Used for movies, games, etc

- Not as portable as flash media
- Very slow to read/write data, slower than HDD
- Easily scratched
- Data can't be overwritten

Solid State Media

- Includes USB, SSD, SDHC
- Holds data using electronic switches
- If switch's open, resembles 1 as it retains electrical charge
- If closed, resembles 0
- It's an electrical form of storage, aka Flash memory

- Very portable in form of USB/SD
- Very large capacity
- Very rugged, no moving parts
- Faster than HDD
- Silent unlike HDD
- Immune to Magnetic fields

- SSD are more expensive compared to HDD
- Less durable, limited number of erase/write cycles until it wears out

Types of Networks

LAN

- Has 2 or more network enabled devices in a small geographical area
- In a business, there's a central server, a switch, and devices connect to switch
- At home, key device is the router

- Log onto any device, still access any file
- Peripherals e.g. Printer can be shared, reducing cost
- Back-ups and Updates done centrally
- Anti-virus carried out by server
- Data's transmitted quickly between networked computers

- Central point of failure, broken server = no network
- If limited bandwidth, but more data used, there'll be a slow service
- Viruses can easily spread around network

- Cables, components and maintenance is expensive
- Businesses will need a specialist technician

WAN

- 2 or more LANs connected in a large geographical area
- WAN are complicated, expensive etc, hired from major telecoms
- Uses Fibre Optic Lines, leased telephone lines, Satellite communication

- Allows LANs to connect to one another
- Allows work collaborations over such a wide area
- Files are shared between LANs

- Expensive to hire WAN
- WAN's failure is out of control due to external suppliers

Performance of networks

Bandwidth Sharing

- It's how much data can be transferred at a given time
- Contentation Ratio is ratio of users compared to available bandwidth
- At peak times, everyone sharing same cable, slow connection
- Businesses need a fast and reliable connection, pay extra for own cable
- 1;1 ratio guarantees a constant speed at all times

Wired Performance

- Popular choice is copper ethernet cables, carrying data electrically
- Cat5 is cheaper, but only up to 100mbps
- Fibre Optic uses light that reflects along inside cable, transmitting data
- Extremely high bandwidth, but expensive
- Usually used as backbone to join LANs, carries heavy data traffic

Bands and Channels

- A Band is a range of frequencies, 2.4GHz/5GHz
- It's further divided into separate channels

- Separate channels reduce interference caused by nearby devices
- 2.4GHz has a few several non-overlapping channels
- 5GHz has many non-overlapping channels, thus higher capacity
- Although, equipment's expensive and shorter range

WIFI Performance

- Radio interferences from microwave/faulty electric motor emits same frequencies, lowers performance
- Wired cable performance isn't affected by radio interferences
- WIFI's blocked by thick walls
- As you get closer to range limit, performance decreases
- Limited connections; WIFI works by allocating a radio channel to user logging in, limits how many users at one time

Errors

- Happens when binary 1 is sent but received as 0
- Mostly due to Interference or a weak signal
- If ethernet's beside power equipment, bits can flip randomly
- Shielded cables and carefully thought cable run layouts reduce this issue
- Longer cable means weaker signal, errors begin to creep in

Latency

- Means 'delay'
- In Large networks, bits take longer to travel
- Not much of an issue on LAN but is on WAN
- Every Switch, Cable, Router adds latency
- Actual connection changes each second as routers decide which path to use
- When data reassembles at destination, adds latency

Wire and Wireless Network Comparisons

Wired Networks affected by;

- Type of cable connection
- Error rates
- Available Bandwidth
- Latency
- Contentation Ratio

Wireless Networks Affected by;

- Band chosen, number of channels to assign
- Interference from sharing channels with other devices
- Interference from non-WIFI devices emitting same frequency
- Thick walls

Wired Network	WIFI Network
• Costly for cables to be installed	• Only need a WAP, cheaper
• Hundreds of users at a time	• Limited Users
• Immune to Radio Interferences	• Affected by Radio Interferences
• Higher Bandwidth	• Lower Bandwidth
• Excellent security, devices need to be physically connected	• Not so secure, strong password and encryption needed
• Not affected by building layout	• Affected by walls and floors
• Not portable as computers need a network socket	• Very portable, you can move laptop to different office

Client/Server and Peer-to-Peer

Client Server	Peer-Peer
• Uses a central server	• No central server
• Device logs into server	• Each peer has own device
• Network admin sets shared folder on server	• Each peer sets their own folder to be shared or not
• Technical skill needed to maintain server	• Little skill needed, Windows has built in support
• Files stored centrally	• Files stored locally
• Broken client, no affect, broken server, network failure	• Broken peer means their shared file no longer there for others
• Commonly used in schools, businesses etc	• Commonly used in small LANs like home, small offices
• Needs own Network Operating System	• Uses standard Operating System

Advantages of Client Server Network

- Single central server, files backed up easily
- Central software installation's easy and fast
- Software's only licensed to server itself
- Clients themselves don't need much software or file storage
- Simpler to manage security and permissions

Advantages of Peer to Peer Network

- No single point of failure
- Easy to manage with small networks
- Cheap

Hardware Needed

Network Interface Card NIC

- Provides a connection to a network
- It converts data from device into compatible data with network
- This format is called a 'Network Protocol'
- The NIC gives a device its MAC Address

HUB

- Computers connect and exchange data via a cable
- Data's moved around as packets that has a destination address
- However, packet is sent to every node, not just intended one, causes a security issue
- Data collisions cause packets to be corrupt, needs to be sent again
- Latency, WAN especially slows down

Switch

- Computers link and exchange data
- Only sends packets to intended destination, improved security
- Network's faster as there's less data collisions
- It has a number of ports and each port has the device's MAC Address
- When data packet goes to switch, its destinations examined and a direct connection is made
- Makes network more efficient
- It's expensive so only used in High Bandwidth, High Performance Networks

Hub	Switch
• Connects all nodes together	• Connects 2 nodes together
• Data Packet's sent to ALL nodes	• Packet only sent to intended node
• High risk of data collisions, slow network performance	• Less risk of data collisions, improved network performance

• Security risk as data sent to all nodes	• Better security as only sent to correct node
• Less expensive	• More expensive

Router

- Transfers data packet by most efficient route
- ***When a data packet arrives:***
  - Reads packet's destination address
  - Looks at all paths available to address
  - Checks how busy each path is
  - Sends packet via least congested path
- ***Another tasks router performs:***
  - Exchanges protocol info across networks
  - Filters traffic – Prevents unauthorised intrusion by malware

Wireless Access Point

- If you want to connect a WIFI enabled device to a wired network, you'll need a WAP
- WAP has a cable connecting to Hub/Switch
- WAP picks data packet via WIFI to compatible packets for wired network
- It doesn't read MAC Address so sends packet to every connected device
- Personal info can be read by another device on WAP

DNS, IP addressing, web hosting and the cloud

ISP

- Company that provides internet access
- Charges monthly fee, provides modem to log in

URL

- Uniform Resource Locator
- Unique web address for every page

IP Address

- For data to be sent to a specific device, Unique address is needed

- Internet Protocol governs activity on internet
- It's a set of rules
- Made up of 4 numbers only, separated by dots
- Provides device's location
- Can either be Dynamic or Static

DNS

- Domain Name System
- Translates web Address to correct IP
- DNS servers have database of IP Addresses

- You enter URL
- Browser contacts DNS server
- Server matches Domain name with registered IP
- DNS sends this info back to computer
- Computer attaches IP Address of data packet to be sent
- Data packet travels over internet to its destination
- Server where the website's stored, sends back data which you requested

- You don't need to remember IP Address
- As long as you're connected to a DNS server, you can access any website where there's a stored IP Address

Website

- Made up of webpages and any other media
- They're saved as files, stored in folders
- Each webpage file contains HTML Mark-up code
- Stored on any 'hosted' storage media

Local Hosting

- Hosting a website from home pc is 'local hosting'
- You set pc as a web server, allowing people to connect and access your hosted files

- Saves money, costing less than external servers,
- Great if it's only for own use or in local network
- You can run a local database attached to webserver

- Local web server's bandwidth is your broadband's, it's not enough
- Computer always needs to be on
- If things go wrong, technical knowledge's needed
- Difficult to stop malware and intrusion attempts
- Your Dynamic IP means no permanent IP to connect to server
- If selling, you'll need a payment gateway; strong encryption and security

External Web Hosting

- You pay company to host website on their servers
- ***For Monthly charge, you get:***
    - Hard disk space on their server
    - Insurance that site is always running
    - Provides bandwidth for users to access
    - Maintenance of server
    - Regular back ups
    - Security from malicious attacks
    - Technical help

External Hosting Types

Shared Web Hosting

- Many sites are hosted on same server
- Cheapest Option
- Server shares same resources, there'll be poor performance
- Might have to accept advertising
- Not allowed to install specific module/scripts

Dedicated Server

- Website's hosted on own server
- Good for companies with high traffic
- Faster, better quality support from web host

- Expensive, can't share cost with other users

Virtual server

- Powerful server needing specialist software
- Creates separated 'virtual servers', which are rented
- Cost kept low, users share physical server
- Overcomes standard sharing host issues

The cloud

- Range of services that run on the internet
- To access, you need a web browser/ app
- Some charge, others are free

- Access from any device with internet connection
- Document can be worked on simultaneously by others
- Store large files, saving space on your HDD
- Automatically backed up

- No internet connection, can't access files
- Forgetting Log in Details, can't access service
- Monthly fee for more space
- Might not be stored in UK, not under any data laws
- 3rd party control, online hackers can access private data

Virtual Network

Virtual Network

- Uses software to divide devices on a LAN into smaller groups
- Whole LAN's physically connected, but software restricts devices from connecting to other devices in a different VN

Virtual Network Advantages

- Flexibility, easy to add/remove devices with VLAN
- Easier to install software for specific groups
- Network traffic's minimal
- Data's sent/received faster, as there's less data collisions
- Improved security, if one VLAN's compromised, others are partitioned, thus not affected

Virtual Private Network

- Possible to use VN to connect devices to a LAN through a WAN
- VPN enables employees to share VPN over a large geographical area

- A secure connection's set up between LAN and external devices
- All data packets are scrambled, only that company can read them
- This encryption is called 'VPN Tunnelling'
- VPN over public network allows security
- VPN is cheaper than maintaining own WAN

Network Topologies

Star Network

- Central device connected to all other nodes

- Very reliable, if a workstation fails, others aren't affected
- Very few data collisions, each node has own cable to server
- Good security, can't interact without server
- Scalability, can add many more devices

- Most expensive due to all the cables
- Installing network needs an expert
- Extra Hardware needed like Hub/Switch
- There's a central point of failure
- Requires a high-performance Switch/Server due to high traffic

Mesh Network

- Each device relays data it receives to the other nodes
- Wired or wireless, if 1 node is connected to another, it's connected to all

- No central point of failure
- Very robust, if one path fails, rest can be used
- Handles very high data traffic
- Data packets can be sent simultaneously
- Device's can join/leave without affecting overall network

- As nodes are added, connections dramatically increase
- Very expensive due to cable and switches for each device
- There'll be a couple of redundant connections

Protocols

TCP (Transmission Protocol)

- Prepares messages for transmission and reassembles any received messages.
- ***When sent, TCP rules include:***
    - Dividing message into packets
    - Adding a sequence number
    - Adding extra error checking info
- ***When receiving data, the TCP rules include:***
    - Examine each packet for errors using error info given
    - Fixing errors or asking packet to be re-sent
    - Spotting missing packets and ask them to be re-sent
    - Use sequence numbers to reassemble message

IP (Internet Protocol)

- It's responsible for providing destination address and to recognise incoming packets
- ***For sending data, IP rules include:***
    - Adding destination address to each packet

    - Adding source address so recipient knows who sent it
- ***For receiving data, IP rules include:***
    - Accepting data packets with own address attached
    - Ignore data packets with no address of its own

HTTP/HTTPS

- Hyper Text Transfer Protocol
- Allows browser to request individual files from web server in an orderly way, and then the website's rendered

- HTTPS is secure
- It encrypts web page's data before being sent out of browser
- Ensures nobody intercepts, changes or reads data

FTP

- File Transfer protocol
- Transfers, upload and download, files between client and a server on a computer network

Email Protocols

POP (Post Office protocol)

- Allows emails to be downloaded, deleted from the mail server and be viewed offline by the email client

- ***Main disadvantages are:***
    - Only handles one mailbox
    - Messages, once downloaded, are removed from email server and can't later be seen by other devices
    - If user's storage becomes broken, the emails are lost
    - Doesn't support complex searches of emails on the server

IMAP (Internet Message Access Protocol)

- IMAP offers more complex commands to manage emails on server itself
- Email remains on server, even after it's downloaded
- This lets you view your emails on multiple devices

- ***IMAP allows you to;***
  - Set flags on emails showing replied, viewed etc
  - Access email on multiple devices
  - Complex searches based on subject, header etc
  - Handles more than one mail box
  - Choose to download specific part of email e.g. just header

SMTP

- Used by mail server itself to send and receive mails from one server to another

Ethernet

- Family of protocols that send and receive data along a network cable

- ***The protocol's in several parts;***
  - ***Hardware*** – Specifies performance expected of network cables, plugs and sockets
  - ***Data Format*** – describes format of data packets sent/ received over the network
  - How to deal with data collisions

The Four Layer Model

Layer	***Layer Name***	***Protocols***	***Purpose***
4	Application Layer	FTP, HTTP, SMTP, POP, IMAP	They provide access to emails, websites, files
3	Transport Layer	TCP	Divides message into packet, add number, error check info etc
2	Internet Layer	IP	Manages source's address and destination address
1	Network/ Data Link Access	Ethernet, WIFI	Transmits data via cable and WIFI

- Each layer only communicates with those above and below
- Each layer has a particular function to perform

- Dividing layers mean we can focus on an area individually, without worrying about other layers
- Model's useful for manufacturers so their new hardware's compatible
- It maps how the layers relate and interact with each other
- We know what protocol does by which layer it's in
- When a new protocol's developed, it can be slotted into the appropriate layer

Packet Switching

Packet Switching

1) The message is broken down into packets
2) The packets are given a sequence number each to identify original order
3) Packets travel in different directions, via the fastest route
4) When all arrive at their destination, they're re assembled into correct order
5) Once everything's correct, confirmation message sent to sender's pc
6) If a packet's missing/corrupted, instead the recipient will ask sender to re-send that particular packet

Packet Information

- ***Each packet has a header with 3 important things:***
    - Source Address to say where packet came
    - Destination Address to tell packet where to go
    - Sequence number so packets re-assemble correctly

- ***Preamble*** – Data that's attached to front of packet to prime receiving hardware that the packet's about to arrive
- When packet arrives, error check performed; uses calculation '***check sum number'***. If an error is found, requests made etc.

Benefits of a Packet Switched Network

- Robust, if one router's broken, finds another path
- Makes efficient use of connections, goes through least congested paths
- Data's still sent even if there's a lot of traffic
- Only lost packets will need to be re-sent, not entire message
- Each packet carries its own error correction code, so if few bits are corrupted, it'll most likely be fixed

- Packets travel at random paths, so no guarantee they'll arrive in a certain time period
- The re-assembling and changing routes causes latency
- If one's missing at destination, packet has to be re-sent

Network Security

Network Threats

- ***Malware*** – Term used for any hostile/intrusive software
- ***Social Engineering*** – Takes advantage that humans are the weakest link e.g. Bribery, Trickery, Threatening
- ***Brute Force Attack*** – Trying every letter and number combination to guess a password
- ***Denial of Service*** – Floods a server with bogus requests to crash it
- ***Man, in the Middle*** – Form of data interception.
- ***SQL Injections*** – Attacking a database by typing special code into the log in box to access confidential info and delete, change, or add users

Good Network Policy reduces these

- Hard Passwords
- CCTV
- No USBs into work computers
- Encrypt Emails
- Password Protected Screens
- No USBs into work computer

Preventing Vulnerabilities

- ***User Access Rights*** – Limits what a user can do
- ***Acceptable Use Policy*** – Governs what a user can/can't do
- ***Back Up Policy*** – Keeps data safe
- ***Disaster Recovery Policy*** – Helps recover data from a Network failure
- ***Network Forensics*** – Monitors Network, examines Logs
- ***Anti-Virus*** – Detects viruses before they harm computer
- ***Firewall*** – Control what data packets flow in/out network
- ***Penetration Testing*** – Tries to find network weakness and abolish them
- ***Strong Passwords*** – Stops anyone accessing network

System software

Operating System

The Operating System

- It's software that manages a computer's hardware and provides a user interface
- ***It Manages:***
  - Memory
  - Multitasking
  - Peripherals
  - Files
  - User access rights

Types of user interface

- ***GUI: Graphical User Interface***
  - WIMP: Windows, Icons, Menus and Pointers
  - Icons representing functions mean less need to type instructions
  - Right-clicking brings up context-sensitive menus
- Menu-driven interface
- Voice Activated
- ***CLI: Command Line Interface***
  - Must be typed in text, No graphics
  - Quicker for experts who know the commands

- Takes less space on the disk and in RAM

Memory Management

- Data used by the program is copied into main memory
- The operating system keeps a record of where each program and its data are located
- It must not overwrite existing programs

Multitasking

- Many background tasks run on the computer
- They're taking it in turns to get processor time to execute instructions
- The OS must manage how the processes share the processor

Interrupts

- ***Interrupts*** – Signals sent to CPU by external devices to indicate an event that needs immediate attention
- They tell CPU to suspend its current activities and execute appropriate instructions
- ***Hardware interrupts*** – Generated by hardware devices E.g. Printer with no paper
- ***Software interrupts*** – Generated by programs E.g. Divide-by-zero error will cause a calculation to be abandoned and an error message displayed

Peripheral Management

- Getting input and sending output
- Copying files from disk to main memory
- Copy data files back to secondary storage

Device Drivers

- It's a program that controls a peripheral device
- Each device communicates with the OS via its own driver

The Print Buffer

- ***Print Buffer*** - A special area of memory in either the computer or printer
- A computer can send data 1000x faster than a printer can print it
- Computer sends the printer output to a print buffer at full speed
- From here, it is transmitted it to the printer, a page at a time
- The print buffer may store a number of jobs waiting to be printed
- If the printer can't print, the OS is notified and passes on the message to the user, E.g. Offline or Printer out of paper

Disk and File Management

- ***The operating system:***
  - Manages where on the disk files are written
  - Keeps track of where they are so they can be retrieved
  - Makes sure no file overwrites another file

Access Rights

- Users and admins have different levels of access rights
- Some users may be allowed to read files but not edit them
- Each user's personal setting is saved for them

Utility Software

- ***Encryption*** – Transforms text so it can't be read without knowing key to decode it
- ***File Transfer*** – We can move, copy, delete folders and files

Defragmentation

- ***When a disk's fragmented:***
  - Retrieving files takes more processing
  - More processing means reduced performance
- ***Defragmenting reorganises files so they're together:***
  - Processing time reduces, performance improves
  - Free space is collected, new files don't need to be fragmented

Compression

- Reduces bandwidth usage and data consumption to download and send a compressed file
- Let's file sizes fit within strict email attachment or ISP limits
- Increases amount of data that can be stored or archived on disk

Back Up

- ***Full backup***
  - Complete backup of everything which can be restored independently of any other backup
  - Takes greater time and disk space to create backup
- ***Incremental backup***
  - Records only the changes made since last backup
  - An entire chain of backups is required to fully restore files

Ethical and Legal

Legislation

General Data Protection Act 1998

1) data must be processed fairly and lawfully
2) data must be adequate, relevant and not excessive
3) data must be accurate and up to date
4) data must not be retained for longer than necessary
5) data can only be used for the purpose for which it was collected
6) data must be kept secure
7) Not transferred outside the European Economic Area (EEC) without adequate protection

Computer Misuse Act 1990

- Unauthorised access to computer material
- Unauthorised access with intent to commit or facilitate a crime
- Unauthorised modification of computer material

- Making, supplying or obtaining anything which can be used in computer misuse offences

Copyright, Designs and Patents Act (1988)

- Copyright law protects owner of a creative work from having it illegally copied

Creative Commons Licensing

- Used when an author is willing to give people the right to share or use a work that they have created
- Creator can choose to allow only non-commercial use, so their work cannot be copied and distributed for profit

Open and Proprietary Source

Open	***Closed***
• Less secure as code's weakness can be exploited	• More secure as code is not shown, no apparent weakness
• Application is free	• Paid Application
• License allows code to be copied and modified	• Restricts copying and modifying
• Less polished interface	• Professional to attract customers
• Written by expert volunteers	• Paid software programmers
• Technical Support Limited	• Technical Support Formally Available
• No enforced deadlines	• Strict deadlines for new releases
• Low development costs	• High development costs
• Hundreds of volunteers mean flaws are patched, but others still could be using old version	• Software Updates from vendor's servers, quickly propagated, no technical knowledge needed for user