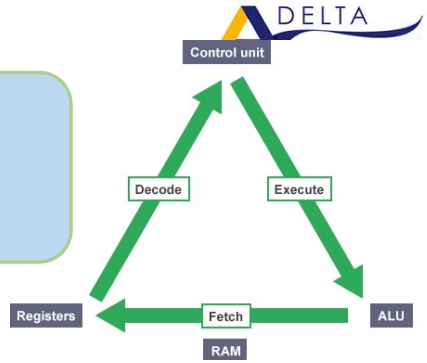
Knowledge Organisers

COMP 1 – Computer Systems

1.1 SYSTEMS ARCHITECTURE

CPU - summary

- Fetches instructions (from memory)
- Fetches data (from memory)
- Decodes instructions
- Executes instructions



VON NEUMANN ARCHITECTURE

describes a system where the CPU runs programs stored in memory.
Programs consist of instructions and data which are stored in memory addresses as binary digits

In short this is the internal, logical structure and the organisation of the computer hardware

PROGRAM COUNTER (PC)
STORES THE LOCATION OF THE NEXT INSTRUCTION IN A PROGRAM WAITING TO BE FETCHED

MEMORY ADDRESS REGISTER (MAR)
STORES THE LOCATION FOR DATA TO BE FETCHED FROM OR SENT TO MEMORY

MEMORY DATA REGISTER (MDR)
STORES THE DATA THAT HAS BEEN FETCHED FROM OR IS WAITING TO BE SENT TO MEMORY

ACCUMULATOR
STORES THE RESULT OF THE CALCULATION PERFORMED BY THE ALU

CURRENT INSTRUCTION REGISTER
STORES THE INSTRUCTION READY TO BE DECODED BY THE ALU

ARITHMETIC LOGIC UNIT (ALU)
part of a (CPU) that carries out arithmetic and logic operations in computer instruction

CONTROL UNIT (CU)
WORKS WITH THE CPU TO **CONTROL THE FLOW OF DATA WITHIN THE SYSTEM** AND TO DECODE INSTRUCTIONS

CACHE
SMALL TEMPORARY VOLATILE MEMORY, STORES FREQUENTLY USED INSTRUCTIONS. QUICKER FOR CPU TO ACCESS THAN MAIN MEMORY

MAIN MEMORY (RAM)
This the volatile memory that stores data and programs **currently in use.**

Fetch- Decode – Execute cycle – How the CPU processes instructions:

FETCH:
The processor checks the program counter to see which instruction to run next.
The program counter gives an **address value** in the memory of where the next instruction is.
The processor fetches the instruction value from this memory location.

DECODE:
Decoding the instructions in the the ALU, storing the result of this in the CIR.

EXECUTE:
The instruction is performed. Once this is complete, the processor goes back to the program counter to find the next instruction.
This cycle is repeated until the program ends.

1.1 SYSTEMS ARCHITECTURE

More detail on the fetch part of the cycle

MAR←[PC]

PC ←[PC] +1; MDR ←[Memory] addressed

CIR ←[MDR]

Instruction is decoded

Executed

** - You might be given something like this in the exam – you need to make sure you are confident at explaining what this shows – see the boxes above

1. Contents of Program Counter (PC) assigned to Memory Address register (MAR)

2. PC incremented by 1 and assigned to PC.

AT THE SAME TIME the addressed contents of memory is assigned to the MDR (memory Data register)

3. Then the contents of MDR is assigned to CIR (current Instruction register) the instruction is decoded and executed

4. The Instruction is decoded in the ALU where all logical and arithmetic calculations are performed. The results of this are stored in the Accumulator.

The instruction is then executed and the cycle starts again

1.1 SYSTEMS ARCHITECTURE

What is the purpose of the CPU?
It Processes Data by fetching, decoding and executing instructions.

HINT: when you answer this type of exam question – you need to EXPLAIN WHY - putting more cores = better performance isn't enough!

FACTORS AFFECTING PERFORMANCE OF CPU:

Clock Speed (measured in Hertz)

- Represents the number of fetch execute cycles / instructions the CPU can process in a given time
- The higher the clock speed the faster the CPU will run **WHY? – Because it will be doing more Fetch-Decode and Execute cycles per second which means more instructions are being processed.**

Cache Size

- The holding area for data from the RAM – stores frequently used instructions. More cache then the better the performance. **WHY? The more cache the CPU has the less time is spent accessing memory (RAM) this means it can retrieve instructions quicker and programs can run faster.**

Level 1 Cache – Quicker to access, doesn't store as much, Level 2 = slightly slower to access, holds slightly more than L1, Level 3 = Even slower to access than L2, but can hold even more

Number of Cores

- Number of Independent processors within the CPU.
- Multiple Instructions able to be processed simultaneously in the same cycle
- The more cores the quicker the performance – **WHY? Quad Core = 4 cores. Can perform 4 instructions at same time in same cycle, 8 cores can perform 8 instructions simultaneously so more cycles/instructions are being processed per second**

EMBEDDED SYSTEMS:
They are dedicated systems that are designed for a fixed purpose. They are a system within a larger system
e.g. Washing machines, car park barriers, microwaves, car engines, MP3 etc

GENERAL PURPOSE SYSTEM:
A machine that is capable of carrying out some general data processing under program control. Your PC /laptop is an example of this but also it could be something far more basic too

CONTROL SYSTEM:
manages, commands, directs, or regulates the behaviour of other devices or **systems** using **control** loops. It can range from a single home heating controller using a thermostat controlling a domestic boiler to large Industrial **control systems** which are used for controlling processes or machines.

1.2 MEMORY

RAM – RANDOM ACCESS MEMORY : The PURPOSE of RAM is to process the instructions & programs that are CURRENTLY in use by the computer system

ROM – READ ONLY MEMORY – The PURPOSE of ROM is to store the BIOS, which contains the boot strap instructions used to boot up (start) the PC

Volatile Memory – this is a type of memory that is temporary – all data stored in here **is LOST** when the computer is turned off e.g. RAM, CACHE, Virtual memory.

Non Volatile Memory – is a permanent type of memory – data **still remains** here when the computer is turned off. E.g. ROM

Firmware – this is permanent software that cannot be changed. – e.g. the BIOS is firmware on the ROM as this contains the instructions to start up the PC

RAM Vs ROM

RAM is Volatile
RAM Stores data & Programs currently in use
RAM is larger than ROM
Data can be changed

ROM - Non Volatile
ROM – stores the BIOS used to start up the PC
ROM is smaller than RAM
data on here cannot be changed

Why do we need Virtual Memory?

VM is created when RAM has insufficient space. The hard Drive will create a temporary memory (virtual Memory) to store instructions waiting to be fetched by RAM.
Data will be sent back and forth between RAM and VM (known as Disk thrashing, paging or swapping) until RAM has enough space to be able to deal with the data.

Flash Memory
This is an electronic re-programmable form of memory. Data here can be erased and re-written. Flash memory is often used for long term storage devices. E.g. SD cards, USB sticks.

1.3 STORAGE

Magnetic (eg Hard Drive) - Uses magnetic patterns to represent information. Has an electronic head that writes to a disk or tape
- Very Large capacity
- relatively cheap

Optical (eg DVD / CD Rom) - uses lasers and lights as its method of reading and writing data.
- Cheap to produce
- Portable
- Universally readable by a most computers

Solid State (eg Flash Drive) - Solid state – non volatile no moving parts when saving data to the device
- No Moving parts so not sensitive to being moved around while used
- Quick access (for instant on)

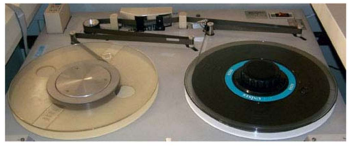
Secondary Storage: Normally non-volatile, data and programs that are not running on a CPU are stored in here. Examples are hard disks, DVD, magnetic tape etc

WHY:
Allows you to save and store things that you need/use on a regular basis or need to use at a later date.

Don't forget about Online storage!
term used to describe services provided over a network by a collection of remote servers.

Flash

Magnetic



Optical

Online - Cloud

1.3 STORAGE

When we talk about how suitable storage is we use these terms…….

Capacity
-how much data can it store?

Speed
-how fast can it access the data?

Portability
-how easy is it to move it from one place to another

Durability
-how well does it last e.g. if it is dropped

Reliability
-how consistently does it perform

Cost
-how much does it cost per KB, MB or GB?

You would be expected to suggest a suitable storage type and give the advantages and disadvantages using these characteristics

Capacity

- Bit (1 or 0)
- Nibble (4 bits e.g. 1101)
- Byte (8 bits e.g. 10111001)
- KB (1000 or 1024 bytes)
- MB (1000 or 1024 KB)
- GB (1000 or 1024 MB)
- TB (1000 or 1024 GB)
- Petabyte (PB) (1000 or 1024 TB)

PRIMARY

VOLATILE – areas of memory that CPU can access quickly

RAM
CACHE
VIRTUAL MEMORY
ANYTHING STORED HERE IS FORGOTTEN WHEN THERE IS NO LONGER POWER TO THE COMPUTER

SECONDARY

NON-VOLATILE – where the OS, applications, files and programs are stored

USED FOR LONG TERM STORAGE
USB
HARD DRIVE
CLOUD
TAPE
CD/DVD

TERTIARY

NON-VOLATILE – for storing more long term – for archives and back-ups

USED FOR LONG TERM STORAGE
USB
HARD DRIVE
CLOUD
TAPE
CD/DVD

1.3 STORAGE – Capacity Questions

A SOUND file has 2 bytes per sample, it takes 10 samples per second, over 2 channels and is 30 seconds long.

The formula to work this out is:
bytesPerSample * samplesPerSecond * channels * duration

2 * 10 * 2 * 30 = 1200 bytes or...
..1200/1024 = 1.17 KB

A TEXT FILE that contains 1000 characters. Give your answer in KB

1 byte per character, + 10% for any overheads (e.g. file type)
**See below to work this out

A text file with 1000 characters will have approximately?
1000 bytes * 1.1 = 1100bytes

How many KB?
1100/1024 = 1.07 KB

An IMAGE is 1024 x 720 pixels in size, 1 byte per pixel. It has 256 different colours

The formula for working this out is……
(Number of pixels * number of bytes per pixel) * 10% for overheads
Divide answer by 1024 to get KB.
Divide further again by 1024 if you want answer in MB

SO……
Number of pixels = **1024 * 720 = 737280 pixels**
737280 * 1 * 1.1 = 811,008 bytes or ...
...811008/1024 = 792KB

Overheads Files store more than the data in the file.
This term refers to the **extra that the system** has to process to. E.g. allocating memory, bandwidth, file types etc. You should **allow for 10% extra** on top of normal storage capacity

To work out an overhead – Find 10% of the number of bytes per character: so 1 byte per character
How do we work out percentages – 10% of 1? (10% as a decimal is 0.10)

1 x 0.10 = 0.1

So we now know that 10% of 1 is 0.1
Lets add this to 1

1 + 0.1 = 1.1 overhead

1.3 STORAGE – Capacity Questions

A database has 6 fields and 200 records:

- **CDNumber,** a text field with 6 characters
- **Title,** a text field with max. 20 characters
- **Artist**, a text field with max. 15 characters
- **DatePublished**
- **NumberOfTracks**, an integer field
- **TotalLength,** a real field

Calculate the file size of this database…..

See right box for how to….

Text = 1 byte per character.
Integer = 4 bytes
Real = 4 bytes
Date = 8 bytes

Step 1: Work out how many bytes are in the record (you will need to know the datatype of each field)

CDNumber= **6** bytes, Title = **20** bytes, Artist = **15** bytes, DatePublished = **8 bytes**, NumberOfTracks = **4 bytes,** TotalLength = **4 Bytes**

Total = 57 bytes

Step 2: Multiply by the number of records

57 * 200 = 11,400 bytes

Step 3: Add 10% for overheads (1.1)

11,400 * 1.1 = 12,540 bytes

Step 4: work out how many KB by dividing by 1024

12,540 / 1024 = 12.24kb

In short:

(6+20+15+8+4+4) * 200 * 1.1 = 57 * 200 * 1.1 = 12540 bytes = 12.24 KB

1.4 Wired & Wireless Networks

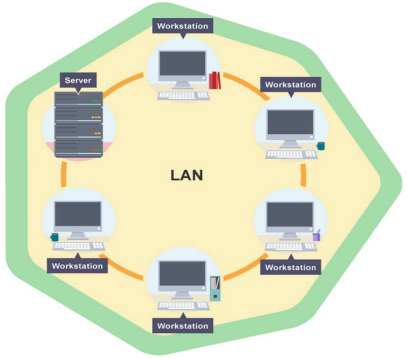
Network
A collection of computers connected together.

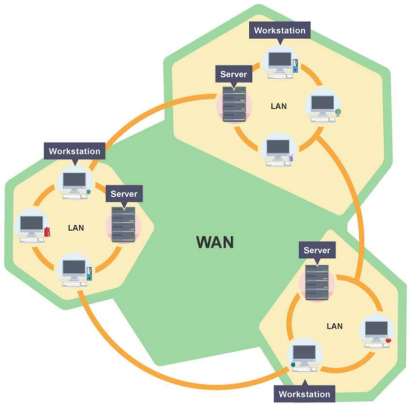
LAN
Network over a local geographical area (eg School)
LAN has its own infrastructure of cabling and network hardware due to distance and practicalities

WAN
Network over a large geographical area (eg WWW)
WAN uses external hardware and external infrastructure e.g. use of satellite, phone lines or The Internet.

Advantages
- Share Internet Connection
- Share Peripherals
- Share files
- Sends Emails

Dis-Advantages
- Risks of Viruses and Hacking
- Expensive Hardware
- Specialist staff often needed (eg Network Manager)





Hardware

Hub – used to connect multiple devices to the network. Now obsolete (use Switch)

Switch – connecting computers and other network capable devices together to form a network.

NIC (Network Interface Card/controller) – Internal hardware allows a device to be connected to a network. Use for wired and wireless networks

Transmission Media – What is used to transmit data across a network –.

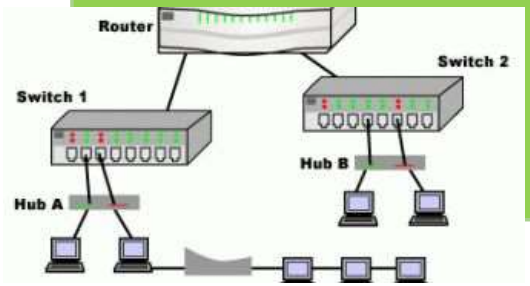
Wired - Ethernet cable (CAT 5e and CAT 6 twisted pair). A networking standard. Coaxial cable , an older standard or Fibre optic very fast but more expensive.

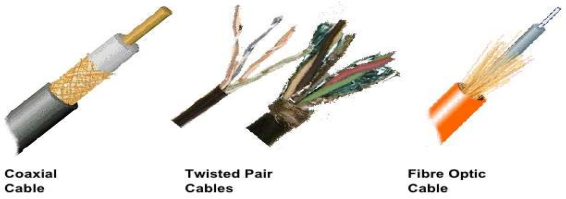
Wireless – Radio and microwaves to transmit data e.g. Wi-Fi is the standard for for networks – uses two radio frequencies 2.4ghz and 5 ghz

Wireless Access Points – for wireless networks – allows devices to connect to a network wirelessly

Server – A computer that holds data to be shared with other computers. A web server stores and shares websites. Servers require server software.

Router– Connects Server to Internet and transmits data (as packets) between networks





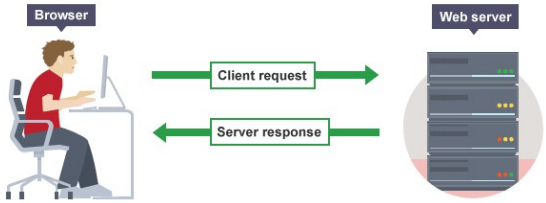
1.4 Wired & Wireless Networks

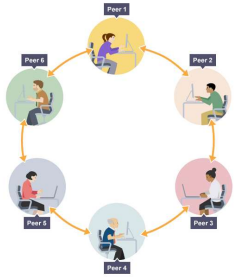
Peer To Peer

No single provider is responsible for being the server. Each computer stores files and acts as a server. Each computer has equal responsibility for providing data.

Client Server

The client-server model is the relationship between two computers in which one, the client, makes a service request from another, the server. For example, websites are stored on **web servers**. A **web browser** is the client which makes a request to the server, and the server sends the website to the browser.





	Client-server	P2P
Security	The server controls security of the network.	No central control over security.
Management	The server manages the network. Needs a dedicated team of people to manage the server.	No central control over the network. Anyone can set up.
Dependency	Clients are dependent on the server.	Clients are not dependent on a central server.
Performance	The server can be upgraded to be made more powerful to cope with high demand.	If machines on the network are slow they will slow down other machines.
Backups	Data is all backed up on the main server.	Each computer has to be backed up. Data can easily be deleted by users.

INTERNET

A global network of computers that any computer can join.
It is a network between many Networks (ie WAN).

World Wide Web (WWW)

A collection of websites that are hosted on web servers and accessed through the http protocol.

URL

Uniform Resource Locator are the addresses used to access the web servers

DNS

Domain Name Server – Holds all the addresses of the web pages and translates the websites domain name in to its IP addresses. **C**onstantly updated by other DNS servers

HOST

When a business uses its servers to store files of another organisation
e.g. hosting websites or hosting cloud storage

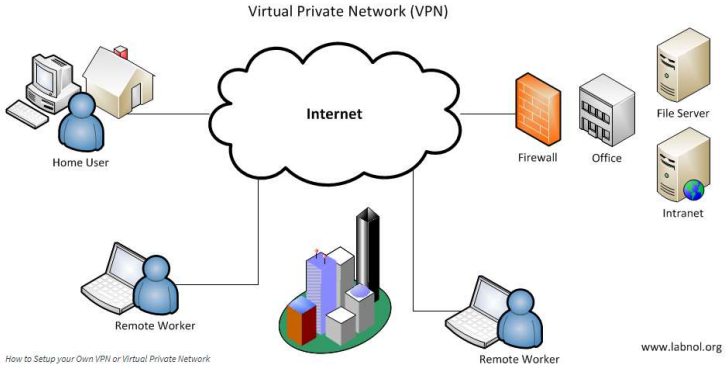
Cloud

Uses the internet to store files and application
PROS: Users can access files from any connected device
Easy to increase how much storage is available.
No expensive hardware to store data
No IT staff to manage hardware
Cloud Host provides the security and back ups for you
Software will be updated automatically

CONS: Need connection to internet to access files
Dependent on Host for security and back ups
Data in cloud can be vulnerable to hackers
Unclear who has ownership over cloud data
Subscriptions fees for could storage and software may be expensive

1.4 Wired & Wireless Networks

Virtual Networks
Entirely software based
Created by partitioning off some of a physical networks bandwidth to form a separate network
PROS:
You can have several virtual networks on the same physical network
They share the same hardware – so VN can be more efficient that standard physical networks
Each VN has own security including own firewall
Can only be accessed by using certain software or login information
Used to send data securely over a large network like WAN or internet e.g. VPN (virtual Private Network) can be used to send data securely between home and office or two different offices or students access files from home
CONS:
Design can be complex and requires expertise to set it up – costly
Needs managing – costly
Tighten up security if wireless devices are connected to it



Remember: these can be good or not so good factors

Factors that affect the performance of Networks

Bandwidth – the amount of data that can be transferred over a given time. **Greater bandwidth = better network can perform.**

If more people are using bandwidth on a network this can cause congestion and slow the network down.
How to solve: You could limit the bandwidth available to different users on the network address

Wired Connections – generally faster and more reliable than wireless
Fibre optic cables = better performance than copper cables
Wireless performances depends of signal quality – Physical objects suhc as thick walls and interference from other devices can affect the network
Choice of hardware and network topology can also have an affect on the performance

1.5 Network Topologies, Protocols & Layers

WiFi - WiFi is Wireless Fidelity – The standard for wireless data transmission

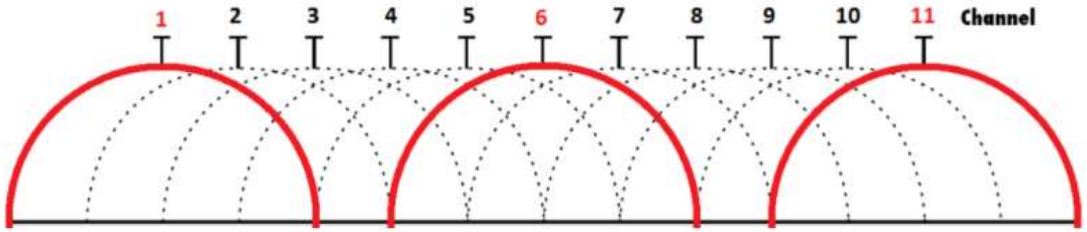
- **- radio waves are used to transmit data packets without the need for wires.**

- This method is slower and more vulnerable to attack but it removes the need for cabling and networks
- This means that it can be set up in remote locations such as in vehicles, in parks or on planes etc.

Frequency & Channels

- Wi-Fi uses radio waves to transmit data.
- To set up you need a WAP (Wireless access point) this allows other devices to be connected to the network
- Hotspots areNOT WAP's – A hotspot is a LOCATION on where you can access a WAP
- Wi-Fi uses two radio frequency band 2.4 Ghz and 5Ghz
- The bands are split in to CHANNELS that cover a small range. The Channels overlap

To avoid problems only certain channels that are spread apart tend to be used



Encryption

Encryption is a method of scrambling data with a key code which makes no sense.
In order to read the data the user is required to decrypt the data using the key.

- When you are using a secure site for example your bank, or purchasing on Amazon, encryption applied to keep your details safe:
- The encryption method used is called 'SSL' (Secure Socket Layer).
- A site that uses SSL is shown in the URL by https and a padlock

Wireless encryption helps secure Wi-fi networks

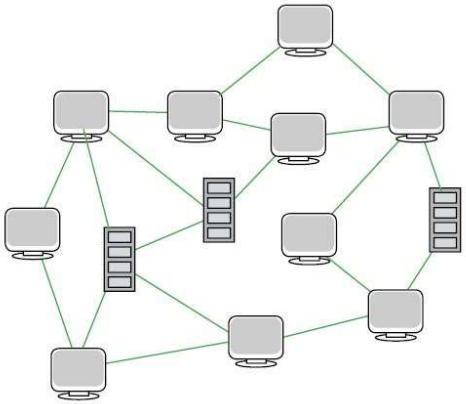
WEP (Wired Equivalent Privacy) – original encryption protocol - offers same level of security as wired network – hence the name CON: Can be easily broken has many flaws

WPA – improves authentication – was developed due to WEP weaknesses. Provides better security to VPN and home networks

WPA2 – 2nd version of wPA – even stronger wireless encryption - WPA2 is the safer and simpler choice to have as it has more advanced encryption algorithms. CON: Can in theory slow networks performance down so ome people prefer WPA

1.5 Network Topologies, Protocols & Layers

Topology
The layout of a network



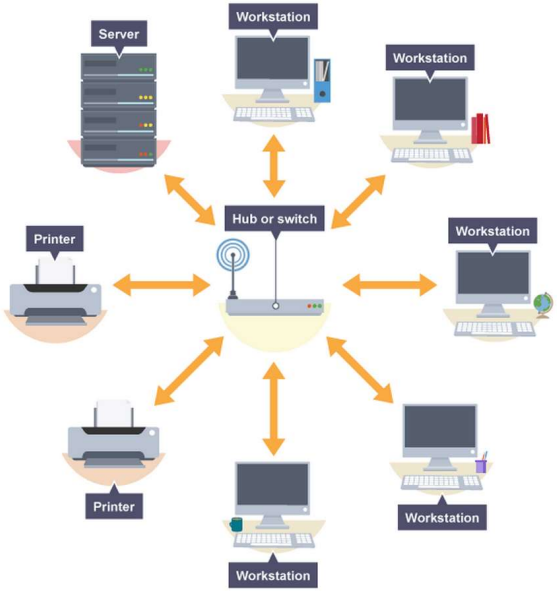
Mesh

Relatively new topology

Decentralised - Where some or all of the workstations or other devices are connected directly to each of other. Most are usually connected to the node that they exchange the most data with.

Advantage
No single point where it can fail
If one device fails then the data is sent along a different route to its target

Disadvantage
Very expensive – a lot of wire is needed to connect devices together BUT can overcome this by using wireless technology
down.



Star

Each device on the network has its own cable that connects to a **switch** or server. It is centralised.
Central switch or server allows many devices to be connected to it

Advantage
very reliable – if one cable or device fails, then all the others will continue to work
high performing as no data collisions can occur
Simple to add more devices to network
Better performance – all data sent to central device so all devices can transmit data at once

Disadvantage
expensive to install as this type of network uses the most cable, and network cable is expensive
if a hub or switch fails, all the devices connected to it will have no network connection

1.5 Network Topologies, Protocols & Layers

Packets and packet switching

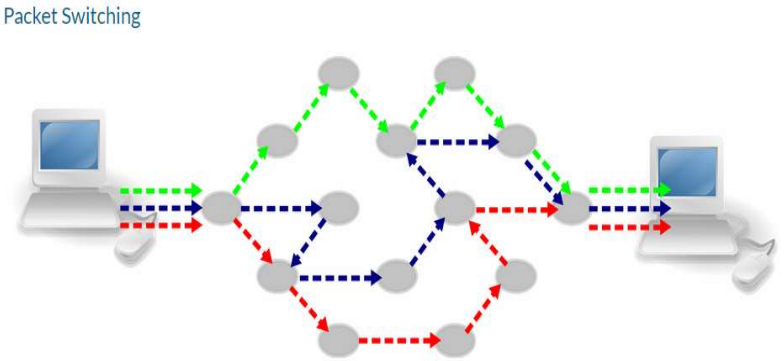
Data is sent in packets

Think of a photo being broken up in to tiny bits (packets) each bit is sent across the network and then re-assembled at the end point.

Every packet has a header – contains destination address (Where its going) Source address (where it from), the packet number (so it can be assembled in the right order at the end point) and a check digit (to validate that it hasn't been corrupted)

Packet switching

- Used by routers to direct packets on the internet and other IP networks
- sending device splits the data in to packets
- Each router reads the packet header and decides which way to send the packet
- depends on network traffic so each packet can take different routes
- Route blocked? then the packer can be re-directed using a different route
- The receiving device checks the packet numbers and puts them in the right order
- Some packets may go missing - so the receiving device will send a 'time out' message to the sending device and ask it to send again
- It is then re-assembled
- **Packet switching is efficient because there are so many possible routes it can take even if there is heavy traffic**



1.5 Network Topologies, Protocols & Layers

Protocol
Set of rules for how devices communicate and how data is transmitted across a network

MAC Addresses
Every device **needs a unique identifier** so it can **be found on a network**
MAC addresses are assigned to all network devices
They are **unique and cannot be changed**
They use 48 or 64 bit binary numbers as a hexadecimal number
e.g. 98-81-55-cd-f2-2f
MAC addresses mainly used by Ethernet protocol on LANs. LAN switches read the addresses and e them to direct data to the right device

IP Addresses
Internet protocol addressees
Used when sending data between TCP/IP networks (e.g internet)
These are not linked tO hardware (like MAC are)
They are assigned either manually (static) or automatically (dynamic) before the device can access the network
Static IP's – permanent – used to connect printers to LAN or for hosting websites on internet. Can be expensive
Dynamic – Assigned to the device by the network server, so your device may have a different IP address every time you log on to a network.
ISP's (internet service providers) use these as they are more cost effective and can be re-used.
An IP address is a 32 bit or 128 bit binary number it is converted in to Hex
Eg. 37.153.62.136

MAC address	IP address
• 48 bit address	• 32 bit address
• Works at OSI layer 2 (link layer)	• Works at OSI layer 3 (network layer)
• Physical address	• Logical address
• Fixed, assigned by manufacturer	• Can change depending on the network environment
00:0C:F5:09:56:E8	150.60.122.98

1.5

What are the advantages of layers?

They can be moved and changed without impacting another
Individual protocols are easier to manage
Different layers can interface with different hardware

Protocol

Set of rules for how devices communicate and how data is transmitted across a network

Protocols

The rules will set out how communication between 2 devices start and end and how it should be organised and what to di if data goes missing.

TCP/IP (Transmission Control Protocol/Internet protocol) is the most important

It dictates how data is sent between networks (e.g. over the internet) it is made up of two protocols

TCP – ruess for how devices connect on the network, how it splits data in to packets and re assembles at the other end

IP – responsible for packet switching

4) Several other protocols build upon TCP/IP to do specific Internet-based tasks:

Protocol	Stands for...	What is it used for?
HTTP	Hyper Text Transfer Protocol	Used by web browsers to access websites and communicate with web servers.
HTTPS	HTTP Secure	A more secure version of HTTP. Encrypts all information sent and received.
FTP	File Transfer Protocol	Used to access, edit and move files between devices on a network, e.g. to access files on a server from a client computer.
POP3	Post Office Protocol — version 3	Used to retrieve emails from a server. The server holds the email until you download it, at which point it is deleted from the server.
IMAP	Internet Message Access Protocol	Used to retrieve emails from a server. The server holds the email until you actually delete it — you only download a copy. Used by most web-based email clients.
SMTP	Simple Mail Transfer Protocol	Used to send emails. Also used to transfer emails between servers.

1.5 Network Topologies, Protocols & Layers

Layers
A group of protocols which have similar functions

Layers

Self contained – protocols in each layer do their job – don't need to know what is happening in other layers

Each layer serves the alyer above it e.g. when you send an email (on layer 4) it triggers actions in layer 3, which riggers actions in layer all the way to layer 1.

Data can only be passed to adjacent layers e.g. layer 2 to layer 1 and 3 but layer 1 only pass to layer 2

Layer Name	Protocols in this layer cover...	Protocol examples
Layer 4 — Application Layer	Turning data into websites and other applications and vice versa.	HTTP, FTP, SMTP
Layer 3 — Transport Layer	Controlling data flow — e.g. splitting data into packets and checking packets are correctly sent and delivered.	TCP
Layer 2 — Network Layer	Making connections between networks, directing data packets and handling traffic. Used by routers.	IP
Layer 1 — Data Link Layer	Passing data over the physical network. Responsible for how bits are sent as electrical signals over cables, wireless and other hardware.	Ethernet

Why use layers? Breaks down communication in to manageable chunks

Layers are self contained – can be changed without other layers being affected

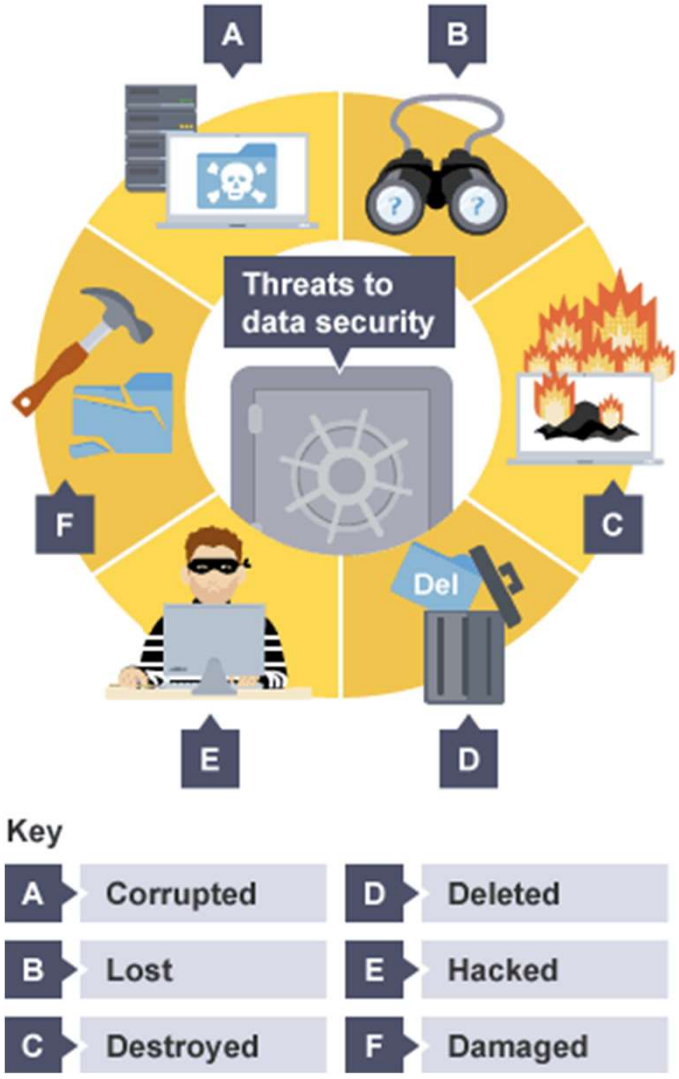
The protocols for each layer forces companies to make compatible, universal hardware and software so different brands will work with each other and in the same way

1.6 System security

- **Attacks come in different forms**

- **Passive Attack –** monitoring data travelling and intercepts sensitive data
- **Active attack –** attacks a system with malware or other such things – they are more easily detected
- **Insider attack –** someone in company exploits their network access to steal info
- **Brute force attack –** used to gain info by cracking passwords through trial and error. These use automated software to produce 100's of likely password combinations
- **DOS (denial of service attack)** where hacker tries to stop users from accessing part of a network or website. They flood the network with useless traffic making it slow or inaccessible for other users

- **Forms of attack**
  - Passive vs. Active
- **Threats posed to networks (how each is carried out // suitable examples):**
  - Malware
  - Phishing
  - Social engineering (people as the weak point in secure systems)
  - Brute force attacks
  - Denial of service attacks
  - Data interception and theft
  - The concept of SQL injection
  - Poor network policy.



Network security threats

Malware – Malicious software installed on someone's device without their knowledge or consent.

Typical actions of malware:

Delete/modify files
Scareware – tells user PC is infected with lots of viruses – to pay for problem to be fixed
Locking files – ransomware – pay to get files back
Spyware – secretly monitors actions and sends info to hacker
Rootkits - alter permissions given hackers admin level access to devices
Backdoor – holes in someone's security leaving them open to future attacks

Malware can access your device in different ways

Viruses – in attachments, or .exe files activated when opened
Worms – self replicating viruses - spread quickly
Trojans – malware disguised as legitimate software users install them not realizing they have hidden purpose

It is your responsibility to make sure you regularly revisit this knowledge outside of class.

1.6 System security

- **People as the weak point in secure systems**

- **Social engineering** - is a way of gaining sensitive info or illegal access to networks by influencing people, usually employees of large companies

- **Phishing** – another type of social engineering – criminals send emails or texts to people pretending to be well known business. They request uses update their details , when users do this the criminals use the details on the users account e.g. bank details

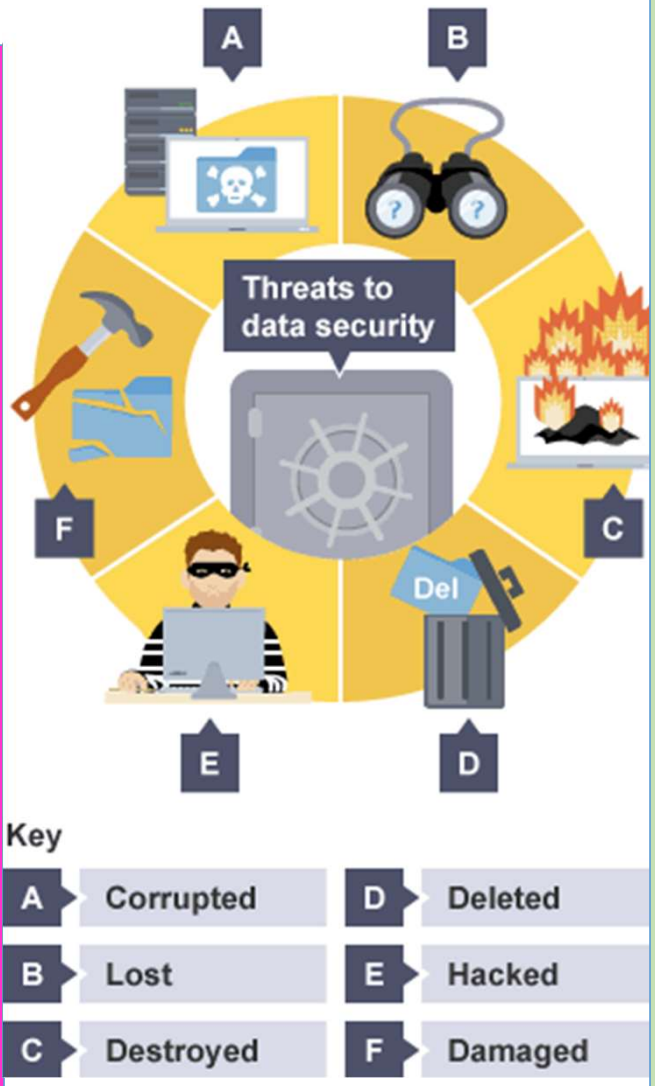
- **SQL Injections – give criminals easy access to insecure data**
- Many companies use databases to store information
- SQL is the main language used to create databases
  - **SQL injections are pieces of SQL typed in to a websites input box which can then reveal sensitive information**

- **Poor network policy**

A GOOD policy will:

- Regular test the network to fix weaknesses
- Use Passwords to prevent unauthorized people
- Enforce user access levels
- Install anti-malware and firewall software to prevent and destroy malicious software attacks

NOT HAVING THIS IN PLACE LEAVES A NETWORK VULNERABLE TO ATTACKS



- **Identifying and preventing vulnerabilities:**

- **Penetration testing** – simulates potential attacks to identify weaknesses
- **Network forensics** - investigate to find the cause of attacks
- **Network policies** – regular test for weaknesses, set passwords and access levels
- **Anti-malware software** - find and stop malware from damaging network and devices
- **Firewalls -** monitors and controls incoming and outgoing network traffic based on predetermined security rules
- **User access levels** – control which part of network different groups of uses have e.g staff drives and student drives at school
- **Passwords** – prevent unauthorized users accessing the network
- **Encryption** – data is translated in to code so only someone with correct key can access it.
  - Symmetric - same keys are used to encrypt (cipher text) and decrypt (plain text)
  - A-Symmetric – where the keys come in pairs, uses two keys to encrypt plain text

It is your responsibility to make sure you regularly revisit this knowledge outside of class.

Systems Software

Systems software – Designed to run and maintain a computer system
Examples

Operating Systems

Manages hardware and software in a computer system

Memory Management
Controls where the programs go in memory when being run.

User Interface
Provides a method of interaction with the user.

MultiTasking
Allows more than one program to run at once by sharing CPU time between programs.

Peripheral Management & driver software
Manages all Input, Output and Storage devices. Allows the OS and the external hardware such as printers, USB's etc to talk to each other

Security
Protects the machine is free from harmful viruses or unwanted access.

File and Disk Management
Helps to store files (images, music, documents etc) and their file extensions, helps you organise and search for files
Disk management such as space on hard drives, and utility software such as disk defragmentation software.

User management
The OS can deal with User accounts – single or multi users – eg. More than one person can us a computer at once. It also allows for use access, e.g. logging in to a system and having access to certain files and permissions etc. OS is also responsible for things like biometric anti-theft measures, fingerprint, and retina scanners.

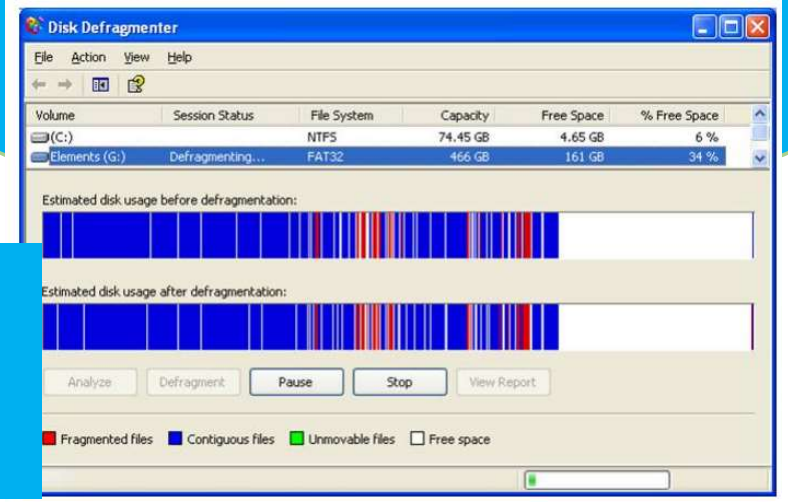
UTILITY SOFTWARE

Helps to maintain or configure a computer. Most are installed in the OS but you can add others.

Disk Defragmenter

Moves (parts of) of files around so that all parts of a file are stored together (allowing files to be accessed more quickly)
 Free space is collected together (allowing large files to be saved easily)

Disk Defragmenter



System Cleanup (Utility)

(Searches for and) deletes files/programs which are no longer used
… eg deletes temporary files / installation files
… deletes settings / registry values which are no longer used

System Information Utility

displays important data about the current state of the computer
· e.g. temperature, free memory, network speed, % processor used

Systems Software

UTILITY SOFTWARE

Helps to maintain or configure a computer. Most are installed in the OS but you can add others

AntiVirus

Scans the computer periodically
- To check if any software has been installed which contains code that may harm the computer
- Removes/quarantines these programs / notifies the user
- Prevents these programs from being installed
- Protects the computer by preventing important files (eg the boot sector or operating system) from being changed

Firewalls

will block unexpected connections coming in to the network.

Automatic Update

Checks on the (software manufacturer's site on the) Internet for newer versions of programs which are installed
- If found it download / installs the software

Diagnostics Utility

attempts to detect/resolve items that are not working correctly
· e.g. missing drivers, network connection

Back-ups

Back up data – copy of a sysytem files and settings stored somewhere externally

Full back up – copy of EVERY file is taken. Faster to restore from
Uses A LOT of storage space, can take a long time to create

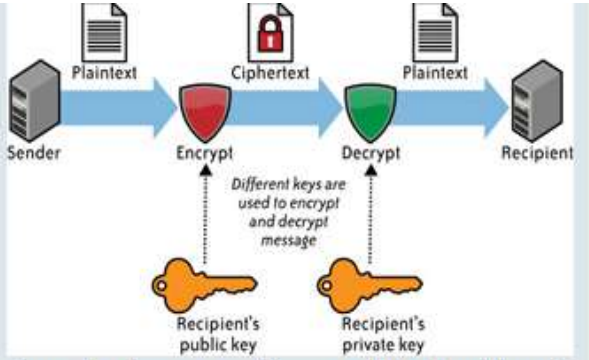
Incremental Back up – only files created and edited since the last back up are copied. Uses LESS storage and much QUICKER to create. BUT full system restore is SLOW

Data Compression

Reduces the size of files so they take up less disk space. Can help upload and download files quicker or send them across email. Standard formats include .zip and .rar to compress the files

Encryption

Scrambles (encrypts) data – this stops people from accessing it. Encryption happens by scrambling the message, you can only decrypt this if you have a special 'key'
Encrypted text is called – Cipher text
Decrypted is called Plain text
Encryption is essential for sending data over a network e.g. internet so it is kept secure



Encryption keys are used to encrypt (lock) and decrypt (unlock) files and data.

1.8 Ethical , Legal, Cultural & Environmental

Export of e-waste

Environmental impact of computer science

E.g. smartphones

- Companies make these with a limited life – bring out new brands
- When we make devices we use up natural resources
- e.g. plastics that come from crude oil, precious metals like gold, silver copper, mercury
- Extracting these materials take a lot of energy, creates pollution and uses natural resources

- E-waste – when we throw away devices we create this
- Not always disposed of safely
- Much of our e-waste foes to 3rd world countries
- Landfills – precious and poisonous metals and toxins from waste leak in to land and water
- This impacts on 3rd world countries environment and health of people e.g. children rummaging through landfill sites looking for food.
- WEEE – Waste electric and electronic Equipment – company that helps dispose of E waste safely and promotes recycling of devices.

Cultural implications

- Shaped out lives – lead to digital divide – some people have greater access to tech than others. This can lead to others being disadvantaged
- Why? Some have more money to buy new devices, urban areas have better network coverage than rural, some don't know how to use the technology e.g. older people haven't grown up with computers so don't know how to use them
- People in richer countries have better access = better opportunities for these people

- Changes in business – streaming media- cheaper – music shops such as HMV closing stores. Cheaper services like Airbnb use internet to rent out rooms – can be cheaper but also risky – safety regulations, insurance might not be in place as if you book through a hotel it would be.

- Shaped our culture – selfies, attention seeking and self obsessed behaviour. Things going viral – easily spread can have positive but a negative impact on peoples lives.

1.8 Ethical , Legal, Cultural & Environmental

Ethical - what is CONSIDERED to be right and wrong by society
Legal - what is ACTUALLY right and wrong in the eyes of the law
Cultural – how groups of people with certain beliefs, practices or languages may be affected e.g. religions, ethnic groups
Environmental – how we impact the environment
Privacy - keeping data secure and accurate

Stakeholders – Individuals or groups of people who have an INEREST in or are AFFECTED by decisions a company makes

- **Owners**
- **Employees**
- **Customers**
- **Shops it sells goods to**
- **Suppliers to the company**
- **Local Community**

Legal

- **Data Protection Act**
  - Keep Personal data secure
  - Keep Personal data Accurate
  - Keep Personal data for a specific purpose
- **Computer Misuse Act**
  - Illegal to access computer material without permission,
  - Illegal to access computer material without permission and with intent to commit criminal offences,
  - Illegal to alter computer **data** without permission

Copyright designs and patents act
- Illegal to copy someone elses work, design eg, novel, music, picture, software, designs etc
- Permission is needed from the copyright holder if you want to use anything – may have a small cost
- Difficult to control with internet in play and not easy to police e.g. streaming videos, music illegally

Creative Commons Licensing
- Allow you to legally share media ad software online without having to ask for permission first.
- Usually take and build upon the work in the public domain that can be shared again

Freedom of information act (2000)
- allows members of public to access information held by a public organise ion about that organisations activities
- Covers data files, email, printed documents
- e.g. NHS, armed forces, Police, Schools
- The acts makes these organisations publish data on a regular basis so the public have access to it
- Public can also request certain information
- e.g. school results data, Hospital waiting lists, crime stats etc

1.8 Ethical , Legal, Cultural & Environmental

Open source software PROS
- free and openly available to everyone. **No licence needed.**
- The code is published and allow others to use and **modify it.**
- Open source products are usually **tested in public by online contributors.**
- **Wide pool of innovative creators – very reliable and secure**

Open source software CONS
- Might not get regular updates
- **May have security holes**
- **May be Limited user documentation**
- **No warranties or customer support**
- **No one to take ownership if something goes wrong**

OPEN SOURCE	PROPRIETARY
Linux,Ubuntu, Open Office	Microsoft windows, word, Pumori
Purchased with source code	Purchased with out source code
User can modify software	User can not modify software.
Free of Charge	Must pay to use.
Can install freely	License required
No one is responsible for support	Full support from vendor if any problem occurs.

Proprietary software PROS
- **legally remains the property of the organisation, group, or individual** who created it.
- Source code not usually published
- Has help and customer support
- Well tested and tried
- A special licence key needs to be purchased to use it.

Proprietary software CONS
- **Can be expensive**
- **Might not exactly fit users needs**
- **Ma not maintain older versions and warranties will expire – as the companies wills want people to buy the latest versions.**