Definition of a LAN:

- Refers to a Local Area Network
- Covers a small geographical area (e.g., a single building or site).
- Owned and managed by the organisation using it.
- Devices in a LAN are typically connected through:

  - Wired connections, such as Ethernet cables (e.g., UTP).
  - Wireless connections, such as Wi-Fi.

- LANs often use switches to connect devices.

Definition of a WAN:

- Wide Area Network (WAN)
- Covers a large geographical area, such as across cities or countries.
- Connects multiple LANs together.
- Allows computers in different locations to communicate outside of a single LAN.
- Infrastructure: Owned and managed by telecommunications companies.
- Connection types:

  - Telephone lines
  - Fibre optic cables

- Satellite links

- Routers are typically used to connect different networks in a WAN.

Advantages of Networking Computers:

- **File Sharing**: Users can easily share files across the network.

- **Peripheral Sharing**: Users can share peripherals, like printers and internet connections.

- **Remote File Access**: Users can access their own files from any computer on the network.

- **Centralized Security and Updates**: Servers manage security settings and handle software updates.

- **User Communication**: Allows users to communicate with each other, such as through emails.

Disadvantages of Networking Computers:

- **Security Risks**: Increased risks to data security when transferring and storing files on the network.

- **Virus Spread**: Viruses can spread to all computers connected to the network.

- **Dependence on Server**: If the server fails, networked computers may lose functionality.

- **Reduced Performance**: High network traffic can slow down computer performance.

Factors affecting the performance of networks:

Bandwidth - Amount of data which can be transmitted on the transmission media and is measured in bits per second

Number of users - Too many users connected to the network can slow down the network if there isn't enough bandwidth

Transmission media - Wired connections have a higher bandwidth than wireless

Error rate - Less reliable connections can increase number of errors when data is transferred. Data has to be resent until it works

Latency – Delay from transmitting data to receiving it

Client server and peer to peer networks:

Client server model:

    Server control access and security to file

    Server manages access to internet

    Server manages print jobs

    Server provide email services

    Server manages backups of shared data

Advantages of Client server model:

Easier to manage security of files

Take backups of shared data

Install software updates to all computers at one time

Disadvantages of Client server model:

Expensive

Requires specialists to operate

Network can go down if server goes down

Peer to peer model:

A peer is equal to all other peers

Peers manage their own files

Peers manage their own security

Peers manage their backups

Peers have their own printers

Advantages of peer to peer model:

Easy to maintain

No dependency on a single computer (server)

Cheaper

Disadvantages of peer to peer model:

Less secure

Users will need to manage backups

Difficult to maintain a well organised file store

Hardware to connect a LAN:

Network Interface Card (NIC):

- Every computer connected to the network needs an NIC
- In modern computers, these are integrated
- They use a protocol
- They allow devices to connect to wired or wireless networks

Wireless Access Point (WAP):

- Allows devices to connect to the network wirelessly
- More convenient

- Security risks to data
- Weak connections sometimes

Switch:

- Allows the segmentation of data on a LAN to allow transmission of data to only some computers
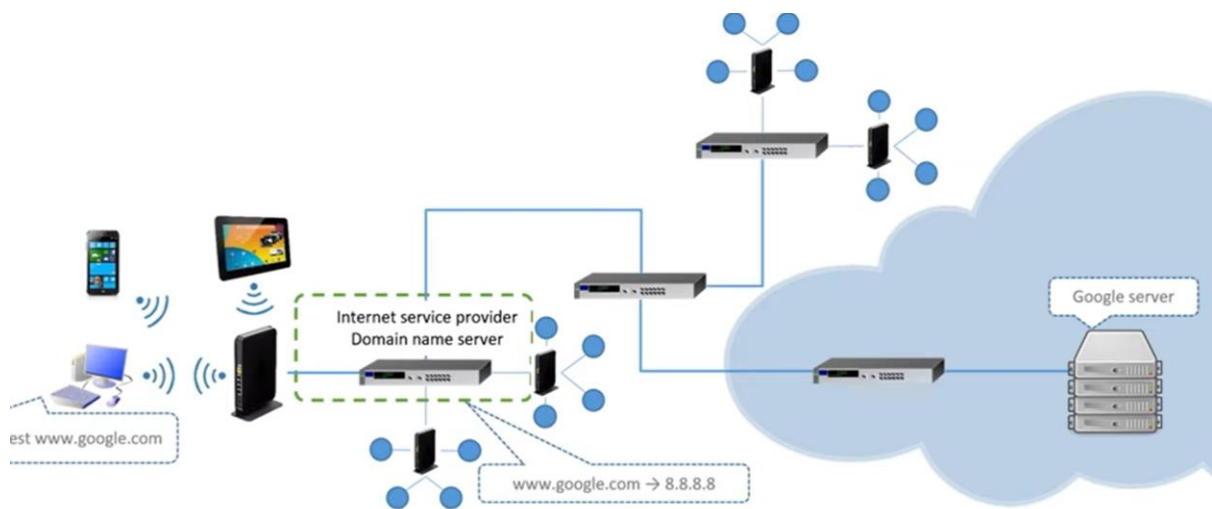
Router:

- Sends data between networks
- You need this to connect to a WAN (e.g. Internet)
- It uses the IP addresses to route traffic

Transmission media:

- Twisted pair cables:
  - Wired connections have maximum bandwidth, security and reliability
  - Twisted pair cables are twisted to reduce interference
  - Used for sending and receiving
  - The grade of copper and insulating material affects quality of the cable
- Fibre optic cables:
  - Uses light to transmit data

o Covers greater distances
o It is used for the backbone of the
  internet
o Reduced interference so higher
 bandwidth

The Internet:

- The home network is connected to the router
- The router is connected to an ISP via
  telephone lines or fibre
- The ISP is connected to a DNS and other
  routers
- Those routers are connected to LANs, other
  routers and servers

Web servers and clients

- Web servers carry out many functions, but by far their most common is:
  - Hosting websites
  - Dealing with client requests e.g. HTTP get requests for a page / resource
- The webpage, stored as text (HTML, CSS, JavaScript) is sent to a browser which uses rules to render it correctly for the user.
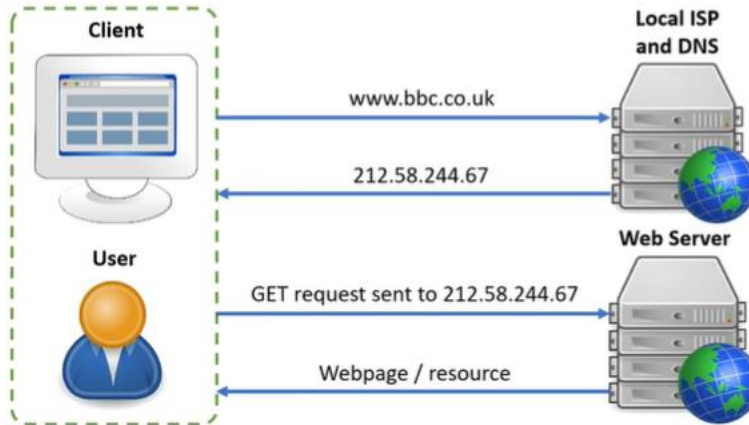
What happens when the user searches something on the internet:

1. URL request is made by the browser
2. The browser sends a domain name to the DNS
3. The DNS finds the IP address linked to the domain and returns it back to the browser
4. A GET request is made for the webpage/resource and is sent to the webserver using the IP address
5. Requested resource is returned to the clients web browser

Hosting is when the website is stored on a web server

The Cloud:

- The cloud is when data is stored on a server and then can be accessed on the internet
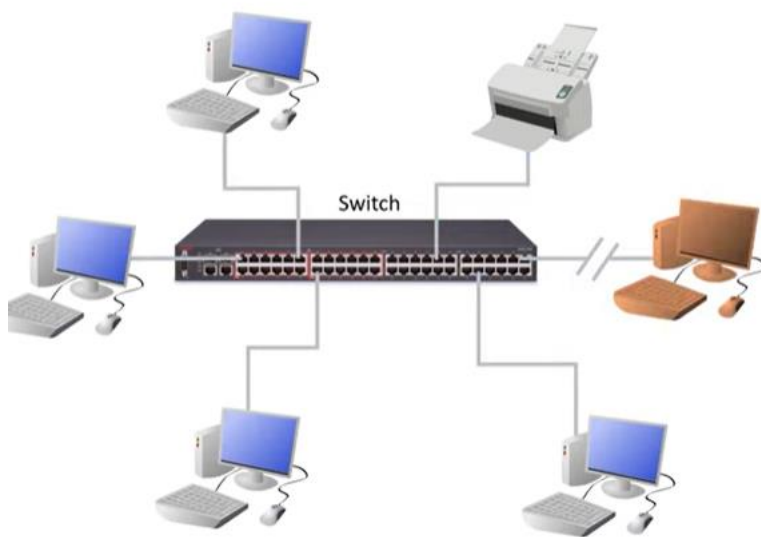
Advantages of the cloud:

- o Access any time
- o Access anywhere
- o Access from any device
- o Large storage
- o Automatic backup
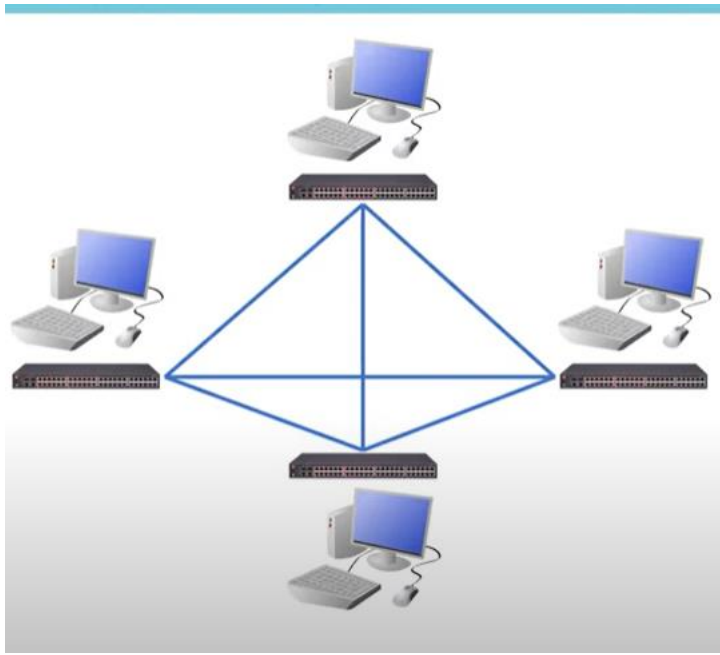- o Online collaboration

Star and mesh network topologies:

A topology is the arrangement of the features needed for a network

Star network topology:

Switch

- All devices are connected to the central switch
- Segments the network
- If one of the cables break, it only affects that device
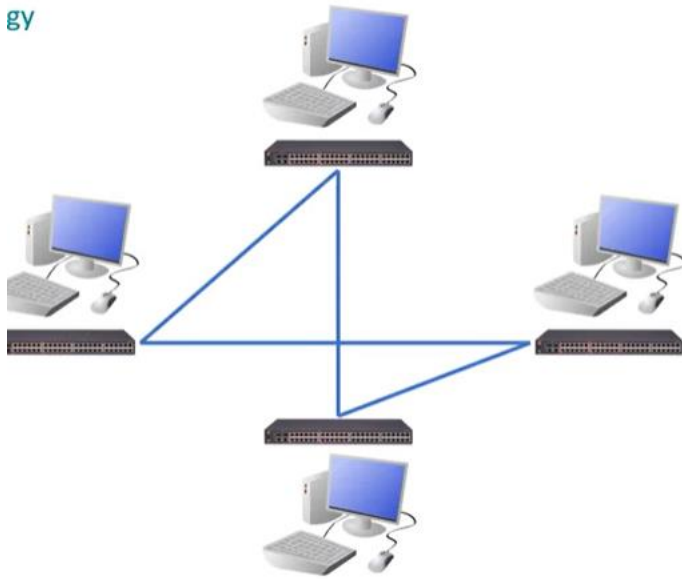- If the switch fails, then the whole topology goes down

Full mesh topology:

- Every device is connected to every other device
- If there is a break in one of the connections, there are still alternate routes the traffic can take
- This is very expensive and involves lots of wires and cables
- Increased chance of data collisions

Partial mesh topology:

- Every device is not connected to each other
- Multiple routes exist
- Lowers the amount of hardware needed

Modes of connection:

Ethernet in a star topology:

- Ethernet is a standard for many years
- With twisted pair cables, sending and receiving at the same time is possible

Ethernet in a mesh topology:

- Additional protocols are needed for route finding between the switches

Ethernet provides error free transmission and receiving

Wireless networks (Wi-Fi, Bluetooth):

- These are popular because there are no cables
- It is portable
- Bandwidth is lower
- Security concerns
- Convenient

Wi-Fi:

- Large range
- Low bandwidth
- High power consumption

Bluetooth:

- Short range
- Low bandwidth
- Low power consumption

<u>Wireless encryption:</u>

Wireless networks are identified by a unique 'Service Set Identifier' (SSID)

The SSID has to be used for all devices that want to connect to that network

It can be set to broadcast to any wireless device within the range of the WAP

Encryption:

- Encryption is done by scrambling the data into cipher text using an encryption key created from the SSID of the network and the password
- Data is decrypted by the same master/encryption key by the receiver so then it is unscrambled back into plain text. The master/encryption key is not transmitted.
- A handshaking protocol is used to ensure that the receiver has a valid master/encryption key before it sends the data
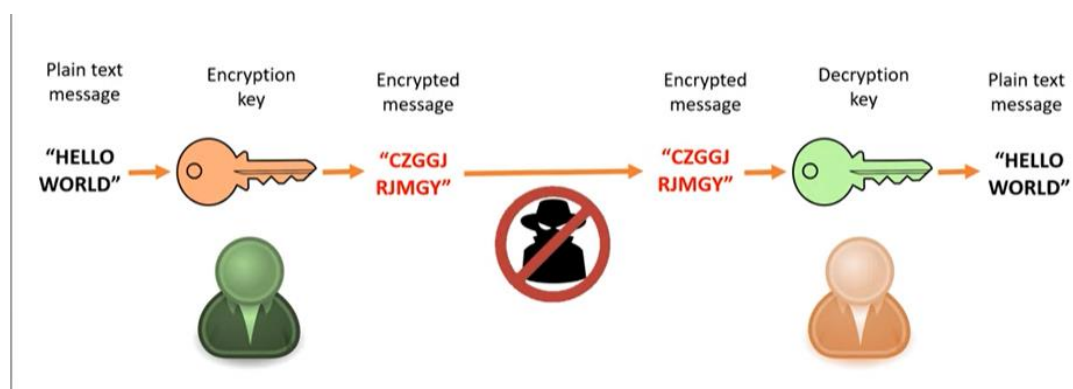
This is called symmetric encryption

IP and MAC addressing:

Every NIC has Media Access Control (MAC) address. This is used to route packets on a LAN.

IP addresses are used to route packets on a WAN.

An IP address is used to identify a computer on a WAN

There are 32 bits in IPv4

IPv6 addresses have 128 bits and are made up of letters, numbers and colons

MAC addresses:

- MAC addresses can't be changed / every device has a fixed MAC address

- MAC addresses are 6 bytes long

- MAC addresses are normally written in Hex

- MAC addresses are configured in hardware

- MAC addresses are only used within a LAN

IP addresses:

- IP addresses can be changed / are allocated as needed

- IP(v4) addresses are 4 bytes long

- IP(v4) addresses are normally written in denary

- IP addresses are configured by software

- IP addresses are used for routing packets across a WAN / internet

Standards:

A computing standard is a set of guidelines that when used with different hardware and software allows them to work with each other (compatibility) and allow data exchange (interoperability)

A standard is something which all computers must be able to understand

HTML is a standard because every device displays whatever you write

A protocol is another standard, it is a set of rules that communicate must follow

Without standards, data wouldn't be abled to be transferred

Example of standards:
- ASCII
- HTML
- PDF, PNG, MP3 etc.

Common protocol:

A protocol is a set of rules which allow two devices to communicate over a network

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 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.

TCP/IP:
- Transmission Control Protocol
- IP routes packets across a WAN

- This means that TCP/IP is when you send packets of data across a WAN
- TCP breaks down large data into smaller packets which is then transmitted and made sure that it arrives in the correct sequence

HTTP/HTTPS:

- A way of sending a receiving requests through the client and server and to deliver HTML pages
- HTTPS does the same thing but it also encrypts the webpage and is usually used on banking websites
- Hyper Text Transfer Protocol

FTP:

- File Transfer Protocol
- Used for sending files over a WAN

SMTP:

- Simple Text Transfer Protocol
- Transfers emails from one server to another server

POP:

- Post Office Protocol

- Used to retrieve emails from the mail server and then remove it and transfer it to your device

IMAP:

- Internet Message Access Protocol
- Keeps email on mail server and manages remote email boxes

Layers:

A layer is a group of protocols with similar functions which are self contained

Layer 1 (Application):

- Makes sure that data is in the correct format for the other software receiving it

Layer 2 (Transport):

- Establishes an error free connection across the network

Layer 3 (Internet):

- Transmitting data across the network
- Checks the sender and receiver of the data

Layer 4 (Network):

- Delivering data to the network
- Makes sure everything goes smoothly