1.3 – Computer Networks, Connections and Protocols

Factors Which Affect Network Performance

Bandwidth is the amount of data that can be transmitted. The larger the amount of available bandwidth, the more data which can be transmitted in a period of time.

- **The type of connection** – wired connection will be faster than wireless.
- **Interference** – walls and other radio signals can interfere with wireless networks. Electrical cables can interfere with wired networks.
- **The number of devices** – if lots of devices are using the network, there will be less bandwidth available to each user.
- **The type of media being accessed** – large files consume more bandwidth, large files such as HD video will take longer to transfer.

If insufficient bandwidth is available for the number of users, or the size of files, performance will be poor.

Protocols

- **HTTP** – HyperText Transfer Protocol – Web pages
- **HTTPS** - Hypertext Transfer Protocol (Secure) – Secure web pages
- **FTP** – File Transfer Protocol
- **SMTP** – Simple Mail Transfer Protocol – Send emails
- **IMAP** – Internet Message Access Protocol – Receive emails
- **POP3** – Post Office Protocol version 3 – Receive emails
- **DNS** – Domain Name System – Converts names to IP Addresses
- **IP** – Internet Protocol – Addresses packets
- **TCP** – Transmission Control Protocol – Provides reliable transmission

The Internet

The Internet – A worldwide collection of computer networks
Hosting – A service which allows you to publish a website to The Internet
DNS (Domain Name System) – A system for converting host names and web addresses into IP addresses
Web Server – A server configured to host websites.
Web Client – A client accessing websites, usually over The Internet.

Addressing

- Addressing allows us to identify devices
- Every device has a MAC address which never changes
- Each device on a network has an IP address but this can change

MAC Address

- Media Access Control (MAC) - 48 bits.
- Hexadecimal values
- MM:MM:MM:UU:UU:UU - MM is the manufacturer ID and UU is the device ID.

IP Address

- 32 bits using 4 sets of decimal values from 0 – 255.
- Used to route traffic to the right network.

Advantages Of Networking Computers

- Easy to share documents, several people can work on a document at once.
- Only one Internet connection is needed and can be shared between devices.
- Centralised backups can be carried out.
- Software updates and patches can be automatically pushed out.
- Users can log in to any machine connected to the network.

Network Hardware

Wireless Access Points
Converts network signals into radio waves allowing devices to connect wirelessly.
Routers and Switches
Connects devices on a LAN together by transmitting data between devices.
NIC (Network Interface Card)
A piece of hardware within a device which allows it to connect to the network.
Transmission Media
Connects the NIC to the router or switch. Could be:

- Wireless - using radio waves
- Ethernet – twisted pair coper cables
- Fibre Optic – data transmitted as light through glass or plastic cable

Encryption

- A method of scrambling data with a key.
- Anyone can join an open Wi-Fi network and see traffic from other users.
- If encrypted data is intercepted, it will have no meaning.
- To read the data, the user must decrypt it using the key.
- The encryption method used is called 'SSL' (Secure Socket Layer).

Cloud Computing

Services such as software, processing or storage hosted in a remote location and accessed via The Internet.

- Easy and quick to increase or decrease resources.
- Maintenance is performed by the cloud provider.
- Data is stored away from the organisation's building.
- There is no upfront cost, organisations pay only for what they use each month.
- Relies on having a suitable Internet connection

Layers

- In a network, data travels through layers where protocols add or removing extra information.
- Layers allow one part of the protocol to be changed or rewritten without affecting the other parts
- Consistency of communication components – ensures that different hardware and software can communicate.
- Divides communication into smaller components - makes troubleshooting easier.

Modes of Connection

Ethernet

- For communication over a wired network.
- Uses a Media Access Control (MAC) address.
- Uses error checking.
- Devices check that no other device is communicating over the link before sending.

WiFi

- Wireless connection which uses radio waves to transmit data through the air.
- Uses an SSID to identify the network.
- Uses WPA2 or WEP to encrypt and secure data.
- Unsecured traffic can be intercepted easily.

Bluetooth

- Wireless connection which uses radio waves to transmit data through the air.
- Much shorter range than Wi-Fi
- Usually used for a direct connection between two devices.
- Bluetooth headphones, mice and keyboards are very common.
- It is possible to send files using Bluetooth but this is slow.

Types Of Network

LAN (Local Area Network)

- Covers a small geographical area
- Usually contained within one building
- Equipment is owned by the organisation
- Lower setup costs
- Faster speeds
- More control over security

WAN (Wide Area Network)

- Covers a large geographical area
- Connects buildings, towns or cities together
- Equipment is owned by a telecommunications company
- Higher setup costs
- Lower Speeds
- Less control over security

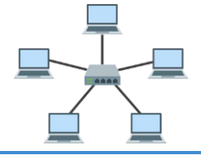
Client-Server Networks

- All devices are connected to a server.
- The server stores user account details.
- Clients access services from servers.
- Servers receive and processes requests from clients.
- File servers, web servers, database servers etc. all provide different services
- If the server fails, clients will be unable to operate.
- They are more involved to setup.

Peer to Peer Networks

- All devices have equal status.
- There is no central server, making them relatively easy to maintain.
- If one device fails only the information stored on that device will be inaccessible but the network will still operate.
- They are relatively easy to set up.
- There is no central control, making security and administration harder.

Star Network



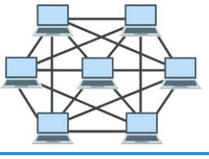
Advantages

- If a single link breaks the network still stays active.
- If one connection fails it does not affect the rest of the network.
- Easy to add additional devices onto the network.
- Fast because each device has its own connection to the switch / server.
- There are few data collisions.

Disadvantages

- Dependent on one central device.
- If the central device fails, the whole network fails.
- The performance of the network is dependent upon the central device.
- The number of devices is restricted by the central device.

Mesh Network



Advantages

- If a link breaks another route is available.
- The fastest route can be chosen.
- Can be quite cheap if wireless.

Disadvantages

- Expensive if wired.
- More complicated to maintain
- Set-up and maintenance can be costly0