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Section 2 - Communication
2.1 - Networking (Part 1)

The Key Terms:

- ARPAnet: Advanced Research Projects Agency Network
 - WAN: Wide Area Network
 - LAN: Local Area Network
 - MAN: Metropolitan Area Network
 - File Server: a server on a network where central files and other data are stored. They can be accessed by a user logged onto the network
 - Hub: hardware used to connect together a number of devices to form a LAN that directs incoming data packets to all devices on the network
 - Switch: hardware used to connect together a number of devices to form a LAN that directs incoming data packets to a specific destination address only
 - Router: device which enables data packets to be routed between different networks
 - Modem: stands for modulator demodulator. A device that converts digital data to analogue data and vice versa
 - WLAN: wireless LAN
 - WAP: wireless access point which allows a device to access a LAN without a wired connection
 - PAN: network that is centered around a person or their workspace
 - Client-server: network that uses separate dedicated server and specific client workstations. All client computers are connected to the dedicated servers
 - Spread Spectrum Technology: wideband radio frequency with a range of 30 to 50 metres
 - Node: device connected to a network
 - Peer-to-peer: network in which each node can share its files with all other nodes. Each node has its own data and there is no central server
 - Thin Client: device that needs access to the internet for it to work and depends on a more powerful computer for processing
 - Thick Client: device which can work both offline and online and is able to do some processing even if not connected to a network
 - Bus Network Topology: network using single central cable in which all devices are connected to this cable so data can travel in one direction and only one device is allowed to transmit at a time
 - Packet: data sent over a network from node to node
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The Key Terms:

- Star Network Topology: a network that uses a central hub/switch with all devices connected to this central hub/switch so all data packets are directed through this central hub/switch
- Mesh Network Topology: interlinked computers which use routing logic so data packets are sent from sending stations to receiving stations only by the shortest route
- Hybrid Network: network made up of a combination of other network topologies
- Cloud Storage: method of data storage where data is stored on off-site servers
- Data Redundancy: situation in which the same data is stored on several servers in case of maintenance or repair
- Wi-Fi: wireless connectivity that uses radio waves in the 2,45 GHz frequency band
- Bluetooth: wireless connectivity that uses radio waves and microwaves
- Spread Spectrum Frequency Hopping: a method of transmitting radio signals in which a device picks one of 79 channels at random. Has a range upto 100 metres
- WPAN: wireless personal area network. A local wireless network which connects together devices in very close proximity.
- Twisted Pair Cable: type of cable in which two wires of a single circuit are twisted together. Several twisted pairs make up a single cable
- Coaxial Cable: cable made up of central copper core, insulation, copper mesh and outer insulation
- Fibre Optic Cable: cable made up of glass fibre wires which use pulses of light to transmit data
- Gateway: device that connects LANs which use different protocols
- Repeater: device used to boost a signal on both wired and wireless networks
- Repeating Hubs: network devices which are hybrid of hub and repeater unit
- Bridge: device that connects LANs which use the same protocols
- Softmodem: abbreviation for software modem; a software based modem that uses minimal hardware
- NIC: network interface card. These cards allow devices to connect to a network
- WNIC: wireless network interface cards
- Ethernet: protocol IEEE 802.3 used by many wired LANs
- Conflict: situation in which two devices have the same IP address
- Broadcast: communication where pieces of data are sent from sender to receiver

The Key Terms:

- **Collision:** situation in which two messages from different sources are trying to transmit along the same data channel
- **CSMA/CD:** carrier sense multiple access with collision detection - a method used to detect collisions and resolve the issue
- **Bit Streaming:** contiguous sequence of digital bits sent over a network/internet
- **Buffering:** store which holds data temporarily
- **Bit Rate:** number of bits per second that can be transmitted over a network
- **On Demand (Bit Streaming):** system that allows users to stream video or music files from a central server as and when required without having to save the files on their own computer
- **Real-Time (Bit Streaming):** system in which an event is captured by camera connected to a computer and sent to a server where the data is encoded. The user can access the data as it happens live

Networking Devices:

ARPAnet - Advanced Research Projects Agency Network

What is the ARPAnet?

It was an early form of packet switching wide area network (WAN), which connected a number of large computers. It later expanded to include university computers

LAN - Local Area Network

What is a LAN?

It is a small network that connects a number of computers and shared devices, such as printers

What is a WAN?

WANs consist of a number of LANs connected via public communications networks

- Because a WAN consists of LANs joined together, it may be a private network

How does the Internet work?

The internet has a vast number of decentralised networks and computers which have a common point of access, so that anyone with access to the internet can connect to computers on these networks

Metropolitan Area Network:

- MANs are larger than LANs as they can connect many small computer networks together housed in different buildings within a city

Wide Area Network:

- WANs can cover a much larger geographical area, such as a country or a continent

Using Networking Computers:

Benefits	Drawbacks
Devices, such as printers, can be shared	Cabling and server can be an expensive initial outlay
Licenses to run software on networks are cheaper	Managing a large network is complex and difficult
Users can share files and data	A breakdown of devices can affect the whole network
Users can communicate using email and instant messaging	Malware and hacking can affect entire networks

Networked Computers:

Hardware	Software	Services
LAN Cards	Operation and Management of Network	Satellite Communication Channels
Routers and Switches	Operation of Firewalls	Wireless Protocols
Cabling	Security Applications	IP Addressing

Private vs Public Networks:

- *Private Networks:* they are owned by a single company. The companies are responsible for:
 - Purchase of their own equipment and software
 - Maintenance of the network
 - Hiring and Training of staff
- *Public Networks:* Owned by a communications carrier company
 - Many organisations use the network
 - No specific password requirements to enter the network
 - Sub-networks under security management

WANs and LANs:

- *LANs:* usually contained within one building. A typical LAN consists of computers connected to hubs/switches
 - One of the hubs/switches is connected to a router/modem to allow the LAN to connect to the internet/WAN
- *WLANs:* similar to LANs but no wires/cables. They provide wireless network communications over short distances using radio/infrared signals
- *WAPs:* connects into a wired network at fixed locations. Due to the limited range, most commercial LANs need WAPs to permit uninterrupted wireless communications.
 - They use spread spectrum technology or infrared
 - They receive and transmit data between the WLAN and the wired network structure

Wide Area Networks (WANs):

They are used when computers or networks are situated a long distance from each other

- If a number of LANs are joined together using a router, they form a WAN

Note: The network of ATMs used by banks is an example of a WAN

What do WANs make use of due to long distances between devices?

- They make use of a public communications network
- They can use dedicated or leased communication lines which are less expensive and more secure

What does a WAN consist of?

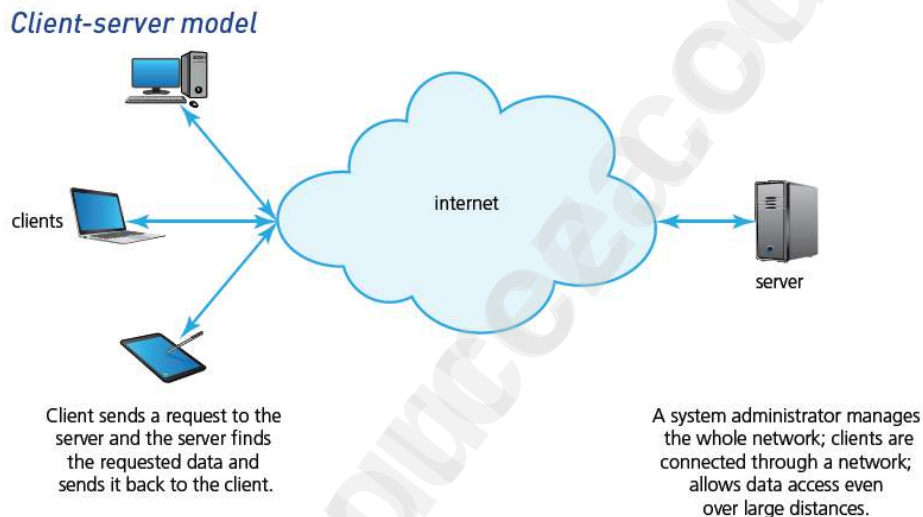
It consists of end systems and intermediate systems.

Determining the size of a network:

- WAN - 100 km to 1000 km
 - MAN - 1 km to 100 km
 - LAN - 10 m to 1000 m
 - PAN - 1 m to 10 m
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Client-Server and Peer-to-Peer Networking Models:

Client-Server Model:



- The client-server model uses dedicated servers and specific client workstations (client computers are connected to the server computer)
 - Users are able to access most of the files stored on dedicated servers
 - The server dictates which users are able to access which files
 - The client-server model allows the installation of software on a client's computer
 - The model uses central security databases which control access to shared resources
 - Once a user is logged into the system, they have access to only those resources, and the files assigned to them by the network administrator (this offers greater security than peer-to-peer networks)
 - Client server networks can be made as large as the user wants and are much easier to scale up than peer-to-peer networks
 - A central server looks after the storing, delivery and sending of emails
 - This model offers the most stable system
 - Client-server networks can become bottlenecked if there are many client requests at the same time
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In a client-server model, a file server is used and responsible for:

- Central storage and management of multimedia files
 - Allows users to share information without needing offline devices
 - Allowing any computer to be configured as the host machine and act as file server
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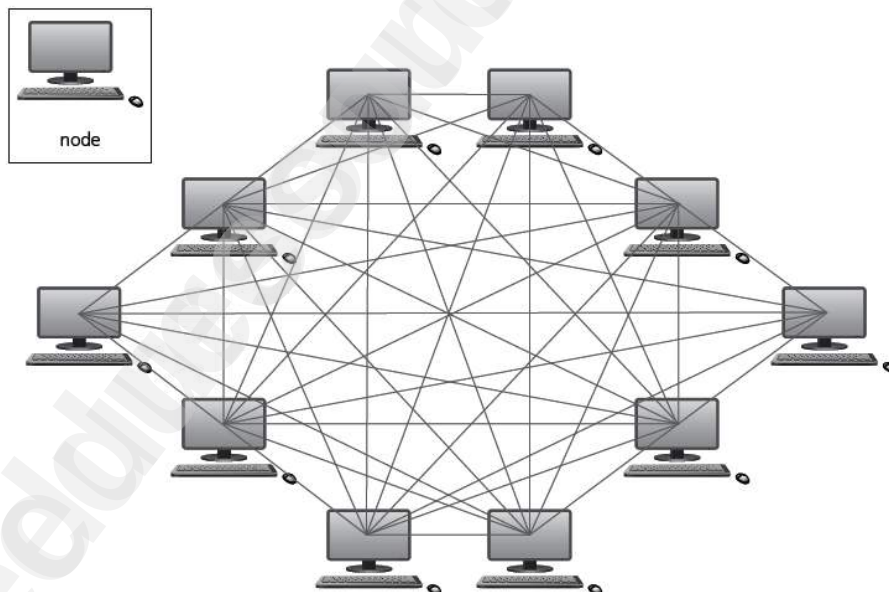
Examples of use of client-server network model:

A company would use a client-server network because:

- The company has a large user-base
- Access to network resources that needs to be controlled
- The need for good network security
- Requires data to be free from accidental loss

Note: Amazon uses a client-server network model. Its customers don't know that other customer are using the website at the same time

Peer-to-Peer Model:



On a peer-to-peer network, each node joins the network to allow:

- The provision of services to all other network users
 - Other users on the network can simply access data from another node
 - Communication with other peers connected to the network
 - Peers to be both suppliers and consumers
 - Peers to participate as equals on the network
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Note: a node is simply a computer

What does the peer-to-peer model not have?

The peer-to-peer model does not have a central server. Each of the nodes on the network can share its files with all the other nodes

- Because there is no central storage, there is no need to authenticate users

Note: This model is used in scenarios where it can be easy for users to be in contact with each other. More than 10 nodes leads to performance and management issues

Disadvantages of peer-to-peer model:

Offers little data security, making it impossible to know who is authorised to share data

Examples of peer-to-peer network model:

A user would choose the peer-to-peer network model because:

- The network of users is small
 - No need for robust security
 - Require workstation-based application rather than server-based
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Thin Clients and Thick Clients:

Thin Client:

- Heavily dependent on having access to a server that:
 - Allows constant access to files
 - Allows applications to run uninterrupted
- It can be either a device or software that needs to connect to a powerful server to allow processing to take place
- Will not work unless it is connected at all times to the server

Examples of thin client:

- A web browser can have limited functions unless it connects to a server
- Mobile phone apps need constant access to a server to work
- POS terminal at a supermarket needs constant access to a server for pricing

Thick Client:

- Can be either a device or software that can work offline or online
 - Can be connected to a LAN/MAN/WAN, virtual network or the internet
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Examples of thick client:

- A laptop since it has its own storage and OS, making it capable of operating online or offline
- A computer game that can run independently on a computer, but can also connect to an online server

	Pros	Cons
Thick Clients	• More robust • Clients have more control	• Less secure • Each client needs to update data and software individually • Data integrity issues
Thin Clients	• Less expensive to expand • All devices are linked to a server • Server can offer protection against hacking and malware	• High reliance on server (if server goes down, then the device can't work) • Despite cheaper hardware, the start-up cost is higher

The difference between thick and thin client server:

Thin Client Software	Thick Client Software
Always relies on a connect to a server to work	Can run some of the features of the software even when not connected to a server
Requires very few local resources	Relies heavily on local resources
Relies on a good, stable and fast network connection for it to work	More tolerant as a slow network connection
Data is stored on a remote server	Can store data on local resources (HDD/SSD)
