

Tiverton High School Year 11

J277 GCSE Computer Science

Knowledge Organiser / Recap

Part 4: Networks

Unit 1.3.1 Types of Networks

A **stand-alone** computer is a computer that is not connected to any other computer or device. Stand-alone means a device is not networked. All resources and data that a standalone computer uses are **local** (directly connected).

A **network** is a **collection** of two or more computer devices that are **connected** together. Networked devices can share resources, programs and data e.g. **printers, databases of information, collections of documents**. A networked device can access resources **remotely** using one or more communication links.

A **Local Area Network (LAN)** covers **one single site** (which may include a small number of buildings that are close together). The distances between devices in a LAN are usually quite small. Devices are often very close together, in the same room or building.

A **Wide Area Network (WAN)** covers a much larger physical area than a LAN. A Wide Area Network can **link devices together over long distances**. Devices may be many miles apart on different physical sites. A WAN can cover a whole city, a county, a country or many countries. A WAN may use **leased** or **public communication links**. **Supermarkets, banks, County Councils, the police and the NHS** all have their own Wide Area Networks.

A **Peer-To-Peer network** is a very small and simple network. It is usually used in a home or by a small business. In a Peer-to-Peer network, **no single device is in control of the network**. They are all equally important. Peer-to-peer networks are ideal for simple sharing, such as sharing files between devices or sharing a printer. Peer-to-Peer networks often use **Wi-Fi** connections or direct **Bluetooth** connections between devices. They are simple to set up.

Some networks are **Client-Server networks**. This means that some devices on the network provide important services or resources to other devices.

A **server** is a networked device that provides a service or resource when **requested** by another device (usually a **client** device). A server may **control access to a resource**. It may refuse permission to certain devices that ask for access.

A **client** is a networked device that **requests** to use **services** or **resources** from one or more **servers** on a network.

Unit 1.3.1 Network Hardware

Network Interface Controller (NIC) This is computer **circuitry** that allows the device to **transmit and receive data from other networked devices**. It is installed in a computer device so that the device can be connected to a network. It may be built directly into a motherboard, or can be a separate circuit-board that plugs into an expansion slot..



Hub A **hub** is a device that **passes data to all devices on a network**, even those that the data is not intended for. This leads to a lot of unwanted data traffic on the network and slow performance.

Switch A **switch** is a device that **passes data to the one device on a network that the data is intended to reach**. A switch results in less network traffic than using a hub, so it results in faster network performance.



Wi-Fi access point A **Wi-Fi access point** can be used to connect devices to a Local Area Network **without cables**. You can connect smartphones, tablets, laptops and desktop computers. Wi-fi radio signals can usually travel through walls and floors, but not thick concrete. They are slower than transmitting data over cables.



Router A **router** is a device that allows you to **join networks to other networks, allowing data packets to pass between them**. A router **examines the address of each data packet to determine where it should be sent next**.

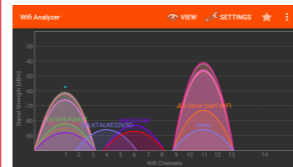
Unit 1.3.1 Factors that affect the performance of a network

Distance between devices. The further away devices are from each other, the longer it may take for data to be transmitted between them. Electrical data signals travelling over a copper cable weaken over long distances.

Number of devices trying to use the network. If many devices attempt to use a network resource (such as a server or a particular file) then the network might experience delays. A server may not be able to cope with the demands placed upon it, causing "time out" errors and retries.

Bandwidth available. If the amount of data being sent by one or more devices uses up all of the available bandwidth, other devices will not be able to transmit their data. Without enough bandwidth, the network may be slow because devices are kept waiting to communicate.

Radio interference, obstacles, physical problems. Radio signals from other devices may interfere with data being transmitted. If more than one Wi-Fi access point is **transmitting using the same range of frequencies ("channel")** then their data transmissions may be **corrupted**, meaning they might need to repeat their transmission many times.



Trees, thick concrete structures or steel can **block** wireless signals, leading to poor network performance. Devices may need to transmit their data repeatedly until it is successfully received, or they may lose a critical connection altogether.

Communication links may become damaged or broken, meaning that data cannot be transmitted using the most efficient route, or perhaps cannot be transmitted at all.

Reliability of hardware and software components. An essential service may **fail** or "**fall over**", meaning that other parts of the network cannot operate normally. This could be due to a program crash, causing delays while the program is fixed or restarted. It could also be due to a failed hardware component, such as a broken hard-disk drive or a network card. In some organisations, the computer network is "**mission critical**", meaning that the organisation cannot operate without it.

Unit 1.3.1 Transmission Media

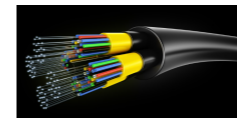
Connections can be made between devices using different kinds of transmission medium:

Copper cables e.g. **twisted pair ethernet cables** or thicker shielded **coaxial cables**.



Data is transmitted over copper cables using **electricity**. Copper cables allow relatively fast transmission but can be affected by other cables nearby, by **electrical interference** or **lightning strikes**. Copper cables can make it very easy to connect new devices and are very cheap. They can only be used over relatively short distances as the transmitted data signals weaken with distance e.g. up to 100m.

Fibre-optic cables



High-speed, high-capacity bundles of **glass fibre** that carry data as **light**, rather than electricity. Fibre-optic cables are expensive and technical to install, but can be used reliably over very long distances, such as connecting different countries together under the sea. They are often used as a backbone connection as part of the infrastructure of a network or the internet. Fibre-optic allows **extremely fast data transmission** and many people can share the use of the same cable due to its massive bandwidth. To connect the UK and USA, only approximately 25 cables are needed under the Atlantic Ocean for all of the internet traffic between the two countries.

Wi-Fi links



Data is sent and received using **radio signals** rather than using any cables. Wi-Fi is ideal for situations where it is difficult to install cables, such as in old buildings, and many devices can be configured to use a single **Wireless Access Point** device. Wi-Fi transmission is **slower** than using copper cables or fibre-optic. Wi-Fi data packets also need to be **encrypted** to protect them from **interception** by others.

Micro-wave links



These are slow radio links that allow data to travel over **long distances** e.g. to and from satellites in space. Micro-waves are useful where it would be very difficult to install a cable e.g. for a moving ship at sea. Micro-wave receiver dishes usually need to be lined up precisely to focus and receive data signals. Micro-wave transmitters and receivers are relatively expensive, but they can be used **anywhere on Earth**.

Bluetooth



Bluetooth is a particular kind of **very high-frequency radio link** that allows data to be exchanged between personal devices. It is relatively slow, but can be used for **wireless keyboards and mice, headphones** and **smartphone-to-computer file transfers**. Bluetooth devices are often **paired** together, exchanging setup information to make communication more secure and to stop unauthorised transfers.