

## Networks — LANs and WANs

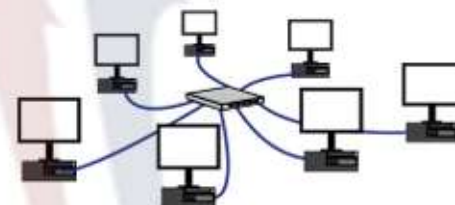
When you connect a device to another one, you're creating a network — networks allow devices to share information and resources. Here we'll look at the two types of network you'll need to know for your exam.

### A LAN is a Local Area Network

- 1) A LAN covers a small geographical area located on a single site.
- 2) All the hardware for a LAN is owned by the organisation that uses it.
- 3) LANs are either wired (e.g. with Ethernet cables) or wireless (e.g. using Wi-Fi®).
- 4) You'll often find LANs in businesses, schools and universities.
- 5) Lots of homes have a LAN to connect various devices, such as PCs, tablets, smart TVs and printers.

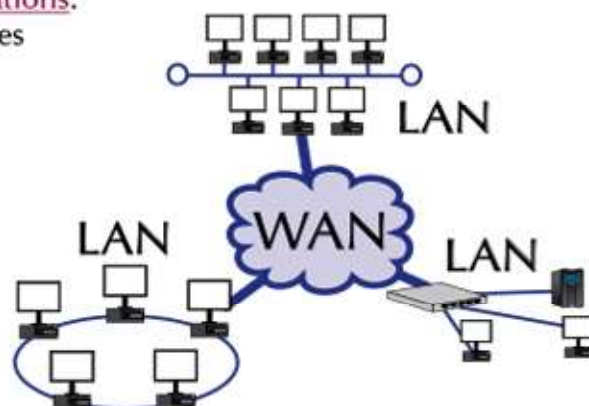
#### Why Use A LAN?

- Sharing files is easier — network users can access the same files, work collaboratively on them (at the same time) and copy files between machines.
- You can share the same hardware (like printers) on a LAN.
- The Internet connection can be shared between every device connected to the LAN.
- You can install and update software on all computers at once, rather than one-by-one.
- You can communicate with LAN users cheaply and easily, e.g. with instant messaging.
- User accounts can be stored centrally, so users can log in from any device on the network.



### A WAN is a network that Connects LANs

- 1) WAN stands for Wide Area Network.
- 2) A WAN connects LANs that are in different geographical locations. For example, a business with offices in three different countries would need a WAN for all their devices to connect together.
- 3) Unlike a LAN, organisations hire infrastructure (e.g. communication lines) from telecommunications companies, who own and manage the WAN. This is because a WAN is much more expensive to set up than a LAN.
- 4) WANs may be connected using fibre or copper telephone lines, satellite links or radio links.
- 5) The Internet is actually one big WAN (see p.43).



**Don't LANguish at the bottom of the class — learn this page...**

Make sure you're absolutely clear about the differences between LANs and WANs before moving on. Remember, companies use their own cables for LANs but for WANs they almost always hire lines.



# Networks — Hardware

Connecting devices doesn't magically happen. To create a network, you need certain pieces of hardware...

## NICs, Switches and Routers

- 1) A Network Interface Controller (NIC) is an internal piece of hardware that allows a device to connect to a network. These used to be on separate cards, but nowadays they're built into the motherboard. NICs exist for both wired and wireless connections.
- 2) Switches connect devices on a LAN. Switches receive data (in units called frames) from one device and transmit this data to the device on the network with the correct MAC address (see p.41).
- 3) Routers are responsible for transmitting data between networks — they're always connected to at least two different networks.
- 4) Routers have a crucial role on the Internet, directing data (in units called packets) to their destination.
- 5) Routers are used in homes and offices to connect the LAN to the Internet.

A typical switch with lots of Ethernet ports



A typical office router.

Ethernet port connects to LAN



ADSL port connects to the Internet

Most home 'routers' are in fact a router, switch and WAP (see p.36) all-in-one.

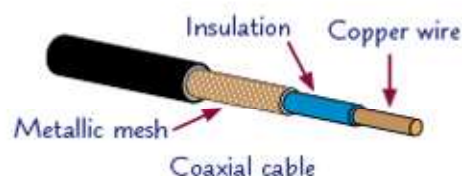
## Wired Ethernet Connections are Fast and Reliable

- 1) Ethernet (wired) networks can use different types of Ethernet cables to connect devices on a LAN.
- 2) The most common Ethernet cables are CAT 5e and CAT 6. They are 'twisted pair' cables, containing four pairs of copper wires which are twisted together to reduce internal interference.
- 3) Coaxial cables are made of a single copper wire surrounded by a plastic layer for insulation and a metallic mesh which provides shielding from outside interference.
- 4) Fibre optic cables transmit data as light. They are high performance (and therefore expensive) cables — they don't suffer interference and can transmit over very large distances without loss of signal quality.



Twisted pair of copper wires

CAT 6 cable



Coaxial cable



Fibre optic cable

## Hardware — nothing to do with concrete jackets...

Make sure you understand how switches and routers are different — it might take a while to click.



# Wireless Networks

If you don't like the sound of all those cables, don't worry — you can throw them all away and use wireless networking instead. You'll still have to learn about both of them for the exam though, I'm afraid.

## Wireless uses Radio Waves to transmit data

- 1) Like mobile phones and TVs, wireless networks use **radio waves** to transmit data.
- 2) Wireless networks are more **convenient** than wired networks as you can **move around** while still being **connected** — they are also **cheaper** as you need **fewer wires**.
- 3) **Bluetooth®** and **Wi-Fi®** are two common wireless technologies:

### Bluetooth®

- Usually a **direct connection** between **two** devices so that data can be **shared**.
- Connection **range** varies, but mobile devices are typically **10 metres**.
- **Low bandwidth** (see below) compared to **Wi-Fi®**.
- Often used in **mobile/wearable devices** — smartphones/watches, headphones, etc.

### Wi-Fi®

- Can be used by **multiple devices** to connect to a **LAN** at the **same time**.
- Connections have a **range** between **40** and **100 metres**.
- **High bandwidth** compared to **Bluetooth®**.
- Often used in the home — **routers, desktops, laptops, smartphones**, etc.

- 4) To set up a Wi-Fi® network, you need a **Wireless Access Point (WAP)** device. The WAP is basically a **switch** that allows devices to connect wirelessly.
- 5) To connect, devices need a **wireless NIC**. This is often built in, but if not you can use a **dongle**.
  - **USB dongles** can be plugged into computers to allow them to connect wirelessly to the Internet.
  - **HDMI dongles** can use wireless networks to stream high-quality video to a TV.



## Many Factors can affect the Performance of Networks

- 1) **Bandwidth** is the **amount of data** that can be transferred in a **given time**, e.g. 500 Mbps. The greater the bandwidth, the better the network can perform.
- 2) Available **bandwidth** is **shared** between the devices on a network — **too many** devices or **heavy use** (e.g. streaming video) may cause congestion and slow the network. You can **limit** the bandwidth available to individual users to address this.
- 3) **Wired** connections are generally **faster** and **more reliable** than wireless. **Fibre optic cables** can give much better performance than **copper cables** (see p.35).
- 4) **Wireless** performance depends on **signal quality** so is affected by the **range** of the device, the amount of **interference** from other wireless networks and **physical obstructions** like thick walls in buildings.
- 5) Choice of **hardware** other than cables (see p.35) and network **topology** (see p.38) also have a big effect.

Mbps stands for megabits per second, a measure of bandwidth.

## Remember, Wi-Fi® is a separate thing from the Internet...

Wi-Fi® allows a device to wirelessly connect to a network with a WAP — that network would then need to be connected to a router in order for the device to be able to access the Internet.

