

## Chapter 2: Communication

### **2.1 Networks including the internet**

# Lesson Objectives

- Show understanding of the purpose and benefits of networking devices
- Show understanding of the characteristics of a LAN (local area network) and a WAN (wide area network)
- Explain the client-server and peer-to-peer models of networked computers
- Show understanding of thin-client and thick-client and the differences between them
- Show understanding of the bus, star, mesh and hybrid topologies
- Show understanding of cloud computing
- Show understanding of the differences between and implications of the use of wireless and wired networks
- Describe the hardware that is used to support a LAN
- Describe the role and function of a router in a network
- Show understanding of Ethernet and how collisions are detected and avoided
- Show understanding of bit streaming
- Show understanding of the differences between the World Wide Web (WWW) and the internet
- Describe the hardware that is used to support the internet
- Explain the use of IP addresses in the transmission of data over the internet
- Explain how a Uniform Resource Locator (URL) is used to locate a resource on the World Wide Web (WWW) and the role of the Domain Name Service (DNS)

# Kev Terms



## KEY TERMS

**Wide area network (WAN):** a network connecting computers on different sites, possibly thousands of kilometres apart

**Local area network (LAN):** a network connecting computers in a single room, in a single building or on a single site



## KEY TERMS

**Client-server:** an architecture where a client runs an application provided by a server on a network

**Thin-client:** a client that only provides input and receives output from the application



## KEY TERM

**Thick-client:** a client that carries out at least some of the processing itself

# Key Terms



## KEY TERMS

**Topology:** the configuration of a network that defines how the various devices on the network are connected

**Bus topology:** contains one shared link to which all devices are attached

**End-system:** a computer or server connected to a network

**Mesh topology:** contains direct links between devices



## KEY TERM

**Star topology:** each end-system is linked to a central device



## KEY TERMS

**Hybrid network:** a collection of connected LANs where some of them have different topologies or supporting technologies

**Cable:** a transmission using copper wire or fibre-optic

**Bandwidth:** a measure of the amount of data that can be transmitted per second

# Kev Terms



## KEY TERM

**Wireless:** a transmission using radio, microwave or infrared



## KEY TERMS

**Server:** a system providing a service to end-systems

**Repeater:** a device that connects two cables and provides a full-strength signal to the second cable

**Bridge:** a device that connects two segments of a LAN

**Network Interface Card (NIC):** a component used to identify the end-system

**Switch:** a connecting device that can send a unicast message

**Wireless Access Point (WAP):** the connecting device in a WiFi LAN

**Wireless Network Interface Card (WNIC):** provides the NIC function in a WiFi LAN



## KEY TERM

**Router:** a device that acts as a node on the Internet

# Key Terms



## KEY TERMS

**Private cloud:** owned by and only accessed by an organisation

**Public cloud:** owned by a cloud service provider for general access



## KEY TERMS

**On-demand:** when the bit stream content is transmitted at a time chosen by the user

**Real-time:** when the bit stream content is transmitted as it is produced

**Bit rate:** the number of bits transmitted per second



## KEY TERM

**IPv4 address:** a 32-bit long, hierarchical address of a device on the Internet



## KEY TERM

**Domain name service (DNS):** a hierarchical distributed database installed on domain name servers that is responsible for mapping a domain name to an IP address. Also known as domain name system.

# Resources:

Computer Science for Cambridge International AS & A Level

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**Description**

**Supports the full syllabus for examination from 2021.**

This coursebook provides a structured and progressive guide to the theoretical and practical skills required by the syllabus. It builds learners' confidence in using a range of technology and programming languages. Concepts are reinforced with exercises, discussion points and reflection tasks, as well as exam-style and past paper questions.

An accompanying teacher's resource is also available and provides chapter by chapter support, lesson plans and answers. Printable worksheets provide differentiation and ready-made lesson materials.

**Further information and sample material for this coursebook**

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# Key Terms

## Network types and topologies

A network is a number of computers linked together to allow the sharing of resources. A server usually provides services like file storage and email.

### LANs and WANs

There are two main types of network:

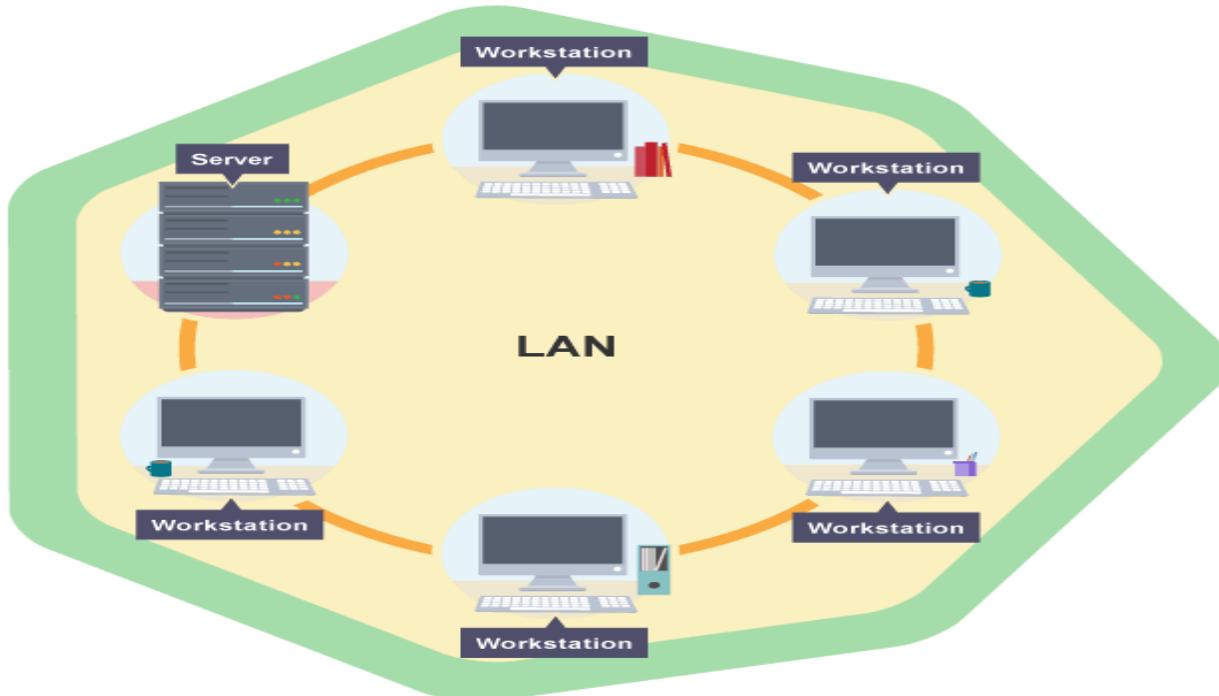
Local Area Network (LAN)

Wide Area Network (WAN)

# Network types and topologies

## **Local Area Network (LAN):**

A LAN covers a small area such as one site or building, example: a school or a college.



**A star network, where devices are connected to a central hub or switch**

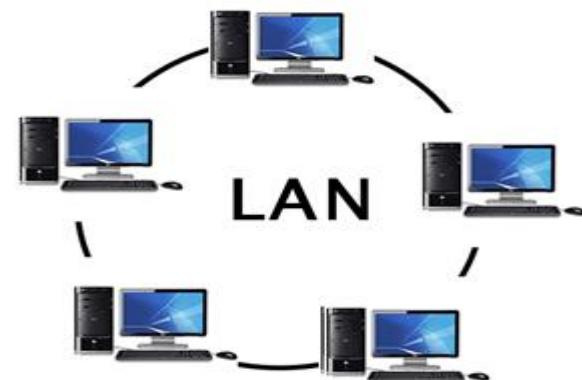
## Network types: LAN (Local Area Network)

**Local Area Network** is a group of computers connected to each other in a small area such as building, office.

**LAN** is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.

It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.

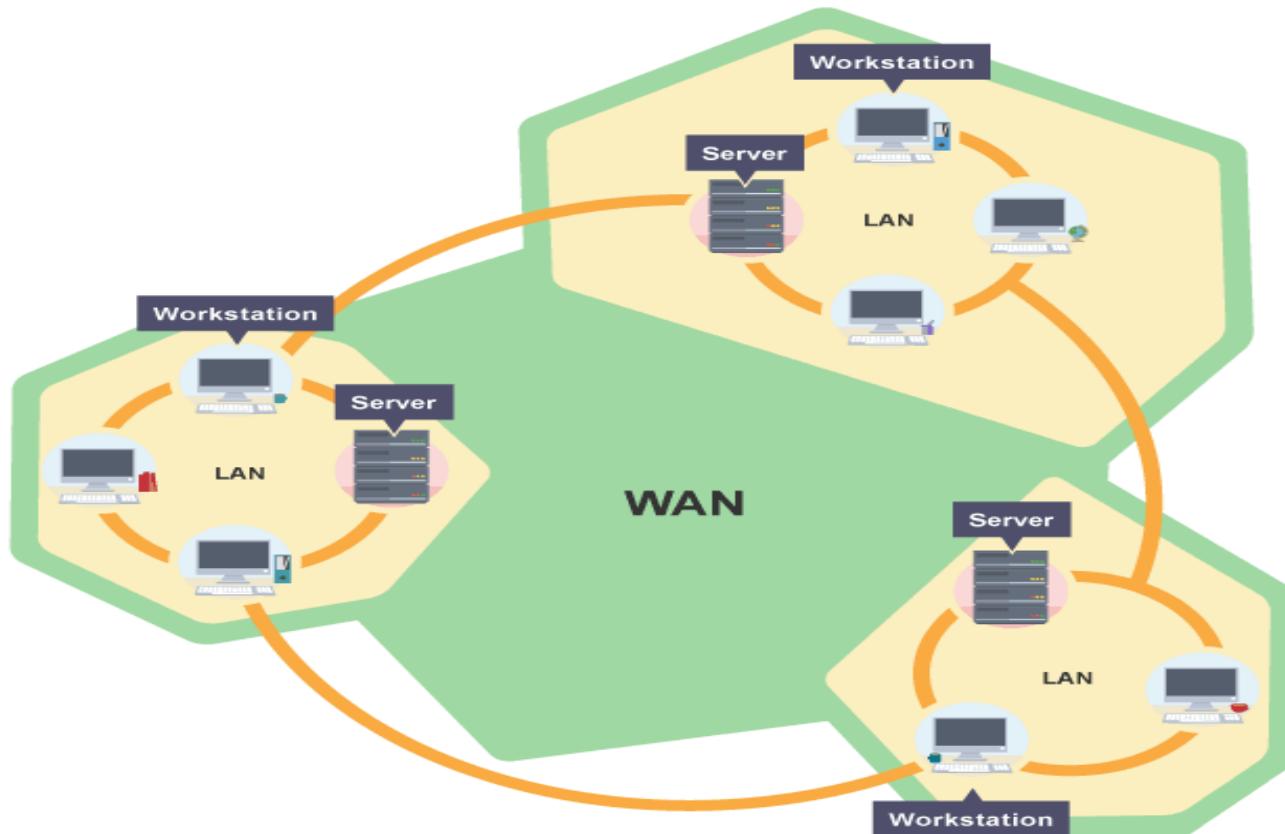
The data is transferred at an extremely faster rate in Local Area Network.  
Local Area Network provides higher security.



## Network types and topologies

### Wide Area Network (WAN):

A WAN covers a large geographical area. Most WANs are made from several LANs connected together.



## Network types and topologies

### Wide Area Network (WAN):

### Advantages and disadvantages of networks

#### Advantages:

Sharing devices such as printers saves money.

Site (**software**) licenses are likely to be cheaper than buying several standalone licenses.

Files can easily be shared between users.

**Network** users can communicate by **email** and **instant messenger**.

Security is good - users cannot see other users' files unlike on stand-alone machines.

Data is easy to **backup** as all the **data** is stored on the **file server**.

## Network types and topologies

### Wide Area Network (WAN):

#### Advantages and disadvantages of networks

##### Disadvantages:

Purchasing the network cabling and file servers can be expensive. Managing a large network is complicated, requires training and a network manager usually needs to be employed.

If the file server breaks down the files on the file server become inaccessible. Email might still work if it is on a separate server. The computers can still be used but are isolated.

**Viruses** can spread to other computers throughout a computer network.

There is a danger of **hacking**, particularly with wide area networks. Security procedures are needed to prevent such abuse, eg a **firewall**.

## Network types and topologies

The **internet** is a **WAN**.

A network of bank cash dispensers is a **WAN**.

A school network is usually a **LAN**.

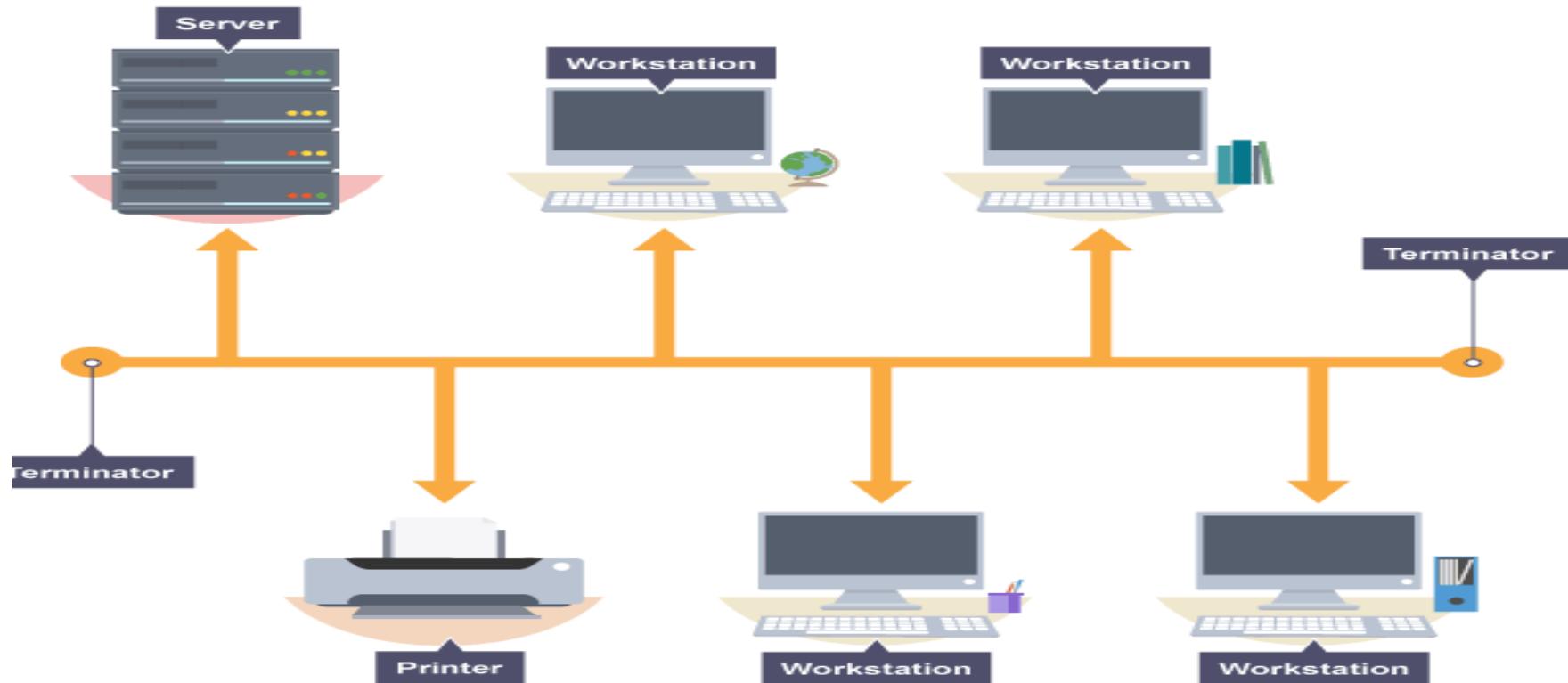
LANs are often connected to WANs, for example a school network could be connected to the internet.

WANs can be connected together using the internet, leased lines or satellite links.

## Network types and topologies

### The bus network

In a bus network all the **workstations**, **servers** and printers are joined to one cable (the bus). At each end of the cable a **terminator** is fitted to stop signals reflecting back down the bus.



## Network types and topologies

### The bus network

#### Advantages and disadvantages of a bus network

**The advantages of a bus network are:**

it is easy to install

it is cheap to install, as it doesn't require much cable

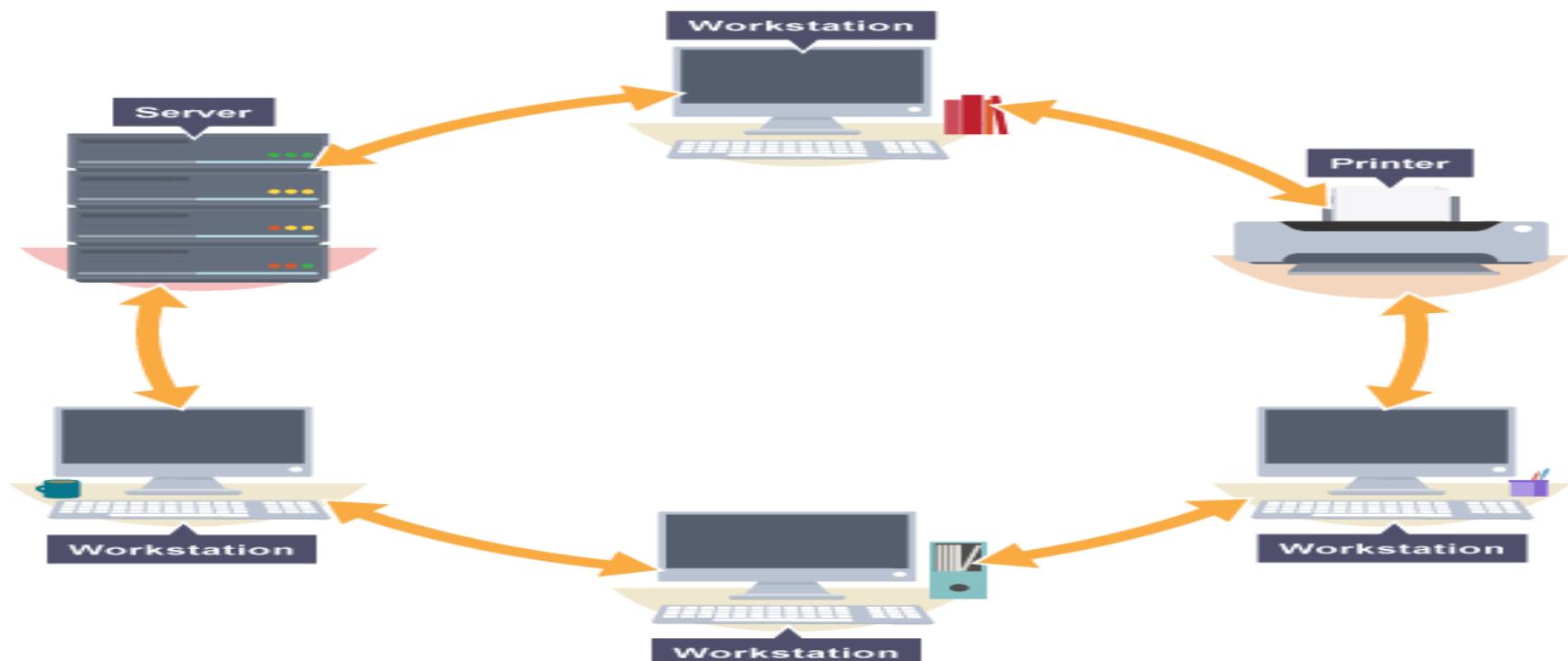
**The disadvantages of a bus network are:**

If the main cable fails or gets damaged the whole network will fail as more workstation connected the performance of the network will become slower because of data collisions every workstation on the network "sees" all of the data on the network – this is a security risk.

## Network types and topologies

### The ring network

In a ring network each device (**workstation**, **server**, printer) is connected to two other devices - this forms a ring for the signals to travel around. Each packet of **data** on the network travels in one direction and each device receives each packet in turn until the destination device receives it



## Network types and topologies

### The ring network

#### Advantages and disadvantages of a ring network

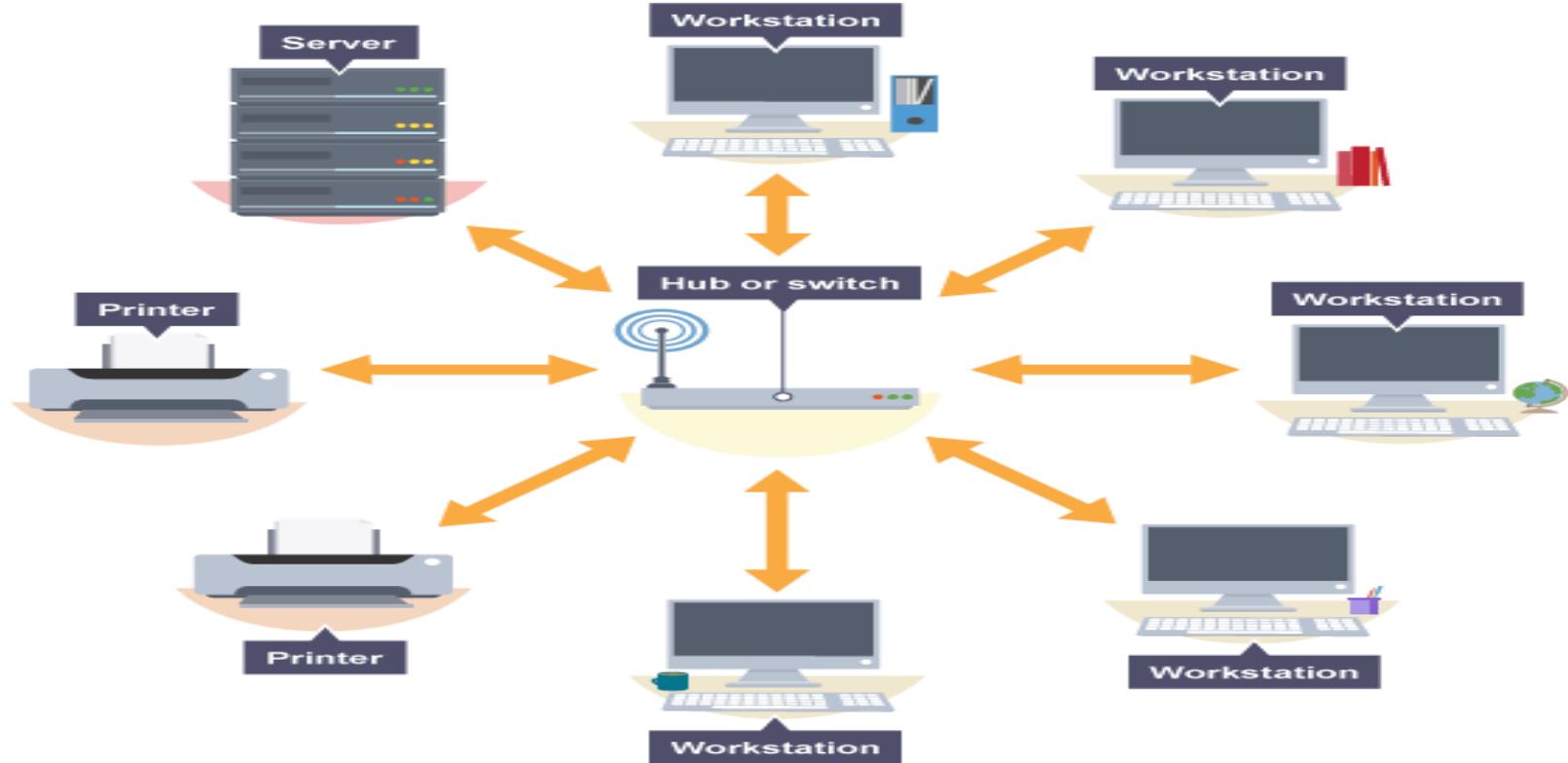
This type of network can transfer data quickly, even if there are a large number of devices connected because the data only flows in one direction, so there won't be any data collisions.

However, the real **disadvantage** is that if the main cable fails or any device is faulty, then the whole network will fail.

## Network types and topologies

### The star network

In a star network each device on the network has its own cable that connects to a **switch** or hub. A **hub** sends every packet of **data** to every device, whereas a switch only sends a packet of data to the destination device.



## Network types and topologies

### The star network

#### Advantages and disadvantages of a star network

**The advantages of a star network are:**

It is very reliable – if one cable or device fails then all the others will continue to work

It is high-performing as no data collisions can occur

**The disadvantages of a star network are:**

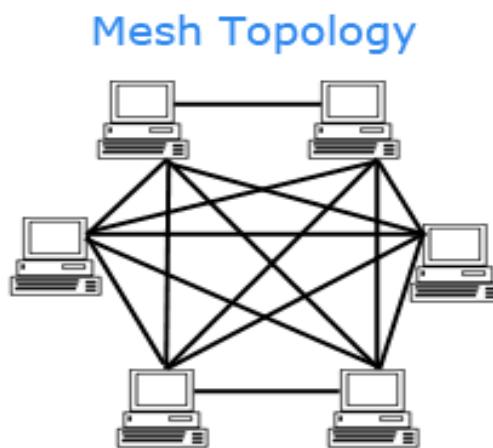
It is expensive to install as this type of network uses the most cable (network cable is expensive)

Extra hardware is required (hubs or switches) which adds to cost

If a hub or switch fails, all the devices connected to it will have no network connection

## Network topologies: Mesh Topology

A mesh topology is a network setup where each computer and network device is interconnected with one another. This topology setup allows for most transmissions to be distributed even if one of the connections goes down. It is a topology commonly used for [wireless networks](#). Below is a visual example of a simple computer setup on a network using a **mesh topology**.



## Network topologies: Mesh Topology

### **Advantages of a mesh topology**

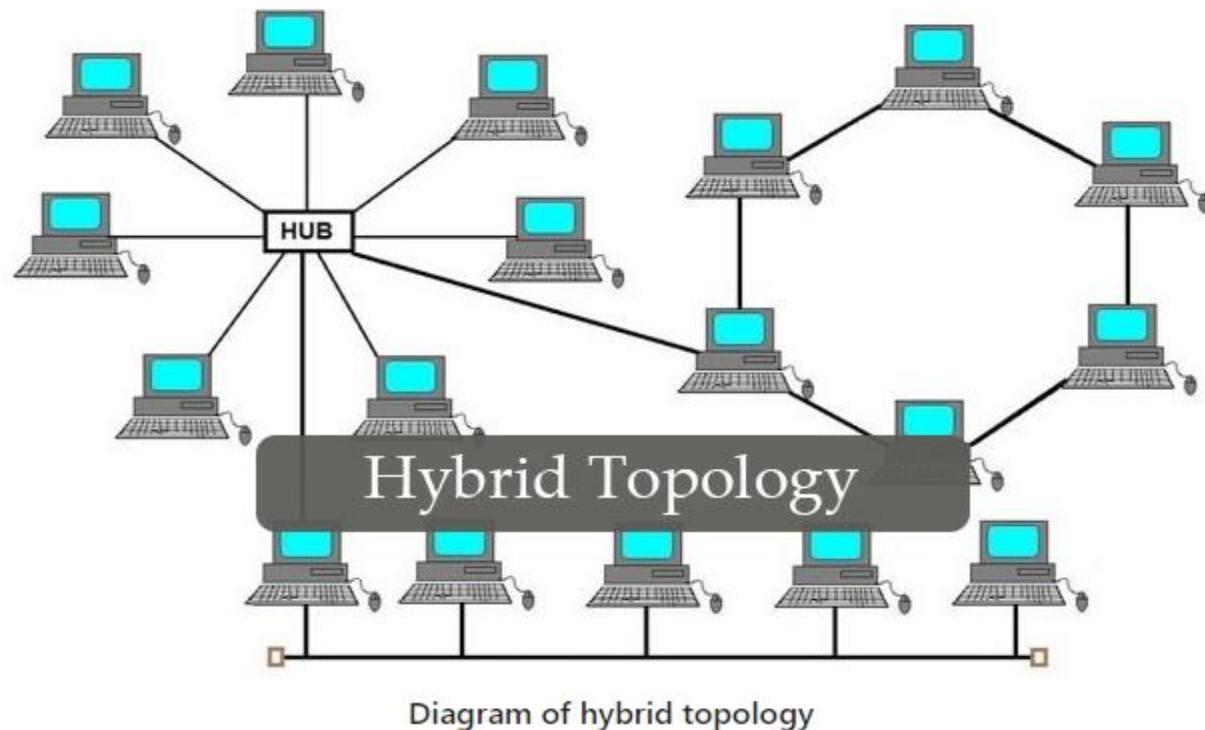
- Manages high amounts of traffic, because multiple devices can transmit data simultaneously.
- A failure of one device does not cause a break in the network or transmission of data.
- Adding additional devices does not disrupt data transmission between other devices.

### **Disadvantages of a mesh topology**

- The cost to implement is higher than other network topologies, making it a less desirable option.
- Building and maintaining the topology is difficult and time consuming.
- The chance of redundant connections is high, which adds to the high costs and potential for reduced efficiency.

## Network topologies: Hybrid Topology

A hybrid topology is a combination of two or more topologies. For example, if you combine Ring and star topology to make bigger network then it will be called hybrid network or hybrid topology. Different topologies are combined via the hubs and switches.



Most common hybrid topologies include star-bus and star-ring network.

## Network topologies: Hybrid Topology

### Features of hybrid topology:

- 1) **Flexible in size:** New topologies and nodes can be added and removed from the network easily.
- 2) Reliable: If there occurs any error in the network then it is detected easily and that network device or node can be exchanged with a new device or node.
- 3) The characteristics of each topology are combined in the hybrid network and weakness of different topologies are eliminated.

### Drawbacks of hybrid topology:

- 1) The hubs which are attached to combine different topologies are expensive. These hubs are different from normal hubs and are more intelligent in performance.
- 2) Designing hybrid networks is a complex process. Hybrid networks are difficult in installing and configuring.
- 3) If the backbone of the network is damaged then network performance is affected also.
- 4) A hybrid topology is used in making large networks so it needs more cables and cooling system. These types of networks also need sophisticated network devices

## Network topologies: Hybrid Topology

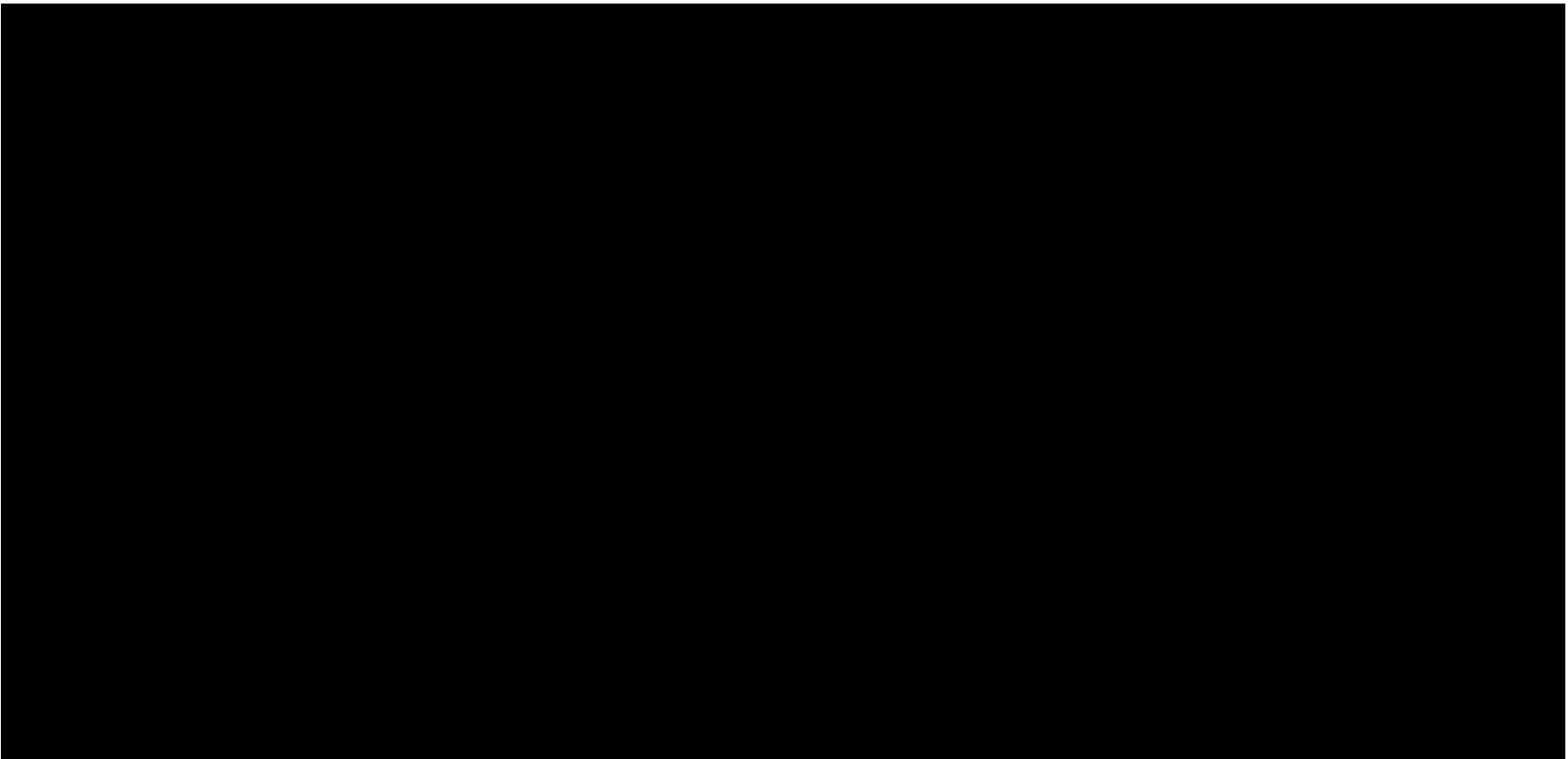
### Examples of hybrid topology:

A hybrid topology is used in various places including:-

- School
- Business
- Office
- In university campuses
- Research organizations
- Multi-national offices
- Banks
- Automated industry

## Network topologies

Watch the video for Network Topologies

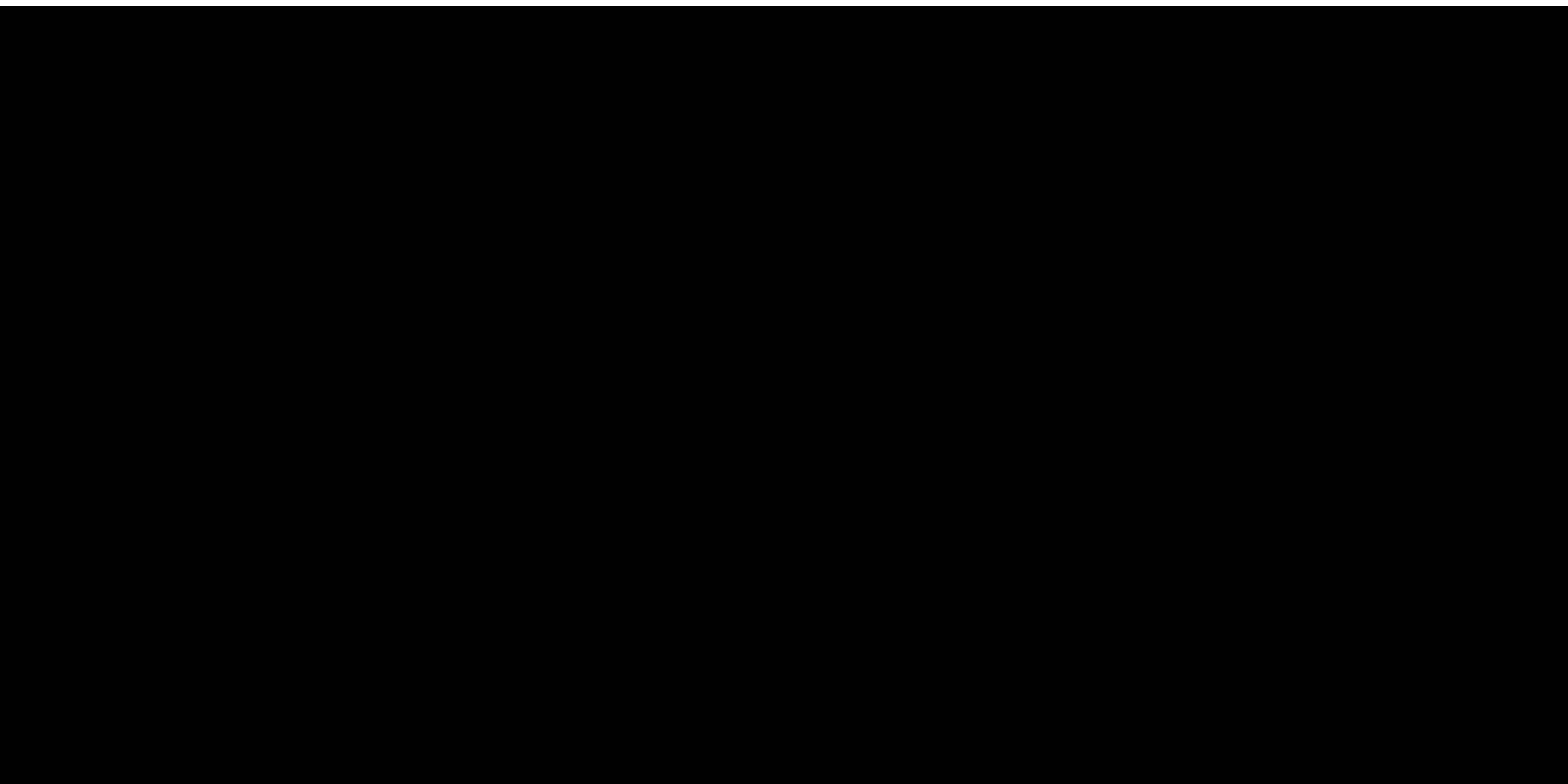


# Network topologies

Watch the video for Network Topologies

## Network types

Watch the video for the Network Types and Performance



## Network types

Watch the video for the Network Types: LAN, PAN, CAN, MAN, SAN, WAN

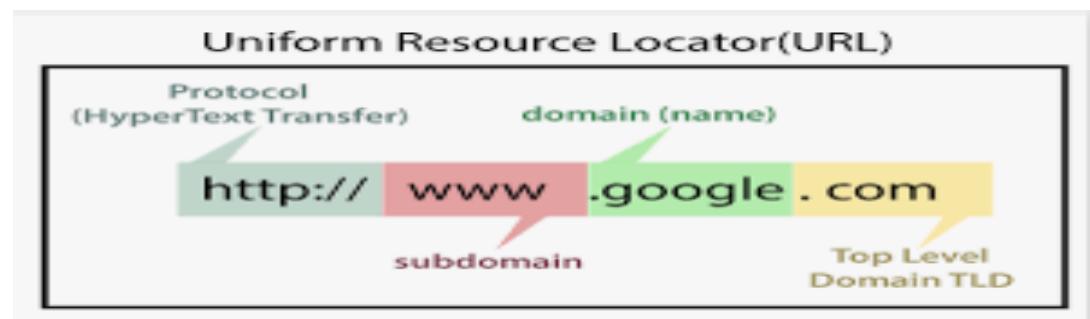
## The World Wide Web

The **World Wide Web** (WWW or 'web' for short) is the part of the internet that you can access using a **web browser** such as **Internet Explorer** or **Firefox**. It consists of a large number of web servers that host websites. Each website will normally consist of a number of web pages. A web page can contain text, images, video, animation and sound.

### Accessing web pages:

You can access a website or web page by typing its URL (Uniform Resource Locator) into the address bar of your browser. An example of a URL is <https://www.nordangliaeducation.com/>.

URLs will have the format '**http**' and a **domain** (such as **.com**).



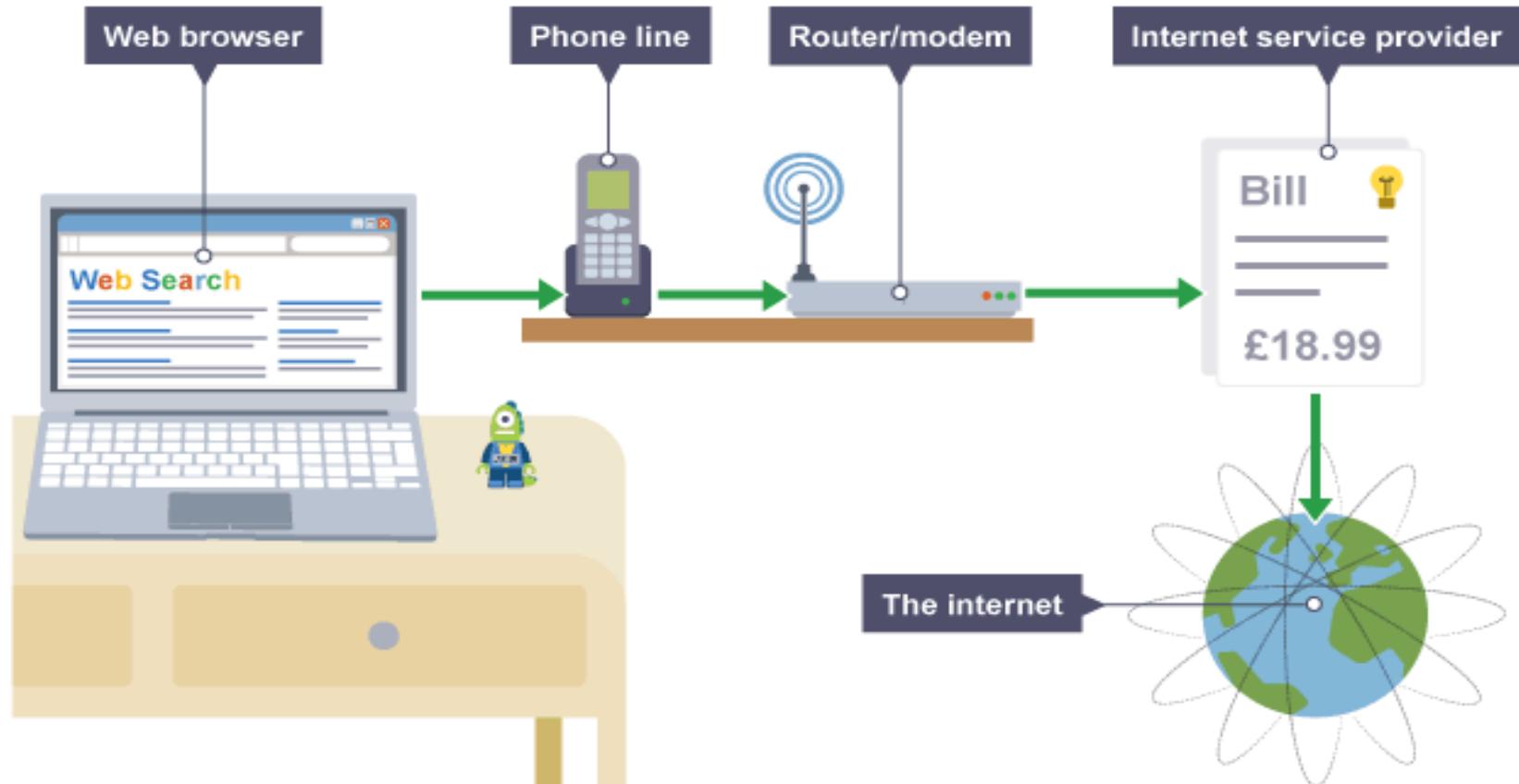
## What is an intranet?

An intranet is a network that works like the internet but is only available within a particular organization, not to the public. An intranet may have web pages used to share company specific data within that company, such as internal telephone numbers or details of employee benefits.

### Connecting to the internet

- a computer
- telephone line (cable being the exception)
- modem and/or router
- an ISP (Internet Service Provider)
- Web browser, eg Internet Explorer, Firefox, Chrome, Safari,  
Opera etc.

## What is an intranet?



## What is an intranet?

### Internet Service Providers (ISPs)

ISPs provide access to the internet. Commonly used ISPs include Sky, Virgin and BT but there are many more. Most offer the same basic package of internet access, **email** addresses and **web space**.

You need a web browser to view **web pages**. The most widely used are Internet Explorer and Firefox. All browsers will have a number of similar features to help you use the web such as:

- forward and back buttons to move between pages
- a history folder which stores details of recently visited web pages
- a stop button if a page is taking too long to load
- favourites and bookmark options to store often visited pages
- options to cut, copy, paste, save and print elements of web pages

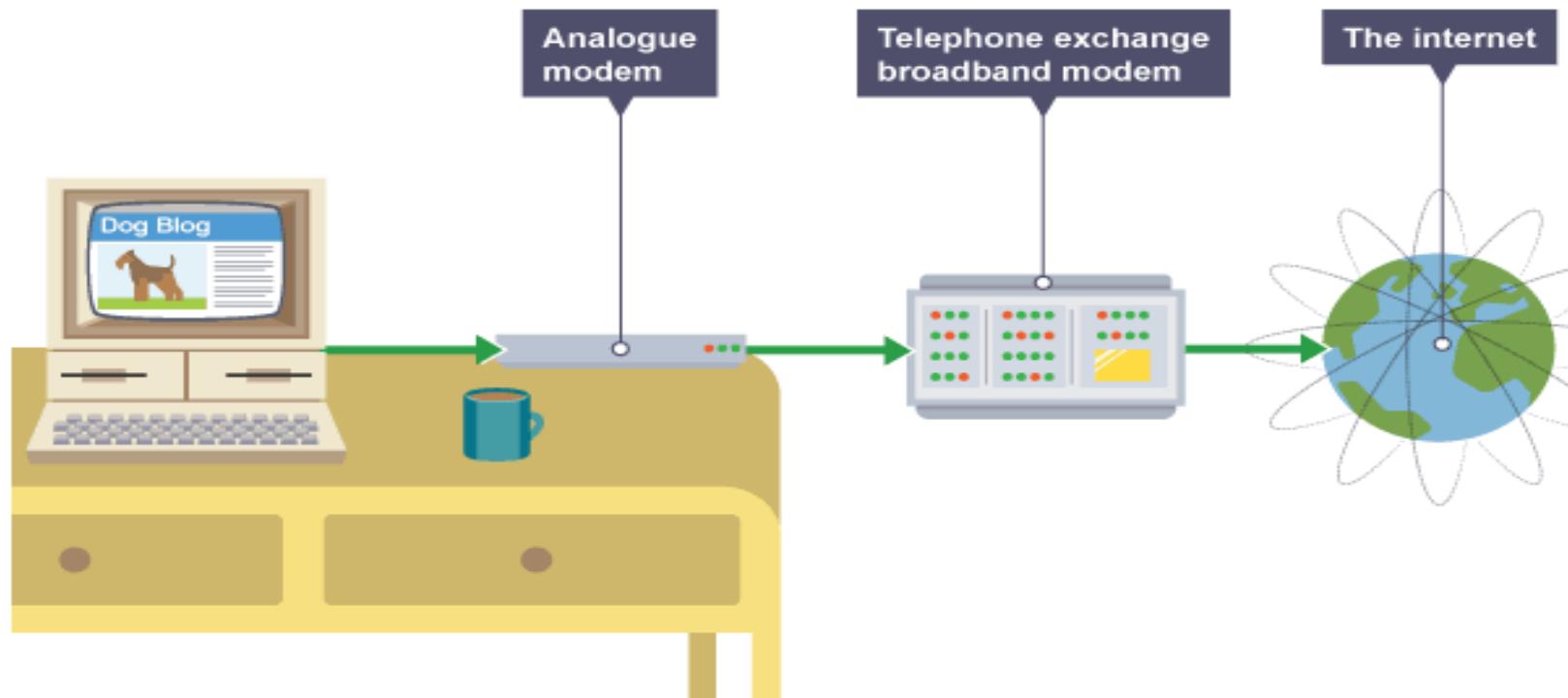
A connection made to the internet will be either **analogue** or **digital**. It is important to know the difference between the two and the technologies they use.

## What is an intranet?

### Analogue connection

#### Dial-up

A dial-up modem converts **digital** signals from a computer to **analogue** signals that are then sent down the telephone line. A modem on the other end converts the analogue signal back to a digital signal the computer can understand.



## What is an intranet?

### Analogue connection

#### Dial-up

The maximum theoretical connection speed is **56 Kbps**. Dial-up is very slow by today's standards and in real world use will typically result in a **download** speed of roughly **5 KBps**.

Phone calls cannot be made whilst connected to the internet.

## What is an intranet?

### Digital connections

#### ISDN

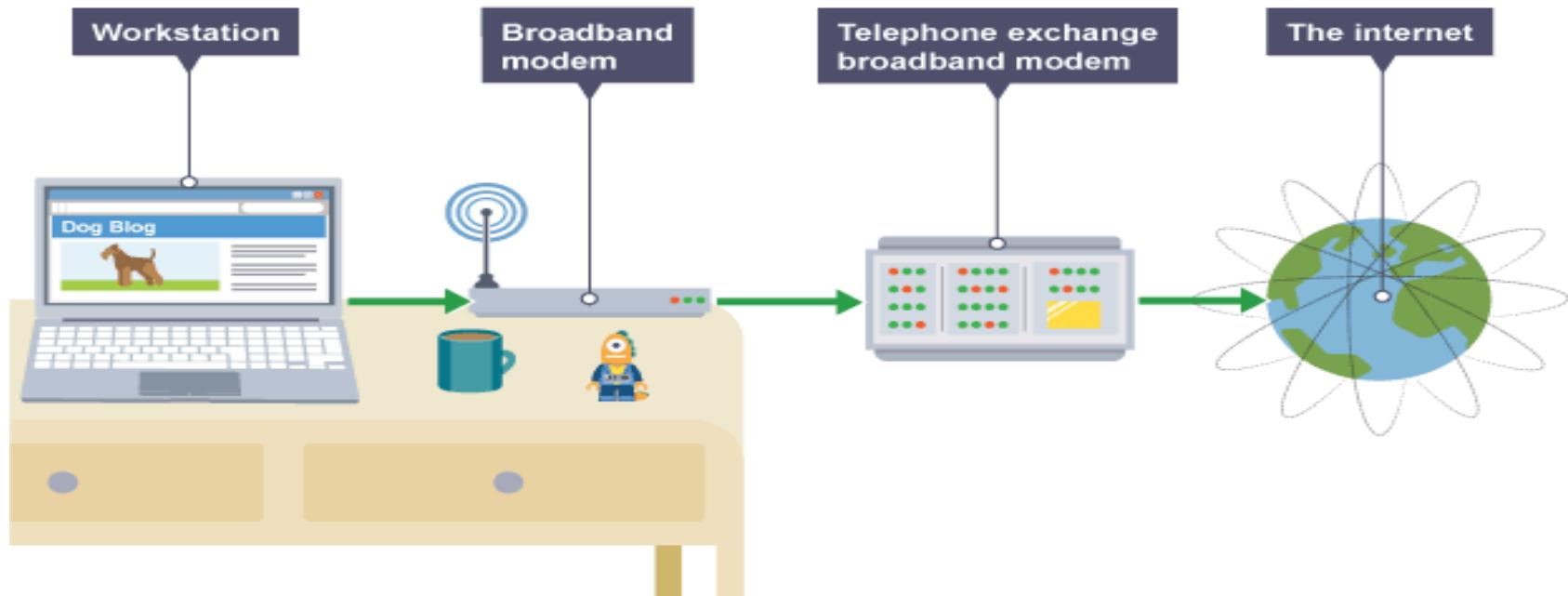
An ISDN (Integrated Services Digital Network) capable phone line can provide connection speeds of up to 64 Kbps (single channel) or 128 Kbps (dual channel) using a terminal adapter often referred to as an **ISDN modem**. The terminal adaptor removes the need to convert **digital** signals to analogue signals before they're sent down the telephone line, this results in a more reliable **internet connection**.

## What is an intranet?

### Digital connections

#### ADSL

ADSL (Asymmetric Digital Subscriber Line) provides connection speeds of up to **24 Mbps** and uses a telephone line to receive and transmit data.



## What is an intranet?

### Digital connections

#### ADSL

The speed that data can be transferred is dependent on a number of factors:

- Phone lines were designed to carry voice signals - not data. Signal quality can vary between lines and whilst it doesn't affect voice signals, it **does** affect data transmissions.
- The distance between your house and the **telephone exchange** has an effect on the speed at which data is transferred. A distance of 4 km is considered the limit for ADSL technology, beyond which it **may not work**.

An **ADSL modem/router** is needed for **broadband** internet access over ADSL. This is usually provided by your **ISP**.

Phone calls can still be made whilst connected.

## What is an intranet?

### Cable

Cable companies do not use traditional telephone lines to provide broadband internet access. They have their own **network**, a combination of co-axial copper cable and **fibre optic cable**.

With their purposefully built infrastructure cable companies are able to provide speeds of up to 50 Mbps - considerably faster than the highest available ADSL speed (24 Mbps).

A **cable** modem/router is needed for broadband internet access over cable. This is usually provided by your ISP.

The making and receiving of phone calls is not affected because the telephone line is not used.

## What is an intranet?

### Why use broadband?

Most people in the UK access the internet using **broadband** because it's much faster than the other methods.

Broadband access allows feature rich **web pages** (ones that have lots of **graphics**, videos, sound, animations etc) to **download** quickly and it allows users to quickly download large files (like music or video clips).

Faster **internet connections** also mean that the response time between clicking on a link and the new page appearing are reduced.

The download times are calculated based on each connection's maximum theoretical download speed

## What is an intranet?

### Why use broadband?



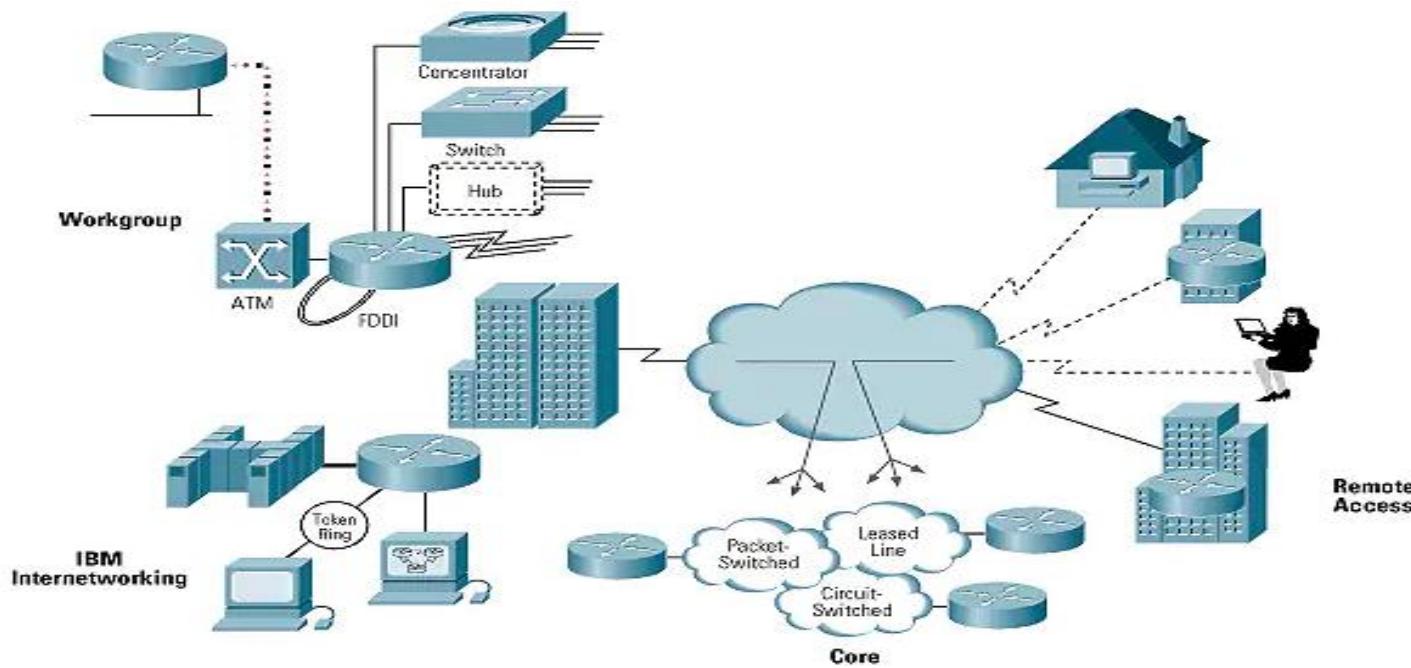
ISPs advertise speeds as 'up to', for example, 'up to 8 Mb'. This means that the maximum speed you will achieve is 8 Mb but that you're unlikely to achieve 8 Mb all the time.

## What can you do on the internet?



## Network types: Internetwork

Internetworking is **the practice of interconnecting multiple computer networks**, such that any pair of hosts in the connected networks can exchange messages irrespective of their hardware-level networking technology. The resulting system of interconnected networks are called an internetwork, or simply an internet.



## What is the internet?

The internet is a global network of computers that any computer can join. It is a **WAN** - which is a series of connected **LANs**.

**Data packets** are sent between computers using **protocols** that manage how data is sent and received. The internet also uses different models - such as the **client-server** model and the **P2P** model - to connect computers in different ways. The internet is leading to more and more people using **cloud** computing to store files and use web applications online.

## What is the internet?

Technologies and services available over the internet include:

Web pages – **HTML** documents that present images, sound and text accessed through a **web browser**

Web applications - web **software** accessed through a **browser**

**Native apps** - applications developed for specific devices (such as **smartphones**) and accessed without the need for a browser

Email

File sharing

Voice calls

**Streaming** audio and video

## What is the internet?

### Web browser

A web browser is a piece of software that enables the user to access web pages and web apps on the internet. There are a range of browsers available, and they are usually free to download and install.

## What is the internet?

### Connecting to the internet

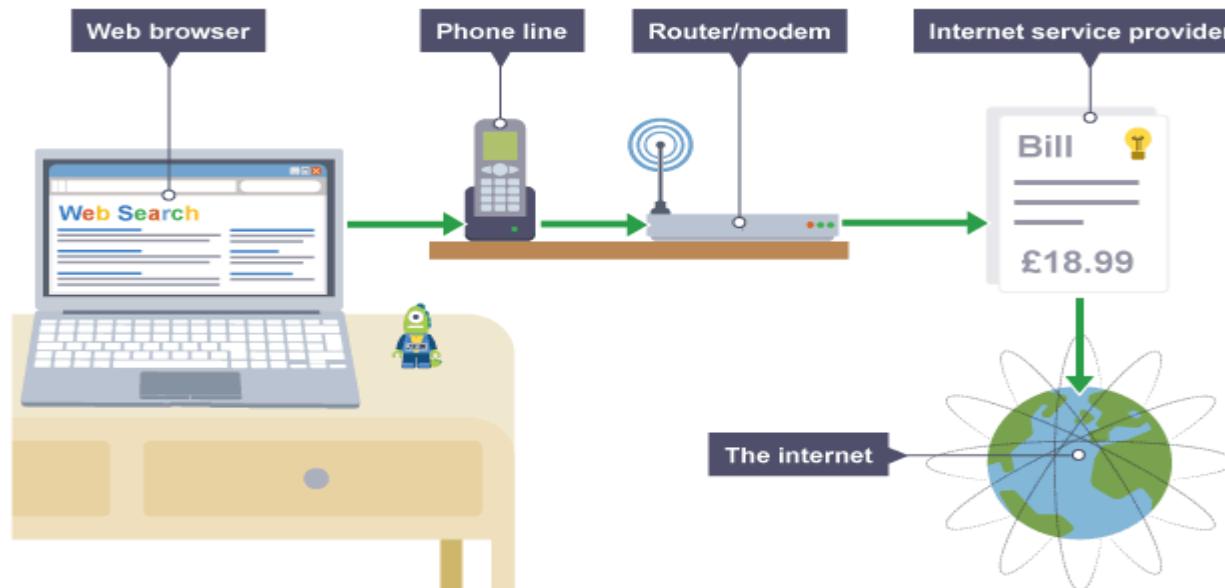
To connect a computer or a device to the internet, you need:

an ISP

a **modem** or **router** (wired or wireless)

a **web browser** or app

a connection to the network (through a copper wire or a **fibre optic cable**)



## What is the internet?

### Connecting to the internet

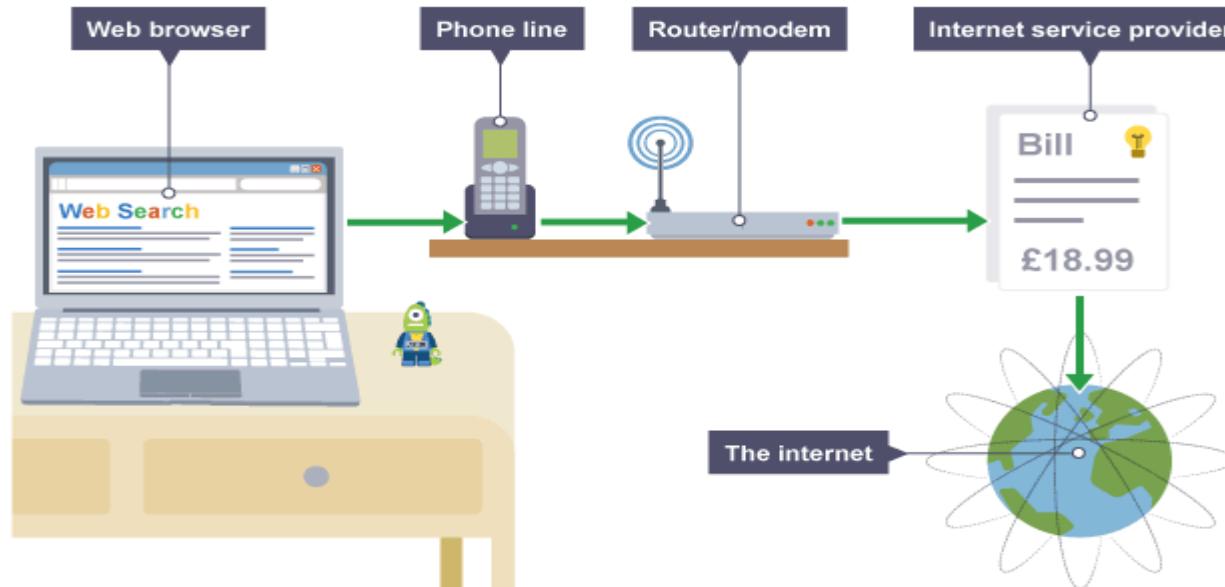
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## What is the internet?

### Fibre optics

Fibre optic cabling is made from glass that becomes very flexible when it is thin. Light is passed through the cable using a **transmitter**. Light travels quickly through the light-reflecting internal wall of the cable.

The transmitter in the **router** sends light pulses representing binary code. When the data is received, it is decoded back to its **binary** form and the computer displays the message.

### Advantages

The individual cables are thinner, so larger quantities of cable can be joined together compared to copper

There is less interference than copper

There is less chance for degeneration

### Disadvantages

the UK or any others counties telephone network still has areas that use copper cable replacing copper with fibre optic cabling is expensive

## What is the internet?

### Copper cable

Copper cable uses electrical signals to pass data between networks. There are three types of copper cable: coaxial, unshielded twisted pair and shielded twisted pair.

**Coaxial** degenerates over long distances.

**Unshielded twisted pair (UTP)** is made by twisting the copper cables around each other and this reduces degeneration.

**Shielded twisted pair (STP)** uses copper shielding around the twisted wires to make them less susceptible to interference.

## What is the internet?

### Copper cable

#### Advantages

A cabled telephone can be powered directly from the copper cable, so the phone will still work if there is a loss of power

Copper can be cheaper to set up than fibre optic cabling

#### Disadvantages

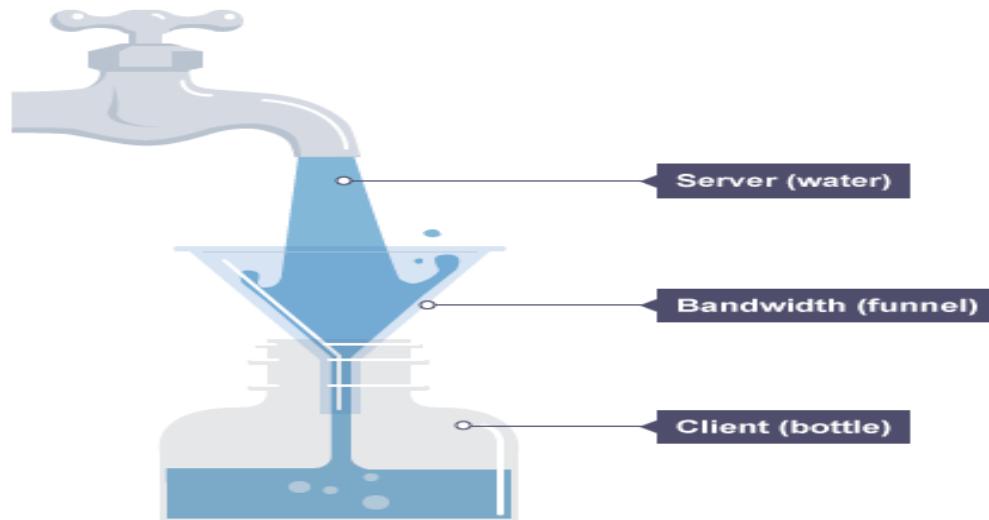
Degenerates over long distance

# What is the internet?

## Broadband connections:

The internet is transmitted both on physical wires and wireless connections. **Broadband** internet is transmitted on **physical wires** that run underground and under the oceans.

**Download** speeds tend to be faster than **upload** speeds. More bandwidth is assigned for downloading because there is a higher demand for downloads. Network speeds are measured by how many megabits they can download per second (**Mbps**).



Broadband can be provided over an ADSL or cable connection.

## What is the internet?

### Protocols:

The internet is similar to a road network in that it has rules (protocols) that you need to follow and only a certain number of vehicles (**data**) can get through at a time (**bandwidth**). If too many vehicles try to go down the same road you get congestion (reduced bandwidth).

When two devices send messages to each other it is called handshaking - the **client** requests access, the server grants it, and the **protocols** are agreed. Once the handshaking process is complete, the data transfer can begin.

Protocols establish how two computers send and receive a message. **Data packets** travel between source and destination from one **router** to the next. The process of exchanging data packets is known as **packet switching**

# What is the internet?

## Protocols:

Protocols manage key points about a message:

- speed of transmission
- size of the message
- error checking
- deciding if the transmission is synchronous or asynchronous

## What is the internet?

### **TCP/IP (transmission control protocol/internet protocol)**

TCP/IP (also known as the **internet protocol suite**) is the set of protocols used over the internet. It organises how data packets are communicated and makes sure packets have the following information:

- **source** - which computer the message came from
- **destination** - where the message should go
- **packet sequence** - the order the message data should be re-assembled
- **data** - the data of the message
- **error check** - the check to see that the message has been sent correctly

# What is the internet?

## Internet protocols

Within **TCP / IP** there are several key **protocols**. These include the following.

### IP address

Every device on the internet has a **unique IP address**. The **IP address** is included in a data packet. IP addresses are either 32-**bit** or 128-bit numbers. The address is broken down into four 8-bit numbers (each is called an **octet**). Each octet can represent a number between 0 and 255 and is separated by a full stop, eg 192.168.0.12.

To find your IP address you can use the ipconfig command line tool.

Home and small business routers often incorporate a basic dynamic host configuration protocol (DHCP) **server** which assigns IP addresses to devices on a network.

### Did you know?

The 32-bit IP address system is also known as IPv4. It allows for just over 4 billion unique addresses. IPv6 is now coming into use. IPv6 uses 16 bits for each section of the address, creating a 128-bit address. This allows almost 80 **octillion** unique IP addresses.

# What is the internet?

## **FTP**

**FTP** is used to transfer large files. It is often used for organising files on a web server for a website. You can have private access to an area on an FTP server where you can **upload** your files. You can then give another user access to **download** the documents that you have shared.

## **HTTP**

**HTTP** transfers web pages from web servers to the client. All web page addresses start with http. An **https** address is a secure web address which has been **encrypted**. An https address is used for sites holding bank details and secure information.

## **SMTP and POP3**

Email uses these protocols to communicate with mail **servers**. **SMTP** is used to send the email; **POP** is used to receive email. Most email **clients** allow for transfers of up to 10 **MB**.

## **VOIP**

**VOIP** is a set of protocols that enables people to have voice conversations over the internet.

# What is the internet?

## Web addresses

Every website address has a **URL** with an equivalent **IP address**.

A web address contains (running from left to right):

1. **http(s)**
2. the domain name - the name of the website
3. an area within that website – like a folder or directory
4. the web page name – the actual page that you are viewing

For example: <http://www.bbc.co.uk/nature/life/frog>

In this example from BBC Nature:

1. *http* is the **protocol**
2. *www.bbc.co.uk* is the domain name stored on a **DNS**
3. */nature/life/* is the folder structure leading to where the web page is located
4. *frog* is the requested web page

## What is the internet?

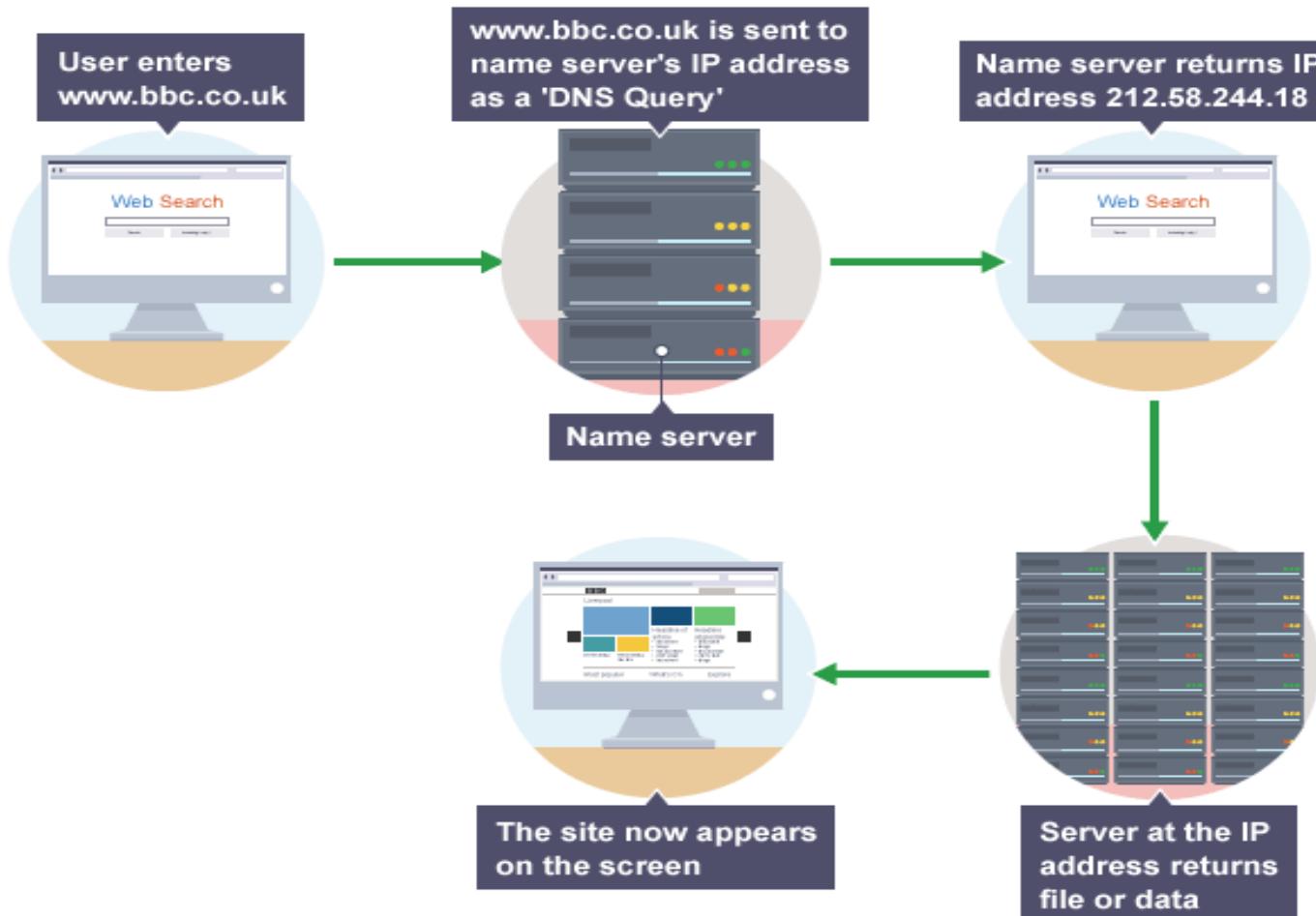
**Name servers** are used to host and match website addresses to **IP addresses**. DNS is the main system over the internet that uses the name server.

When you type in a **URL**, the **ISP** looks up the domain name, finds the matching IP address and sends it back.

The **web browser** sends a request straight to that IP address for the page or file that you are looking for.

Every website has a URL with an equivalent IP address.

# What is the internet?



## What is the internet?

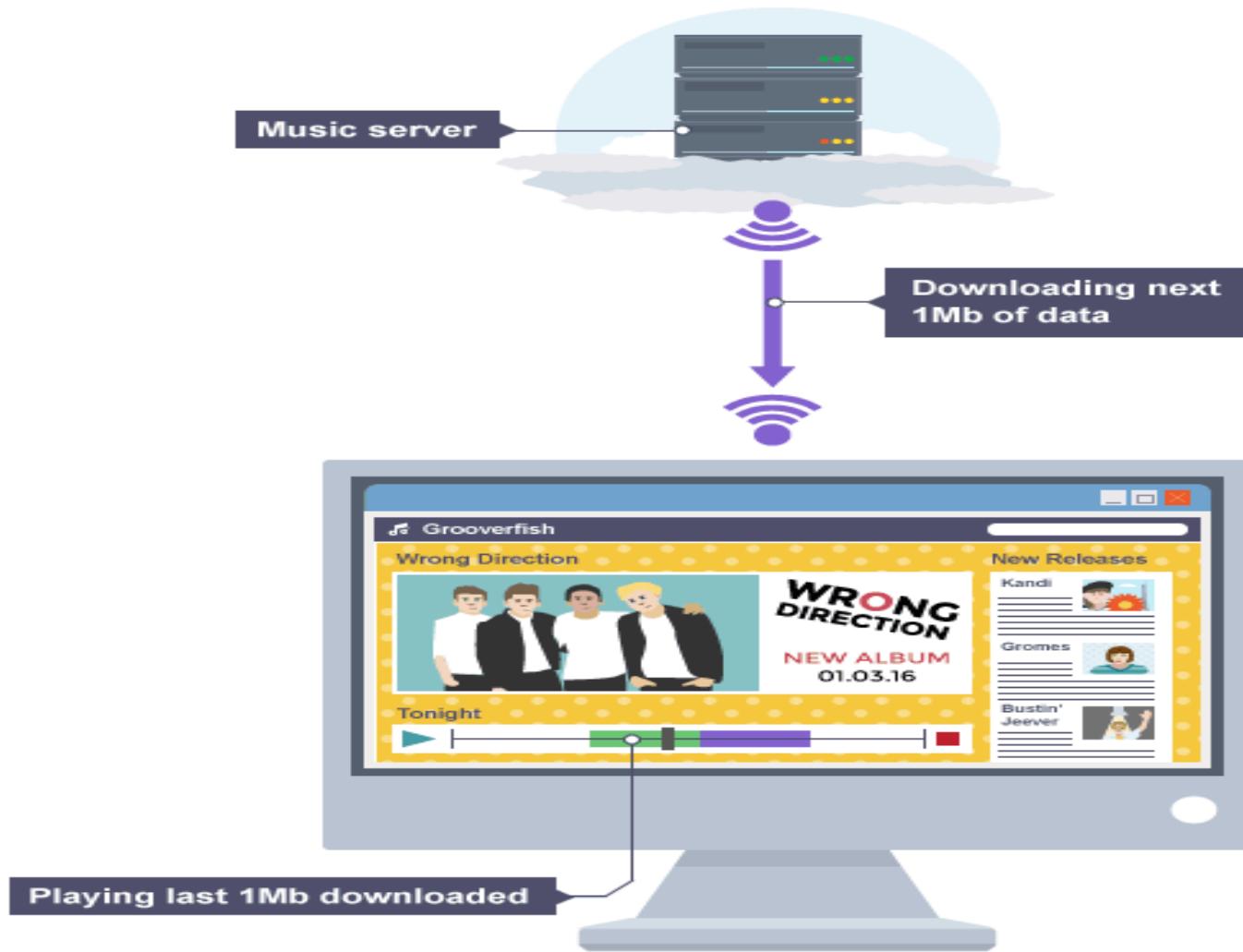
### **Streaming**

Streaming high-quality images, music and video requires a lot of data. **Compression** reduces file sizes whilst keeping the high quality of the original media.

### **Music and video**

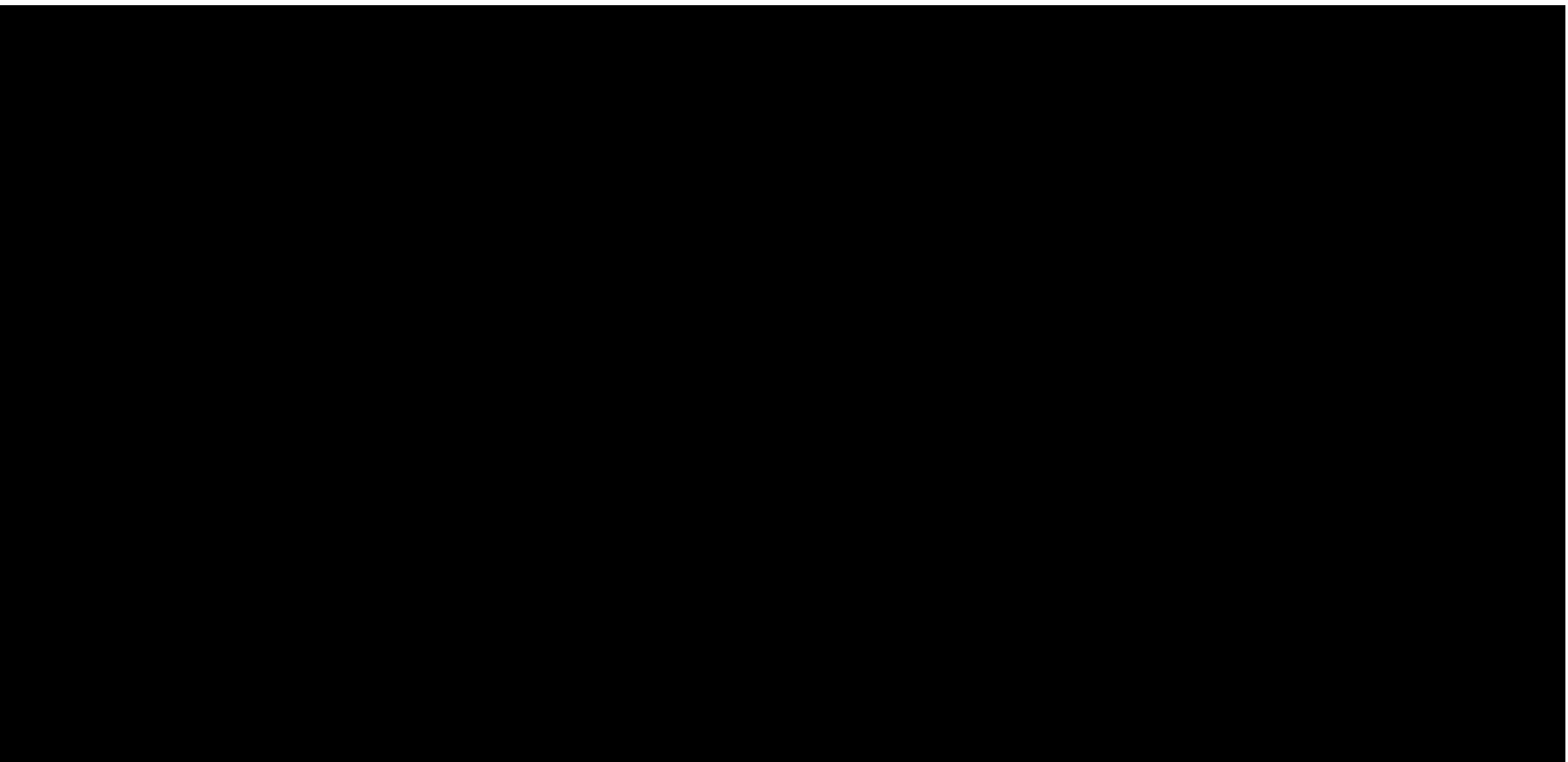
Compression is important for reducing music and video file sizes. Music and video files can both be either **downloaded** as permanent files or streamed temporarily.

## What is the internet?



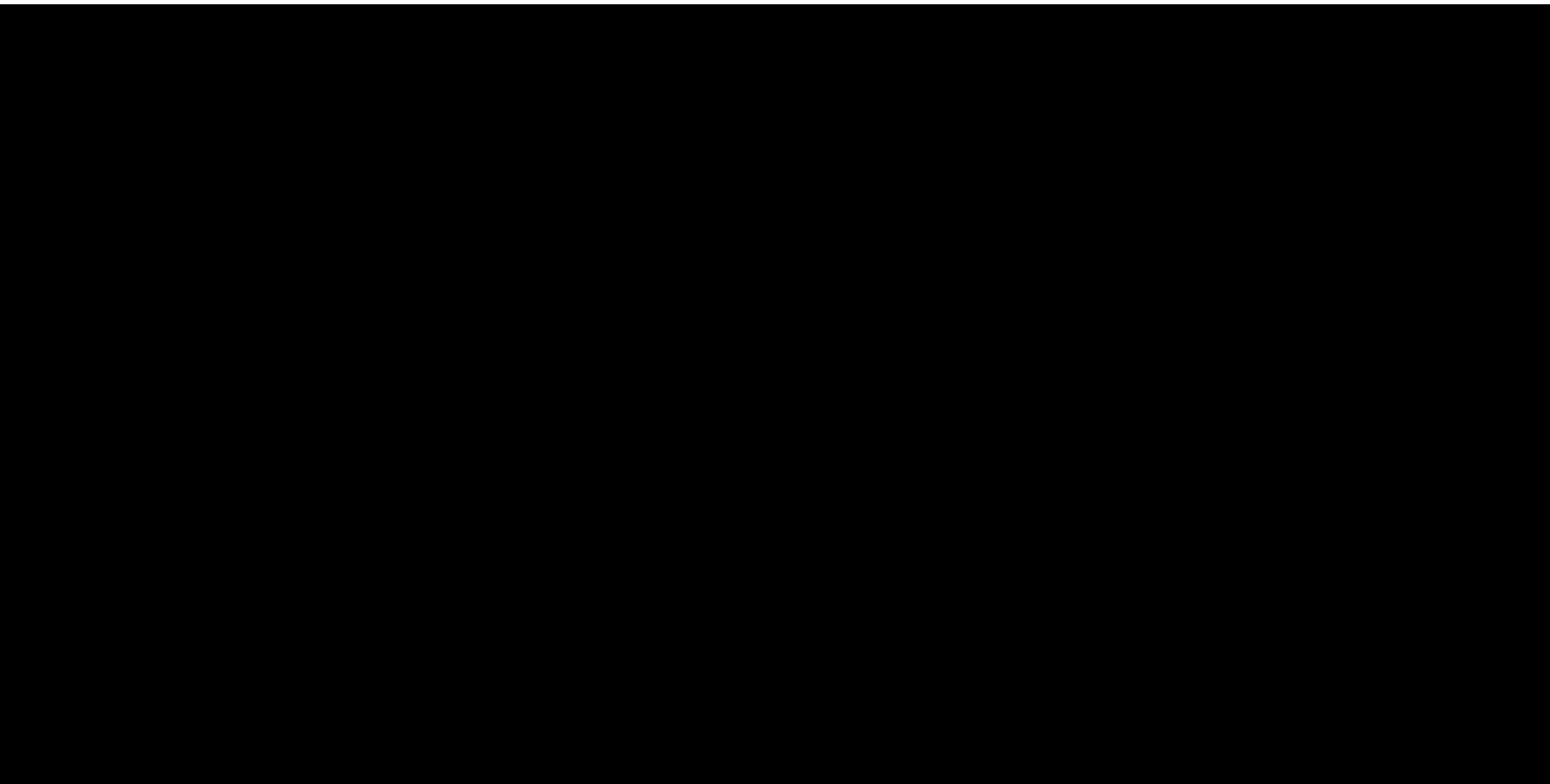
## Network types

Watch the video for How the Internet works.



## Network types

Watch the video for How the Internet Works in 5 Minutes.



## Transmission choices

- Simplex, half duplex or full duplex
- Broadcast, multicast or unicast

## Transmission choices: Simplex, half duplex or full duplex

**SIMPLEX DATA TRANSMISSION** is in one direction only (i.e. from sender to receiver). Example: data being sent from a computer to a printer.

**HALF-DUPLEX DATA TRANSMISSION** is in both directions but not at the same time (i.e. data can be sent from 'A' to 'B' or from 'B' to 'A' along the same line, but not at the same time). Example: a phone conversation between two people where only one person speaks at a time.

**FULL-DUPLEX DATA TRANSMISSION** is in both directions simultaneously (i.e. data can be sent from 'A' to 'B' and from 'B' to 'A' along the same line, both at the same time). Example: broadband connection on a phone line.

## Transmission choices

- Watch the video for the Simplex, Half Duplex, Full Duplex Explained

## Transmission choices

- Watch the video for the Half Duplex vs Full Duplex

## Transmission choices: Broadcast, Multicast or Unicast

Broadcast messages are sent to all stations in the network.

Whereas an unicast message is only sent to one station on the network.

Multicast messages are sent to a group of stations, for example video cameras type. Using multicast allows the building of distribution networks, which are suitable for video monitoring or television transmissions over the Internet, i.e. information with one sender and many receivers

## Transmission choices: Broadcast, Multicast or Unicast

- Watch the video for the Broadcast, Multicast or Unicast

## Network usage models

- Client-server
- Thick client
- Thin client
- Peer-to-peer

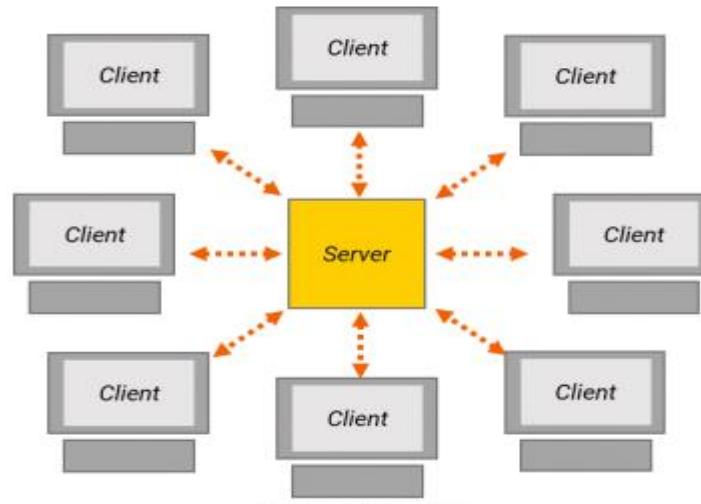
## Network usage models: Client Server Network

Client-server networks are computer networks that use a dedicated computer (server) to store data, manage/provide resources and control user access.

The server acts as a central point on the network upon which the other computers connect to.

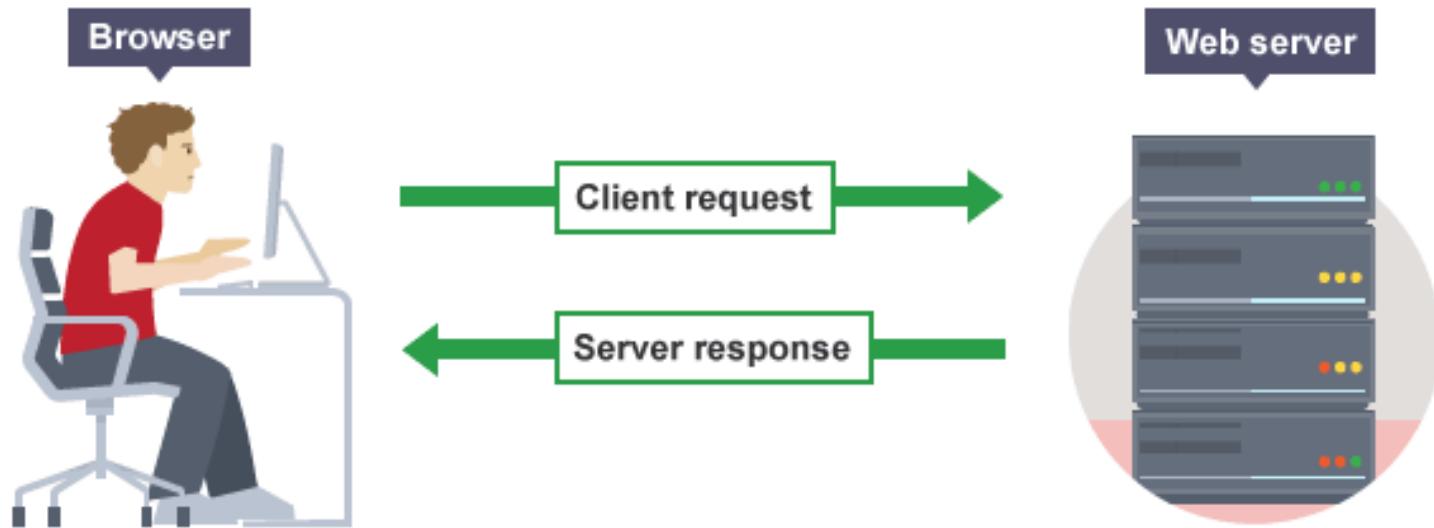
A computer that

nt.



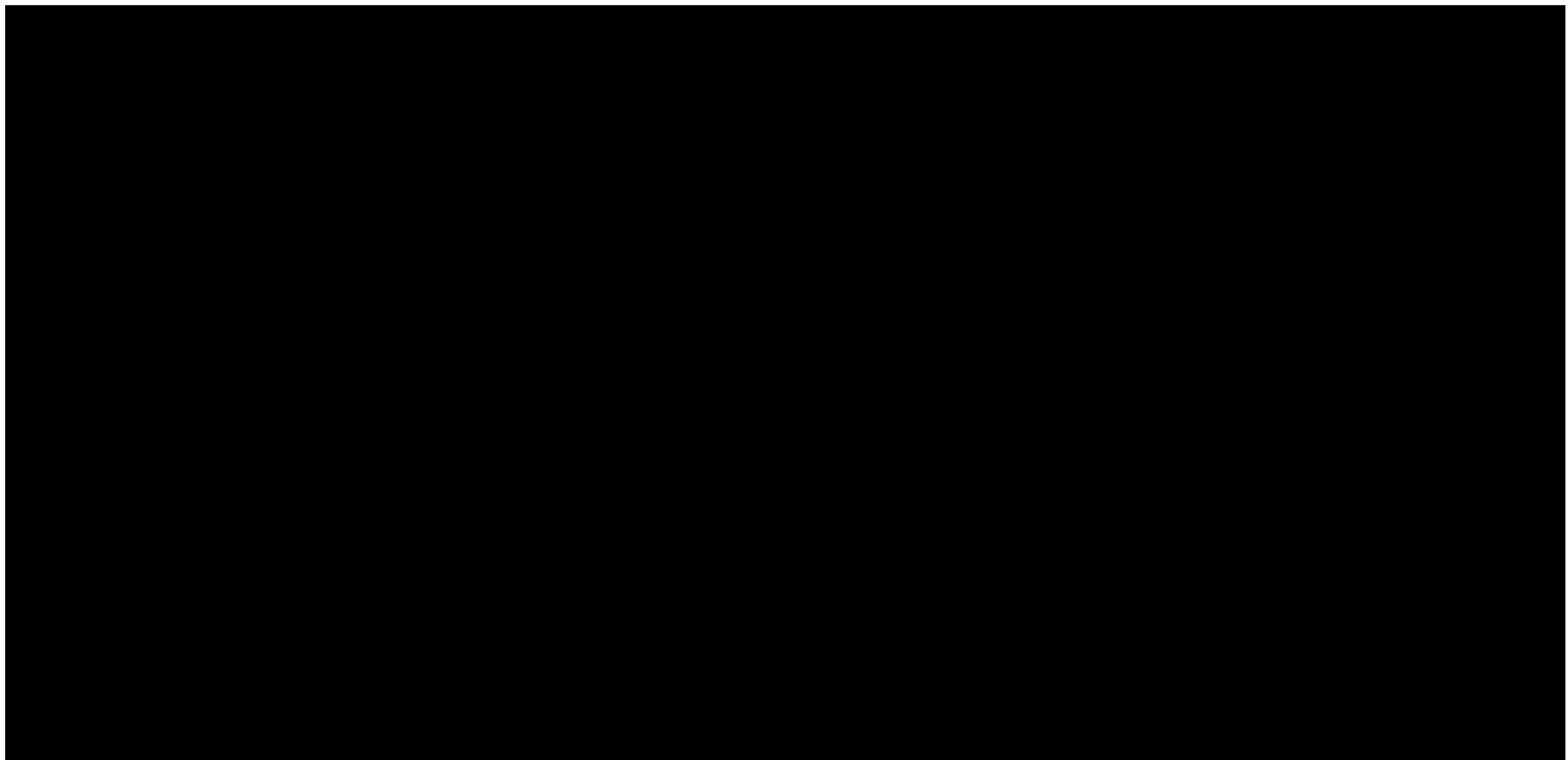
Most schools, colleges and businesses use client-server networks to allow for central management of clients on the network. This can improve security but requires a fair degree of expertise to set up and manage.

## Network usage models: Client Server Network



## Network usage models

- Watch the video for the client server model



## Network usage models: Thin and Thick Client

A **thin client** is software that is primarily designed to communicate with a server. Its features are produced by servers such as a cloud platform.

A **thick client** is software that implements its own features. It may connect to servers but it remains mostly functional when disconnected.

# Network usage models: Thin and Thick Client

Thin Client vs Thick Client		
	Thin Client	Thick Client
Definition	Software that relies on a remote server such as a cloud platform for its features.	Software that runs at least some features directly on your device.
Offline	Functions mostly don't work	Functions mostly work
Local Resources	Generally consumes few local resources such as disk, computing power and memory.	Generally consumes more local resources
Network Latency	Functionality may depend on a fast network connection.	Functionality may work without a connection or with a slow connection.
Data	Data is typically stored on servers.	Data may be stored locally.

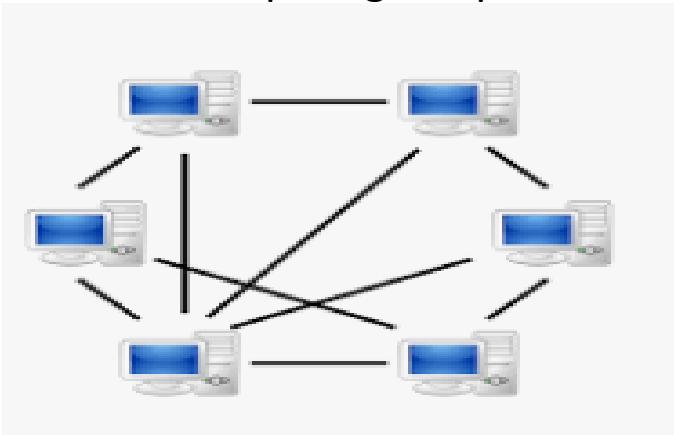
## Network usage models

- Watch the video for the Thin and Thick Clients

## Network usage models: Peer-to-Peer (P2P) Network

### What's a Peer-to-Peer (P2P) Network?

A peer-to-peer network is one in which two or more PCs share files and access to devices such as printers without requiring a separate server computer or server software

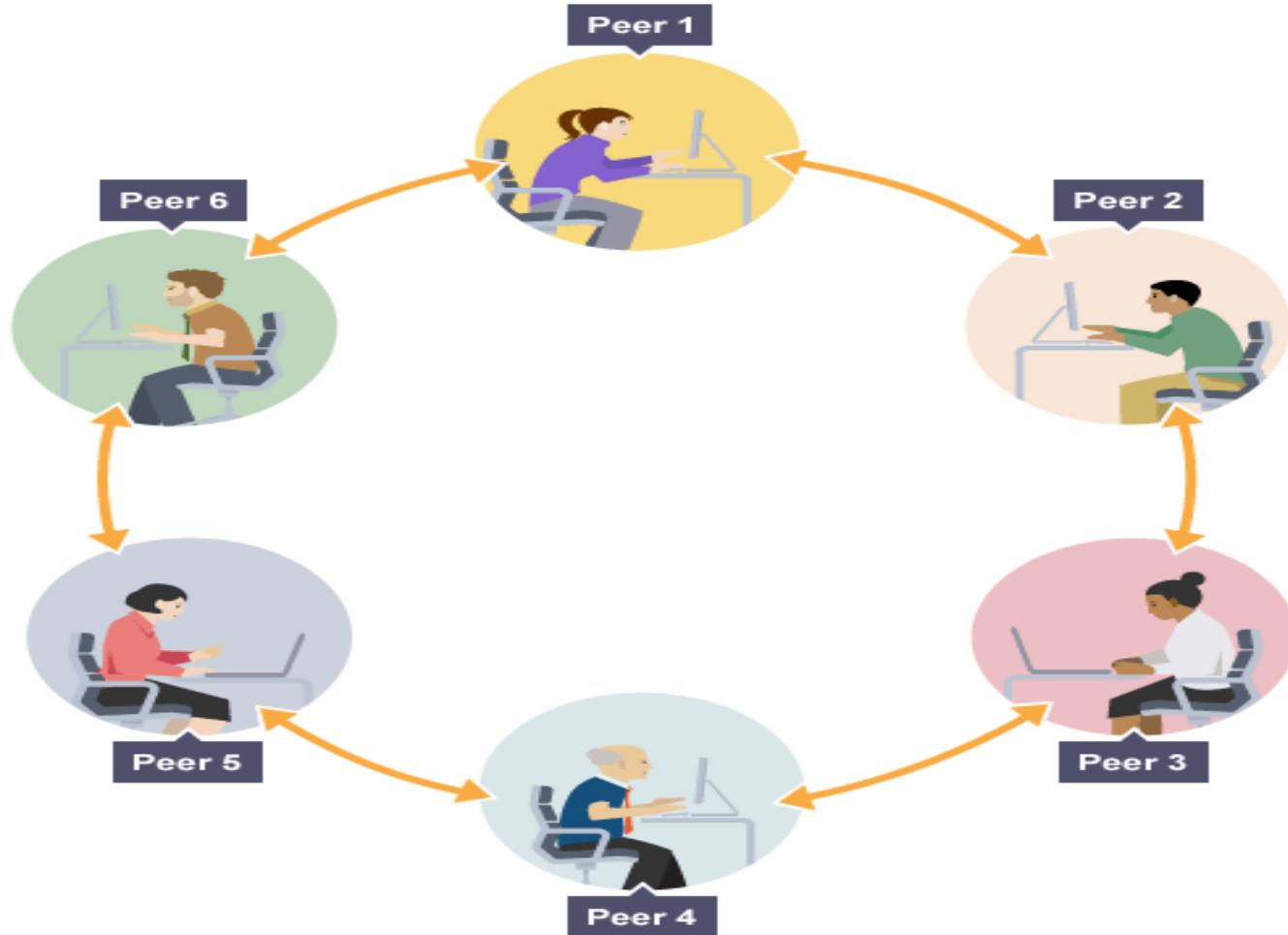


On the other hand, peer-to-peer networking is **more cost effective than client-server networking** as there is **no need for a powerful server** to provide services. Furthermore, peer-to-peer networks are **easier to set up and maintain than their client-server counterparts**

Large file-sharing networks and multimedia providers use peer-to-peer networking to provide high-performance services without the requirement for a server.

## Network usage models: Peer-to-Peer (P2P) Network

### What's a Peer-to-Peer (P2P) Network?



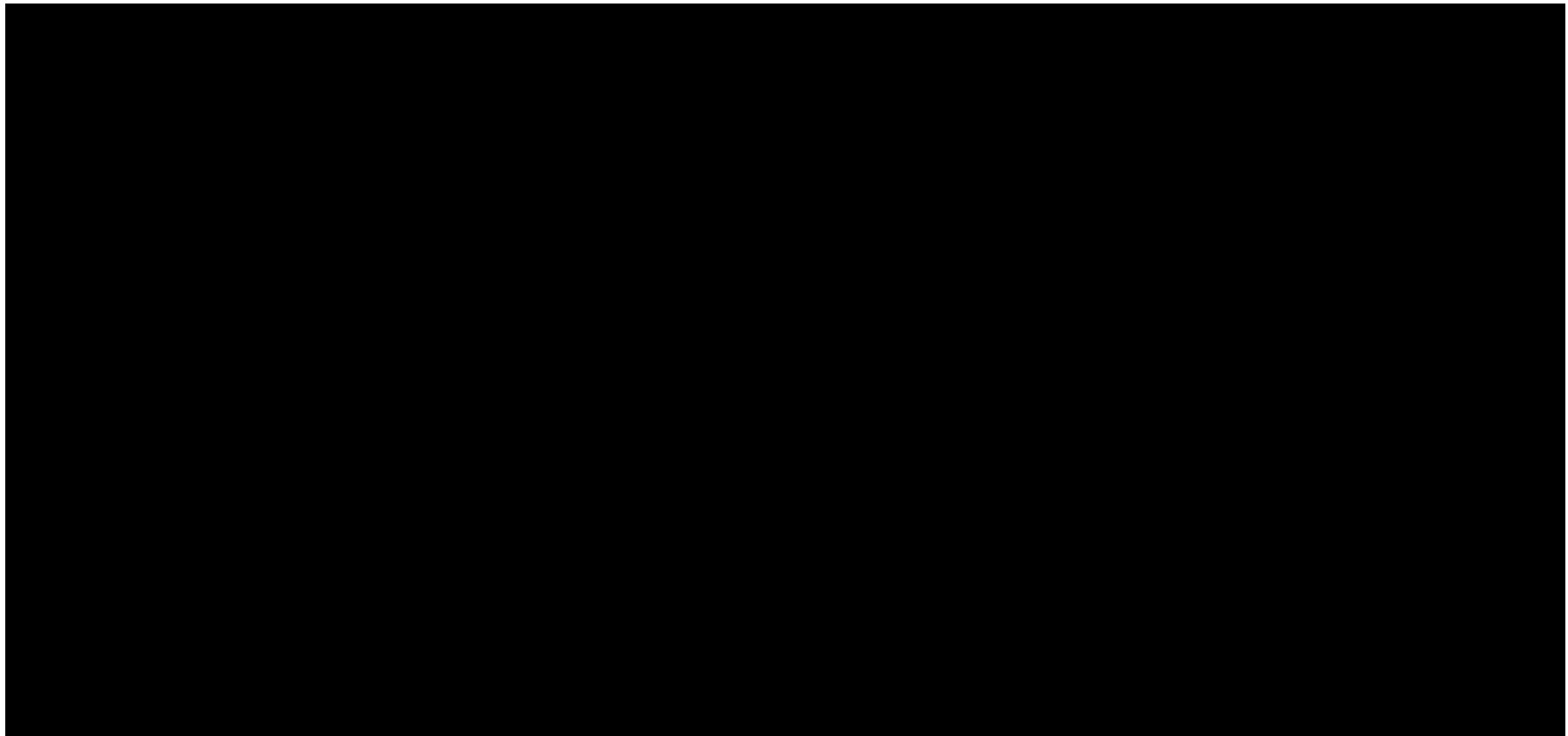
# Network usage models:

## Differences between client-server and P2P networks

	Client-server	P2P
Security	The server controls security of the network.	No central control over security.
Management	The server manages the network. Needs a dedicated team of people to manage the server.	No central control over the network. Anyone can set up.
Dependency	Clients are dependent on the server.	Clients are not dependent on a central server.
Performance	The server can be upgraded to be made more powerful to cope with high demand.	If machines on the network are slow they will slow down other machines.
Backups	Data is all backed up on the main server.	Each computer has to be backed up. Data can easily be deleted by users.

## Network usage models

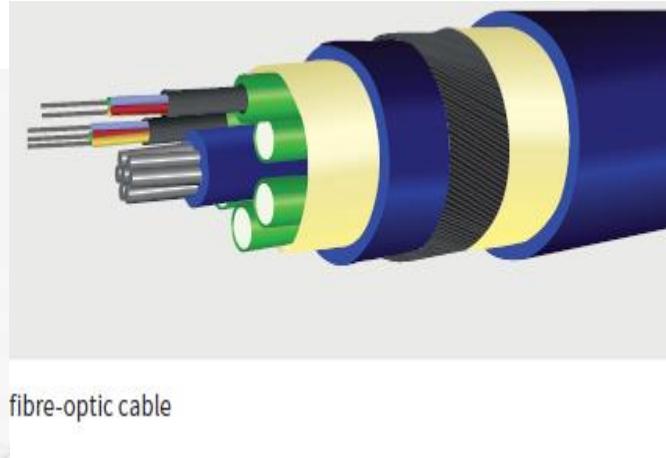
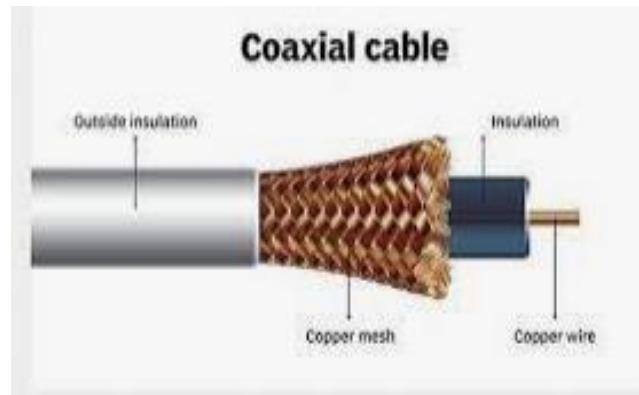
- Watch the video for What Is Peer-To-Peer (P2P)?



## Transmission media

- Twisted pair cable
- Coaxial cable
- Fibre optic cable
- Radio waves
- Microwaves
- Infrared
- Satellite

# Transmission media

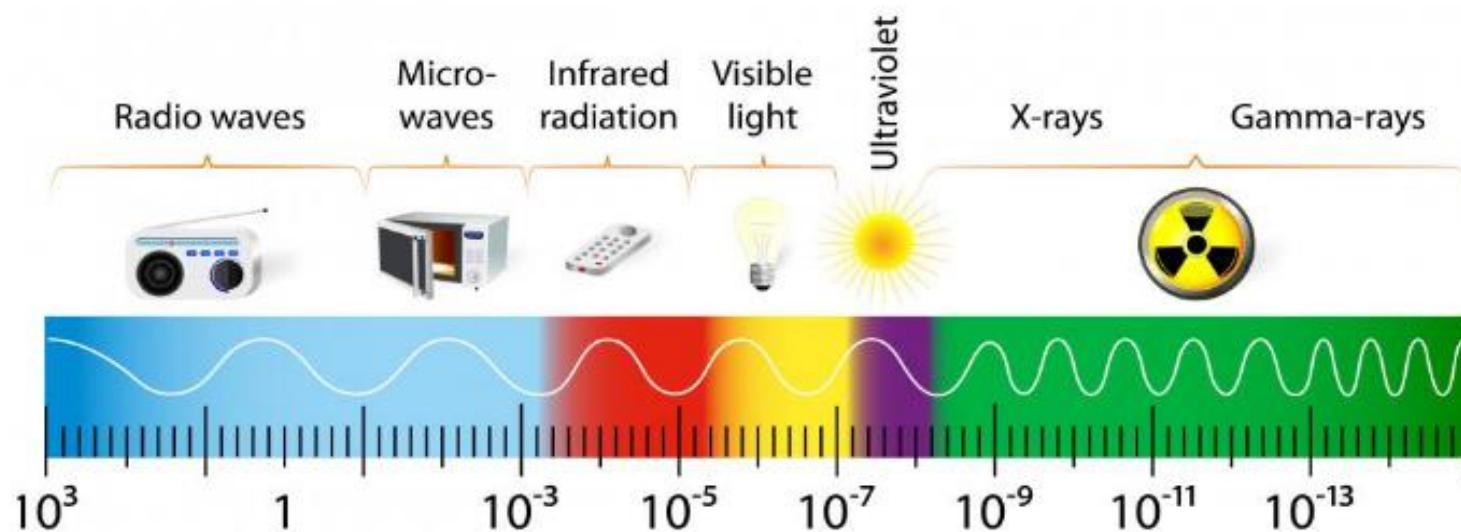


	<b>Twisted pair</b>	<b>Coaxial</b>	<b>Fibre-optic</b>
Cost	Lowest	Higher	Highest
Bandwidth or data rate	Lowest	Higher	Much higher
Attenuation at high frequency	Affected	Most affected	Least affected
Interference	Worst affected	Less affected	Least affected
Need for repeaters	More often	More often	Less often

Table 2.01 Comparisons between cable types

## Transmission media

# THE ELECTROMAGNETIC SPECTRUM



Microwaves have a frequency range of 0.3 GHz to 300 GHz in the electromagnetic spectrum.

## Transmission media

Watch the video to Understanding Spectrum!

## Transmission media

Watch the video for the Data Transmission (Wired)

## Transmission media

### Transmission Media (Wired)

Twisted Pair	Coaxial Cable	Optic Fibre
Each is used in order physically connect networked devices		
		
<b>Material Length:</b> 100m	<b>Material Length:</b> 500m	<b>Material Length:</b> 10 km – 12km
<b>Speed:</b> 10Mbs – 100Mbs	<b>Speed:</b> 10Mbs – 100Mbs	<b>Speed:</b> 10Mbs – 100Gbs
<b>Cost:</b> Cheapest	<b>Cost:</b> Cheap	<b>Cost:</b> Expensive
<b>Advantages:</b> Price, easy to install, widely available and used	<b>Advantages:</b> Less susceptible to EMI interference, can carry several signals	<b>Advantages:</b> Security, size, distance length, no EMI, High bandwidth, low errors
<b>Disadvantages:</b> distance, susceptible to interference	<b>Disadvantages:</b> hard to work, can be tapped, limited bandwidth, failure can bring down network	<b>Disadvantages:</b> Expensive, difficult to install and terminate, need terminators to convert data

# Transmission media

	Twisted pair	Coaxial	Fibre-optic
Cost	Lowest	Higher	Highest
Bandwidth or data rate	Lowest	Higher	Much higher
Attenuation at high frequency	Affected	Most affected	Least affected
Interference	Worst affected	Less affected	Least affected
Need for repeaters	More often	More often	Less often

Table 2.01 Comparisons between cable types

## Transmission media

Watch the video for the Network Transmission Media

## Transmission media

Watch the video for the Radio Waves: What is a Radio Wave?

## Transmission media

Watch the video for the Microwaves and Infrared?

## Transmission media

Watch the video for How does the INTERNET with the use Satellite?

## Factors relating to comparisons

- Cost
- Bandwidth
- Attenuation at high frequency
- Interference
- Need for repeaters
- Penetration through a wall (wireless)

## Factors relating to comparisons

- **Bandwidth: What Is Bandwidth in Networking?**

Bandwidth, expressed in **Hertz**, relates to the **range of frequencies** that a communication medium is capable of transmitting. There is a **direct relationship** between bandwidth and bit rate. Higher bandwidth results in a **higher bit rate**.

## Factors relating to comparisons

- Bandwidth: What Is Bandwidth ?

## Factors relating to comparisons

- Attenuation at high frequency:

## Factors relating to comparisons

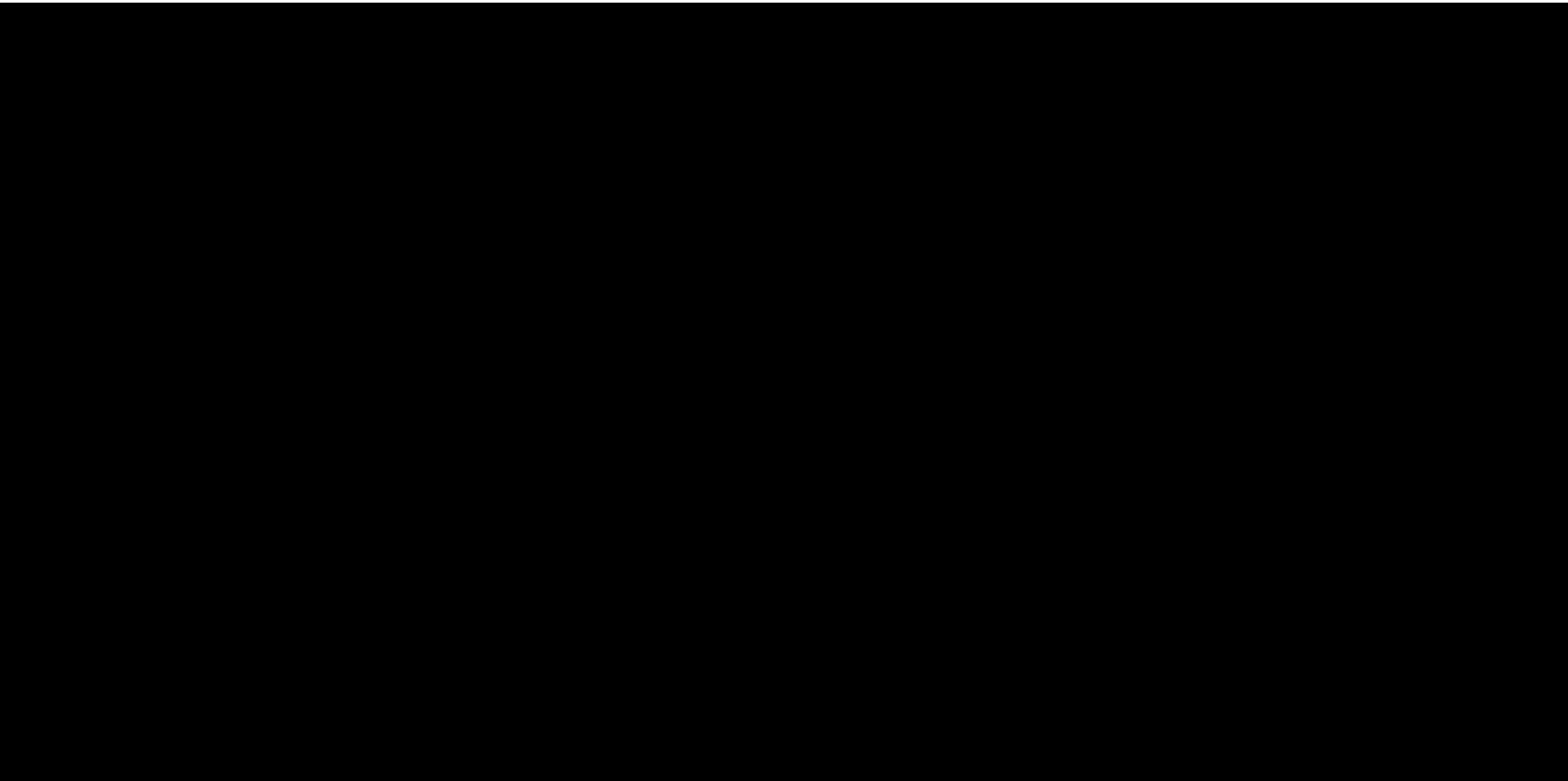
- Interference:

## Factors relating to comparisons

- Need for Repeaters:

## Factors relating to comparisons

- Penetration through a wall (wireless):

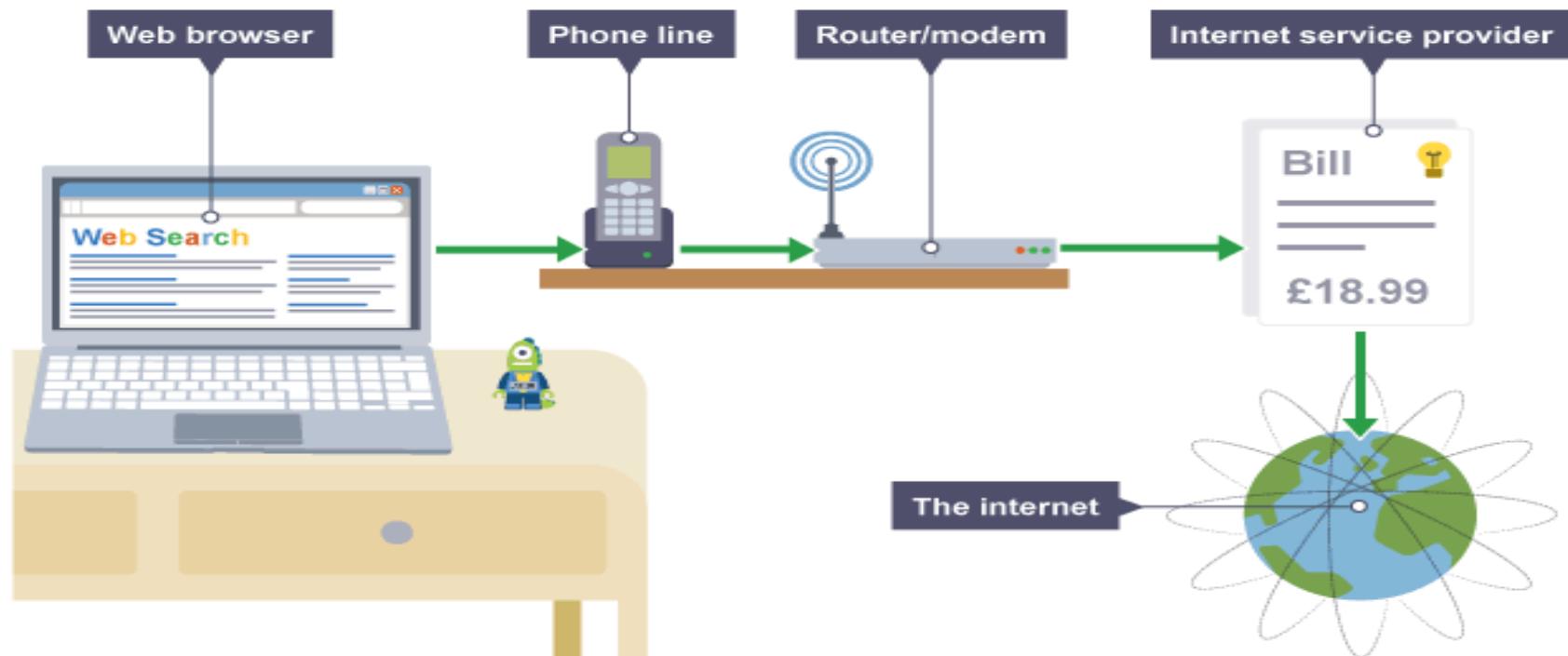


## LAN hardware

- Cable
- Bridge
- Repeater
- Switch
- Network Interface Card (NIC) or Wireless Network Interface Card (WNIC)
- Server
- Wireless access point (WAP)

## Networking hardware

Computers need networking hardware in order to connect to each other. **Routers**, **hubs**, **switches** and **bridges** are all pieces of networking equipment that can perform slightly different tasks. A router can often incorporate hubs, switches and wireless access within the same hardware.



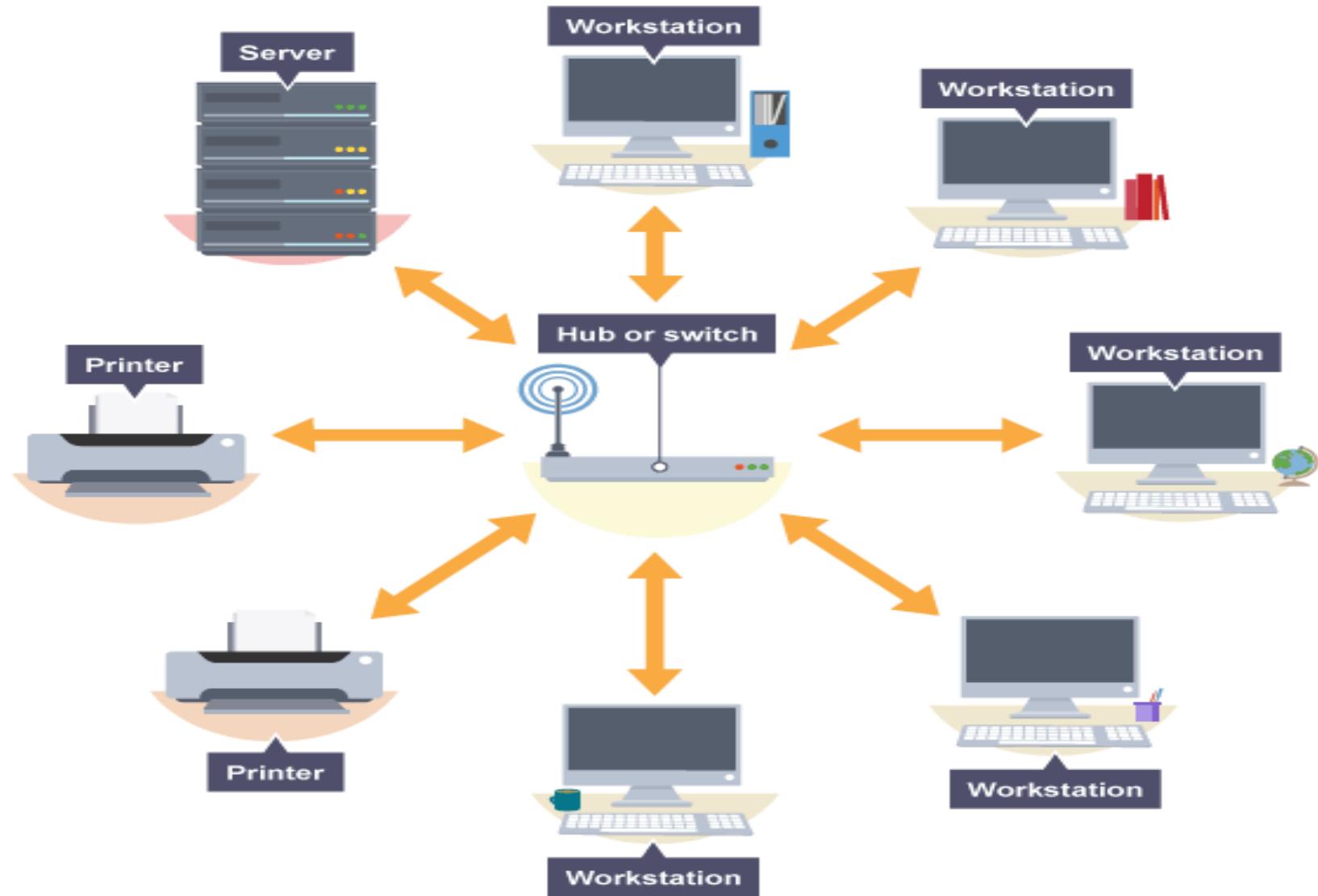
## Routers

A **router** can form a **LAN** by connecting devices within a building. It also makes it possible to connect different networks together. Homes and businesses use a router to connect to the internet. A router can often incorporate a modem within the hardware.

## Modems

A **modem** enables a computer to connect to the internet over a telephone line. A modem converts **digital** signals from a computer to analogue signals that are then sent down the telephone line. A modem on the other end converts the analogue signal back to a digital signal which another computer can understand.

### Hubs, bridges and switches



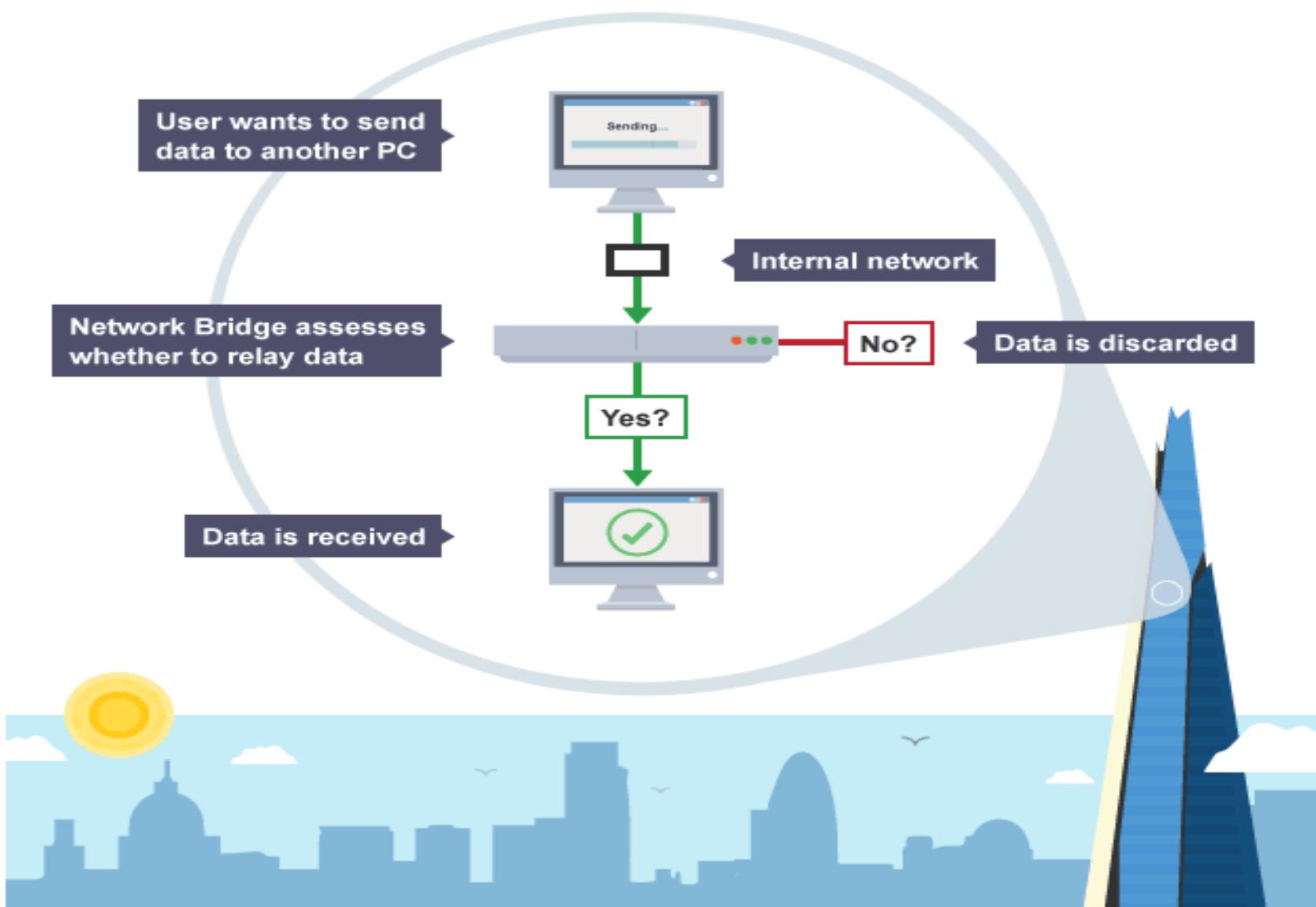
**Hubs, bridges and switches** allow multiple devices to connect to the router and they transfer data to all devices on a network. A router is a more complex device that usually includes the capability of hubs, bridges and switches.

### **Hubs**

A hub broadcasts data to all devices on a network. This can use a lot of **bandwidth** as it results in unnecessary data being sent - not all computers might need to receive the data. A hub would be useful to link up a few games consoles for a local multiplayer game using a wired LAN.

### **Bridges**

A **bridge** is used to connect two separate LAN networks. A computer can act as a bridge through the **operating system**. A bridge looks for the receiving device before it sends the message. This means that it will not send a message if the receiving computer is not there. It will check to see if the receiver has already had the message. This can help save unnecessary data transfers, which improves the performance of a network.



## Switches

A **switch** performs a similar role to a hub and a bridge but is more powerful. It stores the MAC addresses of devices on a network and filters data packets to see which devices have asked for them. This makes a switch more efficient when demand is high. If, for example, a game involved lots of data being passed between machines, then a switch could reduce the amount of latency.

## Wireless access points

**Wireless access points (WAPs)** are required to connect to a network wirelessly. WAPs are usually built into the broadband router.

## Device addresses

**Data packets** include the addresses of the devices they are going to and coming from. Computers need a **network interface card** to connect to a network. All devices on a network have a **MAC address**.

### MAC address

Every piece of **hardware** on a network has a unique **MAC address**. This is embedded in the hardware when the product is made in the factory, and the user cannot change it. On a computer, the MAC address is a unique code built into a NIC. No two computers have the same MAC address. A MAC address is made up of 48 **bits** of data, usually written as 12 **hexadecimal** characters.

## Network interface card (NIC)

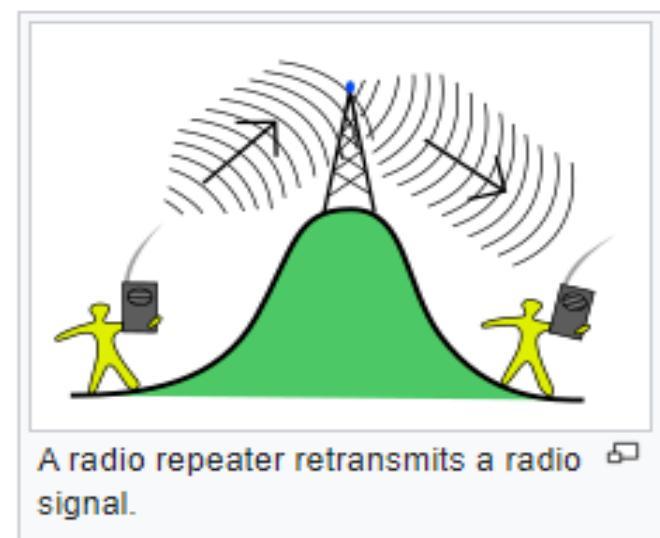
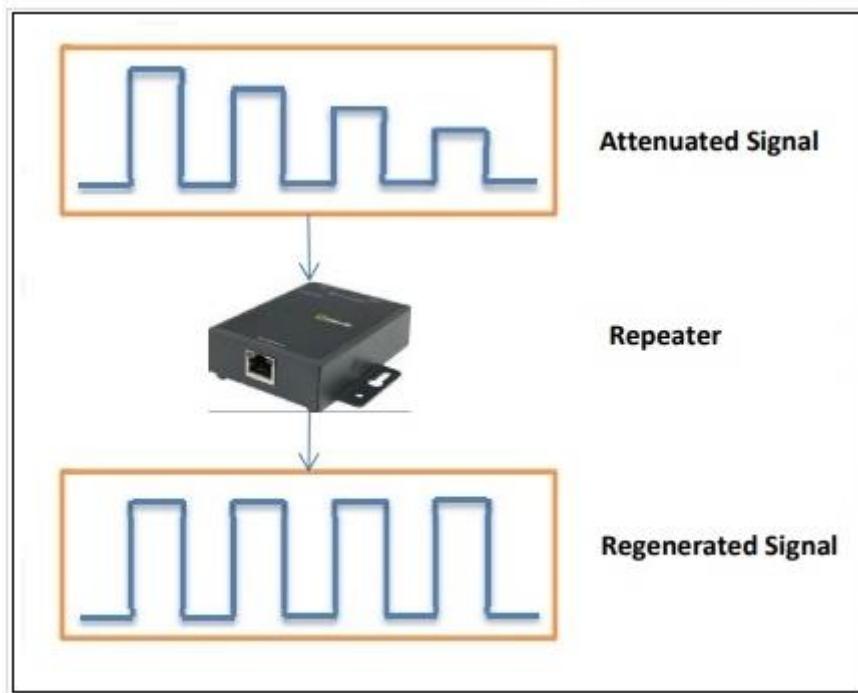
NICs enable desktop and laptop computers to connect to a network. NICs are small circuit boards that connect to the **motherboard**. **Smartphones** also use a **GSM** chip to connect to the telephone network. Games consoles contain a NIC card so users can access the internet, download games and play online.



## What is a **repeater** in computer network?

A repeater is an electronic device in a communication channel that increases the power of a signal and retransmits it, allowing it to travel further.

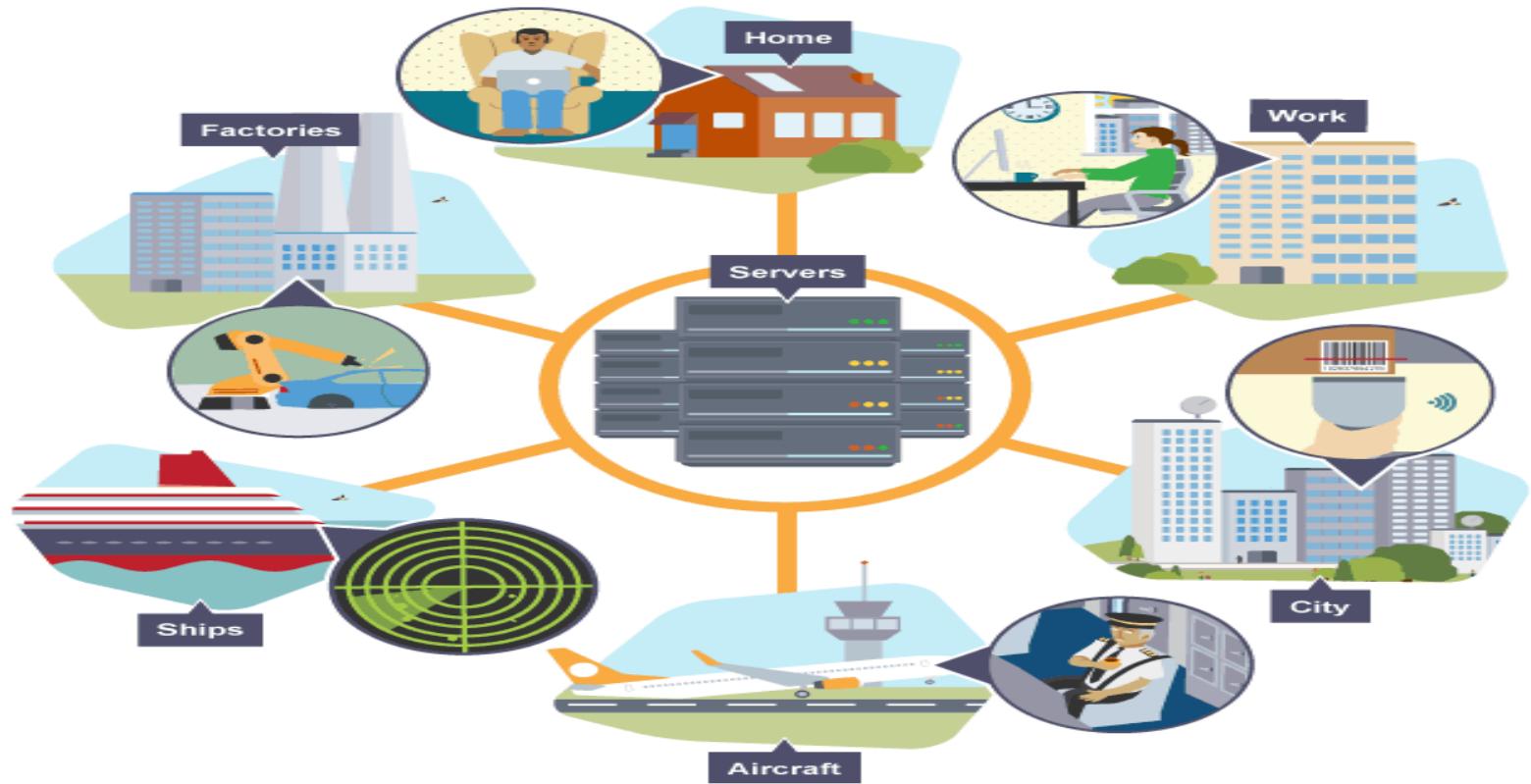
They are incorporated in networks to expand its coverage area. They are also known as signal boosters.



# Server:

## Servers

A **server** stores data to be used by other computers on a network. A server could be a specialised machine or it can be a normal **PC** running server **software**. The server stores data and responds to requests for data or files such as web pages.



# Server

## **Types of server**

There are many different types of server. Some popular examples follow.

### **Web servers**

Web servers host websites and generally handle requests for static information such as **HTML** pages or images. They are used to manage the website on the server and often include **FTP** software, which can easily host and share large files. The Apache web server is a popular type of **open source** web server software.

### **Application servers**

Many websites are classed as **web applications** which contain programming and scripts which are more complex than a static HTML page. For example, many websites use databases held in **MySQL** or **NoSQL** databases which will be accessed via the application server. The application server is generally used to organise and run the web application. A client sends requests to the web server which sends requests to the application server.

# Server

## **Network attached storage (NAS)**

This is a server dedicated to storing and sharing files. It is useful for storing large files, such as music and video, but it is not used for storing websites.

## **Print servers**

These make it easy for various devices to connect to a printer. This removes the need for devices to install the printer **driver** software or connect to the printer using cables.

## **Mail server**

These store email messages. Your browser makes request to mail servers to retrieve the messages.

## What is the role of a wireless **access point WAP** )?

A wireless access point (WAP) is a **networking device that allows wireless-capable devices to connect to a wired network**. It is simpler and easier to install WAPs to connect all the computers or devices in your network than to use wires and cables



## What is Ethernet and why it is used?

**Ethernet** is the traditional technology for connecting devices in a wired local area network (LAN) or wide area network (WAN), enabling them to communicate with each other via a protocol -- a set of rules or common network language.



## **Advantages and disadvantages**

Ethernet has many benefits for users, which is why it grew so popular. However, there are a few disadvantages as well.

## What is Ethernet and why it is used?

### Advantages

relatively low cost;  
backward compatibility;  
generally resistant to noise;  
good data transfer quality;  
speed;  
data security -- common firewalls can be used.

### Disadvantages

It is intended for smaller, shorter distance networks.

Mobility is limited.

Use of longer cables can create crosstalk.

It does not work well with real-time or interactive applications.

Increased traffic makes the Ethernet speed go down.

Receivers do not acknowledge the reception of data packets.

When troubleshooting, it is hard to trace which specific cable or node is causing the issue.

## LAN Hardware: Bridge

### Network Devices Explained Hub, Bridge, Router, Switch

## LAN Hardware: Ethernet Switch

### Hub, Switch, & Router Explained - What's the difference?

## LAN Hardware: Ethernet Switch

### What Is an Ethernet Switch??

## LAN Hardware: Repeater

### What is a Repeater ?

## Internet support infrastructure

- Public switched telephone network (PSTN):

Public Switched Telephone Network or PSTN is a telephone service that connects various residents and businesses through underground copper wires.



Public Switched Telephone Network (PSTN ...)

## Ethernet

- **Used CSMA/CD to minimise the effect of collisions.**

Carrier-sense multiple access with collision detection (CSMA/CD) is a media access control (MAC) method used most notably in early Ethernet technology for local area networking. It uses carrier-sensing to defer transmissions until no other stations are transmitting. This is used in combination with collision detection in which a transmitting station detects collisions by sensing transmissions from other stations while it is transmitting a frame. When this collision condition is detected, the station stops transmitting that frame, transmits a jam signal, and then waits for a random time interval before trying to resend the frame.

## Ethernet

- Used CSMA/CD to minimise the effect of collisions.

<https://www.youtube.com/watch?v=iKn0GzF5-IU>

# Bit streaming

## What is a bit stream?

A bit stream is a continuous flow of bits over a communication path. This path can be within the computer itself, across computer networks from a source computer (usually some sort of server) to a destination computer. We will be focusing on network bit streams and two ways in which they can be handled.

## IP address:

### Public IP Addresses:

Each LAN connected to the internet usually has a single public IP Address\*. This is the address seen by other computers and networks on the Internet and is the address attached to packets sent across the Internet.

There are 2 main types of Public IP Addresses: Static and Dynamic

\* For larger organizations they might have a whole IP range issued to them instead, depending on what kind of network address translation (NAT) they are using.

Public addresses are usually assigned by your ISP.

## IP address:

### Private IP Addresses:

Computers within a LAN have their own private IP Address, that is different to their Public IP Address. This private IP Address is either:

Issued by the Server / Router using Dynamic Host Configuration Protocol (DHCP)

Set manually by the computer user themselves.

Private IP addresses are usually in the 192.168.x.x range though can also be in the 10.x.x.x and 172.x.x.x

Lower bound	Upper bound
10.0.0.0	10.255.255.255
172.16.0.0	172.31.255.255
192.168.0.0	192.168.255.255

Table 2.03 IPv4 addresses to be used in private networks

## IP address:

### Static Public IP Addresses:

These are mainly used by:

Businesses with LANs that need to be accessed externally from the internet

Website Hosts

Gamers who want the fastest, most reliable internet service.

Static IP addresses stay the same, which mean that data is always sent in the most efficient manner. However a static IP address opens your network up to attackers

## IP address:

### Dynamic Public IP addresses:

Most home internet users are issued with a dynamic public IP address when their router connects to the internet and the IP address lease is renewed every month or so. Each time it is renewed a new IP Address is drawn from the pool.

This sharing of IP addresses allows the internet to continue to function even when there are more devices in the world than there are available IP addresses (4 billion different ip addresses are available in total for IPV4 addresses). It is also potentially harder to hack as a network's IP address is constantly changing.

The limited number of addresses available on the internet using IPV4 led to the development of IPV6, though this technology is still in the process of being rolled out...

## IP address:

### IPv4

IPv4 is a 32 bit address split into 4 sections

e.g. 255.255.255.255

Range 0 – 255 (256 Possibilities in each)

Total addresses =  $256 \times 256 \times 256 \times 256 = 4.3$  Billion.

4.2 Billion Addresses is not enough for the modern world as the world has 7 Billion plus inhabitants and many people have more than one internet connected device.

Class	Class identifier	Number of bits for netID	Number of bits for hostID
Class A	0	7	24
Class B	10	14	16
Class C	110	21	8

Table 2.02 Address structure for three classes of IPv4 address

## IP address:

### IPv6

IPv6 is 128 Bit Address,  
340,282,366,920,938,463,463,374,607,431,768,211,456 Addresses.

IPv6 addresses are represented as eight groups, separated by colons, of four hexadecimal digits. The full representation may be shortened; for example, 2001:0db8:0000:0000:8a2e:0370:7334 becomes 2001:db8::8a2e:370:7334.

Probably enough for the foreseeable future.

### Advantages

Future proof – plenty of unique addresses for each device.

Security built in to the profile

Allows for QOS packet prioritizing.

### Disadvantages

A bit more overhead in packet size

Many legacy devices and systems still don't fully support IPv6 so we still need IPv4 backup.

# IP address:

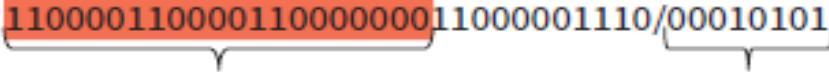
## IPv6

IPv6 address	Comment
68E6:7C48:FFFE:FFFF:3D20:1180:695A:FF01	A full address
72E6:CFFE:3D20:1180:295A:FF01	:0000:0000: has been replaced by ::
6C48:23:FFFE:FFFF:3D20:1180:95A:FF01	Leading zeros omitted
::192.31.20.46	An IPv4 address used in IPv6

Table 2.04 Some examples of IPv6 addresses

## Classless inter-domain routing (CIDR)

The first approach developed for improving the addressing scheme is called ‘classless inter-domain routing’ (CIDR). This retains the concept of a netID and a hostID but removes the rigid structure and allows the split between the netID and the hostID to be varied to suit individual need. The simple method used to achieve this is to add an 8-bit suffix to the address that specifies the number of bits for the netID. If, for instance, we define the suffix as 21, that means that 21 bits are used for the netID and there are 11 bits remaining (of a 32-bit address) to specify hostIDs allowing  $2^{11}$  (i.e. 2048) hosts. One example of an IP address using this scheme is shown in Figure 2.10. The 21 bits representing the netID have been highlighted. The remaining 11 bits represent the hostID which would therefore have the binary value 11000001110.

Binary code:   
The binary address is 110000110000110000000011000001110/00010101. A red bracket underlines the first 21 bits (1100001100001100000000) and a blue bracket underlines the last 11 bits (11000001110). Below the address, the red bracket is labeled 'netID' and the blue bracket is labeled 'suffix'.

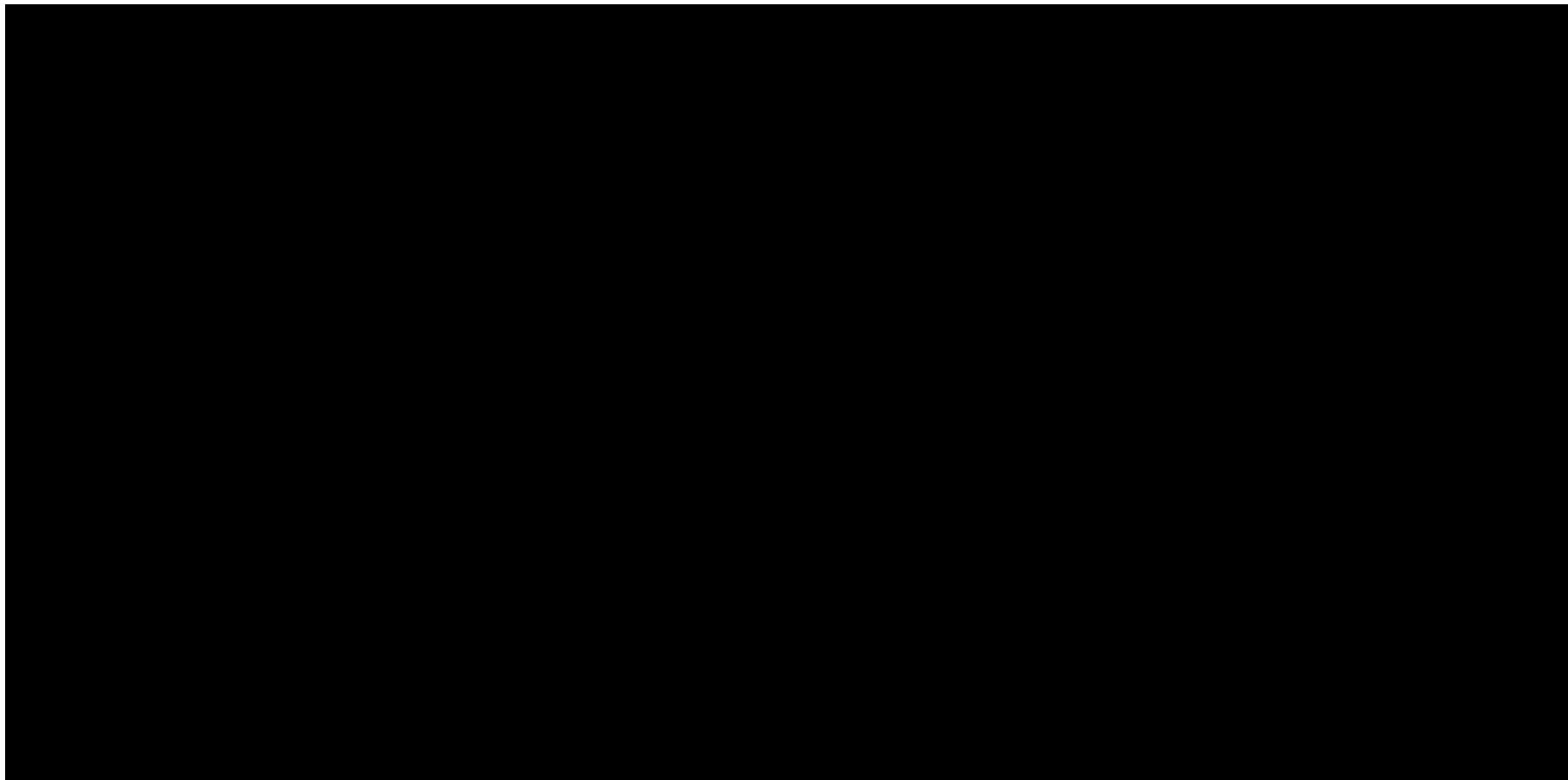
Dotted decimal notation: 195.12.6.14/21

Figure 2.10 A CIDR IPv4 address

Note that with this scheme there is no longer any need to use the most significant bit or bits to define the class. However, it does allow already existing Class A, B or C addresses to be used with suffixes 8, 16 or 24, respectively.

## What is IP address and types of IP address-IPv4 and IPv6

<https://www.youtube.com/watch?v=8npT9AALbri>



## IP addressing

- The original, and still most widely used, version is IPv4
- An address has 32 bits (four bytes)
- Hierarchical addressing defines a netID and a hostID
- As first implemented addresses were assigned on the basis of classes of networks
- Class A, B, C addresses start 0, 10, 110
- IPv6 uses 128 bits

## IP addressing

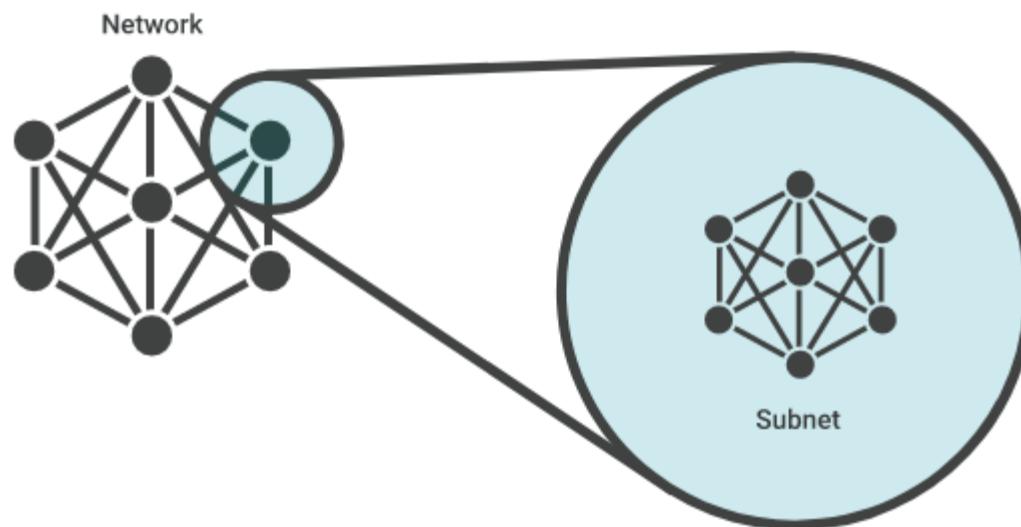
The table below lists the number of netids and hostids available for each IP address class.

Class	Number of network addresses	Number of host addresses
A	$2 - 2 (126)$	$2 - 2 (16,777,214)$
B	$2 - 2 (16,384)$	$2 - 2 (65,534)$
C	$2 - 2 (2,097,152)$	$2 - 2 (154)$

## Subnetting:

### What is a subnet?

A subnet, or subnetwork, is a [network](#) inside a network. Subnets make networks more efficient. Through subnetting, network traffic can travel a shorter distance without passing through unnecessary [routers](#) to reach its destination.



## Summary:

### **Summary**

- Client-server and peer-to-peer networking are options for file sharing.
- The star topology is the one most commonly used for a LAN.
- The main transmission media are copper (twisted pair, coaxial) cables, fibre-optic cables and wireless (radio, microwave, infrared).
- Factors to consider when choosing a medium are bandwidth, attenuation, interference and the need for repeaters.
- CSMA/CD (carrier sense multiple access with collision detection) has been used to detect and avoid message collisions in shared media.
- The Internet is the largest internetwork in existence.
- ISPs provide access to the Internet.
- Internet infrastructure is supported by PSTNs and cell phone companies.
- The World Wide Web is a distributed application accessible on the Internet.
- The current Internet addressing scheme is IPv4, with IPv6 a future contender.
- The DNS resolves a domain name to an IP address.

# AS Level Past Exam: Question 1

(a) Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) system) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		
dedicated channel used between two points for the duration of the call		
connection maintained throughout the telephone call		
encoding schemes and compression technology used		
lines remain active even during a power outage		

## AS Level Past Exam: Question 1

- (b) Distinguish between the Internet and the World Wide Web (WWW).

.....  
.....  
.....  
.....  
.....  
.....  
.....

[3]

- (c) Name the hardware device that is being described:

- (i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

..... [1]

- (ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

..... [1]

- (iii) A device or software that provides a specific function for computers using a network. The most common examples handle printing, file storage and the delivery of web pages.

..... [1]

# AS Level Past Exam: Answer 1

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		✓
dedicated channel used between two points for the duration of the call	✓	
connection maintained throughout the telephone call	✓	
encoding schemes and compression technology used		✓
lines remain active even during a power outage	✓	

[5]

# AS Level Past Exam: Answer 1

(b) **maximum of two marks** for Internet references and **maximum of two marks** for world wide web references

## Internet

- massive network of networks/interconnected network of computer devices
  - Internet stands for Interconnected Networks
  - uses TCP/IP protocol

## **World Wide Web (www)**

- is a collection of (multimedia) web pages/documents
  - ...stored on websites
  - http/protocols used to transmit data
  - web pages are written in HTML
  - URLs specify the location of the web pages
  - web documents are accessed using browsers

[3]

(c) (i) router

[1]

(ii) gateway

[1]

(iii) server

[1]

## AS Level Past Exam: Question 2

- 1 (a) Explain the term bit streaming.

.....  
.....  
.....  
.....

[2]

- (b) A person watches a film streamed from a website on a tablet computer.

- (i) Give two benefits of using bit streaming for this purpose.

1 .....

.....

2 .....

.....

[2]

## AS Level Past Exam: Question 2

- (ii) State **two** potential problems of using bit streaming for this purpose.

1 .....

.....

2 .....

.....

[2]

- (c) Explain the terms on-demand bit streaming and real-time bit streaming.

.....

.....

.....

.....

.....

## AS Level Past Exam: Answer 2

1 (a) any two from:

- sequence of digital signals / bits
- over a communication path / Internet
- transfer of data at high speed
- requires fast broadband connection
- requires some form of buffering
- bits arrive in the same order as sent

[2]

(b) (i) any two from:

- no need to wait for a whole file to be downloaded
- no need to store large files on user's computer
- allows on demand playback
- no specialist software is required for playback in browser

[2]

(ii) any two from:

- video stops / hangs if very slow Internet / broadband speed low
- video stops / hangs if inadequate buffering capacity
- loss of Internet means can't access films / files
- may require specific software to run the files / films
- viruses can be downloaded from the websites

[2]

## AS Level Past Exam: Answer 2

(c) 2 marks for on-demand and 2 marks for real-time

### **on-demand**

- digital video tape, analogue video tape, or digital files are converted to bit streaming – format for broadcasting on the net; this is known as encoding, these encoded streaming video files are then uploaded to a dedicated server
- a link for the encoded video is placed on a web site
- a user clicks on the link to download the encoded streaming video; the streamed video is then broadcast to the user as and when they require it
- can be paused / can go back and re-watch / fast-forward, etc.

### **real-time**

- an event is captured live with a video camera
- the video camera is connected to a computer
- the video signal is converted to streaming media files (encoded) on the computer
- the encoded feed is then uploaded from the computer to a dedicated streaming server via cable, DSL, or a high-speed internet connection
- the server then sends the live images it to all users requesting it as real-time video streaming
- cannot be paused etc.

[4]

## AS Level Past Exam: Question 3

3 (a) The table shows four statements about IP addresses.

Tick (✓) to show which of the statements are true.

Statement	True (✓)
The IP address consists of any number of digits separated by single dots (.)	
Each number in an IP address can range from 0 to 255	
IP addresses are used to ensure that messages and data reach their correct destinations	
Public IP addresses are considered to be more secure than private IP addresses	

[2]

## AS Level Past Exam: Question 3

(b) Consider the URL:

<http://cie.org.uk/computerscience.html>

(i) Give the meaning of the following parts of the URL.

http .....

.....

.....

.....

.....

.....

[3]

(ii) Sometimes the URL contains the characters %20 and ?.

Describe the function of these characters.

%20 .....

.....

? .....

.....

[2]

# AS Level Past Exam: Answer 3

3 (a)

Statement	True (✓)
The IP address consists of any number of digits separated by single dots (.)	
Each number in an IP address can range from 0 to 255	✓
IP addresses are used to ensure that messages and data reach their correct destinations	✓
Public IP addresses are considered to be more secure than private IP addresses	

accept words TRUE or FALSE in right hand column

1 mark per tick, -1 mark for each wrong tick if more than 2

[2]

- (b) (i) http – enables browser to know what protocol is being used to access information in the domain

cie.org.uk – cie.org.uk is the domain name

computerscience.html – actual web page / file being viewed

[3]

- (ii) %20 – because <space> not allowed in a URL, %20 is the coding for a space (32 in denary)

? – separates the URL from all parameters or variables

[2]

## AS Level Past Exam: Question 4

9 (a) An IP address has the following value:

**11.64.255.90**

(i) Write the above IP address in hexadecimal.

..... [4]

(ii) Explain the format of an IP address.

.....

.....

.....

..... [2]

## AS Level Past Exam: Question 4

(b) Study the following sentence:

“When a user enters a URL into their web browser, the DNS service locates the required resource.”

Explain how a URL and DNS are used to locate a resource.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

[4]

## AS Level Past Exam: Answer 4

9 (a) (i) 0B . 40 . FF . 5A

1 mark per byte, deduct one mark if no dots or if alternative separator used

[4]

(ii) Any two from:

- composed of four (denary or Hexadecimal) integers
- each in the range 0–255/00–FF
- each stored in 1 byte/8 bits/stored in 32 bits
- (in IPv4) separated into network ID and host ID

[2]

(b) Maximum 3 marks for URL and maximum 3 marks for DNS

- URL = uniform resource locator
- reference address to a resource/website on the Internet
- includes protocol used /includes domain name
- browser software sends URL to DNS
- DNS = Domain name system // Domain name service // Domain name server
- the true domain name (e.g. cie\_exams.co.uk) is resolved/turned into an IP address by DNS
- DNS server stores a database/list of URLs with matching IP address
- a DNS server may need to pass a request onto another DNS server, (if URL not in its database)
- DNS server adds returned IP address and URL to its cache/database
- DNS server may return an error message if requested domain name is invalid or does not exist
- the DNS service has a hierarchy/or by example
- DNS server returns IP address to browser

[4]

## AS Level Past Exam: Question 5

7 Access to World Wide Web content uses IP addressing.

(a) State what IP stands for.

..... [1]

(b) The following table shows four possible IP addresses.

Indicate for each IP address whether it is valid or invalid and give a reason.

Address	Denary / Hexadecimal	Valid or Invalid	Reason
3 . 2A . 6AA . BBBB	Hexadecimal		
2 . 0 . 255 . 1	Denary		
6 . 0 . 257 . 6	Denary		
A . 78 . F4 . J8	Hexadecimal		

## AS Level Past Exam: Question 5

(c) Describe **two** differences between public and private IP addresses.

1 .....

.....

2 .....

..... [2]

# AS Level Past Exam: Answer 5

7 (a) Internet Protocol

[1]

(b)

[4]

Address	Denary / Hexadecimal	Valid or Invalid	Reason
3 . 2A . 6AA . BBBB	Hexadecimal	Invalid	<p>One point from:</p> <ul style="list-style-type: none"> <li>• This is more than <u>32 bits</u></li> <li>• <u>6AA / BBBB</u> in Hex is bigger than <u>FF / 255</u> in denary</li> <li>• <u>6AA / BBBB</u> uses more than 8 bits / a byte</li> <li>• The third / fourth group is bigger than <u>FF / 255</u> in denary</li> <li>• The third / fourth group uses more than 8 bits / a byte</li> </ul>
2 . 0 . 255 . 1	Denary	Valid	There are 4 bytes, each 255 or below // All the values are in the range 0 - 255
6 . 0 . 257 . 6	Denary	Invalid	<u>257</u> is above 255 // The third group is above 255
0A . 78 . F4 . J8	Hexadecimal	Invalid	J is not a valid hexadecimal digit // J8 is not a valid Hex number

One mark for each combination of valid or invalid and the reason.

## AS Level Past Exam: Answer 5

(c) Two points from:

[2]

- Public address can be reached across the Internet.
- Private address can only be reached internally/through the LAN/Intranet // private address cannot be reached across the Internet.
- NAT (Network Address Translation) is necessary for a private IP address to access the Internet directly.
- A private address is more secure than a public address // A public address is less secure than a private address.
- Public addresses are provided by ISP / assigned by InterNIC // Private addresses are assigned by the router (of the network concerned).
- Public addresses are unique (to the Internet) // Private addresses (are unique within their network, but) can be duplicated within other (discrete) networks.
- 10.0.0.1 to 10.255.255.254 and 172.16.0.1 to 172.31.255.254 and 192.168.0.1 to 192.168.255.254 form the private address space // IP addresses from the private address space are never assigned as public.

## AS Level Past Exam: Question 6

- 6 (a) Explain the difference between the World Wide Web (WWW) and the Internet.

.....  
.....  
.....  
.....

[2]

- (b) Three methods of connecting devices include fibre-optic cables, copper cables and radio waves. The table below gives descriptions relating to these connection methods.

Tick () one box on each row to show the method that best fits each description.

Description	Fibre-optic cable	Copper cable	Radio waves
Wireless medium			
Twisted-pair is an example			
Uses light waves			
WiFi			
Fastest transmission medium			

[5]

## AS Level Past Exam: Question 6

- (c) Bit streaming is used for both real-time and on-demand services.

Describe **one** difference between real-time and on-demand bit streaming.

.....  
.....  
.....  
.....

[2]

- (d) A device needs an IP address to connect to the Internet. IPv4 is the more common type of IP address.

Describe, using an example, the format of an IPv4 address.

.....  
.....  
.....  
.....  
.....  
.....

[3]

## AS Level Past Exam: Question 6

- (e) A computer user keys in the Uniform Resource Locator (URL) of a web page into a web browser.

Describe how the browser uses the Domain Name Service (DNS) to display the web page.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

[4]

## AS Level Past Exam: Answer 6

6 (a) Two from:

[2]

- WWW is a collection of interlinked, hypertext documents/webpages/multimedia resources (accessed via the Internet) //WWW is content from web servers organised as web pages
- Internet is the global connection of interconnected computer networks
- The Internet uses TCP/IP protocol / WWW uses http protocols to transmit data

(b)

[5]

Description	Fibre-Optic cables	Copper cables	Radio waves
'Wireless' media			✓
Twisted-pair is an example		✓	
Uses light waves	✓		
WiFi			✓
Fastest transmission media	✓		

## AS Level Past Exam: Answer 6

(c) One pair from:

[2]

- Real-time - a live stream of an event that is currently taking place
- On-demand - streaming of an event/programme that has taken place in the past
- Real time – the event is captured live with a video camera connected to a computer
- On-demand – Existing media are encoded to bit streaming format and uploaded to a server
- Real-time – cannot be paused / rewound etc
- On-demand – can be paused / re-wound / fast forwarded etc

(d) Two marks for description, one mark for correct example.

[3]

- Four numbers separated with ‘:’
- Each number is between 0 and 255 / 00 and FF in Hex / stored in one byte.
- 32 bits long
- Correct example

## AS Level Past Exam: Answer 6

(e) Four from:

[4]

- URL is a reference address to a resource on the Internet.
- The URL is passed to the nearest Domain Name Server (by browser software).
- DNS server stores a database / list of URLs and matching IP addresses.
- DNS (Name Resolver) looks for the URL in its database.
- Finds the matching IP address and returns it to the originator.
- Or if it cannot find it, it forwards to another Domain Name Server at a higher level.
- (Original) DNS server adds the returned IP address to its cache.
- (Original) DNS server returns the IP address to the browser.

# AS Level Past Exam: Question 7

- 6 A user watches a video available on a website. The website uses on-demand bit streaming.

Describe how it is possible to watch the video without it continually pausing.

..[4]

## AS Level Past Exam: Answer 7

6 Any four from:

- User needs high-speed broadband (connection)
- Data is streamed to a buffer (in the computer)
- Buffering stops video pausing as bits streamed
- As buffer is emptied, it fills up again so that viewing is continuous
- Actual playback is (a few seconds) behind the time the data is received by computer

[4]

## AS Level Past Exam: Question 8

- 1 Four communication media and five features are shown.

Draw one or more lines from each communication media to the appropriate feature(s).

### Communication media

Fibre-optic cable

Radio waves

Copper cable

Satellite

### Feature

Can be twisted pair or co-axial

Transmits light pulses

Large range of wavelengths

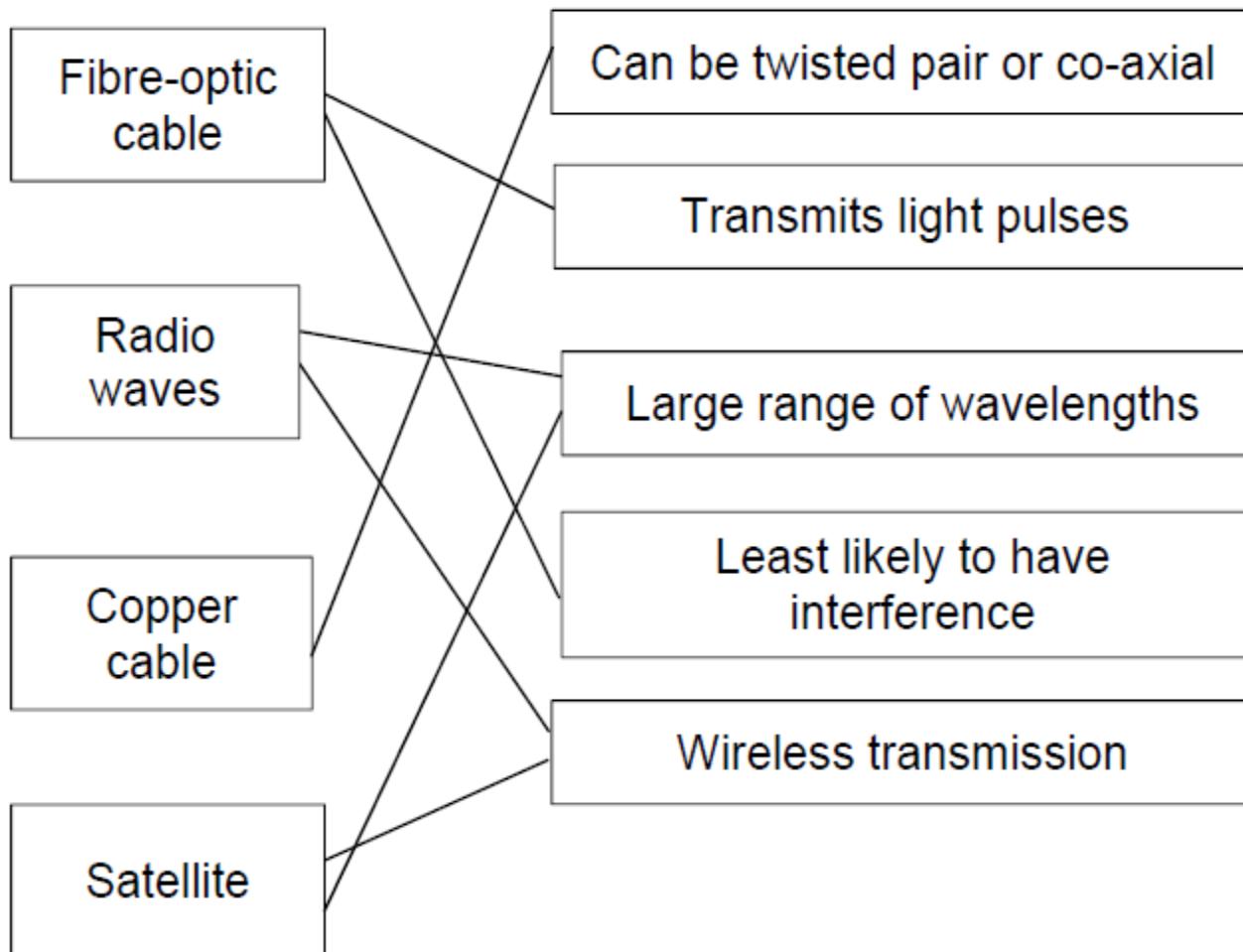
Least likely to have interference

Wireless transmission

[6]

## AS Level Past Exam: Answer 8

1 mark for a correct line from each communication media, max 6



## AS Level Past Exam: Question 9

2 Computer **A** needs to access a web page.

- (a) State how Computer **A** could access the web page without using a Domain Name Service (DNS).

.....  
.....

[1]

- (b) (i) The following table shows four IPv6 addresses.

State if each address is valid or invalid.

IP address	Valid or invalid
21E5:69AA:FFFF:1:E100:B691:1285:F56E	
::255.255.255.255	
59FB::1005:CC57:6571	
56FE::2159:5BBC::6594	

[4]

## AS Level Past Exam: Question 9

- (ii) The following table shows four statements about either public or private IP addresses.

Tick () **one** box in each row to indicate whether each statement refers to a public or a private IP address.

Statement	Public	Private
192.168.2.1 is an example of this type of address		
Assigned by the Internet Service Provider (ISP)		
IP address cannot be duplicated in different networks		
Network Address Translation (NAT) is necessary to access the Internet directly		

[4]

- (c) One type of transmission media is copper cable.

Give **two** additional types of transmission media.

1 .....

2 .....

[2]

# AS Level Past Exam: Answer 9

Question	Answer	Marks										
2(a)	Use the IP address instead of the URL	1										
2(b)(i)	1 mark per correct answer	4										
	<table border="1"><thead><tr><th>IP Address</th><th>Valid or invalid</th></tr></thead><tbody><tr><td>21E5:69AA:FFFF:1:E100:B691:1285:F56E</td><td>Valid</td></tr><tr><td>::255.255.255.255</td><td>Valid</td></tr><tr><td>59FB::1005:CC57:6571</td><td>Valid</td></tr><tr><td>56FE::2159:5BBC::6594</td><td>Invalid</td></tr></tbody></table>	IP Address	Valid or invalid	21E5:69AA:FFFF:1:E100:B691:1285:F56E	Valid	::255.255.255.255	Valid	59FB::1005:CC57:6571	Valid	56FE::2159:5BBC::6594	Invalid	
IP Address	Valid or invalid											
21E5:69AA:FFFF:1:E100:B691:1285:F56E	Valid											
::255.255.255.255	Valid											
59FB::1005:CC57:6571	Valid											
56FE::2159:5BBC::6594	Invalid											

# AS Level Past Exam: Answer 9

2(b)(ii)	<p>1 mark per correct row</p> <table border="1"><thead><tr><th>Statement</th><th>Public</th><th>Private</th></tr></thead><tbody><tr><td>192.168.2.1 is an example of this type of address</td><td></td><td>✓</td></tr><tr><td>Assigned by the Internet Service Provider (ISP)</td><td>✓</td><td></td></tr><tr><td>IP address cannot be duplicated in different networks</td><td>✓</td><td></td></tr><tr><td>Network Address Translation (NAT) is necessary to access the Internet directly</td><td></td><td>✓</td></tr></tbody></table>	Statement	Public	Private	192.168.2.1 is an example of this type of address		✓	Assigned by the Internet Service Provider (ISP)	✓		IP address cannot be duplicated in different networks	✓		Network Address Translation (NAT) is necessary to access the Internet directly		✓	4
Statement	Public	Private															
192.168.2.1 is an example of this type of address		✓															
Assigned by the Internet Service Provider (ISP)	✓																
IP address cannot be duplicated in different networks	✓																
Network Address Translation (NAT) is necessary to access the Internet directly		✓															
2(c)	<p>1 mark per example to max 2</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Fibre-optic</li><li><input type="checkbox"/> Wi-Fi / Radio waves</li><li><input type="checkbox"/> Microwave</li><li><input type="checkbox"/> Infrared</li></ul>	2															

## AS Level Past Exam: Question 10

2 Gopal types the Uniform Resource Locator (URL) of a website into a web browser.

(a) The following sequence (1 to 5) describes the steps that take place. There are three missing statements.

1 Gopal types into the web browser.

2 .....

3 DNS looks up the URL in table

4 .....

5 .....

Three statements **A**, **B** and **C** are used to complete the sequence.

<b>A</b>	DNS finds corresponding IP address
<b>B</b>	Web browser sends URL to Domain Name Service (DNS)
<b>C</b>	DNS returns IP address to web browser

Write one of the letters **A** to **C** in the appropriate rows (2, 4 and 5) to complete the sequence.

[2]

## AS Level Past Exam: Question 10

- (b) Describe the purpose of an IP address.

---

---

---

[2]

- (c) A telecommunications operator has installed fibre-optic cables in Gopal's neighbourhood.

- (i) Give **three** benefits of fibre-optic cable over copper cable.

1 .....

---

2 .....

---

3 .....

---

[3]

## AS Level Past Exam: Question 10

(ii) Give **two** drawbacks of fibre-optic cable over copper cable.

1 .....

2 .....

[2]

# AS Level Past Exam: Answer 10

Question	Answer	Marks
2(a)	<p>1 mark for 1 correct answer, 2 marks for all 3 correct answers</p> <p>1 Gopal types into the web browser 2 B (Web browser sends URL to Domain name Service (DNS)) 3 DNS looks up URL in a table 4 A (DNS finds corresponding IP address) 5 C (DNS returns IP address to web browser)</p>	2

# AS Level Past Exam: Answer 10

Question	Answer	Marks
2(b)	<p><b>1 mark per bullet point to max 2</b></p> <ul style="list-style-type: none"> <li>• Gives each device on a network an identifier // IP address used to locate a device on a network</li> <li>• Each address is <u>unique</u> within the network</li> <li>• Allows a device/gateway/node to send data to the correct destination / a specific device/gateway/node</li> </ul>	2
2(c)(i)	<p><b>1 mark per bullet point to max 3</b></p> <ul style="list-style-type: none"> <li>• Less interference in signal</li> <li>• Signal does not degrade as fast // Needs less signal boosting</li> <li>• More difficult to hack // more secure</li> <li>• Greater bandwidth // <u>Faster</u> transmission speeds possible</li> </ul>	3
2(c)(ii)	<p><b>1 mark per bullet point to max 2</b></p> <ul style="list-style-type: none"> <li>• (Initial) installation cost is higher // Cable / hardware is more expensive to buy (per metre)</li> <li>• Specialists / trained personnel needed to install / maintain</li> <li>• Difficult to terminate // Electronics at both ends are more complex</li> <li>• Fibre-optic cables can break <u>when bent</u></li> <li>• Only transmits data in one direction</li> <li>• If a fibre-optic cable connection fails, many more services can be affected</li> </ul>	2

## AS Level Past Exam: Question 11

4 Ava needs to view a website and she knows the Uniform Resource Locator (URL).

(a) Complete the series of steps that take place.

Write the **letter** of the appropriate statement in each space.

A	DNS finds corresponding IP
B	DNS looks up URL in table
C	Ava types the URL into a web browser

1 .....

2 Web browser sends URL to Domain Name Service (DNS)

3 .....

4 .....

5 DNS returns IP address to web browser

[2]

## AS Level Past Exam: Question 11

- (b) (i) An IPv4 address has been entered as 12.258.3

Give **two** reasons why this IP address is invalid.

1 .....

.....

2 .....

.....

[2]

- (ii) An IPv6 address has been entered as 15EF:5L63::2014:BB::60AA

Give **two** reasons why this IP address is invalid.

1 .....

.....

2 .....

.....

[2]

## AS Level Past Exam: Question 11

(c) The table shows four descriptions of IP addresses.

Tick (**✓**) **one** box in each row to identify whether each description applies to a public or private IP address.

Description	Public	Private
The address can be reached over the Internet.		
The address is more secure.		
The address can only be accessed through the same LAN.		
The address can be duplicated in different networks.		

[4]

# IGCSE Past Exam: Answer 11

Question	Answer	Marks
4(a)	<p><b>1 mark for 1 letter in correct space</b> <b>2 marks for all 3 letters in correct places</b></p> <p>1   <b>C</b> 2   URL goes to Domain Name Service (DNS) 3   <b>B</b> 4   <b>A</b> 5   DNS returns IP address to client</p>	<b>2</b>
4(b)(i)	<p><b>1 mark per bullet point</b></p> <ul style="list-style-type: none"><li>• <b>258</b> is too large/largest individual numbers is 255</li><li>• 4 numbers needed/1 number missing/only 3 groups of numbers given</li></ul>	<b>2</b>

# AS Level Past Exam: Answer 11

Question	Answer	Marks															
4(b)(ii)	<p>1 mark per bullet point</p> <ul style="list-style-type: none"><li>• L not a valid hexadecimal number</li><li>• Only one double colon is allowed</li></ul>	2															
4(c)	<p>1 mark per row</p> <table border="1"><thead><tr><th>Description</th><th>Public</th><th>Private</th></tr></thead><tbody><tr><td>The address can be reached over the Internet.</td><td>✓</td><td></td></tr><tr><td>The address is more secure.</td><td></td><td>✓</td></tr><tr><td>The address can only be accessed through the same LAN.</td><td></td><td>✓</td></tr><tr><td>The address can be duplicated in different networks.</td><td></td><td>✓</td></tr></tbody></table>	Description	Public	Private	The address can be reached over the Internet.	✓		The address is more secure.		✓	The address can only be accessed through the same LAN.		✓	The address can be duplicated in different networks.		✓	4
Description	Public	Private															
The address can be reached over the Internet.	✓																
The address is more secure.		✓															
The address can only be accessed through the same LAN.		✓															
The address can be duplicated in different networks.		✓															

## AS Level Past Exam: Question 12

1 Devices connected to the Internet have IP (Internet Protocol) addresses.

(a) Three IPv4 addresses are given.

Circle either Valid or Invalid to indicate whether each address is valid or invalid. Explain your decision.

Address 1: **3A.21.2H.1**      Valid / Invalid

Explanation .....

.....

Address 2: **299.53.2.2**      Valid / Invalid

Explanation .....

.....

Address 3: **192.2.1.0**      Valid / Invalid

Explanation .....

.....

[3]

# AS Level Past Exam: Question 12

- (b) A website can be accessed using either the Uniform Resource Locator (URL) or the IP address.

Describe how a URL is converted into its matching IP address.

[3]

- (c) People use the Internet to stream media.

Complete the following statements by filling in the names of the missing methods of bit streaming.

..... bit streaming is used when watching a live stream of events that are currently taking place. The event is captured live with a video camera connected to a computer, and it cannot be paused or rewound.

..... bit streaming is used when watching an event that has taken place in the past. Existing media are encoded to bit streaming format and uploaded to a server. It can be paused and rewound.

[2]

# AS Level Past Exam: Question 12

- (d) A recording of a concert is stored as a file. The file is compressed using lossy compression before it is streamed to users.

(i) State why this file needs to be compressed.

[1]

(ii) Define the term **lossy compression**.

[1]

(iii) The file could be compressed using lossless compression.

Explain why lossy compression is a more appropriate compression technique than lossless for this file.

[21]

# AS Level Past Exam: Answer 12

Question	Answer	Marks
1(a)	<p>1 mark for each correct indication and explanation</p> <p><b>3A.21.2H.1</b> Invalid H is not a valid hexadecimal digit</p> <p><b>299.53.2.2</b> Invalid 299 is not in the correct range</p> <p><b>192.2.1.0</b> Valid Consists of four numbers in the range 0–255 separated by full stops</p>	3
1(b)	<p>1 mark per bullet point to max 3</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> URL is parsed to obtain the Domain name</li> <li><input type="checkbox"/> Domain name is sent to the nearest Domain Name Server (DNS)</li> <li><input type="checkbox"/> DNS holds a list of Domain names and matching IP addresses</li> <li><input type="checkbox"/> DNS name resolver searches its database for the Domain name</li> <li><input type="checkbox"/> If DNS does not find the Domain name, the request is forwarded to a higher level DNS</li> <li><input type="checkbox"/> If the Domain name is found, the IP address is returned</li> <li><input type="checkbox"/> If the Domain name is not found, the request is passed to a higher level server</li> <li><input type="checkbox"/> If the Domain name is finally not found, an error message is generated</li> </ul>	3

# AS Level Past Exam: Answer 12

1(c)	<p><b>1 mark for each correct term</b></p> <p>Real-time</p> <p>On-demand</p>	2
1(d)(i)	<p><b>1 mark per bullet point to max 1</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The data files are very large</li> <li><input type="checkbox"/> It would take a long time to send the uncompressed file // Compressed files will download faster</li> <li><input type="checkbox"/> A higher bandwidth would be needed to transmit the uncompressed file</li> </ul>	1
1(d)(ii)	<p><b>1 mark per bullet point to max 1</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Data is lost</li> <li><input type="checkbox"/> The decompressed file is not the same as the original</li> </ul>	1
1(d)(iii)	<p><b>1 mark per bullet point to max 3</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Lossy creates a smaller file than lossless // lossy compresses further than lossless</li> <li><input type="checkbox"/> The recording of the concert is a large file size and needs <u>significant</u> reduction in size</li> <li><input type="checkbox"/> Lossy removes detail which can be lost without people noticing</li> <li><input type="checkbox"/> By example e.g. reduction in sound quality <u>will not be noticed</u></li> </ul>	3

## AS Level Past Exam: Question 13

1 Computers on the Internet have IP addresses.

(a) IP addresses can be in either IPv4 or IPv6 format.

(i) Give an example of a valid IPv4 address.

.....  
..... [1]

(ii) State why there is a need for IPv6 addressing.

.....  
..... [1]

(iii) A computer's IPv6 address is:

C100:2235::1000:25AA:AA50

Explain why this IPv6 address would be an invalid IPv4 address.

.....  
.....  
.....  
..... [2]

## AS Level Past Exam: Question 13

- (b) A company has computers in two separate buildings that communicate using the Internet over a Public Switched Telephone Network (PSTN).

- (i) Describe the transmission of data using a PSTN.

.....  
.....  
.....  
.....

[2]

- (ii) The company wants to install a dedicated line between the two buildings.

Identify **one** benefit and **one** drawback of installing a dedicated line between the two buildings.

Benefit .....

.....  
.....

Drawback .....

.....  
.....

[2]

## **IGCSE Past Exam: Question 13**

- (c)** A network can use routers and gateways.

Explain the role of routers **and** gateways in a network.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

[4]

- (d)** The company has an email server.

Identify **three** other types of server.

1 .....  
2 .....  
3 .....

[3]

# IGCSE Past Exam: Answer 13

Question	Answer	Marks
1(a)(i)	<b>1 mark for any valid example</b>  e.g. 192.168.0.1	1
1(a)(ii)	<b>1 mark for correct answer</b>  The number of IP addresses needed will exceed the number available using IPv4.	1
1(a)(iii)	<b>1 mark per bullet point to max 2</b>  <ul style="list-style-type: none"><li>• Too many digits per group</li><li>• Too many groups of digits</li><li>• The address is more than 32 bits / 4 bytes</li><li>• Colons are used as separators</li></ul>	2

# AS Level Past Exam: Answer 13

1(b)(i)	<p>1 mark per bullet point to max 2</p> <ul style="list-style-type: none"><li>• The PSTN consists of many different types of communication lines</li><li>• Data is transmitted in both directions <u>at the same time</u> // (full) <u>duplex</u> data transmission</li><li>• The communication passes through different switching centres</li></ul>	2
1(b)(ii)	<p>1 mark for benefit, 1 mark for drawback</p> <p><b>Benefit</b></p> <ul style="list-style-type: none"><li>• (Probably) faster connection / communication / transmission of data</li><li>• (Usually) more consistent transmission speed</li><li>• Improved security</li></ul> <p><b>Drawback</b></p> <ul style="list-style-type: none"><li>• Expensive to <u>set-up</u> / maintain</li><li>• Disruption to the dedicated line would leave no alternative</li></ul>	2

## AS Level Past Exam: Question 14

- 2 Yvette runs a company that books walking holidays for groups of people. She has a website that customers use to book the holidays.
- (a) The website has a URL and an IPv6 address.

Describe, using an example, the format of an IPv6 address.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

[4]

## AS Level Past Exam: Question 14

- (b) An IP address can be static or dynamic. Describe static and dynamic IP addresses.

Static .....

.....

.....

Dynamic .....

.....

.....

[4]

- (c) Yvette's company has a LAN (Local Area Network) that has hybrid topology.

- (i) Describe the characteristics of a LAN.

.....

.....

.....

.....

[2]

# AS Level Past Exam: Question 14

- (ii) The LAN has a range of different topologies. One subnetwork connects four computers and one server set up as a star topology.

Describe how packets are transmitted between two of the computers in this subnetwork.

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---

[3]

## AS Level Past Exam: Question 14

(d) The LAN has both wired and wireless connections.

(i) Ethernet cables connect the computers to the server.

Identify **three** other hardware components that might be used to set up the LAN.

1 .....

.....

2 .....

.....

3 .....

[3]

(ii) Describe how Carrier Sense Multiple Access/Collision Detection (CSMA/CD) manages collisions during data transmission.

.....

.....

.....

.....

[3]

# AS Level Past Exam: Answer 14

Question	Answer	Marks	Guidance
2(a)	<p>1 mark per bullet</p> <ul style="list-style-type: none"><li>• A set of 8 numbers</li><li>• Each number is 4 hexadecimal digits</li><li>• Separated by colons:</li><li>• Valid example e.g. 12F3:2356:AB12:2015:0000:0000:1234:5123</li></ul>	4	Allow valid examples such as 12F3:2356:AB12:2015:: where :: designates 0 for remaining spaces

# AS Level Past Exam: Answer 14

Question	Answer	Marks	Guidance
2(b)	<p>1 mark per bullet to max 2 for static, max 2 for dynamic</p> <p>Static:</p> <ul style="list-style-type: none"> <li>When a computer disconnects and rejoins a network</li> <li>... the address does not change</li> <li>Address is assigned by the server/ISP</li> </ul> <p>Dynamic:</p> <ul style="list-style-type: none"> <li>Each time the computer rejoins a network</li> <li>... the address changes</li> <li>address is assigned by the network OS</li> </ul>	4	Accept valid alternatives with the same meaning
2(c)(i)	<p>1 mark per bullet</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>Devices connected over a small geographical area</li> <li>Uses dedicated infrastructure // company-owned infrastructure</li> </ul>	2	
2(c)(ii)	<p>1 mark per bullet to max 3</p> <ul style="list-style-type: none"> <li>Packet has address of recipient</li> <li>Sender transmits packets directly to the server</li> <li>Server reads address and identifies where recipient is</li> <li>Server transmits packets directly to the recipient</li> <li>Server transmits packets only to the recipient</li> </ul>	3	
2(d)(i)	<p>1 mark per bullet to max 3</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>NIC // Network Interface Card</li> <li>WNIC // Wireless Network Interface Card</li> <li>WAP // Wireless Access Point</li> <li>Hub</li> <li>Switch</li> <li>Router</li> <li>Bridge</li> <li>Repeater</li> <li>Modem</li> </ul>	3	Do not award Cables, computers, servers they are in the question. Accept <u>fibre-optic</u> cables

## AS Level Past Exam: Chapter 2: Communication more exercises



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