The origins of the internet stretch back to the 1960s. Consider how the concept of the internet has evolved from then through to now. What was the internet mainly used for in the 1990s? How does that compare with how we use the internet today?

Introduction

There is more to the internet than just the worldwide web. In the following sections you will find out about some of the other things you can do on the internet, including email, data exchange and the use of wireless networks.

There is a lot of specialist terms associated with the internet. You need to be able to recognise these and understand what they mean.

Key internet terms

The internet is simply a worldwide computer network that uses standardised communication protocols to transmit and exchange data.

The internet has a whole vocabulary of its own. Table 1.2 explains some of the terms that you need to be familiar with.

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbrev.</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point of Presence</td>
<td>PoP</td>
<td>An access point to the internet. Normally, it is a location which contains all of the hardware which allows internet users access to the internet. An Internet Service Provider (ISP) may operate several PoPs in their area to allow good access to the internet.</td>
</tr>
<tr>
<td>Network Access Point</td>
<td>NAP</td>
<td>An interchange between networks within the internet. It allows ISPs to interconnect with each other.</td>
</tr>
<tr>
<td>Internet Protocol</td>
<td>IP</td>
<td>The protocol used to route packets of information across the internet. An individual unit of data which is carried across a network, including the internet. It is made up of a header which identifies the packet and a body which is the actual data message. It is one of the functions of the Transmission Control Protocol (TCP) to organise an internet message into packets.</td>
</tr>
<tr>
<td>Transmission Control Protocol</td>
<td>TCP</td>
<td>The protocol which takes data from a user’s application program and passes it to the IP for transfer across the internet. The reverse operation is performed at the destination computer, i.e. the TCP reassembles the data (from individual packets) and forwards them to the user’s application program. The close relation with the IP means that the terms are usually used in combination, i.e. TCP/IP.</td>
</tr>
<tr>
<td>File Transfer Protocol</td>
<td>FTP</td>
<td>A standard protocol which allows files to be transferred between two computers on a TCP-based network. It is commonly used to download programs to your computer from other servers and to upload web pages that you have created to the server that is hosting them on the internet.</td>
</tr>
<tr>
<td>Internet Service Provider</td>
<td>ISP</td>
<td>Direct connection to the internet would be very costly and so ISPs provide a cost-effective gateway for people and organisations to get onto the internet. In the UK there are many ISPs, with some of the most popular ones being BT (British Telecom), Virgin Media and Sky.</td>
</tr>
<tr>
<td>ISP services</td>
<td></td>
<td>In addition to providing a gateway to the internet, ISPs normally provide additional services such as email. Many also provide web space for the development of websites, technical support and troubleshooting.</td>
</tr>
</tbody>
</table>
Internet infrastructure

The internet is essentially a huge client-server system of interconnected computers which uses a wide range of hardware. Some of the main components of the internet’s infrastructure are described in Table 1.3.

<table>
<thead>
<tr>
<th>Infrastructure term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>A computer or program which runs purely to serve the needs of other computers. It runs special server software to service the requirements of the users (clients). There are several types of servers, including file servers and printer servers on a local area network (LAN), and web and email servers that manage communication with the internet.</td>
</tr>
<tr>
<td>Client</td>
<td>A computer which uses the services provided by the server.</td>
</tr>
<tr>
<td>Router</td>
<td>A piece of hardware that connects two or more networks. In relation to the internet, data from the ISP is sent into the network and the router then directs the data packets to the correct destinations. The router also handles data travelling in the other direction. Routers can be described as ‘directors of traffic’ for the networks.</td>
</tr>
<tr>
<td>Connecting backbone</td>
<td>The main connecting data routes between large networks on the internet and smaller networks in local regions.</td>
</tr>
</tbody>
</table>

Activity 1.5

Sketch out on paper a design for a web page which provides definitions of some of the technical terms used when talking about the internet. Include diagrams or pictures where relevant. Use the internet to help you gather information.

Assessment tip

You will need to know and understand the terminology associated with the internet.
Internet connection methods

There are three methods for connecting to the internet, as described in Table 1.4.

<table>
<thead>
<tr>
<th>Connection method</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless</td>
<td>Used by wireless-enabled devices (computers, mobiles, smartphones, etc.) to log in to the internet. Wireless is exactly what it says; there are no wires to connect. (See page 27.)</td>
<td>Not fixed to a stationary computer. Can be used wherever there is a wireless hub which is accessible.</td>
<td>Need to have access to a wireless hub. Can be less secure than wired connections. Tend to have slower data transmission speeds than wired broadband methods.</td>
</tr>
<tr>
<td>Broadband</td>
<td>A wired connection to a broadband supplier. Normally the connection is via a network card in the computer. Cable users have an ethernet connection from their computer to the network.</td>
<td>Broadband connections can give better reception and are usually faster than dial-up.</td>
<td>Requires a base which is wired in, so it is less flexible than wireless.</td>
</tr>
<tr>
<td>Dial-up</td>
<td>A wired connection via a conventional telephone line, which needs a modem to convert signals to and from analogue for transmission.</td>
<td>Can use existing telephone circuits, which is useful in some areas.</td>
<td>Older technology gives poor reception at times. The conversion from digital to analogue signals can cause errors. Tends to be slower than other connection methods.</td>
</tr>
</tbody>
</table>

Bandwidth and transmission rate

**Bandwidth** is a measure of the available capacity of a network (to carry data) measured in bits per second.

The transmission rate is a measure of the number of pieces of information that have been transferred during a specific time period, usually also measured in bits per second.

A high bandwidth means more information can be carried in a given time, so a higher transmission rate is achieved. Insufficient bandwidth can result in websites and servers appearing to run very slowly.

**Key terms**

- **Network** – A group of computers which are connected together by communication channels and which have the capability of sending and/or receiving information between them.
- **Protocol** – Communications protocol is a set of rules which allows a computer system to connect with a different system to transfer data.
- **Ethernet** – An Ethernet cable is used to connect a user to a network.
- **Bandwidth** – Is a way of measuring how much data can be carried over a network.
- **Bit** – Is the amount of data transferred within a unit of time (i.e. bits per second).

**Assessment tip**

You will need to know the infrastructure terminology used with the internet, and what each of the terms on pages 17–19 means.

**Just checking**

1. What do the abbreviations IP, TCP and FTP stand for? What is each of these protocols used for?
2. Name the four main components of the internet infrastructure.
3. Explain the term ‘bandwidth’.
What is the worldwide web?

The content of the worldwide web is held on individual web pages which are gathered together to form websites of associated information.

Web pages are connected using hyperlinks. A hyperlink is a link that, when clicked on, takes the website reader to another web page on the website or to a different website.

Websites are held on a computer called a web server, which is connected to the internet and delivers web pages to users’ computers. When an internet user wants to look at a web page from a specific website, it is the web server’s job to deliver (download) those pages to the user’s computer.

Web pages are viewed through web browsers. These are software application programs which allow internet users to access, retrieve and view information on the internet. Internet Explorer® and Firefox are two examples of web browsers which you can use. It is the web browser which reads document files written in Hypertext Markup Language (HTML) and translates them into viewable web pages.

HTML

HTML is a computer language used to create web pages. You can create HTML directly in the language itself or by using authoring software (such as Adobe® Dreamweaver® or Microsoft® Expression) which uses templates and wizards to create HTML code. HTML files usually have a filename with .htm or .html as the file extension; for example, document.htm.

HTML is a language which relies on a series of tags. Tags usually operate in pairs, as shown in the example in Table 1.5 (page 21). There is an opening tag such as <body>, <bp> or <p>, and an end tag. End tags are identified by starting with the ‘/’ character. For example: </body> closes the section of program called ‘body’; </bp> closes the bullet point tag and </p> ends the paragraph ‘p’.

Tags which don’t operate in pairs include <img> (used to tag an image) and header tags (e.g. <h1>).

The content between each pair of tags is called an HTML element. The language is written as a series of elements. Gradually the elements build up to describe a web page. Table 1.5 gives a small, simplistic example.
Table 1.5 HTML structure

<table>
<thead>
<tr>
<th>Example of html code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;html&gt;</td>
<td>An opening tag for the program</td>
</tr>
<tr>
<td>&lt;body&gt;</td>
<td>An opening tag for the section</td>
</tr>
<tr>
<td>&lt;h1&gt;This is a heading&lt;/h1&gt;</td>
<td>Heading tag, content, end tag – element</td>
</tr>
<tr>
<td>&lt;p&gt;This is a paragraph&lt;/p&gt;</td>
<td>Paragraph tag, content, end tag – element</td>
</tr>
<tr>
<td>&lt;/body&gt;</td>
<td>End tag for the section</td>
</tr>
<tr>
<td>&lt;/html&gt;</td>
<td>End tag for the program</td>
</tr>
</tbody>
</table>

In Table 1.5, the whole code is enclosed within the <html> </html> tags, which define this code as an HTML program. Then the section of working code in the example is written between the <body> and </body> tags.

Within this there are two HTML elements:

- A web page heading enclosed between the <h1> and </h1> tags. The example code in Table 1.5 will show ‘This is a heading’ as a heading on the web page.
- This is followed by a paragraph of text which is enclosed between the <p> and </p> tags. The example would show ‘This is a paragraph’ below the heading.

The whole web page is built up by writing these elements. There are tags used to colour the website, position objects such as text, graphics and media on the website and to do all of the other formatting that we see on websites.

Figure 1.8 Extract of HTML code and the resulting web page

Assessment tip

You will need to know what the worldwide web is, and how it differs from the internet.
You need to be aware of the terminology used when talking about the worldwide web.
You need to know the role of HTML and hyperlinks in creating a web page.
Introduction
As the worldwide web is made up of millions of web pages, each page must have a unique identity, so that it can be found by individual web browsers. This section looks at how web pages are identified and how search engines work.

URLs
Web pages are searched for using a uniform resource locator (URL), which is a string of characters that identify a particular web page on the internet. Every web page has a unique URL.

URLs are made up of three components. An example is shown in Figure 1.9.

Search engines
If you don’t know the name of a particular web page or want to find web pages on a particular topic, you can use a search engine to find it. Search engines such as Google™ and Yahoo! allow you to enter a description of what you are looking for and the search engine will search its indexes (databases of web pages) and find matching items. The items are normally presented in ranking order, with the most popular or relevant search result showing at the top of the list.

The most commonly used search engine is currently Google™, although there is some increase in market share by others. Other search engines include Yahoo! and Bing.

Key terms
URL – A unique string of characters which makes up a web page’s address.
Search engine – A ‘search and find’ system into which you type what you are looking for and a series of ‘best match’ results will then be displayed.

Did you know?
The most commonly used search engine is currently Google™, although there is some increase in market share by others. Other search engines include Yahoo! and Bing.
What do the acronyms HTML and URL stand for?
Give three examples of tags used in HTML code. Why do tags always have to come in pairs?
What are the three components that make up a URL?

Figure 1.10 Example search results

Just checking

1. What do the acronyms HTML and URL stand for?
2. Give three examples of tags used in HTML code. Why do tags always have to come in pairs?
3. What are the three components that make up a URL?
Introduction

Email is short for ‘electronic mail’. It is a system used to send digital messages from user to user.

Using email

The sender and recipient(s) of an email message do not have to be online at the same time. When one person sends a message, it is stored on an email server. It waits in store until the recipient signs in, at which point the server forwards the message to them. The system is known as a store and forward system. This is of great benefit when sending messages and documents to people in different time zones around the world.

Address book

Within your email program, you can create a list of people’s contact details (e.g. name, email address, company name, phone numbers). This is known as an address book.

Attachments

You can send a message and attach files with it (e.g. photos, documents, spreadsheets). These files are known as attachments.

Multiple recipients

You can send the same message to a number of people. You can copy people in to the email using the CC (carbon copy) field. Recipients who are entered in this field will be visible to everyone the email is sent to. If you want to include a recipient on an email – but you don’t want other people to see that the email has been sent to them – then you add them into the BCC (blind carbon copy) field.

Key terms

Store and forward system – When an email is sent, it is stored on an email server and remains there until the recipient accesses their email account. It is at this point when the server forwards the message to them.

Address book – An email tool which allows you to store the names, email addresses and contact details of people.

Attachment – A file or document which you can attach and send with an email.

Did you know?

Email has the ability to send attached documents (including text, spreadsheets and graphics) with messages in a similar way to sending documents enclosed within ‘snail mail’ (i.e. the normal postal system).

Did you know?

The term carbon copy dates back to when typewriters were used. In order to make copies of a letter or memo, a sheet of carbon paper was inserted under the original version and a sheet of blank paper was placed under the carbon paper. As a letter or memo was typed, a copied version would be transferred via the carbon paper to the blank sheet of paper.
Benefits and drawbacks of email

Email has undoubtedly changed the way individuals and companies communicate with each other on a global scale.

Benefits of email include:

✓ Speed of delivery.
✓ Cost. Unlike the conventional mail system, there is no additional cost to the standard broadband charges.
✓ Instant delivery on a global scale.
✓ Delivery to multiple recipients.
✓ Attachments (e.g. documents and audio and video files).
✓ Having a record of the correspondence between users.
✓ Webmail providers (including Hotmail and Gmail) tend to store emails on a remote provider, meaning that you can access them anywhere via a web browser.

Drawbacks of email include:

✗ Privacy and security. People can hack into your emails and read material which should not be available. Some of that material may pose a risk to your security, that of your employer or even that of the nation.
✗ Internet access. The fact that both sender and recipient(s) have to have email accounts can be a problem. Some people do not have access to the internet (or choose not to use it) so you cannot assume that everyone has an email account.
✗ Sometimes a lack of interactivity may be a problem. In situations where an instant reply or interactive discussion is needed, email does have limitations if the participants are not online at the same time.
✗ Spam.
✗ Viruses.
✗ Phishing scams.

Email protocols

A separate system of protocols has been devised for use purely by email. An email protocol is a set of rules which allow computers to send and receive emails from a network. There are three basic protocols used by email, which are compared in Table 1.6.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple Mail Transfer Protocol</td>
<td>SMTP</td>
<td>The internet standard used for sending messages across IP networks in server-to-server transfers. Also used by email users to send a message to an email server.</td>
</tr>
<tr>
<td>Post Office Protocol 3</td>
<td>POP3</td>
<td>Used to retrieve emails from an email server over a TCP/IP connection. This is the most widely used email retrieval protocol. Normally users download emails to their local computer using POP3, deleting them from the email server.</td>
</tr>
<tr>
<td>Internet Message Access Protocol</td>
<td>IMAP</td>
<td>This is the other popular email retrieval protocol. Normally users work on the emails as they reside on the email server using IMAP and do not download them.</td>
</tr>
</tbody>
</table>

Key terms

CC – Stands for carbon copy. You can copy in additional email recipients using this field.
BCC – Stands for blind carbon copy. You can copy in people to emails – but hide their identify and email address from other recipients – by entering them in this field.
Hack – When you use illegal means to access someone’s email account or computer system.

Link

See Possible threats to data 1, pages 38–39 for more on phishing.
Carry out the following tasks:
- Add the email addresses of five friends to your email address book.
- Send the same email to these five friends.
- Ask each person to send a reply.

Carry out the following tasks:
- Create a group using the five email addresses in your address book.
- Send out an email to the group and add an attachment.
- Ask the members in your group to reply to the email and include an attachment.

Make notes about how you did each activity.

Research
Create a table of the important characteristics of:
- the internet
- the WWW.
- email.
Include the history of each of these and the important developments, together with the names of some of the people responsible for the developments.

Discussion point
Businesses need to compete on an international scale and a lot of times people expect businesses to operate 24/7. Discuss how email helps businesses to achieve this. What are the advantages and disadvantages of this?

Assessment tips
You will need to be able to describe what email is and how it is used. Don’t forget the email protocols.

Just checking
1. What is a ‘store and forward’ system?
2. Give two benefits and two drawbacks of email?
3. Describe the differences between the three email protocols SMTP, POP3 and IMAP.
Think about the different devices you have used in the past week (e.g., your computer and mobile phone.) What have you used the device for? Have you played music or videos? Have you sent text messages or email messages? Have you updated your social networking page? Create a list of the data types

Can you identify the ways the data would have moved from one device to another?

Introduction

Data exchange is the term used to cover all methods of passing data (including audio, video, images and text) between devices/components (computers, peripheral hardware, mobile phones, manufacturing machinery, environment monitors) and users over a network.

One network where data is exchanged is, of course, the internet, but data exchange takes place on networks of all types. This section looks at some of the ways in which data is exchanged over networks.

Voice over Internet Protocol (VoIP)

VoIP is a group of internet protocols which provide a means of sending voice and multimedia communication over the internet rather than by public telephone networks. Real-time communication has become more and more common, with communication by Voice over Internet Protocol (VoIP) growing in popularity.

Any computer system which has microphone input, speaker or headphone output and a broadband connection can be used to transmit and receive voice communication using this system. The addition of a webcam will allow multimedia transmission (the simultaneous transmission of video and audio). When many users have these facilities, web meetings and conferencing can be set up.

The software required to run a VoIP system consists mainly of an encoding and decoding program, which is often called a coder/decoder program (codec). This program is used, where necessary, to digitise an analogue voice signal, then compress it and split it into internet packets for transmission. It then performs the reverse at the receiving end.

VoIP is not only available over desktop and laptop computers, but also over many other internet devices™ such as smartphones. One of the most popular VoIP systems in use at present is Skype.

Wireless networks

Wireless networks are another means by which data can be exchanged between a computer and a network, including the internet. A wireless network is any network servicing computers or other devices (e.g. mobile phones), in which the connections do not use cables of any kind. Wireless communication usually uses radio waves, but infrared communication is also used.

In wireless networking all devices using the network need to have a wireless network interface card through which they gain access to the network. The card is used to transmit data across the network and to receive incoming data from the network.

The network itself will contain routers (see Table 1.3 on page 18) and network access points (see Table 1.2 on pages 17–18).

Wireless networks have many advantages – probably the most important is mobility; people are no longer tied to desks and wires.

Key terms

Data – Any kind of information that has been formatted in a specific way. Different types of data include audio, video, images and monitoring signals, as well as text.

Devices/components – Used as a generic term to mean computers, peripheral hardware, mobile telephones, manufacturing plant, environment monitors and many other things.

Peripheral – Any device, such as a printer, attached to a computer to expand its functionality.

Codec – A device or program used to encode or decode data.

Internet packets – A formatted block of data sent over the networks and the internet. A packet contains the addresses of send and destination, the data and error checking.

Assessment tip

VoIP is important – revise everything you can about it.

Research

Find out more about radio waves and infrared communication.
Table 1.7 introduces some of the methods of transmission used, and describes some of the benefits and limitations of each method.

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
<th>Maximum data transfer rate</th>
<th>Maximum range</th>
<th>Benefits</th>
<th>Limitations</th>
<th>Example of how it is used</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTP/STP</td>
<td>Unshielded twisted pair (UTP) cables are basic pairs of cables twisted together. Shielded twisted pair (STP) cables are similar but have a foil shielding.</td>
<td>250 Mbps</td>
<td>100 m</td>
<td>Twisting cancels out some interference. Very low cost and adaptable.</td>
<td>Slower and with less capacity than other cables, and can only be used over short distances. Susceptible to noise.</td>
<td>Analogue telephone network.</td>
</tr>
<tr>
<td>Coaxia</td>
<td>Solid wire core separated from a copper-braided outer cable by a plastic insulation sheath. The inner cable transmits the data and the outer cable connects to earth.</td>
<td>1,000 Mbps (or more for Category 7 cable)</td>
<td>100 m</td>
<td>Fast and reliable.</td>
<td>Costs more than UTP/STP. Susceptible to noise.</td>
<td>Connection to cable TV networks. Aerial/dish connection to TV.</td>
</tr>
<tr>
<td>Fibre optic</td>
<td>Glass or plastic cables which use total internal reflection of light to transmit data. Normally uses LED or laser visible light, although infrared has also been used.</td>
<td>2.4 Gbps (higher has been achieved in laboratory testing)</td>
<td>50 km</td>
<td>Fast. Works over long distances. Little interference.</td>
<td>Complex connection and termination equipment.</td>
<td>The cable networks use fibre from their source to the distribution panels in the street. From there they use coaxial cable to individual households.</td>
</tr>
</tbody>
</table>
### Table 1.7 Alternative transmission methods

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTP/STP</td>
<td>Unshielded twisted pair (UTP) cables are basic pairs of cables twisted together. Shielded twisted pair (STP) cables are similar but have a foil shielding.</td>
</tr>
<tr>
<td>Coaxial</td>
<td>Solid wire core separated from a copper-braided outer cable by a plastic insulation sheath. The inner cable transmits the data and the outer cable connects to earth.</td>
</tr>
<tr>
<td>Fibre optic</td>
<td>Glass or plastic cables which use total internal reflection of light to transmit data. Normally uses LED or laser visible light, although infrared has also been used.</td>
</tr>
<tr>
<td>Infrared</td>
<td>Short range data transmissions using infrared light (just beyond visible light). This is the same technology as is used in TV handsets.</td>
</tr>
<tr>
<td>Microwave</td>
<td>Short wavelength radio transmissions working at very high frequencies. Data is transmitted from Earth to a satellite, which relays it to the relevant receiving station back on Earth.</td>
</tr>
<tr>
<td>Satellite – (high frequency, 1 to 50 GHz range, radio signals)</td>
<td></td>
</tr>
</tbody>
</table>

### Maximum data transfer rate

- **UTP/STP**: 250 Mbps (1,000 Mbps for Category 7 cable)
- **Coaxial**: 2.4 Gbps (higher has been achieved in laboratory testing)
- **Fibre optic**: 4 Mbps
- **Infrared**: 300 Gbps
- **Satellite**: Huge

### Maximum range

- **UTP/STP**: 100 m
- **Coaxial**: 100 m
- **Fibre optic**: Between circa 500 km to 36,000 km
- **Infrared**: 100 m
- **Satellite**: Between 50 km to 36,000 km

### Benefits

- **UTP/STP**: Twisting cancels out some interference. Very low cost and adaptable.
- **Coaxial**: Fast and reliable. Fast. Works over long distances. Little interference.
- **Fibre optic**: Tends to be reliable. Signal degrades very little over long distances. Can increase the distance a network can reach.
- **Infrared**: Tends to be reliable. Can suffer from external interference.
- **Satellite**: Devices must be in a direct line of sight. Devices must be in a direct line of sight. Can be affected by rain, pollen and sun spot activity. Can suffer from external interference.

### Limitations

- **UTP/STP**: Slower and with less capacity than other cables, and can only be used over short distances. Susceptible to noise.
- **Coaxial**: Costs more than UTP/STP. Susceptible to noise.
- **Fibre optic**: Complex connection and termination equipment. Short range. Devices must be in a direct line of sight. Can suffer from external interference.
- **Infrared**: Can suffer from external interference.
- **Satellite**: Expensive.

### Example of how it is used

- Analogue telephone network.
- Connection to cable TV networks.
- Aerial/dish connection to TV.
- Keyboard, printer, mouse to processor unit.
- Handsets.
- Earth to satellite communication.
- Bluetooth.
- Global communication systems.

### Key terms

- **Mbps** – Stands for megabits per second. Approximately a million bits can be transmitted through the media in one second.
- **Gbps** – Stands for gigabits per second. Approximately a thousand million bits can be transmitted through the media in one second.
- **Sun spot activity** – From time to time there is the equivalent of a huge wave of flame released from the surface of the Sun. This releases millions of charged particles, some of which hit the Earth. These can cause disruption to data transmissions.
- **Geostationary satellite** – A satellite orbiting the Earth at a height of 35,786 km does so at the same speed that the Earth is rotating. It therefore appears to be stationary above a single point on the Earth’s surface.

### Did you know?

There are approximately 300 operational **geostationary satellites** in orbit. They provide a broad range of functions, including communications, weather forecasting, television broadcasting and defence and intelligence gathering operations. Just three of these satellites could give coverage on a global scale.
Introduction

Devices on a network use a variety of methods to communicate with each other and to transmit data. This section looks at these methods in more detail, and explains client-side and server-side processing.

Transmission modes

There are three common modes of transmission:

1. **Simplex transmission**: sends data in one direction only. A radio broadcast is a good example of simplex transmission.

2. **Half-duplex transmission**: allows two-way transmissions but the devices don’t transmit at the same time. A system being used to monitor and control manufacturing processes can use half-duplex transmissions. It will send a message to the control computer, which will respond with new settings, but they both cannot send messages at the same time. Some network systems use half-duplex to maximise bandwidth.

3. **Full duplex transmission**: allows two-way communication at the same time. The telephone system, land or mobile, is an example of a full duplex system.

Parallel and serial transmission

**Parallel transmission**

In parallel transmission, a number of bits of data are transmitted simultaneously over an equal number of wires/channels. This allows the bits in a whole byte of information to be transmitted together. It has a short range, with an absolute maximum of around 5 metres.

Parallel transmission used to be popular for connecting printers to computers but it is rarely used these days in computing because of its cost and limited range.

**Serial transmission**

In serial transmission, bits are transmitted one at a time over a single wire/channel. This reduces the cost of the cable, but gives a slower rate of data transfer. There is also some additional complexity, as bytes have to be disassembled into individual bits for transmission and then reassembled after receipt. Serial transmissions can be used over large distances.

**Universal serial bus (USB)**

**Universal serial bus (USB)** is a serial transmission method which was introduced to make many of the connections to a computer look the same. Nowadays USB is used in a wide variety of devices, such as mobile telephones, memory sticks and MP3 players. USB ports also supply power to some devices.

The maximum theoretical transmission rate for USB 2.0 is 480 Mbps, but this is shared among all devices on a USB hub, so the rate for each device will be less than this.
Bi-directional transmission

Bi-directional transmission has several meanings within data communication, but it is essentially about transmitting in both directions. Most recently the term has been applied to fibre optics. Using the current technology, light passes in one direction only, so you have to add extra fibres to the bundle to carry a signal in the opposite direction.

Client-side processing

Client-side processing is the use of a scripting language to create code on web pages which provides interactivity. The important point is that the interaction takes place within the web page and the code is downloaded to the user’s computer when the web page is opened by the user’s browser.

A good example of a client-side interaction is a roll over (often called a mouseover), where some code is triggered when you move the mouse over a particular part of the web page. This might be something simple like the display of an advertisement, or it could be a demand for some data entry (e.g. filling in your details on a social networking website).

Benefits of client-side processing include:

- **Speed**: The interaction may be faster once the code has been downloaded with the page.
- **Security**: It is more secure (than server-side processing) as all the action takes place in the downloaded page and nothing comes from the browser, which could cause corruption or security problems.
Disadvantages of client-side processing include:

- **It is browser specific**: Not all scripts work the same way on all browsers, so you may have to create different versions depending on the browsers used.
- **Computer speed**: It can be affected by the speed of your own computer. As all of the activity is taking place on a downloaded web page, the speed of the download and the speed of processing will depend on your computer system. If the processing is complex or resource hungry, it may run slowly or cause other programs to run slowly on your system.

**Server-side processing**

Server-side processing involves the use of scripts which reside and are run on another computer on the internet (the web server). Information is submitted to a server which processes it to provide results in the form of a web page.

A good example of server-side processing is the submission of a search through a search engine. The search engine matches the word or phrase against an index of website content on the web server using scripts.

Benefits of server-side processing include:

- **Efficiency**: Complex code may run more efficiently, as it does not have to be downloaded on to the user’s computer.
- **Browser independent**: The code is browser independent so therefore can be run on any web browser.
- **Speed**: Performance is affected only by the speed of the web server. As all of the processing is done on the web server, the speed of your own computer is only significant for the downloading of the web pages. All of the other processing takes place on a highly resourced and speedy server.

Disadvantages of server-side processing include:

- **Security**: The exchange of data over the network may present security risks.
- **Overloading**: A server needs to be able to cope with large volumes of users.

**Research**

There are lots of good examples of server-side scripting on the web. Identify three examples. Have a look at these examples and search for other material using a suitable web search. Create a leaflet listing examples of some of the server-side processes.

**Key terms**

**USB (Universal serial bus)** – A higher speed serial connection standard that supports low-speed devices (e.g. mice, keyboards, scanners) and higher-speed devices (e.g. digital cameras).

**Client-side processing** – When the interaction between a web page and code occurs directly on a user’s computer.

**Server-side processing** – When the interaction between a web page and a computer is processed through a server.

**Assessment tip**

Learn the difference between server-side and client-side processing, including examples of each.

**Just checking**

1. Name three methods of transmitting data over a network, and give examples of what each is used for.
2. What does VoIP stand for and what is it used for?
3. Explain the difference between client-side and server-side processing.
WorkSpace

Sam Matthews

Technical support technician

I took a holiday job with my current company before I planned to start the BTEC National Diploma. I’d already taken the BTEC First Diploma in IT and I was keen to continue my studies. Part-way through the summer, the company offered me an apprenticeship as an alternative way of pursuing my education and earning some money at the same time. That was two years ago. When I complete the apprenticeship, the company is going to give me a job and help me continue with my education.

I work as part of a team, dealing with IT queries from staff members. Not everyone in the team is an expert in every field: each of us has developed knowledge in specialised areas, but we also need to have good all-round general technical knowledge. My specialist areas include threats to data, especially online threats, and I continually have to update myself by attending courses and by doing lots of background reading. Some of the most up-to-date courses are provided by manufacturers and suppliers of hardware and software.

I work closely with a senior technician and between us we ensure that all the company’s systems are equipped with the latest security software and that it is kept up to date. Any sign of a virus, or any form of sustained attack, means that we take priority action to identify and remove the problem. If we’re unable to remove it, then we contain it and limit the damage until removal is possible. I like the adrenalin rush caused by a major security alert, even though most of these prove false alarms.

I really love my job. Down the line, I hope to progress to a managerial post in the technical support field.

Think about it

1. Why is it important that Sam keeps his skills and knowledge up to date?
2. What skills and qualities has Sam developed?
3. What do you think are the benefits of taking an apprenticeship?
**Database structure**

A database is a system for managing a collection of data. Data about a particular type of thing – for example, customers or products – is stored in a **table**. You can think of a table as a grid. Every row in the table holds information about a single item; this is also called a **record**. Every column holds information about a property of the items in the table, such as a customer's name or an item's price – these properties are called **fields**.

**Data types**

Every field (column) in a database is set up to hold a certain type of data. The main data types are as follows:

- **Text** (also called **characters** or **strings**): sequences of letters, numbers and other symbols. Someone's name would be a text field. A field that can accept multi-line text is often called a memo field.

- **Number**: represents a numerical value. A product's price or the number of items left in stock would be stored as numbers. This would enable you to produce a report summing up the prices of all the products you had sold, which wouldn’t be possible if they were stored as text.

- **Date/time**: stores dates or a combination of dates and times.

- **Logical** (also called **Boolean** or **Yes/No**): represents a value that is either true or false. For example, when a customer opens an account with an online company, they might be asked whether they are happy to receive marketing material. Their answer could be stored in a logical field (true if they are happy to receive marketing information, false if they are not).
**Relationships between database tables**

A benefit of databases is the ease with which the information they hold can be assessed. All tables have a **primary key** on which they are organised. The primary key is the unique identifier of each record in the table. The tables may themselves hold fields which are primary keys in other tables (**foreign keys**) which can be used to access associated information from many tables in one query.

![Figure 1.14 An example of a simple database relationship](image)

In the example shown in Figure 1.14, the primary key of the product table is the product item number, as each product in the database has a unique number.

The primary key of the supplier table is the supplier account number, which is also held as a foreign key in the product table.

This allows you to find a product in the product table and at the same time find the supplier’s details in the supplier table, and to display all of the information you want about both items.

This link using a foreign key is known as a relation, and you can build up any number of relationships between different tables.

Relationships can be one-way (as shown in Figure 1.14), two-way, one-to-many or many-to-one. Many-to-many relationships also exist in some databases but are extremely complex to provide.

<table>
<thead>
<tr>
<th><strong>Product table</strong></th>
<th><strong>Supplier table</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product item number</td>
<td>Supplier account</td>
</tr>
<tr>
<td>Product description</td>
<td>Name</td>
</tr>
<tr>
<td>Supplier account</td>
<td>Address</td>
</tr>
<tr>
<td>Minimum stock</td>
<td>Telephone</td>
</tr>
<tr>
<td>Number in stock</td>
<td>Other supplier details</td>
</tr>
<tr>
<td>Other product details</td>
<td></td>
</tr>
</tbody>
</table>

---

**Key terms**

- **Database** – A collection of data stored in a structured way.
- **Table** – A two-dimensional representation of data in a database.
- **Record** – A group of selected data which are associated in some way.
- **Field** – A single piece of data within a record.
- **Primary key** – A single unique key used to identify each record in a table.
- **Foreign key** – A field which can be used to cross-reference and access associated information across many tables.

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**Link**

You can find further information on database structures and relationships in Unit 10 **Database development**.
Online databases

Online databases are databases which are accessible using a network, including the internet. They are very different to local databases as they have to be accessed, and possibly updated, by millions of users. Normally these databases will have thousands of rows of information. Usually information is found in online databases by using a search engine (see page 22).

Special database software is available to help users build online databases. Some of the basic software is free, but you will usually have to pay for upgrades to do more sophisticated things. The more sophisticated software usually incurs a charge (for example, KeepandShare, Vectorwise, Microsoft® Office 365, Alventis).

Quite often the data is held by a hosting service, which also supplies the software as part of cloud storage on the internet. (See the section on Cloud computing and cloud storage on page 15.)

These online databases hold many different types of information, from databases of cartoons to databases of financial information.
Database management systems

Database management systems (DBMS) are the programs which allow you to create any database that you need and to use the databases you have created.

The DBMS allows you to create, maintain, search and sort data on a database. It allows different users to access the database at the same time, and can provide different levels of access to the data. (See the section on *Levels of access and file permissions* on pages 9–10.)

Structured Query Language (SQL)

Structured Query Language (SQL) is a high-level language which is used to undertake this management activity. It is normally in two parts:

1. **Data Definition Language (DDL):** This is the part which is used to define the database structure.
2. **Data Manipulation Language (DML):** This is the part used to add, delete, change and query the data which is held in the database structure.

SQL is the language that generates the code used by the DBMS.

**Activity 1.7**

W3Schools has a web page where you can try out some SQL commands for yourself. To access the relevant page, go to [www.pearsonhotlinks.co.uk](http://www.pearsonhotlinks.co.uk) and search for this title.

Try out the example queries.
Write down any other useful queries you come up with.

**Assessment tip**

You will need to know all of the terminology associated with databases, including the purpose of a DBMS.

You will be required to know about online databases.

**Just checking**

1. Give three examples of data types that can be used in a database field.
2. Give an example of how an online database might be used.
3. Explain the difference between a database and a database management system (DBMS).