Syllabus reference

1.2.3 Internet principles of operation

Learners should be able to show understanding of the role of an Internet service provider (ISP).

See also:

2.3 Safety online

2.2 The Internet

What is the Internet?

Introduction

You have learned about data transmission. Data transmission allows computers to send and share data. A group of computers linked together in this way is called a network. The Internet is the biggest network in the world. In this section you will learn about the Internet.

The Internet

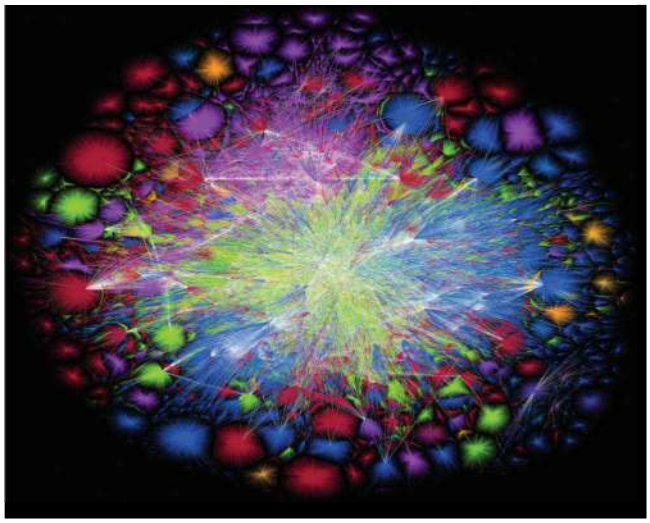
Connected computers can share data through data transmission links. The Internet is a system of computer connections that covers the whole world. To be connected to the Internet a computer must have:

- a data transmission connection (wired or wireless)
- Internet software
- shared protocols.

Any computer can be connected to the Internet if it has these. There were very few computers with an Internet connection 20 or 30 years ago. Now there are literally billions of computers and other devices connected to the Internet. The Internet grows bigger every day. About half the people on Earth have used the Internet.

Nobody is in charge of the Internet. The Internet is the system of links that people can use to share data. Nobody checks that the data is correct. Nobody can control what is on the Internet.

The Internet can be very useful and helpful, but it can also have risks and problems. Learn more about risks and how to keep safe in *2.3 Safety online*.



An illustration of the connections that make the Internet

Internet service provider (ISP)

You can buy a computer that can connect to the Internet. What does it connect to, though?

Most people are connected to the Internet by an Internet Service Provider (ISP). An ISP is an organisation that enables people to use the Internet. Many ISPs are commercial companies that offer Internet services for a connection fee.

The services that might be offered by an ISP include:

- sending signals between the Internet and your computer
- providing email services
- hosting a web page for you.

Different ISPs use different ways of connecting computers to the Internet. Some use the public phone lines; some use wireless, or cables.

Internet software

"Software" means the instructions that let your computer carry out actions. Several different types of software can be used to connect to the Internet. This software reads the signals that come via the Internet connection. It turns these signals into a form that you can see and use on your computer. It also converts the signals from your computer into a suitable form. For example, if you type a message, the software converts your text into a form that can be sent over the Internet and be understood by other computers.

The most common Internet software is a web browser. You will find out more about web browsers on page 47.

Shared protocols

Protocols are communication standards. They are standard rules about how data is turned into signals. If two computers share data, they must use the same protocols. All computers that connect to the Internet use the same protocols.

Key protocols of the Internet are TCP and IP (see pages 52–53).

Test yourself

1. Many ISPs are commercial companies. How do these companies make money?
2. As well as giving you an Internet connection, what other services might an ISP provide?
3. Who makes sure that there are no mistakes on the Internet?
4. As well as a wired or wireless connection, what else do you need to use the Internet?

Learning activity

Use online research to find out how many computers are connected to the Internet. If you find the answer on a website, or in a book, check the date that it was published. The answer is changing all the time.

Not the World Wide Web

The Internet is not the same as the World Wide Web. Find out the difference on page 46.

Syllabus reference

1.2.3 Internet principles of operation

Learners should be able to show understanding of the role of the browser.

What is the World Wide Web?

Introduction

You have learned that the Internet is a series of connections and standards. Many different services and features are available through Internet connections. The most popular is the World Wide Web. In this section you will learn what the World Wide Web is.

Website

The World Wide Web (also called the Web) is the collection of all the web pages in the world. The World Wide Web is the most popular service available through an Internet connection.

A web page is a multimedia document that you can read over the Internet. "Multimedia" means a document that can include many different types of data: text, images, sound and video. Web pages are created in a format called HTML. Find out more about HTML on pages 48–49. Web pages can be viewed by software called a web browser.

Wikipedia has been viewed by hundreds of millions of users

A website is a collection of web pages, stored on a web server. Anybody with an Internet connection can connect to the website and look at the web pages.

Some popular sites include:

- Google
- Amazon
- Twitter
- Facebook
- Wikipedia
- Youtube

Web server

A web server is a computer that is permanently connected to the Internet. A web server hosts web pages, which means that the web server holds the content of the web page in its storage. A web server will send the contents of the web page along an Internet connection to another computer. The web page can be viewed by Internet users. Many ISPs offer web hosting as one of their services.

Web addresses

Every web server has its own numeric address, called an IP address, and a number of text-based names. Every website and web page hosted by the server has its own name, called a URL. The URL contains one of the web server's names. You will learn more about IP addresses and URLs on pages 52–53.

Web browser

A web browser is software that lets you look at web pages. To connect to a web page you type its URL into your web browser. The web browser will:

- get the web server's name from the URL, and use that to connect to the web server
- transfer a copy of the web page onto your computer
- display the web page so that you can interact with the content.

Web pages are written in a format called HTML. A web browser can read HTML. It will interpret the content and show it on your screen.

There are several popular web browsers, including:

- Internet Explorer
- Firefox
- Chrome.

Different browsers may display web pages slightly differently.

Google Chrome is one of the most widely used web browsers

Web protocols

The use of web pages depends on shared protocols:

- HTTP is the protocol that allows web pages to be shared. Find out more about HTTP on pages 50–51.
- IP is the protocol that gives every web server an address. Find out more about IP on pages 52–53.

Test yourself

1. What is the difference between a website and a web page?
2. What types of data can you find on a web page?
3. Many ISPs offer a web hosting service. What does that mean?
4. Describe the job of a web browser.

Learning activity

Choose one of the popular websites listed on the previous page.

Write a short report on the website you have chosen. What features does it have? Why is it so popular?

Download

When you download web content, you copy it from a web server onto your own computer. That means you can see and use the web content on your own computer.

Upload

When you upload web content, you copy it from your computer onto a web server. That means other computers can access it. You have made the content available to other people.

Syllabus reference

1.2.3 Internet principles of operation

Learners should be able to: show understanding of what is meant by HTML; distinguish between HTML structure and presentation.

HTML

Introduction

You have learned that the Web is made of all the web pages in the world. Web pages are made using HTML, which stands for "hypertext markup language". In this section you will learn about HTML.

Markup

HTML is a markup language. A markup language is used to add descriptions to pieces of text in a document. The descriptions are called tags. HTML tags tell a web browser how to display a document. When you make a web page you must enter the text, and also the HTML tags that tell the computer how to display the text.

Tags

Tags generally come in pairs. One tag turns a feature on, another tag turns it off. For example, the tag <h1> turns on the main heading style. The tag </h1> turns it off.

A web page may include the text "My Family". With HTML tags it may look like this:

```
<h1>My Family</h1>
```

When you open the web page in a browser you will not see those tags. The browser will display the words "My Family" as a large heading.

Example

Here is part of the HTML that defines the main (or home) web page of the OUP website: the publishers of the book you are reading.

As you can see, there are a lot of HTML tags. This is only a small part of the HTML that defines the page.

When your browser displays the same page it looks like this.

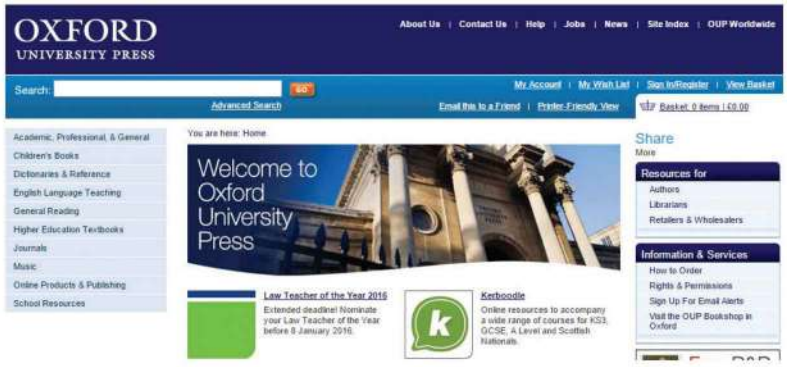
```
<title>Oxford University Press (OUP) - UK Home Page</title>

</td>
<td align="right" valign="top">
  <table cellpadding="0" cellspacing="0" width="100%" border="0">
    <tr valign="top" align="right">
      <td width="100%" class="noBorder"> 

      </td>

      <td nowrap="nowrap" class="topNavRow1Link">
        <a href="http://www.oup.com/uk/about/">About Us</a>
      </td>
      <td nowrap="nowrap" class="topNavRow1Link">
        <a href="http://www.oup.com/uk/contactus/">Contact Us</a>
      </td>
      <td nowrap="nowrap" class="topNavRow1Link">
        <a href="http://www.oup.com/uk/help/">Help</a>
      </td>
      <td nowrap="nowrap" class="topNavRow1Link">
        <a href="http://www.oup.com/uk/recruit/currvac/">Jobs</a>
      </td>
      <td nowrap="nowrap" class="topNavRow1Link">
        <a href="http://www.oup.com/uk/news">News</a>
      </td>
      <td nowrap="nowrap" class="topNavRow1Link">
        <a href="http://www.oup.com/uk/siteindex/">Site Index</a>
      </td>
      <td nowrap="nowrap" class="topNavRow1LinkLast">
        <a href="http://www.oup.com">OUP Worldwide</a>
```

This HTML defines the OUP home web page



When the HTML is displayed by your browser it looks like this

Your web browser software reads the HTML, and displays this web page.

Structure and presentation

HTML tags tell the web browser how to display the web page. There are two main types of HTML tag. They have different effects:

- **Structure:** Some HTML tags control the layout of the web page. This includes adding a page title, headings, sections and paragraphs. For example, the tags `<h1></h1>` mark the start and end of a heading.
- **Presentation:** Some HTML tags change how the web page is displayed. For example the tags `<b></b>` mark the start and end of bold text.

You can also change presentation by adding "style" instructions to HTML. For example this command sets the colours for a whole web page:

```
<style>
body {background-color:yellow;}
h1   {color:red;}
p    {color:green;}
</style>
```

Can you work out what this page would look like? Do you think these are good colour choices?

You can store style commands in an external file called a "Cascading Style Sheet" (CSS). You can link lots of different web pages to the CSS file. All the web pages will have the same style. If you make a change to the CSS file, all the pages will change. This gives a consistent, professional feel to your work.

Hypertext

HTML means "hypertext markup language" – but what is hypertext?

Hypertext is text that makes a link to a new web page. Most web pages include hypertext. Hypertext links are often shown on the screen as blue, underlined text. When you click on a hypertext link your web browser will connect to the linked page. It will be displayed in your browser. In this way you can browse, moving from one website to another.

You have learned that HTML makes hypertext links. Links can be connected to images or areas of the screen as well as to text.

How to make a website

A web hosting service will help you to make a website. The pages of your site will be stored on their web server. That is called publishing your website. The pages can be seen by anyone with an Internet connection.

A web hosting service will provide software to help you make the web pages. The software makes it easy to design the web page. You do not need to type HTML tags. You choose features such as text colour and size from menus. The software turns your choices into HTML. It is similar to using a word processor to make an ordinary document.

Learning activities

1. Connect to a website with your browser. Right-click on the web page and pick "View page source" from the menu. You will see the HTML that made the page you are looking at.
2. Work in a group or as a whole class. Use a free online web hosting service. Create a web page about what you have learned so far in iGCSE Computer Science.

Test yourself

1. HTML stands for "hypertext markup language". Explain the meaning of "hypertext" and "markup".
2. HTML tags often come in pairs. Why?
3. A student made a website. She did not know HTML. How did she manage to make the site?
4. When you look at a website in your browser you do not see the HTML tags. Why?

Syllabus reference

1.2.3 Internet principles of operation

Learners should be able to: show understanding of what is meant by hypertext transfer protocol (HTTP and HTTPS); show understanding of what is meant by cookies.

See also:

6.2 Security protection

HTTP: Hypertext transfer protocol

Introduction

You have learned that hyperlinks are a key feature of web pages. Hypertext transfer protocol (shortened to "HTTP") is the protocol that makes hyperlinks work. In this section you will learn about HTTP.

Hyperlinks

A key feature of a web page is that it can include links (also called hyperlinks). A link is a piece of text on the page, or an image such as button. When you click on the link your browser connects to a new page and displays it in your browser. The hyperlink could take you to different part of the same website, or a new site.

Example

On the previous page you saw part of the HTML that defines the OUP website. The OUP website includes the following HTML. This HTML makes the text "News" into a hyperlink.

```
<td nowrap="nowrap" class="topNavRow1Link">
  <a href="http://www.oup.com/uk/news">News</a>
</td>
```

This HTML defines the word "News" as a hyperlink

The word "News" on this menu bar is a link

The HTML makes a hyperlink to the following web address:

http://www.oup.com/uk/news

The HTML displays the following link on the OUP page.

If you click on the word "News" on the OUP website, your web browser will connect to the web address shown above.

HTTP

HTTP is the protocol that makes hyperlinks work.

A protocol is a shared standard for communication. All web servers use the HTTP protocol. All web browsers use the HTTP protocol too. That is why links work on every web page, and with every browser. Without HTTP the World Wide Web would not work.

The address of every web page begins http:// or https:// That shows you that the page uses the HTTP protocol. Find out more about web addresses on pages 52–53.

HTTPS

HTTPS stands for "HTTP secure". HTTPS is an extended protocol. It has extra features: authentication and encryption. These are not part of the basic HTTP protocol.

Authentication

Some websites are fake. They look as if they are run by a well-known company, such as a bank, but they are not. Learn more about fake websites on page 55.

"Authentic" means not fake. Authenticating a website means checking that it is not fake. HTTPS authenticates a website. If a web page's URL begins with https, you can be sure it is not fake. Learn more about security protocols in *6.2 Security protection (Security protocols)*.

Encryption

When you are using a website you often type details such as your name and address. These details are sent to the website.

Encryption means putting data into a secret code. HTTPS encrypts everything you send to a website, so that nobody can see what you are sending there. This makes it safer to send data to the website. Learn more about encryption in *6.2 Security protection (Encryption)*.

Cookies

Websites often need data that relates specifically to you, for example your email account or bank account details. HTTP and HTTPS do not transmit user details, so when you go back to a website using HTTP protocol, it does not know who you are.

Websites get round this problem by using HTTP "cookies". When you use a website, it collects key data about what you do there. This data is packaged up as a small binary file called a cookie. The binary file is sent back to your computer. It is stored on your own computer, not on the website.

Next time you use the website, the cookie goes from your web browser to the site. The cookie tells the website key facts about you, for example what you bought last time.

Some people do not like cookies, because of privacy concerns. However, cookies are in very common use.

Test yourself

1. What key feature of every web page is supported by HTTP?
2. What is authentication? Explain how authentication makes it safer for you to use the Internet.
3. What is encryption? Explain how encryption makes it safer for you to use the Internet.
4. Explain what a cookie is. What are the advantages and disadvantages of cookies?

Learning activity

In the previous section your class created a web page. Expand the content by including a selection of links to useful websites.

Syllabus reference

1.2.3 Internet principles of operation

Learners should be able to: show understanding of the concepts of MAC address, Internet protocol (IP) address, uniform resource locator (URL).

See also:

6.2 Security protection (Security protocols)

TCP/IP

Introduction

You have learned that a protocol is a standard for communication. In this section you will learn about the main protocol system that allows the Internet to work.

Internet protocols

The main protocol system of the Internet is called TCP/IP:

- TCP stands for "Transmission Control Protocol". This protocol controls the way data packets are transmitted along Internet connections.
- IP stands for "Internet Protocol". This protocol makes sure the data packets go to the right place. Every location on the Internet has an IP address. IP sends the data to the right address.

IP address

An IP address is a number given to every device that is connected to the Internet. Every device has a different number. The IP address identifies the device. The IP address is used to find a route across the Internet to the device's local area network. This means data can be sent to the device down the route.

You have learned that numbers can be stored as binary digits (bits). The larger the number the more bits are needed. IP addresses are very large numbers: 128 bits are needed to store a modern IP address.

These numbers are stored by a service called the Domain Name System (DNS). DNS is an automated directory of all of the Internet servers in the world. You can use DNS to look up any server's name and find its IP address.

URL

URL stands for "uniform resource locator".

Every web browser has an address bar at the top of the screen. You enter the URL of a web page into this space. Then the browser will connect to the web server that hosts that page.

The URL is made up of these components, always in this order.

1. The name of the protocol that the page uses. It usually starts with http or https.
2. The domain name. This identifies the server (Internet computer) and website. You could use the web server's IP address here, but that would be more difficult to remember than a name. Also, when a web server hosts more than one website, it would not be able to tell which site you want.
3. The "path name". This identifies a web page on that server.
4. Sometimes extra details are added at the end.

Domain name

The domain name identifies the server that hosts the website. It also identifies the website itself, in case the server hosts more than one. A domain name typically begins with www. It ends with a short text code. This is the "top-level domain". It tells you the general category of the website.

The top-level domain code might tell you the type of business as follows:

- .com – a commercial organisation
- .gov – a US government organisation
- .edu – a US academic organisation such as a university.

Or it might tell you the country where the server is based. Here are some examples:

- .uk – United Kingdom
- .nz – New Zealand
- .ke – Kenya.

The official list of all top-level domains is maintained by the Internet Assigned Numbers Authority (IANA). There are over a thousand top-level domains.

Example

Here is a typical URL. It is for the website of the UK newspaper, *The Guardian*:

http://www.theguardian.com/world. The URL consists of these parts:

- The protocol is "http".
- The top-level domain is ".com". This tells you it is the domain name of a commercial organisation.
- The domain is "www.theguardian.com". This identifies the web server of *The Guardian* newspaper.
- The path name is "/world". This identifies the particular web page of *The Guardian* that summarises world news.

MAC address

MAC stands for "media access control". A MAC address is an identifying number, like an IP address. It identifies a single device such as a computer or printer. A device's IP address is used to route data across the Internet to its local area network, then its MAC address is used to switch the data across the local area network to the device itself. MAC addresses are often shown in hexadecimal form.

Test yourself

1. Why do people prefer to use a URL rather than an IP address?
2. An IP address is 128 bits. How many bytes is that?
3. An IP address identifies every domain on the Internet. What extra information is provided by the MAC address?
4. Here is a URL. Identify the protocol, the domain name and the page:

   https://www.amazon.com/gift-cards