Oxford International Lower Secondary

8

Computing
Student Book

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Student Book

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Contents

Introduction

Delivering computing to young learners

Oxford International Primary and Lower Secondary Computing is a complete syllabus for computing education for ages 5–14 (Years 1–9). By following the program of learning set out in this series, teachers can feel reassured that their students have access to the computing skills and understanding that they need for their future education.

Find out more at:
www.oxfordsecondary.com/computing.

Structure of the book

This book is divided into six chapters, for Year 8 (ages 12–13).

1. **The nature of technology:** Introduction to computer networks and internet services

2. **Digital literacy:** Using online research for learning and discovery

3. **Computational thinking:** Writing a program using a data structure

4. **Programming:** Using procedures or functions and comparing algorithms

5. **Multimedia:** Using technology creatively to make a video

6. **Numbers and data:** Using technology to analyse data

What you will find in each unit

- Introduction: An unplugged activity and a class discussion help students to start thinking about the topic.
- Lessons: Six lessons guide students through activity-based learning.
- Check what you know: A test and activities allow you to measure students' progress.

What you will find in the lessons

Although each lesson is unique, they have common features: learning outcomes for each lesson are set out at the start; learning content delivers skills and develops understanding.

Activity Every lesson involves a one or more learning activities for the students.

Extra challenge Activities to extend students who are able to do more.

Test A short test of four questions, of progressive difficulty, to check students' understanding of the lesson.
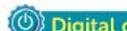
Additional features

You will also find these features throughout the book:

Word cloud The word cloud builds vocabulary by identifying key terms from the unit.

Be creative Suggestions for creative and artistic work.

Explore more Extra tasks that can be taken outside the classroom and into the home.

Digital citizen of the future Advice on using computers responsibly in life.

Glossary Key terms are identified in the text and defined in the glossary at the end.

Assessing student achievement

The final pages in each unit give an opportunity to assess student achievement.

- Developing: This acknowledges the achievement of students who find the content challenging but have made progress.
- Secure: Students have reached the level set out in the programme for their age group. Most should reach this level.
- Extended: This recognises the achievement of students who have developed above-average skills and understanding.

Questions and activities are colour-coded according to achievement level. Self-evaluation advice helps students to check their own progress.

Software to use

We recommend Python for writing programs at this age. For other lessons, teachers can use any suitable software, for example: Microsoft Office; Google Drive software; LibreOffice; any web browser.

Source files

You will see this symbol on some of the pages.

This means that there are extra files you can access to help with the learning activities. For example, half-completed Python programs or spreadsheet files.

To access the files, click 'Download resources' at: www.oxfordsecondary.com/computing.

Teacher's Guides

For more on these topics, look at the Teacher's Guide that accompanies this book.

You will learn

▶ about network hardware and how the components work together

▶ how messages are sent over the internet

▶ about packet switching

▶ how to connect to a network and how to solve problems with network connections

▶ about cloud storage and other services in the cloud.

In Student Book 5 you learned how to look for clues that tell you there is a network in your school. You learned that networks use special hardware such as hubs and routers. In this unit you will learn more about networks. You will learn about the hardware components of a network and how they are connected. You will learn how messages are sent over the internet. You will also learn how to connect to a network and how to solve some of the problems you might experience along the way. Finally, you will learn about cloud storage and other services in the cloud.

🔌 Unplugged

What do you know about network connections? Look around the room you are in and make a note of everything you can see that tells you there is a network in the room. If there is time, take pictures or make drawings.
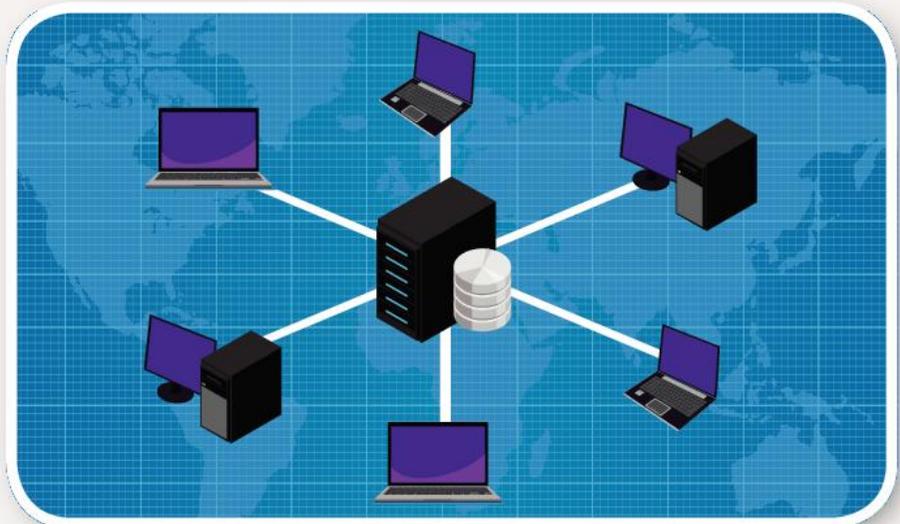
network   hub

switch   server   router   packets

packet switching   cloud

data centre   wireless access point

Cloud

Talk about…

In 2019, more than half (around 56%) of the world's population had access to the internet.

The number of people with access to the internet varies in different parts of the world. The rates are high in Europe, North America and parts of Asia. In parts of Africa, access to the internet is still very low.

Is it fair that some people are unable to access the internet? What do you think people miss out on? Is there anything the rest of the world could do to make the internet easier to access?

Did you know?

A new improved mobile phone service called 5G was introduced in 2019. 5G provides an internet connection that is faster than home internet links that run over cables. Some people think that 5G phone networks will become the way that we access the internet at home in the future.

1.1 Network hardware

In this lesson

You will learn:

▶ about the hardware needed in a network.

Using networks

When you use a computer, you are usually using a **network**.

You may use your school network. If you are at home, you may have a **broadband network** that connects you to the internet.

When you are sending an email, saving a school assignment or posting your thoughts on a social media site, you use a network. You often don't think about using a network. You save a document and expect it to be available next time you need it. But what happens to the file and where does it go?

When we send or receive a message over a network, we use many pieces of computer hardware. In this lesson you will learn more about network hardware.

Network hardware

Servers and storage

One of the most important pieces of hardware in a network is a **server**. A server is a computer.

The clue to what a server does is in the name. When you go to a restaurant, a waiter serves you food. The job of a waiter is to make sure everyone gets the meal they ordered.

A server stores and sends computer files and messages to users and to devices like printers. The job of a server is to make sure files go to the person or device that they are intended for.

Here are some examples of what a server can do.

It can:

▶ receive a word-processed file and save it to a network storage drive

▶ find a spreadsheet file you ask for and send it to your computer

▶ receive an email from you and pass it on to someone else

▶ receive a request from you to print a file and send the file to a printer.

Different types of servers do different jobs. For example, there are file servers, print servers and email servers.

⚙ **Activity**

What type of server is used for each of the examples?

What job do you think a web server does?

All computers need to store data. Servers are no different. They have storage devices attached to them. The storage devices used by servers are larger and faster than the ones in personal computers. This is because **network storage** is shared by many people who use the network.

Hubs and switches

When messages are sent out across a network, they need to be sent to the correct place. Hubs and switches do this job. They work in different ways.

When a **hub** receives a message, it sends it to all the computers that are connected to it. Every computer checks the message. The computer that the message is meant for keeps the message. The other computers ignore the message.

When a **switch** receives a message, it decides which computer the message is meant for. It sends the message only to that computer.

So, for example, if a hub is connected to 20 devices, it sends a message to all 20 devices. A switch only sends the message to the device it is meant for.
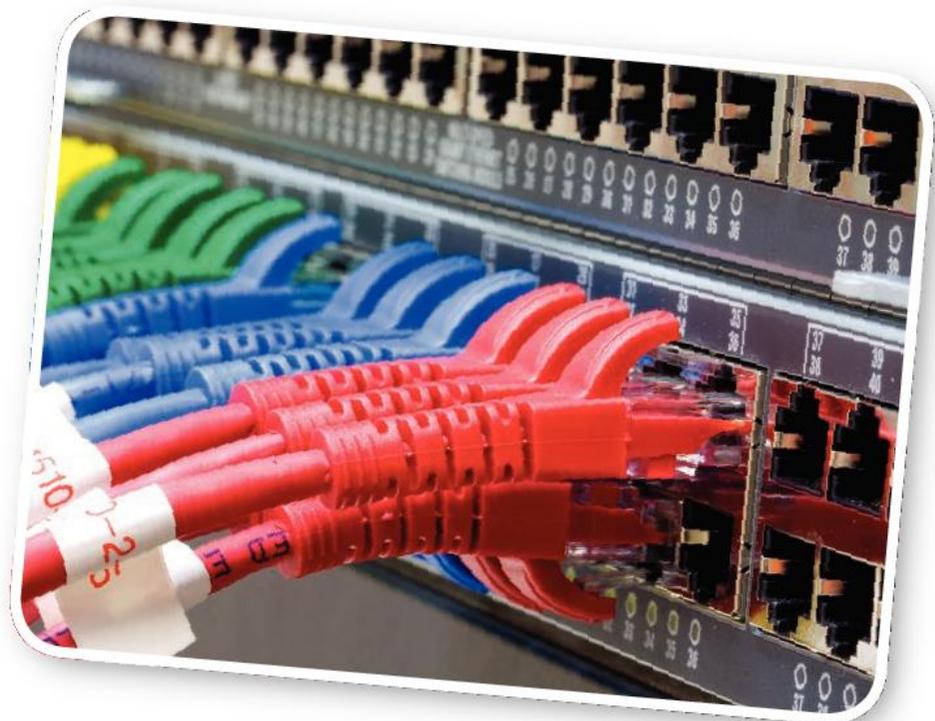
Hubs and switches: advantages and disadvantages

When a network is busy, the extra messages a hub sends out can slow the network down. A hub is also less secure than a switch. A hacker has more chance of stealing messages.

A switch is more expensive than a hub and is more difficult to set up. But it is more secure and works faster.

⚙️ **Activity**

Imagine you work in a computer department. Your manager sends you this email.

I am planning to upgrade the network in our accounts department. The computer manager wants to use a switch for the network. I have been told a hub would be cheaper. What is your advice?

Write a short reply to the email.

Routers and modems

A **router** joins two networks together. Routers are usually used to connect a LAN or a home network to the internet.

When two networks are joined together, they sometimes use different ways to send data. It is like two people talking in different languages. They can communicate if a translator works with them. A translator understands both languages. A translator changes words from one language to the other. This is the job of a **modem** in a network. It takes data sent by one network and translates it into a form that can be understood by the second network.

A wireless access point

Most modern networks allow wireless connection. This means that devices like laptops and tablets can connect to the network without having to use a cable. A wireless connection needs a special piece of hardware called a **wireless access point** (WAP).

A WAP is connected to the network by a cable. But computers can connect to the WAP wirelessly, without a cable. Several computers can connect to a single WAP. WAPs are put on ceilings or high on walls.

A network interface card

A **network interface card** (NIC) allows a computer or other device to connect to a network. Most devices come with a NIC fitted.

A standard desktop or laptop computer will be fitted with two NICs.

▶ One allows a network cable to be plugged in.

▶ The other allows a wireless connection.

NICs are fitted inside the computer case but you will see the network cable socket on the outside of the case.

Activity

Look for network hardware at school. Take photos of the hardware you find.

Make a document and label the photos.

If you have a home network, take a photo of your home router and add it to the document.

Extra challenge

Search the web for images of the types of network hardware described in this lesson.

Paste the images at the end of the document you created in the activity. Label them.

✓ Test

1 What does a server do in a network?

2 What piece of network hardware is used to give a wireless connection?

3 How do a router and modem work together in a network?

4 Explain why you would use a switch in a network instead of a hub.

In this lesson

You will learn:

▶ how the hardware components of a network are connected

▶ how the hardware components work together.

Home network

Many people have internet connections at home. An internet signal reaches your home through telephone or special broadband cables. When the internet connection reaches your home, it is connected to a device called a home router.

In Lesson 1.1 you learned about the devices used in a network. A home router combines the main devices needed for a network into a single small case that sits on a shelf or desk. The small home router contains four main components.

▶ A **router** connects your home to the internet.

▶ A **modem** converts the signals that pass along telephone or broadband cables into digital data your home network can use.

▶ A **switch** makes sure that messages coming into your home are sent to the correct computer.

▶ A **wireless access point** lets you connect to the network wirelessly, from anywhere in your home.

The photo shows the back of a home router. The yellow cable links the internet to the router. The four empty sockets allow devices to be plugged into the router using a cable. The sockets are sometimes used to connect other devices like a printer.

The three aerials (which look like black sticks in this photo) are connected to the wireless access point. Not all WAPs have aerials, but aerials can improve the wireless signal. Most people connect computers to the router using a wireless connection.

⚙ Activity

Which components of a network listed in Lesson 1.1 are not included in a home router? List them.

Explore more

If you have a home broadband connection, examine the home router carefully. Can you identify the features described in this lesson?

Don't touch or remove any cables. It is an electrical device so can be dangerous.

Local area network

A **local area network** (LAN) is much bigger than a home network, but it contains the same components. The components in a LAN are larger and there are many more of them. A LAN is not stored in a single case like a home network. LAN equipment is spread around a building. The equipment is stored in cabinets that either stand on the floor or are attached to walls.

Connecting LAN components

Network components like servers and switches are connected by cables.

Two types of cable connect network equipment.

▶ **Copper cable** is the most common cable in a network. Networks use **twisted pair cables**, made up of pairs of thin copper wires twisted together. Data is sent along copper cables as pulses of electricity.

▶ **Fibre-optic cable** is made up of thin strands of clear fibre. Data is sent along **fibre-optic cables** as pulses of light.
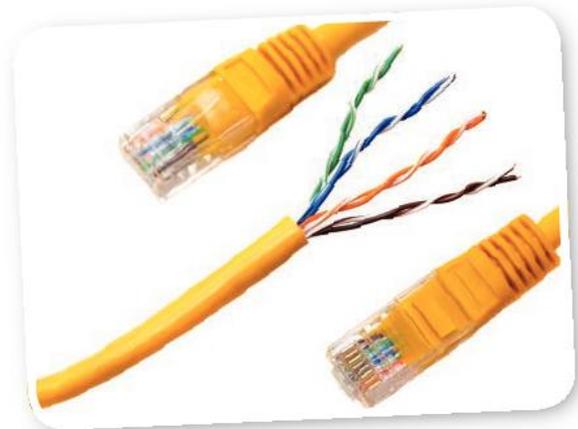
There are three important differences in the two types of cable.

1. More data can be sent at faster speed along fibre-optic cables. Data is sent as light. Nothing travels faster than light.
2. Fibre-optic cables can be used over longer distances than copper. Electrical pulses fade as they travel. Copper cables can only be used over distances of 100 metres.
3. It is cheaper to use copper cable.

The server room

At the centre of a network is a **server room**. The room is usually air conditioned. This is because computer equipment makes a lot of heat. If it gets too hot, the equipment may break down.

The server room contains all the servers in the network. It also contains hubs and switches so that the rest of the network can be connected to the servers.

All servers must be connected to a hub or switch. Data passes along a single cable between the server and a hub or switch. All devices must be connected to a hub or switch. A single hub or switch can connect to many devices. Each connection uses its own cable.

When a computer is plugged into a network socket, it is connected to the network. It sends messages along a cable to the hub or switch. The hub or switch passes the messages from many devices to and from a server.

The hub room

Sometimes you need to connect an area of a building to a network that is more than 100 metres away from the server room. This can't be done with copper cable. The electrical signal won't transmit that far. So a **hub room** is set up close to the area that is going to be connected to the network.

A hub room does not contain servers. It only has switches and hubs. Every network socket in the distant area is connected to a hub or switch in the hub room. The hubs or switches in the hub room are connected to the main server room using a fibre-optic cable. Using a fibre-optic cable means that the network can be more than 100 metres from the server room.

⚙️ Activity

The diagram shows an area in a school that is going to be connected to the school LAN. The area contains four classrooms, an IT classroom containing 20 computers, an office and a storeroom.

Each of the classrooms (including the IT classroom) must have:

▶ two network connections on the teacher's desk

▶ a network connection for a WAP installed on the ceiling.

The IT classroom should also have:

▶ a single network connection for each of the 20 computers

▶ a network connection for a printer.

The office will be used by four teachers. Each will have their own desk.

▶ Each desk will have two network connections.

▶ There will be an extra network connection for a printer in the office.

Draw a copy of the plan. In each room, write the number of network connections needed.

How many network connections are needed in total?
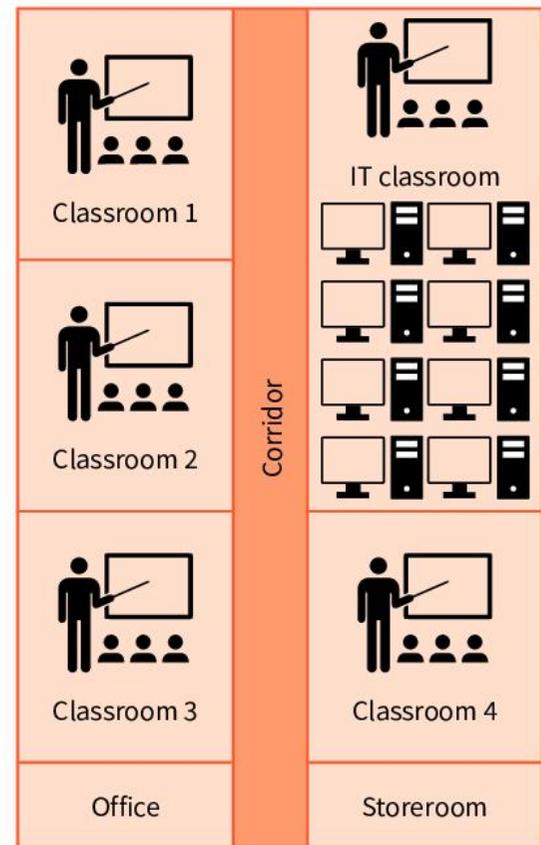
➡️ Extra challenge

Hubs or switches for the network will be kept in a cabinet on the wall of one of the rooms. Suggest two rooms that the cabinet could go in.

The school has two spare switches it can use. Each switch has 24 input connections. Does the school need to buy any more switches?

✅ Test

1 List four network components that are contained in a home router.

2 What are the two types of cable used in LANs?

3 Give an example of where a fibre-optic cable is used in a LAN.

4 Explain why hub rooms are used in LANs.

In this lesson

You will learn:

▶ the rules the internet uses to send messages.

Being connected

Being connected to the internet means you can send and receive messages. There are many types of messages you can send. These include simple text messages, audio, video and photographs.

To a computer, a text message and a video are treated the same – they are both **digital data**. A computer stores all files as digital data made up of zeros and ones. It sends every file across the internet in the same way.

In this lesson you are going to build a model. You will use it to learn how messages are sent over the internet. When you have completed the model, it will look like the one in the diagram. It looks complicated but you will build it step by step before using it in the next lesson.
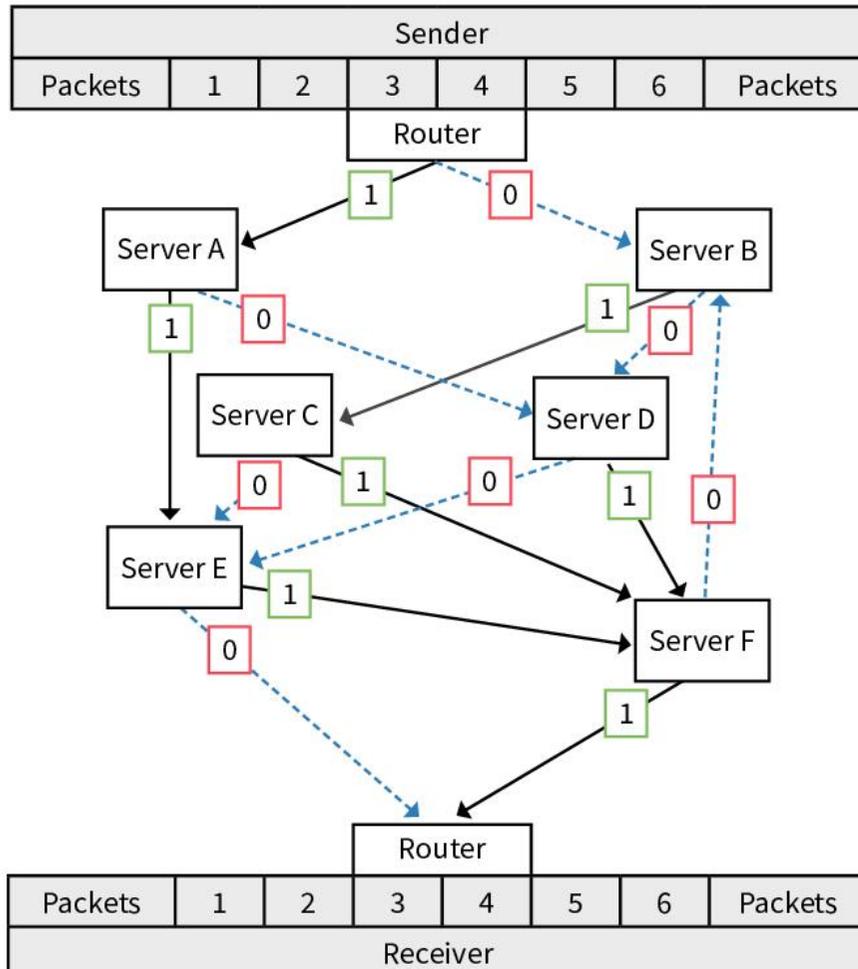
Get ready to build your model. You will need a large sheet of paper, two or three coloured pencils or pens, and a ruler. If you don't have a large sheet of paper, stick two sheets of A4 printer paper together along the long edge.

First, add a sender section to the top of your sheet. There are three parts to it:

▶ the word 'Sender'

▶ a row labelled 'Packets'. This row should contain six boxes, numbered 1 to 6.

▶ a box labelled 'Router'.

Add a similar section at the bottom of your sheet. This section is called 'Receiver' and is a mirror image of the 'Sender' section you have drawn at the top of the page.

Do not draw the sections too large. Leave plenty of room in the centre of the sheet.

What are packets?

A computer does not send messages as a single section of data over the internet. Any file that you send over the internet is split into smaller sections before it is sent. The small sections are called **packets**. Whether the message is an email, a photograph or a word-processed file, it is split into small packets before being sent. This makes sending a message easier for the equipment in the network to handle. A packet is about the size of this paragraph (about 550 characters). If you could look inside a packet you would see digital data – 0s and 1s.

When the packets reach their destination, they must be put back together into the original message. You don't have to worry about creating packets or putting them back together. Your computer does it automatically whenever you send a message over the internet.

Many thousands of packets are sent if you are sending a photograph or another large message. Each packet is addressed to the person receiving the message. Each packet is numbered so that the message can be put back together in the right order.

What does a router do?

In Lesson 1.1, you learned that a router is used to connect your school or home network to the internet. Every packet in your message will pass through the router one after the other. When you use the model, you will move packets onto the router box before they are sent.

Activity

Go back to the model you started to draw. In the space in the centre of your page, do the following:

▶ Draw six boxes. Don't make the boxes too large. Make sure there is plenty of space between them.

▶ Label the boxes 'Server A' to 'Server F'. Look back at the diagram on page 14 if you're unsure how the boxes should look.

What does a server do?

As discussed in Lesson 1.1, the job of a server is to send files over a network. When you send a message over the internet, it is split into packets. Each packet travels in steps across the internet, jumping from one server to another until it reaches its destination.

Activity

In this activity you will add links, joining servers in your model together. In the real world, each server will be linked to many other servers. You will add just two links from each server in your model. This keep things simple.

To make your model easy to follow, choose two different line styles.

▶ Use two different colours.

▶ Label one style of line '0' and the other '1'.

Add an arrow to indicate the direction of the line.

Start from the router at the top of the page. Draw connections to two servers. Use different line styles.

Work through each of the servers, adding two links to the other servers in your model. Make sure each server is linked to at least once.