# KS4 - Computer networks

## Unit introduction

Computer networks have become an integral part of our daily lives. This unit allows learners to explore how a computer network works from the hardware required to the protocols used for communication. It also allows them to explore simulations of networks using Packet Tracer software. Packet Tracer is free for schools to use and is used in universities to train network engineers.

To download Packet Tracer, you will need to enrol in CISCO’s “[Getting started with Cisco Packet Tracer](https://skillsforall.com/course/getting-started-cisco-packet-tracer)” free course.

## Overview of lessons

| **Lesson** | **Brief overview** | **Learning objectives** |
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| 1 What is a computer network? | This lesson introduces learners to the term ‘computer network’. They develop their understanding by looking at other networks in the real world before discovering what a computer network is. They then discuss the advantages and disadvantages of a computer network before learning about the peer-to-peer model through an unplugged activity. Finally, learners are given real-world examples of peer-to-peer networks before completing a keyword matching exercise. | * Define a computer network * Discuss the advantages and disadvantages of computer networks * Describe the role of a computer in a peer-to-peer network |
| 2 The client–server model | This lesson introduces learners to the client–server model by using a similar unplugged activity to the one used in Lesson 1 for peer-to-peer networks. This allows learners to see the similarities and differences between the two models. After discussing the advantages and disadvantages of the client–server model, learners are introduced to the three types of area network: PAN, LAN, and WAN. Finally, learners complete a mini quiz that assesses learning from the last two lessons. | * Describe the role of a computer in a client–server network * Describe the purpose of a PAN, LAN, and a WAN |
| 3 Network hardware | This lesson gently steps learners through the key hardware components required for communication across a network. They are first given definitions, using pause points to check recall. They are then given an activity where they spot the missing device from a network, before designing their own networks based on given scenarios. Finally, learners are given a quick ‘Who am I?’ quiz where they must decide which hardware component is being described. | * Describe the tasks performed by the network hardware: wireless access point, router, switch, hub, NIC, and bridge * Define a MAC address |
| 4 Network topologies | This lesson focuses on the four main network topologies: star, bus, mesh, and ring. Learners are introduced to each topology through a series of slides that illustrate how data is transferred between nodes. Learners are then given an activity sheet that lists the advantages and disadvantages of each topology; they use this to decide which network topology should be used for the given scenarios. For each scenario, learners draw the topology and justify their answers. Finally, learners are given a quick quiz to check which topologies they can remember. | * Draw and describe a star, bus, mesh, and ring topology * Describe the advantages and disadvantages of the star, bus, mesh, and ring topologies * Select an appropriate topology for a given scenario |
| 5 Wired and wireless transmission media | This lesson introduces learners to wired and wireless transmission media. Transmission media is defined before going into the specifics of each type of transmission media. They are then given an activity where they must read about the advantages and disadvantages of each type and select the most appropriate transmission media for six given scenarios. Finally, learners are introduced to Packet Tracer, a popular network training tool used in industry and universities. Here, they add to pre-built networks and develop some essential networking skills. | * Define a wired and a wireless network * Define transmission media * Describe the attributes of fibre optic and copper cables used in wired networks * Describe Bluetooth as a mode of connection * Discuss the advantages and disadvantages of wireless networks compared to wired networks |
| 6 Network performance and routing costs | This lesson begins with a quick check that learners have remembered some of the transmission media types covered in the last lesson. They then move on to look at the four main factors that affect network performance. A keyword matching exercise is used to check their recall of these terms. Next, learners are shown the formula for calculating the transmission time of a file over a network before attempting some calculations themselves. Finally, learners use the Packet Tracer software to investigate routing costs across a network. | * Describe the factors that affect network performance (bandwidth, range, latency, number of devices) * Determine how network speeds are measured and construct expressions involving file size, transmission rate, and time * Determine methods of routing traffic on a network and calculation of routing costs |
| 7 What is the internet? | This lesson begins by testing learner recall and asking them to sketch each of the four topologies given. It then moves on to describing the internet from its invention to how it works now. Next, learners discover how a web browser is used to access the WWW by using DNS to find the IP address of each website. At this point, learners use the Packet Tracer software to see a simulation of this, which they can investigate. Finally, learners are given a more in-depth view of how DNS works and the different types of domain servers that are available. | * Describe the internet as a network of computer networks * Describe the function of an IP address * Describe a DNS and its role in the conversion of a URL to an IP address * Describe the role and function of a web browser |
| 8 Hosting services | This lesson builds on the knowledge covered in Lesson 7 where learners learnt how a web browser works and how web pages are located and presented on devices. Learners now take a look at web hosting and services that are hosted in the cloud. They take a tour of a Google data center whilst completing a scavenger hunt. Then they take a look at the environmental impacts of cloud computing and vote on whether it is positive or negative for the environment. | * Describe how servers are used for hosting services across the internet * Describe the role of web servers and clients * Describe how the cloud provides services for software and storage * List the advantages and disadvantages of the cloud |
| 9 Protocols | Learners begin by thinking about the types of rules there are for communication in the world that we live in. The term ‘protocol’ is then formally defined. They should already be familiar with this term as it has been used throughout the unit. Some of the most common networking protocols are then defined before learners complete a matching exercise. Finally, learners work in groups to create their own protocol and attempt to send a message. This is used to gently introduce them to the TCP/IP model that will be covered in Lesson 10. | * Determine the need for standards in network communications * Define the term network protocol * Define the purpose and common use of the network protocols: Ethernet, WiFi, HTTP, HTTPS. FTP, POP, SMTP, and IMAP |
| 10 The TCP/IP model | This lesson is designed to deepen learner understanding of the protocols covered in the last lesson and how these protocols operate in the four layers of the TCP/IP model. It starts with a quick recap of what a protocol is. It then moves on to a brief description of the four layers of the TCP/IP model. Learners then take part in an unplugged activity that clearly shows how each of the four layers operate and how this works in relation to data transmission. They learn about segments, packets, and frames and how routing tables are used to decide the ‘next hop’ for the data. Finally, learners are given a repack and recap activity before a quick plenary to check if learners can remember the protocols used at each layer. | * Describe the four layers of the TCP/IP model (Link, Internet, Transport, Application) * Define the purpose and common use of the network protocols: TCP, IP, UDP * Describe that the HTTP, HTTPS, SMTP, IMAP, and FTP protocols operate at the application layer * Describe that the TCP and UDP protocols operate at the transport layer * Describe that the IP protocol operates at the internet layer * Describe the typical contents of a TCP/IP packet and packet switching |
| 11 The OSI model | Note: This is a short lesson that goes into the details of the OSI model. The OSI model only appears on one English examination board specification, which means that teachers of the other specifications may wish to skip this lesson. This lesson will not be referred to in subsequent lessons.  This lesson introduces learners to the conceptual, OSI model. It provides descriptions for each of the seven layers and how these relate to the TCP/IP model that was covered last lesson. Learners are then given an activity sheet to complete that relates to the content covered in the slides. Finally, a plenary checks that they can remember the names of some of the seven layers. | * Describe the purpose of each layer in the seven-layer Open Systems Interconnection model (OSI model) * Describe the use of contemporary networking protocols in the seven-layer OSI model |
| 12 Protecting a network | This lesson starts by asking learners what data the school might hold about them. It also asks why it is important to keep that data safe. This will allow them to think about why it is so important to protect a network from cyber crime. Learners are then introduced to the two main types of attack, which are social engineering and malicious code. Next, learners use Packet Tracer to see a simulation of a pharming attack. Finally, learners play a network security game to introduce them to all of the threats and methods to protect a network before being asked to list some examples in the plenary.  Note: This lesson is a brief overview of network security threats and methods to prevent attacks. For a more in-depth look at cybersecurity, please use the KS4 Cybersecurity unit, which is available on TeachComputing.org. | * Determine the need for and importance of network security * Identify different forms of attacks on networks (social engineering, malicious software) * Explain network security methods |
| 13 Summative assessment | This lesson gives the learners time to complete the summative assessment. | * Recall knowledge of networks through a final, summative assessment |

## English examination board specifications

This unit offers full coverage of the four main examination boards used in England. You can view specification mapping within the Lesson 1 folder. This will enable you to teach the materials suitable for your examination board if you teach in England.

## Progression

This unit progresses learners’ knowledge and understanding of computer networks. Two learning graphs have been provided to demonstrate how learning will progress throughout the unit.

## Curriculum links

[**National curriculum links**](https://www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study/national-curriculum-in-england-computing-programmes-of-study)

* Develop their capability, creativity, and knowledge in computer science, digital media, and information technology
* Develop and apply their analytic, problem-solving, design, and computational thinking skills

[**Education for a Connected World links**](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683895/Education_for_a_connected_world_PDF.PDF)

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* I know that accessing some websites or services may increase the risk of encountering viruses and other types of malware.
* I can explain how the security of devices connected to the internet may be compromised e.g. webcams, monitors, phones. or toys. I can demonstrate actions people can take to minimise such compromise (e.g. covering cameras on computers when not in use).
* I can explain why it’s important to know how to recover a device or account if it gets compromised / hacked.
* I can explain why backing up data is important and how this can be done.
* I understand the benefits of two factor authentication and use it where available.
* I can explain what malware is and give some examples of how it operates and what the impact could be on a device or user (e.g. viruses, trojans, ransomware).

## Assessment

### Summative assessment

* A multiple choice summative assessment has been created for this unit.

## Subject knowledge

This unit focuses on the GCSE topic, computer networks.

Enhance your subject knowledge to teach this unit through the following training opportunities:

### Online training courses

* [An introduction to computer networking for teachers](https://teachcomputing.org/courses/CO214/an-introduction-to-computer-networking-for-teachers)

### Face-to-face courses

* [An introduction to computer systems, networking, and security in GCSE computer science](https://teachcomputing.org/courses/CP238/an-introduction-to-computer-systems-networking-and-security-in-gcse-computer-science-face-to-face)

Resources are updated regularly — the latest version is available at: [ncce.io/tcc](http://ncce.io/tcc).

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