Number of weeks (between 6&8)	Content of the unit	Assumed prior learning (tested at the beginning of the unit)
6	This is a theoretical unit covering the basic principles and architecture of local and wide area networks. Pupils will learn that the World Wide Web is part of the Internet, and how web addresses are constructed and stored as IP addresses. Client-server, peer-to-peer networks and the concept of cloud computing are all described. Ways of keeping data secure and simple encryption techniques are also covered. In the final lesson, pupils will sit a multiple choice test which will form the Unit assessment.	No previous learning is necessary with this unit.

Assessment points and tasks	Written feedback points	Learning Outcomes (tested at the end and related to subject competences)
Each week there will be exam style questions as part of the teaching which will be assessed. There are also tasks which need to be completed each lesson. This Schemes of work is aimed towards GCSE Grades A*- C	Provide written feedback every 2 weeks	I can use the greater than (>) and less than (<) relational operators correctly I can use AND, OR and NOT in simple operations I can identify that binary data is made up of 1s and 0s I can explain the relational operators >=, <=, <> I can explain binary representation (e.g. 101=5) I can describe the term Data Capture I can identify the terms Backup and Archiving I can describe a number of different data capture methods I can explain the difference between hardware and software I can define the terms Proprietary & Open file formats I can explain what a CPU is I can discuss advantages and disadvantages of prototyping I can explain what 3 input and 3 output devices do I can identify some storage devices I can define the terms LAN and WAN I explain the functions of different network devices e.g. wireless router I can define the term Operating System I can explain the function of an operating system

At the end of this Unit all pupils should be able to:

- State that the Internet is a wide area network and the world wide web is part of the Internet
- Define the meaning of the terms "domain name", http protocol
- Explain the basic principle of packet switching
- Give examples of LANs and WANs
- State three different network topologies
- Describe what is meant by a client-server network and state some of its advantages
- State why some transmissions are encrypted, and use a simple algorithm to encrypt and decrypt a message

Most pupils will be able to:

- Explain the meaning and significance of bandwidth
- Explain what is meant by buffering and why it is used
- State the advantages and disadvantages of different network topologies
- Design a simple network layout
- Identify some of the extra hardware components used in a LAN
- Compare the uses of peer-to-peer networks and client-server networks

Some pupils will be able to:

		• Design a network layout for their school, using icons to represent server, hub, switch, router, Internet, workstation, printer
		• Describe the concept of cloud computing and some of the benefits it brings to individuals and organisations

Lesson	Clear learning intentions	Clear success criteria	Hook	Presentation of content	Guided practice	Independent practice (homework)	Closure

| 1 | • Learn what the Internet and World Wide Web are

• Learn how web addresses are constructed

• Learn what a protocol is and why one is needed for data communication

• Understand how packet switching works

• Learn what the Domain Name Server (DNS) does | Understand what the Internet and World Wide Web are

Understand how web addresses are constructed

Know what a protocol is and why one is needed for data communication

Know how packet switching works

Know what the Domain Name Server (DNS) does | Students to come up with a definition of the Internet. | Explain the world wide web is just a part of the Internet. VoIP, Email and instant messaging, for example, may use the Internet but not the world wide web.

Introduce pupils to the term 'URL'. Discuss the various parts of a web address and different domain names.

Explain why HTTP is needed and introduce the concept of splitting data for transmission into data 'packets'. It's fairly remarkable that the whole world managed to agree on a single set of rules! What if we could all use the same currency or speak the same language?

Explain how packet switching works using the **Packet Switching Resource Sheet**. Using this, you can role play the job of routers and the packet switching process from sender to receiver. You can also explain that images are sent in the same way as text; the image is split into chunks and sent as packets too.

An IP (Internet Protocol) address is a numerical label assigned to each device connected to the Internet. These used to be 32-bit numbers, giving a possible total of 2^{32} different addresses (about 4.3 billion).

Explain that a Domain Name Server is used to convert each URL into its unique IP address. URLs are only required because we find it too difficult to remember web addresses as long strings of numbers. Demonstrate finding the IP address for Google using **www.who.is** or **Link Who Is DNS Lookup**. Copy the IP address you find into the address bar of a browser and show the pupils what happens. | **Worksheet 1 Domain names** or let the pupils access a digital copy. They can complete Activity 1 and will complete the rest as the lesson progresses.

Pupils can test out the system themselves in Activity 2 of **Worksheet 1 Domain Names**.

Extension activity

Pupils to complete Activity 3 of **Worksheet 1 Domain Names**. Pupils use a website such as **www.uk2.net** to search for a domain name to check its availability. | Write a paragraph about the history of the Internet | Videos: **Link How the Internet Works** provides a good summary of the lesson. **Link DNS** gives an animated overview of how the DNS works. |

| 2 | • Learn the meaning and significance of bandwidth
• Compare different types of cable, and the relative speeds of data transmission
• Calculate time taken to download files of different sizes at different bandwidths
• Understand what is meant by buffering and why it is used | Understand the meaning and significance of bandwidth

Understand the different types of cable, and the relative speeds of data transmission

Know how to calculate time taken to download files of different sizes at different bandwidths

Know what is meant by buffering and why it is used | Ask the class how data is transmitted across the Atlantic or the Pacific Ocean. They may not realise that it is by under-sea cables. You could tell the class a little about the history of cable-laying. | Show the class the map of under-sea cables. You could also demonstrate this with an interactive version using **Link Undersea Internet Cable Map**. Occasionally these cables are damaged or severed, sometimes deliberately, cutting off large parts of the world from the Internet. Divers were reportedly caught cutting the cable off the coast of Egypt in 2013. Users of the Internet in Egypt reported slower connection speeds afterwards.

Explain the meaning of bandwidth. One analogy for bandwidth is to compare it to the amount of water that can flow through various sized pipes at any one time. The water (or data) flows no faster, but more can flow at once.

Demonstrate an Internet speed test using **Link Internet Speed Test.** Depending on timing, pupils may like to have a go at this too. Ask them why the upload and download speeds are so different? – Downloading is generally faster than uploading. Internet providers give priority to downloading because most users spend far more time downloading than they do uploading.

Explain broadband and fibre optic cable. Find some cables to pass around.

Explain the advantages and disadvantages of using a wireless connection. | If there is time, you can ask pupils to find the transmission speeds of various types of cable. E.g.

Fibre Optic Cable transmits data as pulses of light with speeds of up to 10Gbs or more

Coaxial cable – max 100Mbs, sent as an electronic signal

WiFi – typically 54Mbs, sent as a radio signal

CAT5 – 100-1000Mbs, sent as electronic signals

(http://www.ni.com/white-paper/13724/en/)

Pupils complete **Worksheet 2 Transmission Speed**. | Compare the attributes between
Ethernet (Cable connection)
Wireless (WiFi) connection
& Powerline | Re-cap on what has been covered within the lesson. |

3	• Understand the difference between LANs and WANs • Be able to give an example of each type of network • Know what extra hardware is needed for a LAN to operate • Identify three different network topologies – bus, ring and star	Know the difference between LANs and WANs Understand how to give an example of each type of network Understand what extra hardware is needed for a LAN to operate Be able to identify three different network topologies – bus, ring and star	Hold a class discussion about the advantages and disadvantages of standalone vs networked computers, say in a school. **Advantages: can share devices such as printers, scanners, external drives. Easy to share folders and files of data. Backup is taken care of centrally.**	Explain the difference between a WAN and a LAN. Discuss the extra hardware needed to operate a LAN. Show the example of a Network Interface Card (NIC) and explain that all computers need one to connect to any network. These include desktop computers, laptops, tablets and mobile phones. Identify the three common network topologies: bus, ring and star and then ask pupils what they think might be the advantages and disadvantages of each. Explain that some networks will require additional pieces of hardware such as routers, hubs and switches. Describe the differences between them.	Pupils design the network layout for their school, using icons to represent server, hub, switch, router, Internet, workstation, printer etc. **Worksheet 3 Designing a network**.	Compare and explain the advantages and disadvantages of LAN and WAN	Re-cap on LAN and WAN as well as the three different network topologies.

| 4 | • Understand what constitutes a client-server network

• Contrast a client-server network with a peer-to-peer network

• Be able to list advantages and disadvantages of each model

• Understand what is meant by cloud computing

• List the main advantages of cloud computing | Know what constitutes a client-server network

• Understand a client-server network with a peer-to-peer network

• Know how to list advantages and disadvantages of each model

• Know what is meant by cloud computing

• Understand the main advantages of cloud computing | Discuss what is meant by a client/server network. Ask if pupils have ever used one. (Yes: school network!). Clarify what a server is, and that there may be different servers each with different functions, or in a smaller network, just one server doing everything – acting as file server, email server, print server etc. | With reference to the last lesson, point out that star and bus networks are both client-server networks. Client-server networks could be either LANs or WANs.

Discuss the example of a computer network in a hospital – what different types of user will there be?

Discuss the advantages and disadvantages of a client-server network.

Peer-to-peer networks

Continue with a discussion of peer-to-peer networks. Do any of the pupils have two linked computers at home?

Peer-to-peer (P2P) networks have been at the centre of the file-sharing controversy, highlighting sites such as Napster and Pirate Bay in recent news. These sites enable file sharing and can encourage illegal sharing of copyright material such as music and software applications. Several of these sites have been 'shut down' after courts have ruled them illegal. Their owners have even been sentenced to prison. However, they keep springing back up since it is very difficult to control a P2P network as there is no central store of data.

Cloud computing

In cloud computing, instead of software applications and data being held on your computer or a LAN server, they are held on the network of computers that make up the "cloud".

The only thing a user's computer needs is the cloud computing system's interface software – for example, a Web browser such as Chrome or Internet Explorer. | Give out **Worksheet 4 Client-server networks** and let pupils work on it individually or in pairs. | Compare the advantages and disadvantages of client server network vs Peer 2 peer network- Complete workbook homework page 6 | Why have your word processing and spreadsheet software on your home computer? In the future, will we have small hard disks and keep almost all data and applications on the cloud?

As Cloud computing grows, will computer use and ownership become cheaper? |

| 5 | • To identify some of the types of data that need to be kept secure

• To learn some of the ways in which data is kept secure

• To learn how unauthorised people can break ciphers and read encrypted data

• To learn some classical encryption techniques | Understand that some types of data need to be kept secure

Understand ways in which data is kept secure

Understand how unauthorised people can break ciphers and read encrypted data

Know some classical encryption techniques | Discuss the padlock symbol found on banking and shopping websites. When a small padlock appears in the browser search bar, it means encryption is switched on. This is one way that organisations can keep data transmitted over the Internet secure from hackers. | Refer to the http protocol and ask what the 's' of https might stand for. Discuss the questions on security in the PowerPoint guide.

Encryption

Go over the terms used, i.e. plaintext, ciphertext, encryption, algorithm, key.

How can a message be decrypted by someone who does not know the key? Decoders at Bletchley Park in WW2 had the difficult job of decoding messages, with a key that changed every day.

Explain the two approaches to code breaking: the brute-force attack and the cryptanalytic attack where a logical approach is used to work it out.

Explain that using statistics, you can begin to guess which letters may have been substituted with which others based on the frequency of their occurrence.

Show how different ciphers work, e.g. the Caesar Shift cipher, or substitution key depending on a key word – 'jellybean' is given as an example. The key word or phrase could change with every message, so even if one message is deciphered it will not mean that the cipher is broke. For example, the message could start with the page number of an agreed book, and the key word could be the first n letters on that page. | Pupils complete **Worksheet 5 Encryption**. | Using double key encryption create your own cipher text-
Revise for lesson based assessment next lesson | Re-cap on what has been covered in the lesson. |

| 6 | • Assessment of learning for the unit. | | | Briefly revise at the start of the lesson.

Explain rules for the assessment.

Explain how the assessment is to be completed. | Final Assessment | Exam past paper on network, connectivity and topologies | |