Lesson plan

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| Topic 5 Data transmission |
| Learning Objectives:   * Describe:   + Protocols used to govern and control data transmission for: email, voice and video calls over the Internet, web pages, secure payment systems   + Security issues and considerations when transmitting data over different connection types and networks   + Factors affecting bandwidth and latency and the implications of these on the use and performance of an IT system   + Types of compression: lossy, lossless   + The applications and implications of data compression   + The use and implications of codecs when using and transmitting audio and video in digital format |
| Content |
| Starter  PowerPoint Guide: Topic 5 Data transmission  The starter aims to get students thinking about protocols that occur in real life. This allows people to communicate with a set of rules. Students should be able to describe some of the rules around meeting a head teacher or principal at your school or college. There are different protocols in countries such as Japan. In the same way, when electronic communications are made these have different protocols.  Main  Protocols  Protocols are used for network communications and services. Students may be aware of some email protocols. In addition to SMTP, POP3 and IMAP which are discussed in the following slide, there are also proprietary protocols used for Gmail and Exchange (Outlook).  Email protocols: SMTP, POP3 and IMAP  SMTP (Simple Mail Transfer Protocol) is a protocol that is only used to send email. If an internal email is sent in a company then the email first goes to the SMTP server which will send it to the companies mail server – it is therefore unlikely to go to the Internet. Outside an organisation, SMTP servers on the Internet will relay the email until it reaches the final mail server. Emails are generally sent without encryption; hence they are insecure.  POP3 (Post Office Protocol 3) and IMAP (Internet Message Access Protocol) are both protocols to receive mail. With POP3, when a user presses the receive mail button all the email waiting for them are downloaded. Only one copy is available at any time, just like with a real letter that is posted. IMAP works differently in that the server stores the emails. Email clients can download and cache copies of emails. If many devices access the same IMAP inbox, they will all be synchronised. If one device deletes an email, it will be deleted on all the other devices. IMAP is therefore more advanced and useful, especially now that many users access email on both a PC and a mobile device.  Give out **Worksheet 5** and ask students to do **Task 5.**  Topic 5 Worksheet 5  Topic 5 Worksheet 5 Answers  Voice protocols  VoIP (Voice over Internet Protocol) is a protocol that allows voice communications such as telephone calls to be placed over the Internet. These can be made from a program on a computer or a physical device. Telephones make use of a protocol called SIP (Session Initiation Protocol). This is used for signalling and controlling the connection of the phone. If the Internet connection is lost, then all phones that use VoIP will not work. Companies that rely on VoIP will have backup Internet connections and may have a number of backup traditional lines too.  Video calls and Google Duo  Students are likely to be aware of apps that are available to make video calls. Most of these make use of proprietary protocols. Facetime is one example of a proprietary set of protocols. The disadvantage with this is that users can only use Facetime with other users of an Apple operating system such as MacOS, iPadOS or iOS.  Google Duo works with other operating systems but still has the problem that it uses proprietary protocols. It can’t phone people on Facetime for example. Other video services that Duo competes with include Facebook messenger, Skype, Viber and What’s app.  Web pages and HTTP  Students are often confused in thinking that the Internet and World Wide Web (WWW) are the same thing. The Internet is the network (which uses the protocols such as TCP/IP) whilst the web is used for sending web pages with the HTTP protocol. The hypertext transfer protocol specifies how a web address (URL) is formed and also the response codes that a web server will reply with. Students will likely be aware of the response code 404 meaning page not found (on the web server). Other codes are also used, such as 200 for OK, 301 for a permanent redirection and 500 for an internal server error.  Secure Payment Systems and NFC  Payments made through the Internet need to be secure. HTTPS, and SSL or TLS are used to make the encryption of web pages. In addition, SSL certificates are issued so that users can verify who owns the web server. Demonstrate the contents of an SSL certificate by visiting a webpage that uses HTTPS and then clicking the padlock next to the web address. If a payment system is hacked it can reveal a large amount of personal data. In 2018, British Airways had 380,000 sets of payment details compromised resulting in loss of reputation, potential fines and risks to customer’s ID and finances. NFC is another way in which payments can be made. Security features to restrict payments can include expecting users to enter a password or have a fingerprint scan.  Ask students to do **Task 2** on the worksheet.  Security issues  Take students through the slide and ask how communications can be made more secure. Students are likely to mention encryption, but access controls are equally important. Answers to the question are given on the following slide.  Bandwidth and latency  Bandwidth and latency have previously been discussed so students should have a good idea of both topics and an ability to answer the questions. If you have any multiplayer gamers in the class, they may be well informed about the topic of latency, even if they describe it as ‘lag’ or ‘ping’. Take students through the two slides and answer slides.  Ask students to do **Task 3** and **Task 4** on the worksheet.  Compression  Compression allows file sizes to be reduced. This is very important for images and video which require a lot of storage space. Lossy compressions (such as JPEG and MPEG) will often result in compressed files that are 1/10th the size of the original.  Lossless compression  Zip files make use of a lossless compression. They look for similar patterns in the data and then create a dictionary of these patterns. It is important that the original data is exactly restored as lossless compression is used for word-processed documents and computer programs. In fact, a Word document with the extension docx is just a zip file. If you change the extension to .zip then you will be able to see the contents inside. Ask students to come up with a method to compress the data. The solution on the answers slide assumes that 1=The, 2=big etc.  Lossy compression  Lossy compression techniques such as JPEG work by assuming that the pixels near each other will be similar. This is why the edges of text often look poor on JPEG images as there is a sudden change from black to white. In video compression, it is possible to look at previous and future frames to work out what the current frame should be. Without compression, video streaming would be impossible with the connection speeds that most people have. It would be useful at this point to demonstrate different qualities in audio compression: <https://www.youtube.com/watch?v=53tdYmJuUmM> [0m:00s-1m30s]. You may also like to ask students to use an audio editing program such as Audacity to try different bit rates and see the difference in sounds quality that results.  Codecs  Codecs are often confused as meaning compression/decompression. They actually mean coding/decoding. Many codecs will perform compression as part of this, but they don’t have to. Take students through the slides. If a codec is missing on a computer when a file, such as an AVI, is opened, then the file will not play.  Ask students to do **Task 5** and **Task 6** on the worksheet.  Plenary  Ask students to complete the plenary task and then go through the answers.  Hand out **Homework 5**.  Topic 5 Homework 5  Topic 5 Homework 5 Answers |