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COMMON ASSESSMENT TASK

Level 3 Digital Technologies and Hangarau Matihiko 2021

91908 Analyse an area of computer science

Credits: Three

Achievement	Achievement with Merit	Achievement with Excellence
Analyse an area of computer science.	Analyse, in depth, an area of computer science.	Critically analyse an area of computer science.

Type your School Code and 9-digit National Student Number (NSN) into the space below. (If your NSN has 10 digits, omit the leading zero.) It should look like "123-123456789-91886".

There are three questions in this document. **Choose ONE question to answer.**

Make sure you have the PDF of the Resource Booklet 91908R. This contains resources for Questions Two and Three.

You should aim to write **800–1500 words** in total.

Your answers should be presented in 12pt Times New Roman font, within the expanding text boxes, and may include only information you produce during this assessment session. Internet access is not permitted.

Save your finished work as a PDF file as instructed by your teacher.

By saving your work at the end of the examination, you are declaring that this work is your own. NZQA may sample your work to ensure this is the case.

Achievement

TOTAL | **03**

ASSESSOR'S USE ONLY

INSTRUCTIONS

There are three questions in this assessment, on the topics of:

- Formal languages ()
- Network communication protocols ()
- Big data ().

Choose only ONE question to answer.

Questions Two and Three require you to refer to the separate resource booklet.

Read all parts of your chosen question before you begin.

OR: **QUESTION TWO: Network communication protocols**

This question includes references to **Resources A to D** on pages 2 and 3 of the resource booklet.

(a)   Name TWO application layer protocols and TWO transport layer protocols, and state the function of each. You may refer to **Resources A and B** in your answer.

(1)	Application layer protocol: HTTP
	HTTP (HyperText Transfer Protocol) is used for transporting hypermedia (text, images, webpages etc) from a server to your computer. HTTP works by using GET requests to request webpage files, to which the server then responds by sending the HTML files to your browser.

(2)	Application layer protocol: DNS
	DNS is used for translating domain names, such as youtube.com, into IP addresses. Domain names are used as they are user friendly, so that we do not have to remember IP addresses to type into the search bar. However, IP addresses are needed for your computer to make a connection with a server. DNS works by route mapping, for example for youtube.com it would first search for all domain names with ".com", and within that it will search for "youtube.com", taking the quickest route it can find to the desired IP address.

(3)	Transport layer protocol: UDP
	UDP is a transport layer protocol, meaning that it dictates how data is formatted, and splits data into packets. UDP is used for its speed. This works by the receiver sending a request, and the sender then sending all the packets of data.

(4)	Transport layer protocol: TCP
	TCP is another transport layer protocol that dictates how data is formatted and splits it into packets. TCP is a reliable transport layer protocol as it makes sure data is received. TCP uses the "three-way handshake" for this. The "three-way handshake" begins with a sender sending a SYN to a receiver, requesting to synchronize. The receiver then sends back a SYN-ACK, synchronizing and acknowledging the message it received. The sender then sends an ACK, acknowledging that it received the receiver's message, and data transfer can begin. This establishes a strong connection, between sender and receiver, which makes TCP reliable.

(b)   Give examples of the ways you use network communication protocols.

Network Communication Protocols are used for all things over the internet, for things such as applications or webpages. I use Discord, which is an online chat messaging, and voice/video calling application. Discord uses HTTP for its web-application which allows it to reach a larger audience over the internet. It also uses both TCP and UDP for transport layer protocols. Discord uses UDP for voice and video calling as packet loss is acceptable because these things need to be live, and UDP prioritizes speed. Discord uses TCP for its chat messaging as accuracy of data is more important in this case, as people do not want random characters showing up in the place of their message.

(c)   (i)   What are the capabilities and limitations of a network communication protocol you have investigated this year? You may refer to **Resource C** in your answer.

Capabilities of TCP are confirming that data keeps its integrity and arrives at its destination. TCP uses checksums to make sure the integrity of the data sent is kept. If the checksum sent does not equal the checksum received, then the receiver knows that the packet is corrupted and can ask for retransmission, to which TCP then retransmits the packet. TCP also uses ACKs to confirm that the receiver received all packets.

Limitations of TCP are security and speed. TCP does not encrypt data, which means that cyber attackers can interfere with data sent over the internet. TCP is also slow (as opposed to UDP) because of the ACKs it uses.

       (ii)   Explain how the limitations you identified could be addressed.

Security is an issue that can be solved by applying TLS (Transport Layer Security) onto TCP. This is a protocol which encrypts data and is often used with TCP for things such as online banking or even emailing to ensure that users' data is secure and will not be interfered with.

UDP is often used in conjunction with TCP to allow combat the limitation of speed for TCP.

(d) Two ways of communicating over the internet are **email** and **videoconferencing** (using Zoom, Skype, FaceTime etc.).

For each of these two ways, explain why TCP and / or UDP would be used as network communication protocols. Comment on the advantages and limitations of the protocol for each.

You may refer to **Resources C and D** in your answer.

TCP and UDP prioritize different aspects of transporting packets.

For emailing, TCP is the protocol that is used. This is because TCP is more reliable as it makes sure that data arrives in its destination. This is beneficial for emails, as data needs to be accurate, and it does not matter much if it takes longer to arrive. UDP would not be used for emails as it does not prioritize integrity of data, rather it prioritizes speed, which is an attribute that is more suited to other applications.

For videoconferencing, UDP is the protocol that is used, as it is much faster than TCP. This is partially due to packet sizes being much smaller as it does not perform the same proofing measures as TCP (TCP having 20 bytes of extra data, while UDP only having 8 bytes, according to Resource C). With UDP, packet loss is not an issue because a pixel being out of place or the wrong shade does not affect the overall image in video calling. Video calling needs to be live, and UDP is used because it prioritizes speed. TCP would not be used for video calling as although it is more reliable than UDP, it is much slower, and the video would lag behind.

The number of internet-connected devices is increasing globally. In 2018 there were approximately 8.4 billion networked devices. A forecast at the beginning of 2020 predicted that this number will increase to 29.3 billion by 2023, and that 71 per cent of the global population will be mobile subscribers by then.

Source (adapted): Hill, K. (2020). Connected devices will be 3x the global population by 2023, Cisco says. RCR Wireless News, 18 February 2020. https://www.rcrwireless.com/20200218/internet-of-things/connected-devices-will-be-3x-the-global -population-by-2023-cisco-says

(e) With reference to the statement above, what are some possible future uses or improvements you think will be necessary in the field of network communication protocols?

With the rate of internet and computer users rising, it is highly likely that Quantum Computers will be developed soon. Quantum Computing will allow for better and faster internet access and astronomically larger storage and better processing power. These attributes are highly sought after as many people are now switching to cloud storage, emailing, and online banking, as opposed to doing these things in-person.

Network Communication Protocols will have to be adapted completely to Quantum Networking, as this will be much different from current networking, due to the nature of Quantum Computers. With the current error rate of Quantum Computers, protocols such as TCP would need major revamping to include more error control. With the increased speed UDP might essentially be useless and detrimental even, considering the rate of packet loss Quantum Computers may have.

Quantum Computers are said to be able to breach all modern encryption. This would be detrimental, considering that the resource above states that "29.3 billion (networked devices are expected) by 2023, and that 71 per cent of the global population will be mobile subscribers by then." which would mean that billions of people's information will be accessible to the entire world if Quantum Computing gets in the wrong hands. This affects Network Communication Protocols as it uses encryption for security of data being sent over the internet and is an issue that is necessary to address before Quantum Computing becomes mainstream.

Achievement Exemplar 2021

Subject	Level 3 Digital Technologies		Standard	91908	Total score	03
Q	**Grade score**	**Annotation**				
2	A3	In parts (a) and (b), the candidate has accurately identified and stated the functions of application and transport layer protocols, and has provided examples of protocols in everyday use. In part (c) the candidate has shown some ability to interpret the resource, and while their response is partially correct, some aspects are totally incorrect In parts (d) and (e) the candidate has repeated themselves to a certain extent, giving information that supports and strengthens the evidence provided in previous parts without meeting the requirement of these tasks.				