B5.

a) Describe the concept of hidden node (also known as hidden terminal) problem in wireless media access. How does RTS/CTS overcome the hidden node problem, and what are the downsides of using RTS/CTS?

(10 marks)

b) Compare and contrast the acknowledgements in the TCP transport layer protocol with acknowledgements as implemented by IEEE 802.11 wireless networks. Consider the relative merits of the source of the acknowledgements in each case, and the effect these may have on network throughput.

(7 marks)

c) IEEE 802.3 Ethernet uses collision detection whereas IEEE 802.11 Wi-Fi uses collision avoidance. Consider and discuss why the two different approaches have been taken for these two network technologies.

(8 marks)

END OF EXAMINATION

NETWORK INFORMATION SYSTEMS

Monday 17th April 2023 - Morning

Answer **any** THREE questions out of FIVE. All questions carry equal marks.

Time: THREE hours

Answer any <u>Section A</u> questions you attempt in <u>Answer Book A</u>
Answer any <u>Section B</u> questions you attempt in <u>Answer Book B</u>

For all questions, illustrate your answers with diagrams where appropriate.

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are **NOT** allowed in this examination.

Section A
Answer Section A questions in Answer Book A

A1.

    a) Explain what CAP theorem is. In your answer refer to:

- Consistency
- Availability
- Partition Tolerance

(8 marks)

    b) One of the most popular distributed data stores in everyday use today are MongoDB, Amazon Web Service's S3, and Google Cloud Platform's Spanner. Explain their advantages in terms of performance, scalability and reliability.

(6 marks)

    c)

        i) What is a critical section in a distributed application?

        ii) With the help of a diagram, explain what deadlock in distributed systems is.

(11 marks)

A2.

    a) What is round-trip time?

(4 marks)

    b) Slow start, defined by RFC 5681, is part of the congestion control strategy used by TCP. Explain how it works.

(6 marks)

    c) Explain how the TCP's Congestion Window (CWND) parameter is formed and state the difference with the TCP's receive window parameter.

(10 marks)

    d) What is latency in computer networks and what is the relationship between latency and round-trip time?

(5 marks)

Section B
Answer Section B questions in Answer Book B

B3.

Using Secure Sockets Layer/Transport Layer Security (SSL/TLS) as an example implementation:

    a) Describe the function of Public Key Encryption and Symmetric Encryption. In your answer, you should explain why SSL/TLS uses a combination of public key encryption and symmetric encryption.

(9 marks)

    b) Describe what is meant by a digital signature and its role in a digital certificate, explaining also the function of the digital certificate.

(10 marks)

    c) What is the purpose of the message digest or hash function used in digital signatures, and what risks might be associated with Hash Collisions?

(6 marks)

B4.

A university library service wishes to open a new library branch at a location off campus. The new site will connect to the university LAN through a point-to-point wireless solution.

The library branch will offer patrons public Wi-Fi access, as well as a wired network of wired Ethernet connected PCs to support staff and public workstations. All users will need access to the World Wide Web.

The library runs a library management system that must be available to staff and patrons through its web-based Online Public Access Catalogue (OPAC), but the server for this will be maintained at the main university campus server room.

The university is short of available IPv4 addresses but must continue to support IPv4. They propose to allocate the private address range 10.1.1.0/24 to the branch library.

Design a network topology for the library. Draw a diagram of your solution that clearly identifies any network hardware and software components that would be required to implement your solution. Give suitable IP addresses to each subnet, computer and switching component.

For **each** hardware and software component which is required to implement your solution, describe its function, and justify why it is required.

(25 marks)