

Two hours

**UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE**

Computer Networks

Date: Tuesday 24th January 2017

Time: 14:00 - 16:00

Please answer any THREE Questions from the FOUR Questions provided

Use a SEPARATE answerbook for each SECTION.

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text

[PTO]

Section A

1.
 - a) When creating a network application, there are technical factors that can determine its successful long-term deployment. For each of the factors listed below define what the factor means in relation to network applications and why it is important. [6 marks]
 - i) Scalability
 - ii) Extensibility
 - iii) Resilience
 - b) Describe two approaches, excluding content distribution networks (CDNs), that applications use to implement scalability. For each approach, your description must include why the approach gives scalability, drawbacks of the approach and how these drawbacks can be overcome. [8 marks]
 - c) Alice wishes send a message to Bob. He will only read the message if he can confirm that it comes from Alice and is unaltered. Both Alice and Bob have public/private key pairs. Describe how Alice should send her message in a single transfer and be sure that Bob will read the message. [3 marks]
 - d) Assuming that the computational cost of encryption must be minimised, how would your solution for the previous part need to be changed if the message also needed to be confidential? [3 marks]

- 2)
- a) Applications require Quality of Service (QoS) parameters to be provided by the network over which they are deployed. Possible QoS parameters include reliability, minimum bandwidth guarantees and minimum packet delivery delays. For following applications give, with reasons, the QoS parameters they will and will not require from the underlying network. [4 marks]
 - i) Watching online films
 - ii) Interactive voice conversations
 - b) Networks are fundamentally unreliable. To provide applications with a reliable QoS that gives reasonable network utilisation, the transport layer can implement reliability using a sliding window with either a go-back-N or a selective-repeat approach. Outline how these approaches ensure reliability. [4 marks]
 - c) A transport layer is going to implement reliability over a network that only very occasionally loses data. Discuss the use of the go-back-N and selective-repeat approaches to implementing reliability in this case and, with reasons, state which of the two approaches would be the most efficient. [2 marks]
 - d) Reliable flow-controlled communication is occurring between two ends of a transport layer connection. The implementation is using sequence numbers for individual bytes. The source has an unlimited amount of data that is available to send; the sequence number of the first byte is 10. The receiver has a 100 byte buffer which at time zero is empty; the sending end knows this. The propagation delay in each direction along the connection is two and the transmission delay is zero. Assuming that no packets are lost, and the receiving application reads 20 bytes of data at time 10 and 40 bytes of data at time 20, show what packets will be transmitted across the network from time 0 to time 30. For packets from the sender to the receiver show the amount of data that each contains and sequence number of this data. For packets from the receiver to the sender show the window size and the value of any acknowledgement. [6 marks]
 - e) State why manual configuration is a poor design choice in networking. What are the key characteristics of mechanisms that IP hosts use to autoconfigure themselves? IP hosts uses DHCP and ARP to autoconfigure themselves, what are the similarities and differences of these two mechanisms? [4 marks]

Section B

- 3) Using one of YouTube™, Facebook™, Netflix™ or Amazon Prime™ as an example, briefly explain how a video and other media streaming Internet site can be scaled from handling a few tens of concurrent queries and downloads to handling many millions of such queries worldwide? [20 marks]
- 4)
- a) At the physical layer, using examples, explain the difference between a bit and a symbol? [3 marks]
 - b) Why do Ethernet and almost all other data-link layer frames start with a preamble? [2 marks]
 - c) How does an Ethernet receiver know when the preamble has finished? [2 marks]
 - d) Ethernet uses longer addresses than IPv4 does? Why? [5 marks]
 - e) A zebra file consisting of repeated large blocks of zeros followed in each case by a large block of ones is transmitted over a network. How can the network's physical layer reliably act to prevent errors in the zebra file at the file's receiver? [8 marks]

END OF EXAMINATION