

Two hours

**UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE**

Computer Networks

Date: Friday 16th January 2015

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) For a distributed application running in a heterogeneous (mixed) environment, describe why the need to convert data may arise. [2 marks]
 - b) Give details of canonical and receiver makes right approaches that can be used in a distributed environment to implement data conversion. For each approach, your description should include a small example to illustrate the operation of the approach. [6 marks]
 - c) For distributed applications, explain the meaning of extensibility and why it is important to distributed applications. [2 marks]
 - d) Describe the extensibility features of both Telnet and HTTP and what changes in the applications these allow. [5 marks]
 - e) Alice and Bob have a shared secret (key) but neither have a public/private key pair. Describe how they can exchange non-confidential data and be assured that is not altered during transmission. The approach that you describe should minimise the use of individual keys and whenever possible use the least computationally expensive encryption operations. [5 marks]

2.
 - a) Network reliability can be implemented using Go-Back-N, Selective Ack and Negative Ack, illustrate how each of these approaches operate when no error occurs and when an error occurs. [6 marks]
 - b) In terms of speed of recovery and overhead, compare and contrast the above three approaches to implementing reliability and the factors that affect these. [4 marks]
 - c) Describe why the need for flow control can arise in a distributed application and why having flow control in these circumstances is important. [2 marks]
 - d) In networking, what is a sliding window and how can this principle be adapted to implement flow control. [2 marks]
 - e) Assume that a transmitter has its output buffer permanently full and that the total transfer time between the transmitter and receiver is $3\mu\text{s}$ in each direction. For a receiver that initially has its input buffer full, show including their time of transmission and receipt the messages (generic descriptions are sufficient) that will be sent between the receiver and transmitter when:
 - i) The receiver removes 3 bytes from its input buffer at time $2\mu\text{s}$ [2 marks]
 - ii) The receiver removes 4 bytes from its input buffer at time $12\mu\text{s}$ [2 marks]
 - iii) The receiver removes 5 bytes from its input buffer at time $22\mu\text{s}$ [2 marks]

Section B

3. a) By using a small example and pseudo English questions and answers for the messages exchanged, show how the Internet Group Management Protocol (IGMP) manages local IP multicast frame distribution. [5 marks]
- b) A media streaming service needs to decide between using TCP and UDP for streaming live high definition 1080p (1920 x 1080 pixels) video. [6 marks]
- i) Why is TCP a bad choice to achieve this service?
- ii) What are the advantages and disadvantages of streaming using multicast UDP?
- iii) Many non-live streaming services use TCP. Why is TCP a sensible choice in these cases?
- c) What is meant by half and full duplex in a communications context? [2 marks]
- d) How do switches differ from hubs in order to support full duplex communications? Your answer should label each difference as adding or removing either hardware or software or both. [4 marks]
- e) If IP addresses are sufficient to identify where each packet should be received using today's Internet, why is a separate addressing and identification scheme used at the data-link layer? [3 marks]
4. a) Why is the amount of traffic sent between routers limited by policing on the Internet? [2 marks]
- b) Why are weighted fair queues (WFQ) often used as part of the Quality of Service (QoS) implementation in Internet routers? [2 marks]
- c) Using diagrams where useful, explain how token buckets are used to police demand from particular traffic streams in quality controlled Internet routers? [7 marks]
- d) What happens if lots of frames arrive when the token bucket is empty? [3 marks]
- e) What happens if lots of frames arrive when the token bucket is already full? [3 marks]
- f) If a group of full token buckets configured to handle a differently labelled traffic stream are each sent a large number of frames at almost the same time what will happen? Is this fair? Give reasons for your answer. [3 marks]

END OF EXAMINATION