

Two hours

**UNIVERSITY OF MANCHESTER  
SCHOOL OF COMPUTER SCIENCE**

Computer Networks

Date: Friday 22nd January 2016

Time: 09:45 - 11:45

---

**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) Quality of Service (QoS) parameters provided from a network to an application include reliability, bandwidth, packet delivery delays and security. For web browsing, internet radio and on-line banking, give, with reasons, the QoS parameters they will require from the underlying network. [6 marks]
  - b) Distributed applications must exchange application control information and user data between the ends. To identify control information that they must interpret and data that they must transparently pass on, applications must distinguish between the two types. Three approaches are the separation of control and data, data in control and control in data. For each of these approaches, outline how it operates, give an example of its use and describe the situations in which it is most appropriate. [9 marks]
  - c) Distributing workload and data is a key part of ensuring that network applications are scalable. If the same data is required across the network, caching is one-way of distributing data in a controlled way.
    - i) Explain how caching gives scalability. [2 marks]
    - ii) Discuss approaches to ensuring that cached data is up-to-date with the original source of the data. You should include the advantages or disadvantages to each approach that you describe and the situations to which it is best suited. [3 marks]
- 2)
  - a) Network security is based on algorithms and keys. Approaches using these can be classified into symmetric and asymmetric (public/private). For each of these, outline the approach and its advantages and disadvantages. [4 marks]
  - b) Authentication, confirming identify, is one aspect of network security. Three approaches to implementing authentication are three-way handshake, trusted third party and public key. For each of these, describe, including an illustration, how each end proves its identity to the other end. [6 marks]
  - c) A fundamental element of security is distributing identity/key combinations in a secure manner. The answer to this is digital certificates. Describe how digital certificates allow this information to be securely distributed and the assumptions present in the process. [5 marks]
  - d) Alice wishes send a confidential message to Bob. He will only read this if he can confirm that it comes from Alice. Both Alice and Bob have public/private key pairs. Assuming that the computational cost of encrypting the message must be minimised, describe how Alice should encrypt her message so that only Bob can read the message and that Bob can be sure that it comes from Alice. [5 marks]

**Section B**

- 3)
- a) The speed of light in the optical fibre for this question is  $2.4 \times 10^5 \text{ kms}^{-1}$  and that there are no repeaters or routers along the optical cable.
    - i) Calculate the maximum distance in kilometres over which a Voice over IP (VoIP) conversation would be expected to operate successfully. List any additional assumptions that you made in order to calculate the correct answer. [3 marks]
    - i) In a real world network, how would the actual distance over which the VoIP conversation would operate successfully vary from your answer to 3 a) above. [2 marks]
    - ii) Giving reasons, explain what features of TCP can make it a bad choice for transporting the VoIP conversation in the above scenario? [5 marks]
  - b) A router has two incoming connections, just one outgoing connection and three separate classes of traffic labelled as Video, Audio and Best-Effort.
    - i) Draw a sketch of the main components and data flows within this router that you would use to implement guaranteed QoS. [3 marks]
    - ii) What constraints are needed in order for the QoS guarantee to be valid? [2 marks]
    - iii) Using pseudo-code, or an activity diagram, show how a leaky token bucket in software is very simple to implement. [5 marks]

- 4)
- a) What does the Address Resolution Protocol (ARP) do? Why might ARP be a problem when used in networks of mobile devices? [4 marks]
  - b) Compare and contrast the use of:
    - i) Your mobile phone number.
    - ii) Your mobile phone's MAC address.
    - iii) Your mobile phone's IP address.
    - iv) Your name.for use as a place for network message packet delivery and for identification of the person to whom a message should be delivered. [4 marks]
  - c) Are there more switches than routers in today's Internet? Why? [3 marks]
  - d) What should an Ethernet do in between frames:
    - i) When a frame is waiting to be sent through the link.
    - ii) When there are no frames waiting to be sent through the link.For each of your answers state why this is what should happen plus give important advantages and disadvantages of your answers. [7 marks]
  - e) For a shared network carrying only voice telephone calls what type of MAC protocol is most suitable? Why? [2 marks]

**END OF EXAMINATION**