Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Computer Networks

Date: Tuesday 18th January 2011

Time: 14:00 - 16:00

Please answer any THREE questions from the FOUR questions provided

Use a SEPARATE answerbook for each Section

For full marks your answers should be concise as well as accurate
Marks will be awarded for reasoning and method as well as being correct.

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) Explain why in the context of network applications, extensibility is an important concept. (2 marks)

    b) By using examples from two existing applications, show how applications and application protocols can be constructed to support extensibility. (4 marks)

    c) One of the major issues with shared information is accessing and maintaining large volumes of information. By using examples from both the web <u>and</u> DNS, show how bottlenecks in the accessing and maintenance of information can be avoided. (8 marks)

    d) A client wishes to access their bank over the Internet. They have previously established a client identifier and a shared secrete key with their bank. For security, the bank needs to authenticate any user accessing its services and wants to ensure that any messages passing between it and a client have not been altered.

        Outline a protocol (message sequence) that authenticates all client accesses and ensures the integrity of all messages that pass between the bank and its clients. The protocol should also minimise the chance that any eavesdropper can reverse engineering the shared secrete key. (6 marks)

2. a) For the following TCP transmissions, show what data and acknowledgements are sent across a connection. For data, you must show the sequence number of the data, the size of the data segment, and the time of transmission and receipt. For acknowledgements, you must show the sequence number acknowledged, and the time of transmission and receipt. You should assume that the TCP window size is sufficiently large for all data to be sent, that the propagation delay between the source and destination is one (1), that the time to transmit data or acknowledgements is negligible, the initial sequence number at the source is seven (7), the timeout at the source is six (6) and acknowledgements are sent immediately data is received.   (6 marks)

   > Time 1: source sends 3 bytes of data that are successfully received
   > Time 4: source sends 4 bytes of data that are not received; when retransmitted, the data is successfully received
   > Time 8: source sends 6 bytes of data that are successfully received
   > Time 12: source sends 2 bytes of data that are not received; when retransmitted, the data is successfully received

   b) Explain why there are differences in the implementation of reliability in datalink ARQ and in the Transmission Control Protocol (TCP). Your answer should include consideration of what is acknowledged and the delay before retransmission occurs.   (4 marks)

   c) To allow an IP datagram to be sent across an Ethernet physical network the Address Resolution Protocol (ARP) maps logical IP addresses to physical Ethernet addresses. By using an example, explain how ARP implements this mapping.   (5 marks)

   d) Broadband connections to a home normally provide a single worldwide unique IP address to a household. Explain by using an example how private IP addresses and Network Address Translation (NAT) allows several computers within a home to simultaneously access the Internet.   (5 marks)

Section B

3.   a)   Give two characteristics that clearly distinguish audio and video network data from most other forms of media such as e-mail and web pages.   (2 marks)

b)   A web based multi-media system transfers all media embedded into HTTP documents. What transport layer protocol is used to transfer the media? From a networking perspective, give two advantages and two disadvantages to using your selected transport protocol for media transfers.   (5 marks)

c)   You have been given the task of designing an audio and video conferencing system. The client has insisted that UDP alone is sufficient for this application. Explain why the client is either wrong or both right and wrong?   (10 marks)

d)   Why are errors in media received from a network connection at the application layer rare? Where are errors in the received media detected and what then happens?   (3 marks)

4.   a)   Explain the difference between a network switch and a router.   (2 marks)

b)   Using diagrams where appropriate, briefly explain how network collisions are usually avoided in:

      i. A hub based Ethernet local area network.
      ii. A switch based Ethernet local area network.
      iii. Bluetooth.

    (8 marks)

c)   The diagram below shows 4 switches interconnected with the computers A to I on a single local area network (LAN).
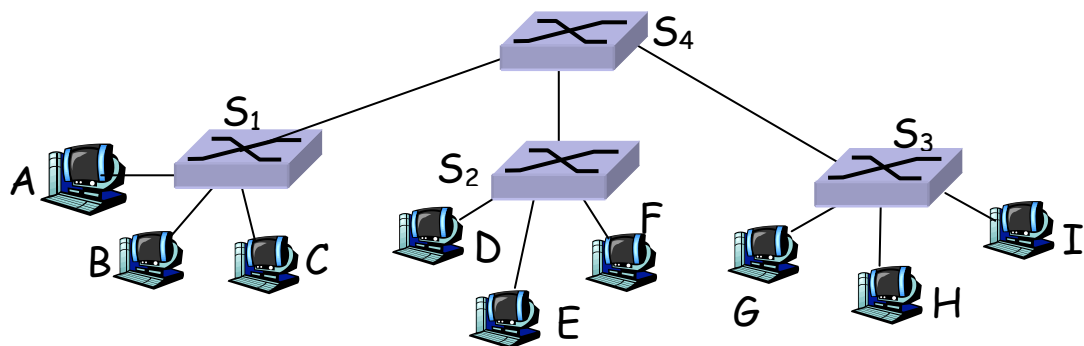
Assuming that the computers and the switches have only just been switched on, briefly describe how a **link layer frame** from computer A will find its way to its destination computer E.   (5 marks)

d)   Quality of Service (QoS) is very important to real-time multi-media applications such as "Second Life". Suggest how QoS aware routers might be used by Second Life to improve the user experience whilst not disadvantaging other network users?   (5 marks)

END OF EXAMINATION