

Two hours

**UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE**

Computer Networks

Date: Thursday 16th January 2014

Time: 09:45 - 11:45

Please answer any THREE Questions from the FOUR Questions provided

Use a SEPARATE answerbook for each SECTION.

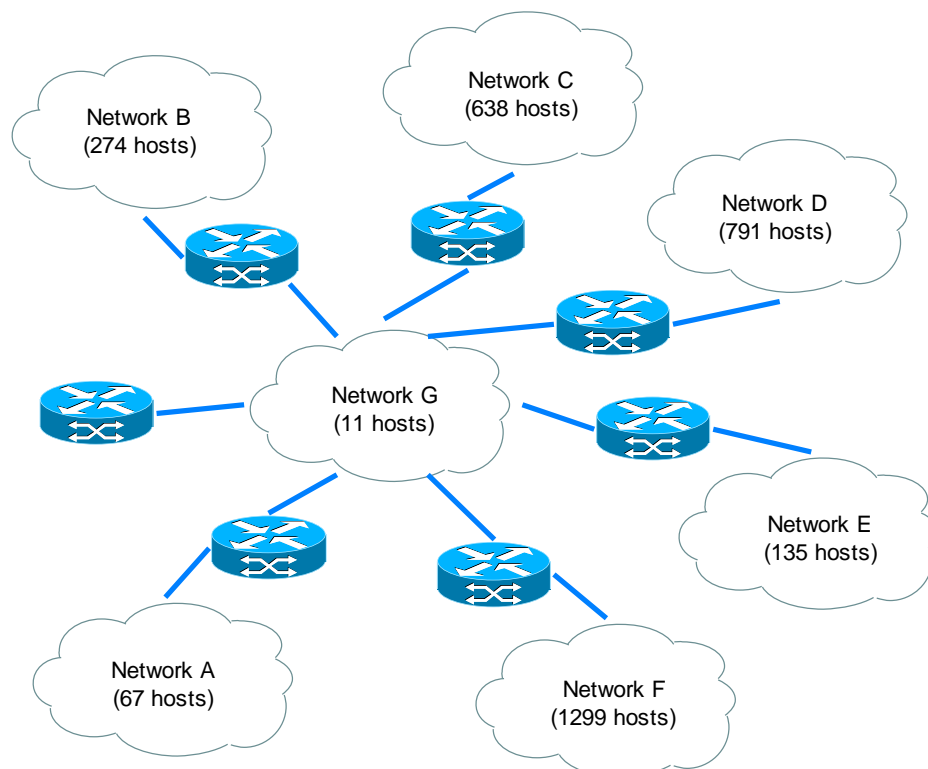
This is a CLOSED book examination

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

[PTO]

Section A

1. a) ISPs (e.g. broadband providers) for residential homes normally assign a single worldwide unique IPv4 address to each household. Identify two other pieces of information that they will provide to the households Internet modem/router to enable it to communicate with the rest of the world. [2 marks]
- b) Explain by using an example how Network Address Translation (NAT) uses a household's single worldwide unique IPv4 address and private IPv4 addresses to allow several devices, e.g. computers and TVs, within a home to simultaneously access the Internet and receive replies to the correct device. [4 marks]
- c) The following picture shows the physical structure of an organisation's network. The Internet authorities have allocated this organisation the block of IPv4 class C network addresses 193.74.0.0-193.74.63.0. By using Classless Inter-Domain Routing (CIDR), decide how these network addresses should be allocated within the organisation, and what netmask should be used for each of the physical networks, to allow all of the organisation's hosts to be fully connected to each other and the external Internet. Your answer should show how you determine the class C network addresses allocated to each physical network. [4 marks]



- d) In terms of a networking protocol stack, state what a protocol's service model is and how it is used within the stack. [2 marks]

Question 1 continued overleaf

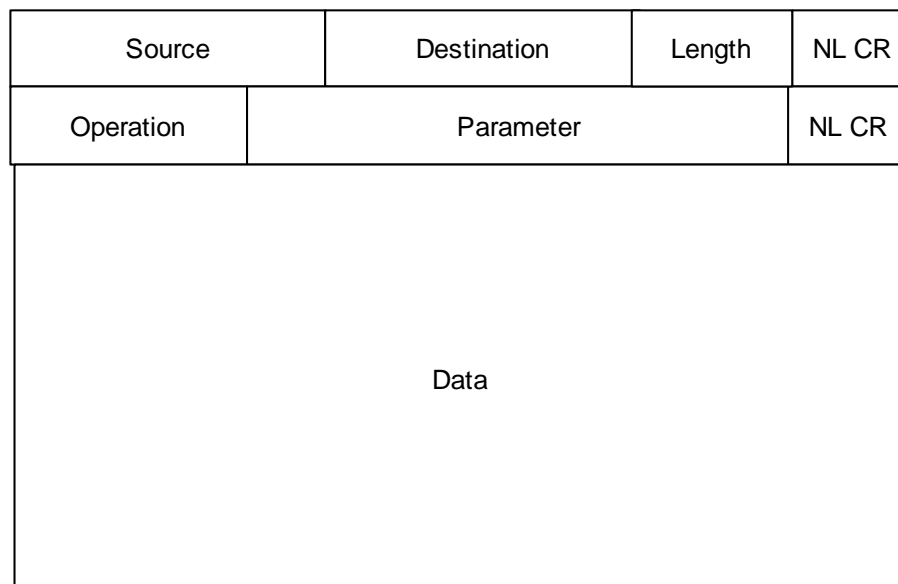
Question 1 continued

- e) Outline the service model that the two transport protocols, UDP and TCP, provide and indicate with reasons the types of applications that are built on top of each. [4 marks]
- f) Variable sized sliding windows are used by TCP to implement part of its service model. State the part of the service model that they implement and for the scenario below what packets are sent from the transmitter to the receiver, and what acknowledgements (packet number and window size) are sent from the receiver to the transmitter. Your answer should include the time at which each transfer happens. [4 marks]

A sender is transmitting packets (numbered 1, 2, 3, ...) to a receiver that has a buffer that can hold six packets. Assume that it takes 1 unit of time for data to flow from the sender to the receiver, or vice versa. At time 0 the sender has 30 packets ready to send and the receiver's buffer is empty meaning that the initial size of the send window is six. At time 4 the application at the receiver consumes three packets from the buffer.

[PTO]

2. a) One aspect of the correct operation of a networked (distributed) application is ensuring that all of the parts of the application make the same interpretation of data exchanged. Outline two approaches to ensuring that all parts of the application make the same interpretation. [4 marks]
- b) Coordination of information is a key part of the successful operation of the Internet. Describe the process that DNS uses to ensure that globally unique names are used and the mechanism via which the name server that can translate a name to an IP address is found. [4 marks]
- c) The diagram below shows the format of a packet used by a new application being developed. In relation to extensibility, identify four good or bad points about the indented packet format. [4 marks]



- d) In network security one of the choices that must be made is between the use of symmetric and non-symmetric keys. State three consequences of choosing one or the other in terms of performance and what can be done with them. [3 marks]
- e) Alice has a very large file of confidential information that she wants to send securely (without its contents being visible or tampered with) to Bob. As Bob has recently been receiving SPAM, he will only open files if he can verify who they are from. Both Alice and Bob already have a public/private key pair and their public keys have been securely exchanged. Describe a mechanism that will allow Alice to perform her secure transfer and Bob verify the sender of the message; your answer should be in terms of basic network security elements and not just suggest that TLS is used. [5 marks]

Section B

3. a) List six features of TCP that can affect its choice as a transport protocol for streaming real-time multi-media data. For each feature that you list, classify it as "Good", "Bad" or "Both", and give a justification for your classification. [12 marks]
- b) Suggest additional information that if communicated would remove (or reduce) the reasons why TCP is a bad choice of transport protocol for streaming real-time multi-media data.

In each case suggest how this information could be made available and how this information would be used. [8 marks]

4. a) Why do many Internet connections to homes and offices via telecommunications carriers use Point-to-Point Protocol (PPP) over ATM (PPPoA) or Ethernet (PPPoE) instead of just using Ethernet on its own? [9 marks]
- b) How is the start of an Ethernet frame found? How is the end of an Ethernet frame found? [3 marks]
- c) Why does Ethernet use a 32 bit CRC whereas ATM works perfectly well with only an 8 bit CRC? [2 marks]
- d) Using Ethernet and ATM as examples, briefly compare, including their advantages and disadvantages, the following properties of link layer protocols: [6 marks]
- i) The position and use of "length" fields in data-link layer protocols.
 - ii) The sizes of frames.

END OF EXAMINATION