

Two hours

**UNIVERSITY OF MANCHESTER  
SCHOOL OF COMPUTER SCIENCE**

Computer Networks

Date: Monday 23rd January 2012

Time: 09:45 - 11:45

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**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.**

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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 network applications, explain the concept of extensibility and describe why it is important. (3 marks)
- b) An application is being developed that allows the exchange of information about events. Currently it is believed that the information to be exchanged about an event is its title, location, start date, end date and a description of the focus of the event.

Design a protocol (message types and structure of messages) for this application that will allow a search for an event to be sent and a response of details of any matching events to be returned to the requester. The search request should allow a search pattern for any information field to be given. As the information associated with an event could change in the future, your proposed protocol should include support for extensibility. (5 marks)

- c) For network applications running on a variety of devices, e.g. desktop, laptop and mobile, explain why there is the possibility of incorrectly interpreting data that is sent between these devices. By using examples, describe two ways in which network applications ensure that all of the distributed parts of an application make the same interpretation of data. Your answer should indicate any data transforms that are required. (6 marks)
- d) A customer has previously established a shared secret key and client identifier with an on-line shop. They now wish to purchase a product over the Internet.

Outline a process that allows the shop to authenticate the customer access and ensure that any messages passing between it and the customer have not been altered. This process should minimise the chance that any eavesdropper can reverse engineer the shared secret key. (6 marks)

2)

- a) Explain the basic principles of implementing a reliable service model using acknowledgements, timeouts, retransmissions and sequence numbers. (5 marks)
- b) A pair of hosts are communicating using TCP as their transport layer protocol. Currently one host has 2048 bytes of data ready to send to the other host. The receiving host has a buffer capable of holding 100 bytes of data that is currently empty and has communicated this fact to the sending host. The sequence number of the first expected byte is 96, again the sending host knows this fact. At time zero, the sending host sends 100 bytes of data to the receiving host. The receiving host will remove 10 bytes at time 5, 20 bytes at time 10 and 7 bytes at time 15.

Assume that it takes 1 unit to transfer a packet between the two computers, that no packets are lost, that the sender sends as much data as it is allowed and the receiver informs the sender of available space in its buffer as soon as it is available.

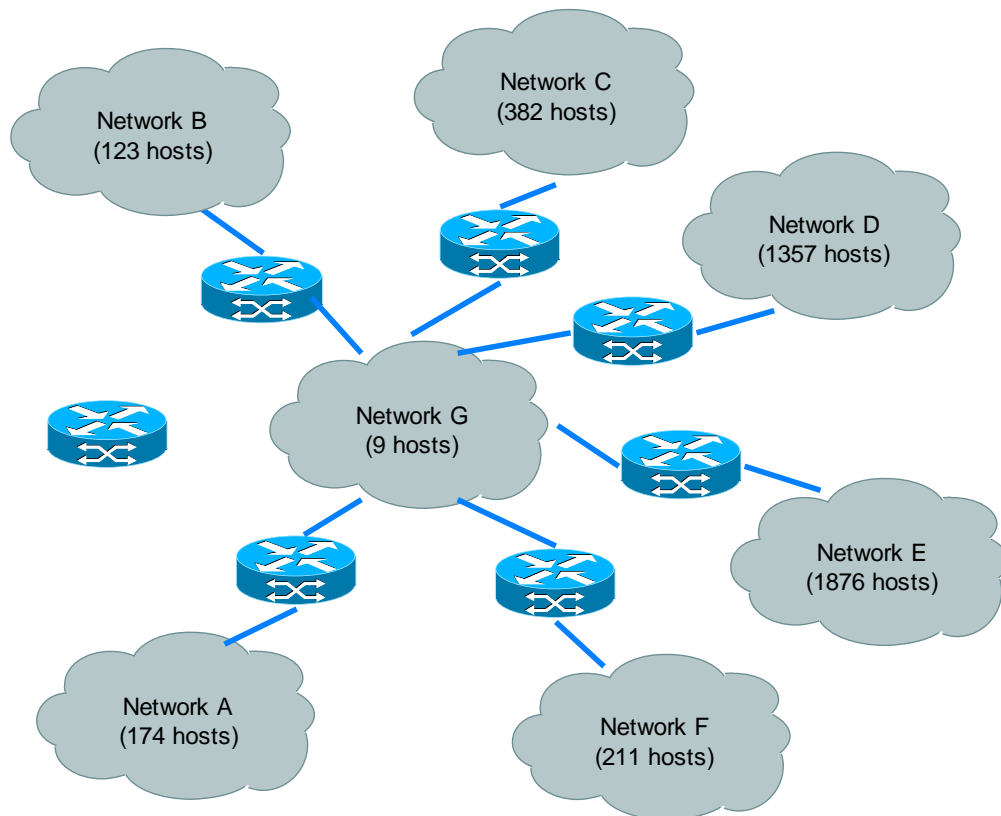
Given these assumptions, show the TCP packets that would be transferred between times zero and 20. For data transfers, you only need to indicate a value for the sequence number field of the packet and the number of data bytes sent. For acknowledgements, you only need to indicate values for the acknowledgement and window size fields. Your answer should indicate the time at which packets leave the sender and the time at which they arrive at their destination. (5 marks)

- c) Outline why network congestion might cause TCP packets to be dropped within a network and describe how TCP attempts to detect this and reduce the congestion while still maximising the effective bandwidth that it can achieve. (5 marks)

Question continues on next page

2) (Continued)

- d) The following picture shows the physical structure of the network being used by an organisation. The Internet authorities have allocated this organisation the block of IPv4 class C network addresses 195.123.0.0-195.123.63.0. 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 Internet. Your answer should show how you determine the class C network addresses to be allocated to each physical network. (5 marks)



**Section B**

3)

- a) Briefly describe the changes between IPv4 and IPv6 addresses. (3 marks)
- b) The European address registry has decided to allocate all customers a /48 bit mask. Explain what this means? (1 mark)
- c) An Internet Service Provider (ISP) who has received an address block (2001:600:123/48) from the European address registry decides to allocate each of its customers 256 static IPv6 addresses rather than IPv4 ones. This means customers will no longer rely on Network Address Translation (NAT) to support extra machines within their home network. However, the ISP will only use IPv4 itself until the rest of the world switches over to IPv6.

How many customers can the ISP support with its current scheme? (2 marks)

- d) The above ISP needs to interconnect all its customers with one another over its internal IPv4 routers.

Its user Janet is allocated the address range 2001:600:123::4567:8900/UVW and an ISP router address of 130.88.100.100 and user John is allocated the address range 2001:600:123::7654:3200/XYZ with an IPv4 router address of 130.88.100.200. In each case, the router has a device `ppp0` connected to an ADSL broadband link and an `eth0` device connected locally.

- i) What are the two values UVW and XYZ? (2 marks)
- ii) How should Janet, John and all the other ISP customers interconnect their IPv6 home networks so they can send IPv6 traffic directly to one another? Write a list of Linux commands you would expect a system manager to use to configure Janet's router to send IPv6 connection to John's router. You should assume that for simplicity the routers are programmed with static routes. (9 marks)
- e) What happens to IPv4 traffic at the router? What should happen? (3 marks)

4)

- a) Wireless networks suffer from much more interference than wired networks, outline why this statement is correct. (2 marks)
- b) In any given physical medium, does increasing the data rate make the bits in a message travel faster from source to destination? (1 mark)
- c) For all wired networks, outline the techniques that are used to increase achievable data rates. (2 marks)
- d) By using a simple example show why in wired networks, higher data rates result in higher error rates? (5 marks)
- e) If the data rate is much higher, what is done to maintain network reliability? (2 marks)
- f) Why do 3D Virtual Immersive worlds, like Second Life, rely mainly on UDP for Internet communications? (3 marks)
- g) Given that UDP is simply a fire and forget technology. By using examples show how applications like Second Life that use UDP can ensure sensible behaviour for:
  - i) Configuration data such as Inventory lists of clothing and objects owned by an avatar.
  - i) Reliability: pop up graphics showing configuration, scripts etc must be error free and only displayed when all the data is ready. (5 marks)

**END OF EXAMINATION**