On-Line Examination

Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Computer Networks

Wednesday 16th January 2008
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
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 paper will be taken on-line and this is the paper format which will be available as a back-up

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

1. a) Using a diagram (if you wish) to illustrate your answer explain:
   i) What QAM stands for as a type of modulation?
   ii) What 16-QAM modulation is?
   iii) When a 16-QAM system sends data at 20K baud/second. What is the data rate in Kbits/second? (4 marks)

b) Using one or more small annotated diagrams to illustrate your answer; why is a mesh network more likely to continue to operate after either a connection or a host breaks than other network topologies? (5 marks)

   Briefly explain how broken equipment affects the connectivity of different network topologies in slightly different ways. (3 marks)

c) In networks as in other domains, resources must be shared. Using examples, explain the different ways in which several network users might be multiplexed so that they can all succeed in communicating. For each type of multiplexing give one or two examples from real life where this method is used. (5 marks)

d) Which type of multiplexing would you suggest for carrying several voice only telephony connections? Would you use the same type of multiplexing for voice mixed with Web and other forms of Internet traffic? Why or Why not? If you chose to use a different type of multiplexing for mixed traffic, what would your choice be? (3 marks)
2.  a) Using the data “0101101011000011” (in Hexadecimal - 5AC3) show how by using two dimensional even parity, a single bit error can be both detected and corrected. What is the overhead using your two dimensional parity scheme? (5 marks)

b) A High level Data-link Control (HDLC) frame has the structure:

<table>
<thead>
<tr>
<th>Flag</th>
<th>Address</th>
<th>Control</th>
<th>Information</th>
<th>FCS</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8</td>
<td>8</td>
<td>/</td>
<td>32</td>
<td>8 Bits</td>
</tr>
</tbody>
</table>

A Point to Point Protocol (PPP) frame has the structure:

<table>
<thead>
<tr>
<th>Flag</th>
<th>Address</th>
<th>Control</th>
<th>Protocol</th>
<th>Payload</th>
<th>Checksum</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>/</td>
<td>32</td>
<td>8 Bits</td>
</tr>
</tbody>
</table>

Where in each case the numbers underneath indicate the bit sizes used for each field in the frame which may vary.

What is the overhead percentage to transmit 1500 bytes of payload data sent in a PPP frame which is embedded into an HDLC frame for transport? State any assumptions that you needed to make. (5 marks)

c) If the physical link used in Q2b above has a data rate of 10Mbps, a propagation speed of $3 \times 10^8$ meters / second and a length of 1.250km to a low earth orbiting destination at a satellite which is nearing the horizon. What is the complete transfer time for the packet? What does this make the link’s throughput? How could the throughput achieved be made greater? (5 marks)

d) Using the 4 bit generator $x^3 + 1$ and the message “10101100”:

i) What will the Cyclic Redundancy Check (CRC) calculated for this generator polynomial be, show any calculations used to calculate the CRC. (5 marks)

ii) What is the binary code of the message as transmitted? (5 marks)
Section B

3. a) In terms of a networking protocol, outline what the term service model means. (1 mark)

b) Outline the difference between a connection-less and a connection-oriented service model and the other aspects of a service model that are associated with each of these choices. (2 marks)

c) For a user’s transfer of a file and an operating systems save of a file to a remote disk, discuss whether the use of a connection-less or connection-oriented service model is appropriate. (3 marks)

d) Explain the basic principles of how using acknowledgements, retransmissions, sequence numbers and sliding windows, a reliable service model can be implemented. (3 marks)

e) 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. (3 marks)

f) For the following TCP transmissions, show what data (described by its sequence number) and acknowledgements are sent across a connection. You should assume 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 nine (9), the timeout at the source is three (3) and acknowledgements are sent immediately data is received. (4 marks)

Time 1: source sends 4 bytes of data that are received

Time 5: source sends 3 bytes of data that are not received; the retransmitted data is received

Time 10: source sends 6 bytes of data that are received

Time 15: source sends 2 bytes of data that are not received; the retransmitted data is received

g) Describe using examples and diagrams, how in TCP the sliding window is adapted to implement flow-control aspect of a service model. (4 marks)
4. a) State the assumptions about implicit formats for information exchanged that parts of a distributed application usually make. (2 marks)

b) By using examples, show two ways in which these implicit assumptions can be explicitly transmitted with the information sent. (3 marks)

c) The information exchanged by the parts of a distributed application usually includes control information used by the application and data produced by the user of the application. Outline three ways in which these two types of information can be transmitted so that the receiving part of the application knows whether to interpret the information or pass it on to a user. (4 marks)

d) An event information application is to be implemented for all events in the UK. Originators of events should be able to give details of their events and users of the system should be able to see information for any event. Outline an example architecture that could be used to implement a solution to this. You should follow the principles of good network design, e.g. the service model, coordination, distributed information capture and management, error detection, error recovery and scalability. Your outline solution should indicate what programs run where, what they are used for, how they interact, and the type of application messages that must be exchanged. (7 marks)

e) The issue of managing information is significant in network protocols; by using the way in which addresses are allocated in the Internet Protocol (IP), describe how the potential conflicts of global coordination and distributed maintenance of information can be avoided. (4 marks)