Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Mobile Communications

Date: Tuesday 19th May 2015
Time: 09:45 - 11:45

Please answer any THREE Questions from the FIVE Questions provided

Use a SEPARATE answerbook for each QUESTION

This is a CLOSED book examination

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

[PTO]
1. a) How do wireless mobile devices detect one another? Does there need to be a difference between the wireless discovery process for ad-hoc and centrally controlled infrastructure (Access Point) networks? If so, briefly describe the differences. (5 marks)

b) Why is ARP an unreliable protocol for mobile networks whereas it works with few, if any, problems for most wired networks? (1 mark)

c) How might ARP like protocols be tuned to perform better in a mobile environment? What are the advantages and disadvantages of your suggestion? (4 marks)

d) What do you think happens when a device drops out of a network due to:
   i) A signal loss in the signal which lasts at most one or two frames in length?
   ii) A signal loss of a few seconds due to, for example, the line of sight signal being blocked?
   iii) An even longer loss of signal lasting from a few seconds to several minutes or longer? (10 marks)

2. a) For sampled media such as voice data, assuming each sample is represented as 8 bits after analogue to digital conversion, which bit of each sample matters the most? Why? (1 mark)

b) What is the purpose of ARQ within a multi-hop network? Why might error detection be required to enable ARQ? Give two simple examples of the use of ARQ in multi-hop networks. (6 marks)

c) What is interleaving? Why is interleaving of data sent with no ARQ method acceptable for some types of data transmission? When is it unacceptable? (4 marks)

d) Why is FEC effective in cellular wireless networks? If FEC was not used, how could low error transmissions be achieved? What are the advantages and disadvantages of avoiding the use of FEC for cellular wireless networks? (4 marks)

e) Draw a schematic of a convolution encoder with upper branch 171 and lower branch 133. How many leading zeros are needed before the real data starts to initialise the encoder? (5 marks)
3. a) What is meant by “horizontal” and “vertical” handover? Why is “vertical” handover considered a bigger challenge? (4 marks)

b) For each situation where GSM is required to execute a handover, outline the process required. (6 marks)

c) For handover between WiFi and cell phone systems list criteria that should be evaluated by the handover control services before deciding to carry out a handover. Give reasons for including each criteria and suggesting where values can be obtained from. (6 marks)

d) Briefly suggest how typical mobile phone handover operations, both horizontal and vertical, will need to be adapted to handle communications sent via Low Earth Orbiting (LEO) satellites instead of local cell towers? What specific issues that do not occur with static cell towers have to be resolved for communication via LEO satellites? (4 marks)

4. a) Why do devices connected to the Internet need two addresses (MAC and IP)? What might happen if a device invented its own IP address? (4 marks)

b) Compare slotted Aloha with IEEE 802.11’s CSMA/CA MAC scheme for usage in a battery powered Wireless Sensor Network (WSN) where randomly positioned devices are both network routers and data collectors used for occasional ambient temperature sensing:

i. In a low contention, low interference environment. (6 marks)

ii. In a high contention, high interference environment.

Diagram 4.c

c) Consider a wireless network of sensing devices positioned randomly in an area where the devices must send their sensor readings to two base stations as shown in Diagram 4.c above. Propose an appropriate transport protocol for the network given the requirement that sensor readings must reach either both of the base stations or neither of them. (10 marks)
5. a) Describe the process by which a device can use DHCP to obtain an IP address when joining a new network. What is different if the device is asking to renew an IP address? (6 marks)

b) Why is the allocation of IP addresses to ad-hoc networks a problem? (5 marks)

c) Why is DNS difficult to use in ad-hoc networks? (2 marks)

d) In an ad-hoc network with no infrastructure connection how can machines map device names to their IP or MAC addresses? (7 marks)