Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Mobile Communications

Date: Wednesday 22nd May 2013
Time: 14:00 - 16:00

Please answer any THREE Questions from the FIVE 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.
Section A

1. Answer all parts.

a) Why is mobile commerce not yet used by most mobile phone users? What core mobile services are required to make mobile commerce simple and safe to use for the consumer? (5 marks)

b) What information is needed and how is this information obtained in order to accurately pin-point the location of a mobile phone? (5 marks)

c) Why is the use of forward error correction (FEC) much more important with mobile systems using WiFi and cellular radio than with systems that use wired connections? (4 marks)

d) Answer all sub-parts.

i. With the IEEE802.11 standards (versions b, g and n), what happens to packets with bit-errors that cannot be corrected at the data-link layer (DLL)?

ii. What new techniques are introduced by the mobile WiMAX and 3GPP-LTE standards for correcting bit-errors at the DLL?

iii. How would it be possible for the receiver to fail to detect uncorrected bit-errors within a packet?

iv. If this did happen with a packet conveying email, what problems would then occur? (6 marks)
Section B

2. Answer all parts.

a) What information is provided by the Dynamic Host Configuration Protocol (DHCP) when a new device connects to a Local Area Network (LAN)? (4 marks)

b) Briefly describe how DHCP communicates in order to provide the requested network information in part 2.a above? (4 marks)

c) Briefly compare and contrast your answer to part 2.b with how the same information is obtained in a wireless cellular network. (5 marks)

d) Briefly compare what happens when a device using DHCP to obtain its network information moves from:

   i. one cell to another in a cellular wireless network.
   ii. one LAN to an adjacent LAN.

Suggest modifications to DHCP to avoid changes in any network information when a device moves from one LAN to another? Is it necessary to change any other WLAN protocols? (7 marks)
3. Answer all parts.

a) Explain what happens to TCP performance when a connection passes over many wireless hops. What protocol mechanisms cause this performance change? (4 marks)

b) Suggest how the TCP performance over wireless can be improved by making changes to

i. network layer,
ii. data link layer or
iii. physical layer

protocols? (6 marks)

c) A flood has caused all wired and cellular mobile phone networks to shut down. How can some connectivity be achieved using remaining battery power in mobile phones equipped with Bluetooth and WiFi? For each idea you suggest, discuss its communication capabilities, advantages and disadvantages. (10 marks)
4. Answer all parts.

a) How does wired equivalent privacy (WEP) aim to provide confidentiality, integrity and authentication in IEEE802.11 wireless LANs? What are the functions of the integrity check vector (ICV), the RC4 cipher stream generator, the initialisation vector (IV) and the WEP key. (7 marks)

b) Explain why WEP is not considered a good security solution for wireless LANs. In giving your answer, explain how its confidentiality, integrity and authentication mechanisms may be compromised? (5 marks)

c) Three ASCII characters are believed to have been encrypted by the same 8-bit RC4 stream producing the cipher-text bytes:

   C1 = 1 0 0 0 1 0 1 0 0
   C2 = 1 0 0 1 1 1 0 0 0
   C3 = 1 0 0 0 0 1 0 1

If they are all assumed to be decimal digits 0 to 9 or a space as listed in table 1, what are the three digits and what is the 8-bit RC4 stream?

What does this example illustrate about the requirements for achieving strong security? (8 marks)

<table>
<thead>
<tr>
<th>Character</th>
<th>Ascii code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 0 1 1 0 0 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>0 0 1 1 0 0 0 1</td>
</tr>
<tr>
<td>2</td>
<td>0 0 1 1 0 0 1 0</td>
</tr>
<tr>
<td>3</td>
<td>0 0 1 1 0 0 1 1</td>
</tr>
<tr>
<td>4</td>
<td>0 0 1 1 0 1 0 0</td>
</tr>
<tr>
<td>5</td>
<td>0 0 1 1 0 1 0 1</td>
</tr>
<tr>
<td>6</td>
<td>0 0 1 1 0 1 1 0</td>
</tr>
<tr>
<td>7</td>
<td>0 0 1 1 0 1 1 1</td>
</tr>
<tr>
<td>8</td>
<td>0 0 1 1 1 0 0 0</td>
</tr>
<tr>
<td>9</td>
<td>0 0 1 1 1 0 0 1</td>
</tr>
<tr>
<td>space</td>
<td>0 0 1 0 0 0 0 0</td>
</tr>
</tbody>
</table>

Table 1: ASCII codes for decimal digits 0 to 9 and space
5. Answer all parts.

   a) By what multiplexing mechanism does the third generation of cellular mobile telephony (3G) share radio spectral bands among many users in any given cell.  
      (2 marks)

   b) What are the main goals of 4G IMT-Advanced as proposed in 2008 by ITU-R for the fourth generation of cellular wireless standards (4G)? What are the two main technologies that are currently striving to meet these goals, and what was decided by the ITU in December 2010 that is affecting the marketing of these technologies currently.  
      (6 marks)

   c) What are the features of orthogonal frequency division multiplexing (OFDM) and multi-input multi-output (MIMO) smart antenna techniques that have led to their adoption by the two main technologies that are competing to achieve the 4G IMT-Advanced goals.  
      (4 marks)

   d) Explain why IEEE802.11b and IEEE802.11g wireless local area (WiFi) networks are not ideal for providing mobile access to voice over IP (VoIP) telephone services. What problems can contention mode access (CSMA) cause when battery powered mobile equipment is used for voice over WiFi? What features of more recent IEEE802.11 standards could, in principle, be employed to reduce these problems?  
      (8 marks)