Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Mobile Communications

Date: Wednesday 7th June 2017

Time: 09:45 - 11:45

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

[PTO]

Section A

1.

a) Briefly describe how mobility effects any two of the following ISO network layers:

- Application Layer
- Transport Layer
- Network Layer
- Data-link Layer
- Physical Layer

[6 marks]

b) Why are satellite telephone links used much less than terrestrial cell phone links? [4 marks]

c) A wireless sensor mote is configured to work in an ad-hoc wireless network but initially knows nothing about any neighbours to whom it might eventually forward its data and any data that other motes send it to forward. Outline a system design, protocol behaviours and the contents of transmitted frames between the motes that will permit the mote on being switched on to:

- Discover its neighbours.
- Keep an almost accurate repository of its neighbours and their capabilities even if they are mobile not static.
- Determine the best neighbour to send sensor data or any other type of data to in order to reach any destination mote in the wireless sensor network.

[10 marks]

2.

a) What is Hamming distance? What is the binary Hamming distance between the hexadecimal numbers FC51 and FFFF?

[2 marks]

b) Draw a schematic of a convolution encoder with upper branch 11_{10} 54_8 and lower branch 13_{10} 64_8. How many leading zeros are needed before the real data starts to initialise the encoder? What rate is used to describe the decoder?

[5 marks]

c) After suitable initialization the convolution encoder above is fed the data 11001 (in left to right order). What is the output of the encoder for this input bit pattern?

[5 marks]

d) A Global System for Mobile Communication (GSM) frame has 114 bits of user data and 34 other bits. What are these other bits used for?

[3 marks]

e) A GSM frame is on air for 4.615ms. Assuming that binary data is sent throughout this time what is the data rate in bits per second?

[5 marks]

[PTO]

3.

a) Why is one-way delay for network communication impossible to measure accurately? How have modern systems almost resolved this issue?

[3 marks]

b) Why is Packet Loss Concealment (PLC) for voice communications essential even when there is little or no jitter?

[6 marks]

c) Speech is normally sampled at around 8,000 samples per second for mobile phone applications. It is transmitted in modern phones at just 12.2kbps giving sound that is at toll quality or better. Show briefly how this can be achieved stating any (must be sensible) assumptions that you have made? [5 marks]

d) An end-to-end VoIP over WLAN session uses frames carrying 50 ms of G711 speech, zero stuffing PLC, overall it delivers a Mean Opinion Score (MOS) score of about 2.5 when working, a round trip delay of 200ms but frequently crashes due to network congestion.

What steps could you consider to improve the performance of this WLAN link? Which steps would you use and why? [6 marks]

Section B

4.

    a)   Explain the differences between mobile communications and wireless communications providing examples to illustrate your answer.

                     [4 marks]

    b)   Explain what a MAC address is. For what is it used? What limitations does it have? Contrast it with an IP address. Why is another level of addressing needed?

                     [9 marks]

    c)   How are IP addresses allocated to devices?

                     [7 marks]

5.

    a)   Explain the concepts of 'horizontal' and 'vertical' handover and give an example for each. Which of the two is more challenging? Why?

                     [5 marks]

    b)   Discuss three routing methods for ad-hoc networks, briefly describing there:
          i. basic operation,
         ii. main advantages and
        iii. disadvantages.

              [3 marks per method. Total 9 marks]

    c)   What are the main advantages and disadvantages of the following implementations of TCP for wireless communications:

        i)   Indirect TCP.
        ii)   Snooping TCP.
        iii)   Mobile TCP.

                     [6 marks]

END OF EXAMINATION