Mobile Communications

Date: Tuesday 3rd June 2014
Time: 14:00 - 16:00

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) Why are mobile communications not necessarily the same as wireless communications? Give examples to illustrate your answer. [4 marks]

b) Since most fixed and mobile computing devices have pre-assigned physical (or mac) addresses, would it be practical to use these addresses for communications globally over computer networks? Explain your answer. [4 marks]

c) How are physical addresses used in practice, and what would MOST LIKELY happen if two mobile communication devices were manufactured and released with the same physical address? [2 marks]

d) What are the main goals of ‘4G–IMT Advanced’ as proposed by ITU-R for the 4th generation of cellular wireless standards (4G)? [4 marks]

e) To what extent has 3GPP-LTE technology met the ‘4G-IMT Advanced’ goals and how may speech services be provided by this technology? How might cognitive radio affect future generations of mobile telephony? [6 marks]

2. a) Describe the two fundamental methods of allocating IP addresses in DHCP. [4 marks]

b) What is the DHCP mechanism that allows the re-use of IP addresses and what implications does it have for a client? [5 marks]

c) Briefly describe the purpose and functions of the ‘home agent’ and the ‘foreign agent’ in the context of ‘mobile IP’. [5 marks]

d) What is the essential difference between circuit switched and packet switched network links? Highlight the advantages of each of these two types of network link when used for speech telephony. Are circuit switched network links still used? [6 marks]
3. a) In what way is an error control mechanism over-loaded as a congestion control mechanism in TCP. What assumptions are needed to justify its use in wired networks and why are these assumptions not appropriate for radio networks? [5 marks]

b) What are the main advantages and disadvantages of the following three forms of TCP:

i) Indirect TCP [2 marks]
ii) Snooping TCP [2 marks]
iii) Mobile TCP [2 marks]

c) Give three routing methods that are suitable for ad-hoc networks. For each method, briefly outline its basic operation, and its main advantages and disadvantages. [9 marks]

4. a) In principle, why are pulses of finite duration not used for data transmission over radio channels with single-carrier modulation? With the aid of a sketch or sketches, indicate what pulses-shapes are generally used and state their main properties. What limitation does the use of such pulses impose on the maximum achievable bandwidth efficiency with binary signalling? [6 marks]

b) A mobile communication system uses a radio channel of bandwidth 40 kHz. The reception is affected by ‘additive white Gaussian noise’ (AWGN) whose constant level is such that the signal-to-noise ratio is 30 dB.
   (i) According to the Shannon-Hartley Law, what is the maximum bit-rate that can be conveyed with arbitrary low bit-error probability over this radio channel?
   (ii) What is the maximum bit-rate achievable over this same channel using QPSK signaling?
   (iii) How can techniques other than QPSK be used to further increase the bit-rate towards the theoretical maximum channel capacity? [5 marks]

c) What are the essential differences between block codes and convolutional codes for forward error correction (FEC)? If a convolutional coder has two generator functions expressed in octal as (13) and (11), what is the ‘rate’ of the coder and what is its ‘constraint length’? Draw a diagram for the coder and calculate the first 10 bits of its output when the first 5 bits of the input are ‘1 0 1 0 1’. Assume the encoder starts in zero memory state. [5 marks]

d) Explain why error detection and forward error correction (FEC) are used simultaneously at the data-link layer on IEEE802.11 WLAN networks, whereas only error detection is generally used on wired networks. [4 marks]
5. a) Explain the principle of cellular spatial multiplexing as used by mobile telephony. How can an existing spatial multiplexing scheme be modified to accommodate more mobile phone users? [4 marks]

b) How does the use of forward error correction (FEC) in cellular mobile systems increase the energy efficiency and effectiveness of spatial multiplexing by frequency re-use? [4 marks]

c) Explain how the ‘code division multiple access’ (CDMA) multiplexing mechanism used by third generation of cellular mobile telephony (3G) is able to share a radio spectral band in any given cell among many users. What do you consider to be the three main advantages of CDMA over the mechanism used by 2G-GSM telephony. What do you consider to be the main disadvantage of CDMA? [8 marks]

d) Explain how ‘multi-input multi-output’ (MIMO) smart antenna techniques can increase the capacity of a radio channel as used by Wi-Fi or cellular telephony. [4 marks]

END OF EXAMINATION