Digital Wireless Communication and Networks

Date:     Friday 17th May 2013
Time:     14:00 - 15:30

Please answer any TWO Questions from the THREE Questions provided

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text.
1. Answer all sections.

a) In a wireless system, why do noise and interference occur? What causes them? (2 marks)

b) List six different ways that a radio transmission medium may be shared among many different users. (6 marks)

c) What is meant by multipath propagation? Consider to what extent multipath propagation occurs in each of the four environments below. (4 marks)

   A Outer space.
   B An untidy room.
   C A city street.
   D An empty room.

d) Reorder the four environments in part c) above in terms of the amount of Inter Signal Interference (ISI) they are likely to create for a high symbol rate wireless connection. Give reasons for your choices. (6 marks)

e) Briefly explain why multipath propagation is a problem for single antenna systems (SISO) but often an advantage with multi-antenna systems (MIMO). (2 marks)
2. Answer all sections.

a) How do two wireless mobile devices using
   i. Bluetooth
   ii. WiFi

   discover each other and initiate contact to form a connection for data interchange.

   (5 marks)

b) Answer all sub-parts.

   i. What happens when two connected Bluetooth or WiFi devices move away from each other and become too far apart to maintain direct connectivity?
   ii. What happens to TCP and UDP traffic when Bluetooth or WiFi devices lose contact?
   iii. What happens to TCP and UDP traffic if a connection is later made to a different device?

   (5 marks)

c) If cellular mobile phone or other infrastructure wireless networks are not available:

   i) Outline how packet transport and routing between frequently disconnected ad-hoc devices can be achieved.

   (5 marks)

   ii) How should networking addresses be allocated to ad-hoc devices in order to prevent routing and transport failures, as far as possible, as the devices move around?

   (2 marks)

   iii) If infrastructure networks become available, suggest how handover from the ad-hoc networks to the infrastructure could be implemented.

   (3 marks)
3. Answer all sections.
   
a) What is throughput? How is it measured? (2 marks)

b) How many bits are represented by a single symbol using 64-QAM as used in WiFi? (1 mark)

c) What is meant by the bit-rate and the chip-rate of a 3G WCDMA system? (2 marks)

d) For a 3G WCDMA chip-rate of 3.84Mchips per second, if the spreading factor is set to 512, what is the bit-rate? What is the advantage of spreading? (3 marks)

e) Why do WiFi systems that use fixed power transmissions have a lower wireless network throughput compared to those that can adapt their transmit power? (4 marks)

f) Considering each WiFi frame one by one, how could transmit power control be applied to the RTS-CTS-DATA-ACK frame sequence to improve the network throughput?

   For each frame discuss what advantages or disadvantages that power control has. (8 marks)