

Two hours

**UNIVERSITY OF MANCHESTER  
SCHOOL OF COMPUTER SCIENCE**

Mobile Communications

Date: Friday 20th May 2016

Time: 09:45 - 11:45

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**Please answer any THREE Questions from the FIVE Questions provided**

**Use a SEPARATE answerbook for each QUESTION**

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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) Briefly explain how the two different addressing schemes used in most Internet connected devices are used to find and pass packets from a source device to a destination device that is at least 3 communication hops away. [5 marks]
  - b) What are the roles of DHCP, DNS and ARP in connecting devices to the Internet and allowing them to exchange IP packets? [3 marks]
  - c) What continues to work and what ceases to work if:
    - i. The router connecting a LAN to the Internet is switched off?
    - ii. The router and the DHCP server are switched off?
    - iii. The router and DNS are switched off?
    - iv. The router, DHCP and DNS are all switched off?
    - v. What happens if ARP is switched off?[9 marks]
  - d) Why does the Neighbour Discovery Protocol (NDP) use multicast whereas ARP uses broadcast? [3 marks]
- 2.
- a) Why is it useful to both add extra bits and interleave all the bits in real communication systems? [3 marks]
  - b) What are the differences between block codes and convolution codes? [3 marks]
  - c) Derive a code using 7 bits to represent 5 values where the hamming distance between the codes is  $\geq 3$ ? [4 marks]
  - d) For error detection, using an example such as your code from part (c), explain the difference between hard and soft decision methods. Why are soft decisions often better for real-time media or high error probability channels? [5 marks]
  - e) Draw a schematic of a convolution encoder with upper branch 5 and lower branch 7. 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]

3.

a) Is TCP a good choice for two way VoIP conversations? Explain your answer?

[5 marks]

b) How does TCP perform for downloading streamed High Definition (HD) video to 2G, 3G and 4G mobile phone devices?

[5 marks]

c) Why does TCP perform badly for large downloads to fast moving mobile devices over WiFi? For any issues you have identified describe possible protocol changes that will improve the TCP performance.

[10 marks]

4.

a)

i. Using diagrams where appropriate explain why WiFi systems since IEEE 802.11a including 802.11n and 802.11ac perform worse using both CSMA/CA and RTS/CTS for interactions with more distant devices when there are other devices on the same channel than in earlier versions of the standards.

[12 marks]

ii. Using a diagram explain why MIMO is at least a part solution to this problem?

[4 marks]

b) Show how busy tone MAC protocols can almost solve both the hidden node and the exposed node problems? Suggest why this technology is not yet part of WiFi, Bluetooth and other widely used protocols.

[4 marks]

5.

On a single lane each way straight country road, it is proposed to install WLAN base stations with a maximum range of roughly 50m at intervals of almost exactly 500m apart. Also assume that all vehicles are equipped with physical and data-link layer compatible WLAN devices with a maximum range of about 50m. All vehicles travel at 1km every 50 seconds or  $20\text{ms}^{-1}$ .

- a) Estimate the duration of contact each vehicle has with each base station? How can this time be exploited to aid in appropriate routing of packets from the Internet to base stations ready for forwarding to vehicles? [5 marks]
- b) Giving your reasoning, design a network layer routing protocol suitable for use in the vehicles' when the road is busy with traffic. Clearly explain your protocol's operations which should be to forward packets to and from vehicles that are the sources and destinations for packets. All, packets are either from or directed to road side base stations which provide Internet access. [15 marks]

**END OF EXAMINATION**