Queen Mary
University of London

Winter Examination Period 2022 – January - Semester A

ECS702P Mobile and WLAN Technologies Duration: 3 hours

This is an open-book exam, which should be completed in approximately 3 hours.

You MUST submit your answers within 24 hours from the exam being released.

Follow all instructions on the download page.

You can refer to textbooks, notes and online materials to facilitate your working, but normal referencing and plagiarism rules apply, and you must cite any sources used.

You must upload a **SINGLE PDF** file containing your solutions. These can be typed or handwritten,or a combination of the two. Multiple submissions are not permitted, so be sure that you check your submission before uploading it.

Calculators are permitted in this examination.

Answer FOUR questions.

You MUST adhere to the word limits, where specified in the questions. Failure to do so will lead to those answers not being marked.

If you answer more questions than specified, only the first answers (up to the specified number) will be marked. Cross out any answers that you do not wish to be marked.

YOU MUST COMPLETE THE EXAM ON YOUR OWN, WITHOUT CONSULTING OTHERS.

Examiners: Prof Xiaodong Chen and Dr Maged Elkashlan

Question 1

a) In GSM-900 network.

i) Find the frequency reuse ratio D/R;

ii)Find the carrier to interference ratio C/I in dB if an omni-directional antenna is used;

iii) Find the carrier to interference ratio C/I in dB if three 120 degree directional antennas are used;

iv) If 496 channels are allocated to this cellular network, given a GOS 2%, using Erlang B Table to find out the traffic intensity being supported in each cell in ii) and iii), respectively.

[12 marks]

b) Assume a cell receives on average 360 calls per hour, the mean holding time of a call is 120 seconds and the grade of service is 0.02. Using Erlang B Table, answer the following questions.

i) Calculate the offered traffic in the cell.

ii) How many channels are needed in this cell if an omnidirectional antenna is used?

iii) Considering the offered traffic is uniformly distributed inside the cell, how many channels does the cell need if three 120 degree directional antennas are used?

iv) Compare and comment on the channel utilisation efficiency in sub-questions ii and iii.

[13 marks]

Question 2

a) Explain how OFDM works, with the help of diagrams.

[8 marks]

b) Describe the main features in the IEEE802.11ac proposal.

[8 marks]

c) Explain how the WLAN security is improved in WPA2.

[5 marks]

d) Explain the network topology in Bluetooth 2.0.

[4 marks]

Question 3

a) Answer the following questions in the GSM system.

i)What kind of random access method is used when a Mobile Station wants to access to GSM system?

ii)Explain what kind of power control is used in the GSM system.

[4 marks]

b) Explain how the capacity of a single CDMA cell can be calculated and supply an example considering an SIR between 3dB and 9dB, a data transmission rate of 9600bps and the carrier bandwidth used in IS-95 (the channel bandwidth is 1.25MHz).

[5 marks]

c) What code is used to encode the reverse channel in IS-95 system? If the input bits is: 101010, please select the right code for mapping.

[5 marks]

d) The GPRS network is built on the GSM network to provide data services. Sketch the GPRS network architecture and describe briefly the function of each node.

[11 marks]

Question 4

a) UMTS system uses W-CDMA as its multiple access technique. Answer the following questions in the UMTS system.

(i) What kind of power control is used in UMTS, in particular in the uplink, to tackle the near-far problem? Fast power control

(ii) In what kind of power control, the BS performs frequent estimates of the received Signal-to-Interference Ratio (SIR) in the uplink and compares it to a target SIR? Closed Loop Power Control

(iii) What will BS do if the measured SIR is different from the target SIR?

(iv) What kind of power control adjusts the target SIR in the BS according to the needs of the individual radio link.

[5 marks]

b) Figure 1 gives an overview of several types of handover in a combined UMTS/GSM network. Indicate what handover UE_2 is performing and describe this type of handover.

[4 marks]

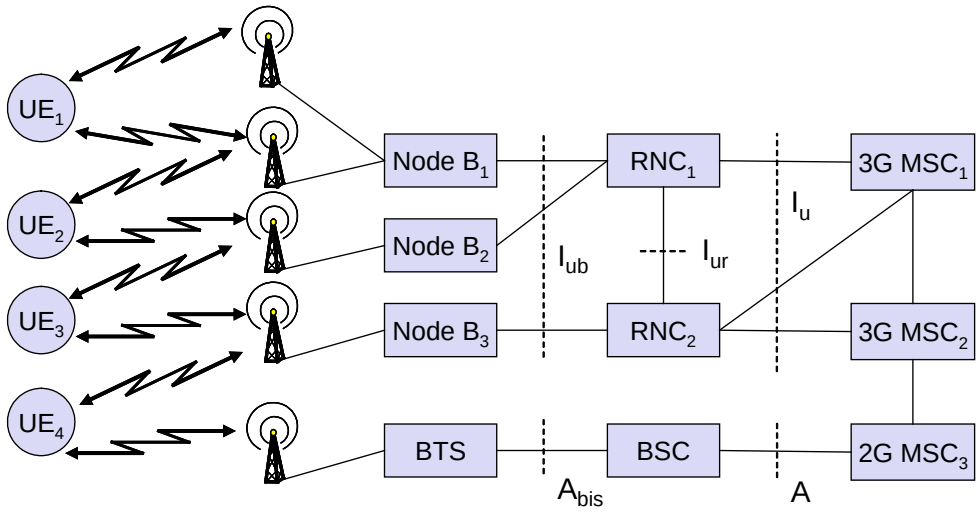

Figure 1: Handovers in UMTS

c) Describe the general functionality of HSUPA.

[4 marks]

d) With the help of diagrams, explain how the OFDMA works in LTE downlinks.

[12 marks]

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