Queen Mary
University of London

***MSC* Examination by course unit**

Tuesday, 10 May, 2016, 2:30 pm

ECS702P Mobile and WLAN Technologies

Duration: 2 hours 30 minutes

YOU ARE NOT PERMITTED TO READ THE CONTENTS OF THIS QUESTION PAPER UNTIL INSTRUCTED TO DO SO BY AN INVIGILATOR

Answer TWO questions of PART A AND TWO questions of PART B.

If you answer more questions than specified (in each part), only the first two questions (in the order they appear on your answer script) will be marked unless you have crossed out any answers you do not wish to be marked.

Calculators are permitted in this examination. Please state on your answer book the name and type of machine used.

Complete all rough workings in the answer book and cross through any work that is not to be assessed.

Possession of unauthorised material at any time when under examination conditions is an assessment offence and can lead to expulsion from QMUL. Check now to ensure you do not have any notes, mobile phones, smartwatches or unauthorised electronic devices on your person. If you do, raise your hand and give them to an invigilator immediately. It is also an offence to have any writing of any kind on your person, including on your body. If you are found to have hidden unauthorised material elsewhere, including toilets and cloakrooms it will be treated as being found in your possession. Unauthorised material found on your mobile phone or other electronic device will be considered the same as being in possession of paper notes. A mobile phone that causes a disruption in the exam is also an assessment offence.

EXAM PAPERS MUST NOT BE REMOVED FROM THE EXAM ROOM

Examiners:

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PART A

Question 1

a) Explain Flat fading and frequency selective fading. Describe their impacts on the wireless channel, with the help of a sketch of BER vs Eb/No curves.

[6 marks]

b) With the help of diagrams, explain how Direct Sequence Spread Spectrum (DSSS) works and what the processing gain is.

[6 marks]

c) Describe how CDMA works, with the help of diagrams if necessary.

[6 marks]

d) The RTS/CTS Protocol is defined to solve a problem in the IEEE802.11 standard. Describe the problem and explain how the RTS/CTS Protocol solves it.

[7 marks]

Question 2

a) Describe how OFDM works, with the help of diagrams if necessary.

[6 marks]

b) Describe in detail the power management in IEEE802.11.

[7 marks]

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

[6 marks]

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

[6 marks]

Question 3

a) Describe the Radio Specification of Bluetooth 2.0.

[6 marks]

b) With the help of a diagram, explain how data transaction is done in the Bluetooth Low Energy standard (4.0).

[7 marks]

c) Describe the network topology used in WiMedia.

[6 marks]

d) Explain what makes Zigbee a competing technology in the Wireless World.

[6 marks]

PART B

Question 4

a) 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. Considering Table 1, 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 iiii.

[12 marks]

Blocked-Calls-Cleared (Erlang *B*)

	A, erlangs												
	B												
N	1.0%	1.2%	1.5%	2%	3%	5%	7%	10%	15%	20%	30%	40%	50%
1	.0101	.0121	.0152	.0204	.0309	.0526	.0753	.111	.176	.250	.429	.667	1.00
2	.153	.168	.190	.223	.282	.381	.470	.595	.796	1.00	1.45	2.00	2.73
3	.455	.489	.535	.602	.715	.899	1.06	1.27	1.60	1.93	2.63	3.48	4.59
4	.869	.922	.992	1.09	1.26	1.52	1.75	2.05	2.50	2.95	3.89	5.02	6.50
5	1.36	1.43	1.52	1.66	1.88	2.22	2.50	2.88	3.45	4.01	5.19	6.60	8.44
6	1.91	2.00	2.11	2.28	2.54	2.96	3.30	3.76	4.44	5.11	6.51	8.19	10.4
7	2.50	2.60	2.74	2.94	3.25	3.74	4.14	4.67	5.46	6.23	7.86	9.80	12.4
8	3.13	3.25	3.40	3.63	3.99	4.54	5.00	5.60	6.50	7.37	9.21	11.4	14.3
9	3.78	3.92	4.09	4.34	4.75	5.37	5.88	6.55	7.55	8.52	10.6	13.0	16.3
10	4.46	4.61	4.81	5.08	5.53	6.22	6.78	7.51	8.62	9.68	12.0	14.7	18.3
11	5.16	5.32	5.54	5.84	6.33	7.08	7.69	8.49	9.69	10.9	13.3	16.3	20.3
12	5.88	6.05	6.29	6.61	7.14	7.95	8.61	9.47	10.8	12.0	14.7	18.0	22.2
13	6.61	6.80	7.05	7.40	7.97	8.83	9.54	10.5	11.9	13.2	16.1	19.6	24.2
14	7.35	7.56	7.82	8.20	8.80	9.73	10.5	11.5	13.0	14.4	17.5	21.2	26.2
15	8.11	8.33	8.61	9.01	9.65	10.6	11.4	12.5	14.1	15.6	18.9	22.9	28.2
16	8.88	9.11	9.41	9.83	10.5	11.5	12.4	13.5	15.2	16.8	20.3	24.5	30.2
17	9.65	9.89	10.2	10.7	11.4	12.5	13.4	14.5	16.3	18.0	21.7	26.2	32.2
18	10.4	10.7	11.0	11.5	12.2	13.4	14.3	15.5	17.4	19.2	23.1	27.8	34.2
19	11.2	11.5	11.8	12.3	13.1	14.3	15.3	16.6	18.5	20.4	24.5	29.5	36.2
20	12.0	12.3	12.7	13.2	14.0	15.2	16.3	17.6	19.6	21.6	25.9	31.2	38.2

Table 1: Erlang B table

Question 4 continued

b) Given the following *number of cells per cluster*, find the respective ***cochannel reuse ratio***.

i) *Number of cells per cluster* = 3.

ii) *Number of cells per cluster* = 12.

[4 marks]

c) With the help of a diagram, describe four possible schemes in searching for a candidate cell in the handoff procedure.

[5 marks]

d) What is the carrier to interefence ratio and how can it be calculated?

[4 marks]

Question 5

a) Describe 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 bandwith used in IS-95.

[6 marks]

b) Describe the functionality of the Rake receiver in CDMA systems.

[6 marks]

c) Sketch the GSM/GPRS reference architecture and explain the function of the GPRS entities.

[8 marks]

d) Describe the operation of a Mobile Terminated ***Short Messaging Service*** (SMS) in GSM.

[5 marks]

Question 6

a) Supply the appropriate words to fill the blanks in the following sentences about the UMTS system (**Note: write your answer in the answer book and NOT on this page**):

UMTS uses _____ (1) as its multiple access technique. Each frequency carrier in UMTS occupies a frequency band of 4.4 to _____ (2) MHz. _____(3) power control is a very important aspect in UMTS, in particular in the uplink, because of the _____(4) problem. _____ _____ (5) power control mechanisms make a rough estimate of path loss by means of a downlink beacon signal. In _____ _____(6) power control, the BS performs frequent estimates of the received Signal-to-Interference Ratio (SIR) in the _____ (7) and compares it to a target SIR. If the measured SIR is higher than the target SIR, the BS will command the MS to _____ (8) the power; if it is too low it will command the MS to _____ (9) its power. _____ _____ (10) power control adjusts the target SIR in the BS according to the needs of the individual radio link.

[5 marks]

b) With the help of a diagram, explain how the soft-handover works in UMTS.

[7 marks]

c) Figure 1 gives an overview of several types of handovers in a combined UMTS/GSM network. Indicate what type of handover UE3 is performing and describe this type of handover.

[6 marks]

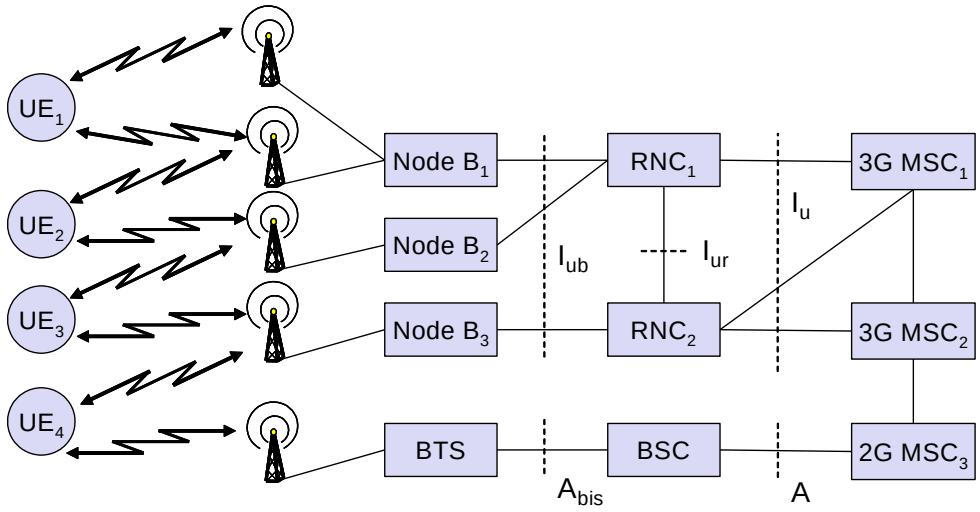

Figure 1: Handovers in UMTS

Question 6 continued

d) Explain the main concept of HSDPA and give a simple illustration of the general functionality of HSDPA.

[7 marks]

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