Queen Mary
University of London

***MSC* Examination by course unit**

Wednesday 3 May 2017 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

There are SIX questions. Answer only Four questions.

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.

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.

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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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Eliane Bodanese

Question 1

a) Explain Rayleigh and Rician fading, respectively. Describe their impacts on the wireless channel, with the help of a sketch of BER vs E_b/N_0 curves.

[6 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 0.03. 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 six 60 degree directional antennas are used?

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

[15 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 1 continue

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

i) *Number of cells per cluster* = 4.

ii) *Number of cells per cluster* = 7.

[4 marks]

Question 2

a) Describe the Physical layer specification in the IEEE802. 11a, 11b and 11g standards, respectively.

[6 marks]

b) Describe in detail the handoff process in IEEE802.11.

[6 marks]

c) What are hidden terminals? Explain in detail how this problem is solved in the IEEE802.11 standard?

[7 marks]

d) Describe the main improvements being made in IEEE802.11n standards.

[6 marks]

Question 3

a) Explain the network topology and access methods in Bluetooth.

[6 marks]

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

[7 marks]

c) Describe the security improvement made in Bluetooth 2.1.

[6 marks]

d) With the help of diagrams, explain how the Frequency Hopping Spread Spectrum (FHSS) works and what the processing gain is.

[6 marks]

Question 4

a) Describe the operation procedure in the mobile terminated call in the GSM system.

[6 marks]

b) Answer the following questions related to Short Messaging Services (SMS) in GSM:

i) Explain briefly the architecture of ***Short Messaging Service*** (SMS) in GSM;

ii) Describe the operation of a Mobile Terminated SMS in GSM.

[6 marks]

c) Considering the importance of power control in cellular networks, answer the following questions.

i) Explain Open Loop Power Control used in the IS-95 system.

ii) Why is Power Control so important in CDMA systems?

[7 marks]

d) Describe how the capacity of a single CDMA cell can be calculated and supply an example considering an SIR between 4dB and 10dB, a data transmission rate of 9600bps and the carrier bandwith used in IS-95 (the channel bandwidth is 1.25MHz).

[6 marks]

Question 5

a) Explain the ***outer loop power control*** used in UMTS.

[4 marks]

b) Figure 1 gives an overview of several types of handover in a combined UMTS/GSM network. Indicate what handover UE_i(i=1 - 4) is performing and describe this type of handover.

[13 marks]

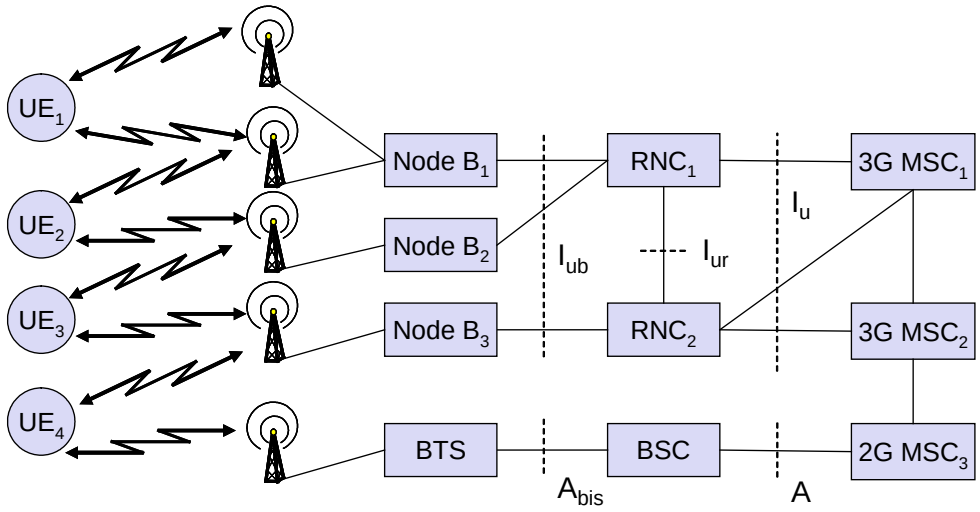

Figure 1: Handovers in UMTS/GSM Network

c) Sketch the GPRS network architecture and describe in detail two GPRS supporting nodes.

[8 marks]

Question 6

a) What are the improvments deployed in HSDPA.

[7 marks]

b) Describe the general functionality of HSUPA.

[4 marks]

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

[8 marks]

d) Explain in detail the Carrier Aggregation in the LTE-A standard.

[6 marks]

End of Paper