

UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 8 Examination in Engineering: October 2015

Module Number: EE8247

Module Name: Wireless and Mobile Communication

[Two Hours]

[Answer all questions, each question carries 5 marks]

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- Q1 a) i) Briefly explain the **Cellular** and **Frequency Reuse** concepts in wireless mobile communication systems.
- ii) Briefly explain the two main channel assignment strategies used in cellular systems. Discuss the advantages and disadvantages of these strategies in terms of Capacity and Implementation Complexity
- [2.0 Marks]
- b) A mobile operator has specified a signal to interference (S/I) ratio of 18 dB for satisfactory forward channel performance of a cellular system. The operator needs to determine the cluster size that should be used for different areas of the country that maximizes the capacity while maintaining the desired S/I level. If there are six co-channel cells in the first tier, and all of them are equal distances away from the mobile station,
- i) Determine the frequency reuse factor and cluster sizes that should be used for maximum capacity if the path loss exponents are $n=4$ and $n=2$ respectively.
- ii) Explain the relationship between system capacity and the level of interference in a cellular system.
- [3.0 Marks]
- Q2 a) Figure Q2a depicts three base stations serving an expressway and surrounding areas. MS1 denotes a mobile station that is inside a moving car at higher speeds. MS2 belongs to a pedestrian walking in a parallel path to the express way. An engineer monitoring the performance of the area notices a higher number of handovers happening in the express way. He has also received some complains about several calls being dropped and blocked while travelling in the expressway at higher speeds.
- i) What could be the cause for the higher number of handovers in the given system?
- ii) What is the impact of the higher number of handovers on the system and on the mobile user?
- iii) Suggest a solution that could decrease the number of handovers happening in the area.

iv) The monitoring engineer also receives complaint from some pedestrian saying that they experience call drops in the given area. When analyzing this problem the engineer observes that when the pedestrian users are moving away from one base station to another certain calls keeps on dragging without handing over at the correct time.

- i. State possible reasons for such call dragging behavior?
- ii. Explain what steps can be taken to rectify this problem and how those steps help to address the given issue.

[3.5 Marks]

b) A mobile system consists of 21 cells each containing 10 channels. System is expected to have a 1 % Grade of Service value. How many users can be supported by the system if each user generates 0.1 Erlangs of traffic? Use the data given in table Q2b

[1.5 Marks]

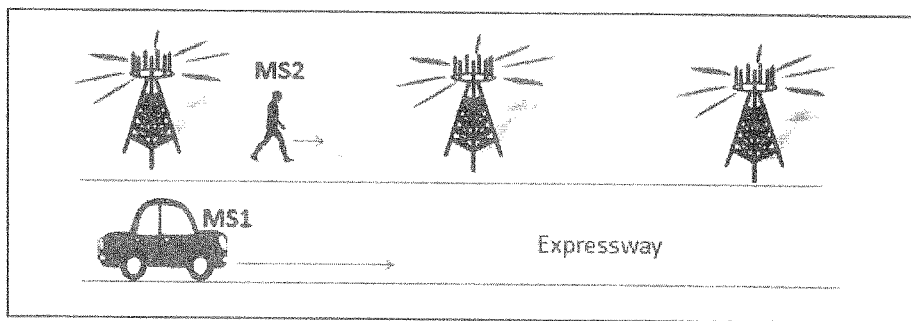


Figure Q2a

Table Q2b : Capacity of an Erlang B System

Number of Channels C	Capacity (Erlangs) for GOS			
	= 0.01	= 0.005	= 0.002	= 0.001
2	0.153	0.105	0.065	0.046
4	0.869	0.701	0.535	0.439
5	1.36	1.13	0.900	0.762
10	4.46	3.96	3.43	3.09
20	12.0	11.1	10.1	9.41
24	15.3	14.2	13.0	12.2
40	29.0	27.3	25.7	24.5
70	56.1	53.7	51.0	49.2
100	84.1	80.9	77.4	75.2

- Q3. a) What is the main difference between handover and roaming [1 Mark]
- b) Which roles do MS, BTS and BSC respectively have in the handover procedure? [1 Mark]
- c) List any three factors influencing small scale fading [1 Mark]
- d) State the limitation of conventional mobile telephone system [1 Mark]
- e) State the main causes for the diffraction effect [1 Mark]
- Q4. a) Assume a receiver is located 10 km from a 50 W transmitter. The carrier frequency is 900 MHz, free space propagation is assumed, power gain at transmitter $G_t = 1$, and power gain at receiver $G_r = 2$. Determine
- the power at the receiver
 - the magnitude of the E-field at the receiver's antenna
 - the rms voltage applied to the receiver input assuming that the receiver antenna has a pure real impedance of 50Ω and is matched to the receiver [3 Marks]
- b) i. Name the main elements of the GSM system architecture and describe their functions.
- ii. What are the advantages of specifying not only the radio interfaces but also all internal and external interfaces of the GSM system [2 Marks]