Mobile Radio Networks

Prof. A. Capone

Written Exam - January 25, 2018

Surname	
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Time available for the exam: 1:45 hours

1	2	3	4	5	A

Question 1 (6 points)

Design the multiplexing scheme of a TDMA mobile radio system similar to GSM. The system has radio carriers with a net rate of 462 Kb/s and it requires the following logical channels:

- ✓ Traffic channels TCH (uplink and downlink) with rate 44 Kb/s
- ✓ Associated control channels SACCH (uplink and downlink) with rate 11 Kb/s
- ✓ Broadcast channel BCCH (only downlink) with rate 36 Kb/s
- ✓ Frequency channel FCCH (only downlink) with rate 18 Kb/s
- ✓ Synchronization channel SCH (only downlink) with rate 6 Kb/s
- ✓ Paging channel PCH (only downlink) with rate 42 Kb/s
- ✓ Access grant channel AGCH (only downlink) with rate 24 Kb/s
- ✓ Random access channel RACH (only uplink) with rate 132 Kb/s

On a carrier you have to multiplex 5 TCHs and their 5 SACCHs and one signaling channel for each of the types indicated above. Design the multiplexing scheme indicating the frame and multi-frame structure for both uplink and downlink (solutions similar to GSM will get a higher score).

Question 2 (6 points)

a) Calculate the uplink capacity of a CDMA system with a minimum *Eb/No* equal to *13* dB, processing gain *Gp* equal to *100* and noise power *N* equal to *-10* dBm. Assume a multi-cell scenario with inter-cell interference equal to 66% of the intra-cell interference.

b) Consider a CDMA cellular system with 2 base stations and 3*n* active terminals. Attenuations a_{ij} ($=1/g_{ij}$) between each base station *i* and terminal *j* are reported in matrix *A*. A power control mechanism based on a closed loop control keeps the *Eb/No* at a constant value of *10 dB*. The processing gain *Gp* is *100* and noise power *N* is *-10dBm*. Calculate the emitted power values for the case of n=1, and calculate the maximum value of *n*.

$$A = \{a_{ij}\} = \begin{bmatrix} \overbrace{10 \cdots 10}^{n} & \overbrace{20 \cdots 20}^{2n} \\ 20 \cdots 20 & 10 \cdots 10 \end{bmatrix}$$

Question 3 (6 points)

Consider the following frequency assignment problem based on the compatibility matrix C and the frequency request vector M. Find a solution using the greedy algorithm so that to minimize the total number of frequencies.

$M = \{m_i\} = \{2,2,1,1,1,1,1,1,1,1\}$

$$C = \{c_{ij}\} = \begin{bmatrix} 2 & 1 & 2 & 0 & 1 & 0 & 1 & 0 & 0 & 2 \\ 1 & 2 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 2 & 0 & 2 & 0 & 0 & 2 & 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 & 2 & 0 & 0 \\ 1 & 1 & 0 & 0 & 2 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 & 0 & 2 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 1 & 0 & 2 & 1 & 0 & 1 \\ 0 & 1 & 0 & 2 & 0 & 0 & 1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 2 & 2 \\ 2 & 0 & 2 & 0 & 0 & 1 & 1 & 0 & 2 & 2 \end{bmatrix}$$

Question 4 (5 points)

Describe into detail the signaling procedure for a call setup initiated by a mobile user of operator A and terminated on a mobile user of operator B.

Question 5 (6 points)

Describe into detail the characteristics and the elements of the core network of LTE (EPC) and make a comparison with the core network of UMTS data services.

Additional topics (2 points)

It is possible to present here topics directly related to those of the course but not discussed during lectures, including those in the suggested readings available on the web page.