

Written Exam – July 17, 2017

Surname	
Name	
ID	

Time available for the exam: 1:45 hours

1	2	3	4	5	A

Question 1 (6 points)

- a) Make a comparison between location/routing update procedures in cellular systems for circuit switched mobile calls and packet switched data services.
- b) Calculate optimal size of location area for the case: squared cells; edge length 800 m; average speed of users 70 km/h; paging overhead 500 bytes (per user per cell per call); location update overhead is 10000 bytes (per user per update); traffic per user is 1 calls/h.

Question 2 (6 points)

- a) Describe the logical to physical channel mapping in GSM and the TDMA scheme used.
- b) Design the multiplexing scheme of a TDMA mobile radio system similar to GSM. The system has radio carriers with a net rate of 210 Kb/s and it requires the following logical channels: Traffic channels TCH (uplink and downlink) with rate 14 Kb/s; Associated control channels SACCH (uplink and downlink) with rate 7 Kb/s; Broadcast channel BCCH (only downlink) with rate 18 Kb/s; Frequency channel FCCH (only downlink) with rate 12 Kb/s; Synchronization channel SCH (only downlink) with rate 9 Kb/s; Paging channel PCH (only downlink) with rate 15 Kb/s; Access grant channel AGCH (only downlink) with rate 3 Kb/s; Random access channel RACH (only uplink) with rate 60 Kb/s
On the carrier, you have to multiplex 7 TCHs and their 7 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 3 (6 points)

Define the maximum cell size of a TDMA system in order to guarantee coverage (power above minimum threshold) and a maximum call blocking probability of 5%. Assume: hexagonal cells, minimum threshold for received power P_{th} equal to -100 dBm, minimum SIR equal to 7 dB, propagation factor equal to 4, number of carriers equal to 9 with 5 time slots per TDMA frame (one call per time slot), received power at reference distance $d_0=20$ m equal to -39 dBm, shadowing margin 6 dB. Consider the two cases:

- a) rural area with traffic density of 1 Erlang/km²,
- b) dense urban area with traffic density of 30 Erlang/km².

Question 4 (6 points)

Describe into detail the signaling procedure for location update considering different possible cases.

Question 5 (6 points)

Describe into detail the signaling procedure for a call initiated by a mobile user of operator A and terminated to a mobile user of operator B who is roaming in the network of operator C.

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.