S-72.620 Radio Network Planning Methods
Examination 21.2.2005. Part A. Closed book tasks (2 tasks)

The examination consists of two parts. When you have done the tasks in Part A (**closed book**) you should give the answers to the exam supervisor, and then you will get Part B (**open book**) including 3 problems which may be done with any literature. You can decide yourself the time you spend with each part, but the total exam duration is 3 h. You can leave the exam room 1 hour after the exam start.

1. Answer the following questions with one or a few sentences. Use figures when appropriate.

a) Which Grade of Service measure is the basis for coverage planning of a cellular network offering circuit switched services?

b) Define the quantities in the Erlang B blocking formula: $B = \dfrac{T^N/N!}{\sum_{n=0}^{N} T^n/n!}$

c) Coverage planning is based on the radio link budget. List terms in the down-link and up-link budgets of FDMA/TDMA based cellular networks.

d) What does the term co-channel protection ratio tell about?

e) How large is the fractional load in a WCDMA cell, if the interference margin is 7 dB?

2. This task should be treated somewhat deeper than the previous one.

Make a theoretical analysis on how much the down-link pole capacity will increase in a DS-CDMA based networks with identical base station parameters where the other to own cell interference ratio is 0.72 and the own cell decorrelation factor is 0.5 and noise is insignificant, if cells with omni-directional antennas are ideally sectorised into cells with

i) three sectors, reducing the number of interfering cells from six to two, and

ii) six sectors, reducing the interfering cells to one.

The average interference limited down-link capacity can be obtained from the expression $\dfrac{P_k}{\dfrac{(1-\alpha+f)}{G_C}\sum_{\substack{i=1\\ i\neq k}}^{M}\rho_i P_i + \dfrac{N_o R_s}{2}} = \gamma_k \geq \gamma_o$

S-72.620 Radio Network Planning Methods
Examination 21.2.2005. Part B. Open book tasks (3 tasks)

3. A cellular network operator has been granted a 2×10 MHz bandwidth. He intends to use an FDMA/TDMA/FDD-system with 200 kHz carrier spacing and 8 timeslots/carrier in both down-link and up-link. The co-channel reuse factor is 7.

a) How many traffic channels are available in each base station? It is assumed that all signaling is multiplexed on the traffic channels.

b) How much traffic can be served in a base station, if the blocking probability target is 2 %, and the traffic obeys Erlang-B?

c) The frequency regulator requires an average channel load of 90%. To which approximate value will the blocking probability increase?

4. The base station is dimensioned for a 90% cell coverage probability. The shadow fading standard deviation is 6 dB and the path loss exponent of the average path loss vs. distance is 4.

a) How large is the coverage probability at the cell border?

b) At which distance from the base station is the coverage probability still 10%? [Q(1.29)=0.1] Hint: Determine the flat fade margin for 50% and 10% coverage probability, and use then the average path loss model to determine the distance ratio.

5.

a) How large is the minimum distance between base stations using the same carrier frequency normalised to the disturbed cell diameter that in the down-link gives an average carrier to average interference ratio of 12 dB in the worst cell location. The interference power is estimated to 6 times the power of the nearest interfering base station. All equipment parameters and propagation environments are identical for all signals. The value of the path loss exponent is 4.

b) How large is, with this reuse distance and a 12dB CIR-requirement, the cell interference outage probability based on the method in the lecture material, which assumes a 6 dB standard deviation of the log-normal shadowing fading?