

# **S-72.3270 Cellular Radio Network Planning Methods, P**

## **Course presentation year 2006**

**Sven-Gustav Häggman**

---

## Course presentation

20.1.2006/sgh

### **S-72.3270 Cellular Radio Network Planning Methods, P (3 ECTS-credits)**

#### Course status

#### **For students following the old degree regulations**

- The course is lectured every academic year in the Period III.
  - The course can be included as a compulsory course in the major/minor subject
    - Communications Engineering (Radio Communications path)
    - Communication Systems
- and as optional course in the major/minor subjects
- Radio Engineering,
  - Signal Processing for Communications,
  - Teletraffic Theory.
-

## **For students following the new degree regulations**

- The course is lectured every academic year in the Period III.
  - The course is a compulsory course in the option Radio Communication Systems of the Master's major subject Radio Communications on the degree program of Communications Engineering and in the option Radio Communication Systems of the Master's major subject Communications Applications in the degree program of Electronics and Electrical Engineering.
  - Included in the curriculum of the International Master's Program in Telecommunications
-

## Course targets

The course gives *basic knowledge about radio network planning* with the *focus on cellular radio network planning*. This knowledge is needed by *radio network planners* employed by *system manufacturers, operators*, or other parties in the mobile communications area. After the course the participant will understand and be able to apply in his own work:

- the objectives and general outline of radio network planning,
  - the radio link budget and its application to BS design to meet coverage targets,
  - traffic estimation and its application to cell design to meet capacity targets,
  - interference analysis and its application to frequency allocation to meet interference outage targets in FDMA/TDMA based radio networks,
  - connection between capacity and coverage especially in CDMA networks.
-

## Prerequisites

It is assumed that the participants have done S-72.245 Transmission Methods in Telecommunication Systems (4 credits) or S-72.1140 Design Methodology of Telecommunication Systems (5 ECTS-credits), S-72.3210 Channel Modelling for Radio Communication Systems (3 credits (op)), and S-72.610/S-72.2210 Mobile Communication Systems and Services (2 credits/3 ECTS-credits) or equivalent courses.

## Teacher

Professor Sven-Gustav Häggman is the responsible teacher of this course.

## Lectures and exercises

- Lectures are held on Fridays 10 – 14 in Room H302.
- Separate exercises hours are not held, but typical problems and their solutions are shown interleaved with the lectures.

## Assignment

The course includes a compulsory assignment where the described planning methods are applied to the preliminary design of a GSM1800 radio network for a fictive service area. The assignment is done in two persons' teams.

---

The plan comprises a capacity plan, a coverage plan, and a frequency plan, which are done like in the lecture example (which is not GSM). The plan is based on the use of macrocells in all regions, but in the city region a separate macrocell plan for vehicular originated traffic and microcell plan for pedestrian originated traffic are implemented. The target is to first estimate the offered traffic and then minimize the number of cells, and then to minimize the number of transceivers in each cell still fulfilling the blocking and interference outage targets for this traffic, given the maximum parameter values. Network tuning and easy network expandability are not considered.

The purpose of this exercise is to help the student to understand how different things interact in cellular radio network planning, and, hopefully, to give the student skills to design computer planning tools. It corresponds mainly to the initial network dimensioning to get a rough cost estimate when a vendor should offer a network. Final network planning should be made with computer tools and may be based on other objectives than minimising excess capacity as in this assignment.

To facilitate the work some unsupported Excel-tools for radio link budget and minimum reuse distance calculations are provided.

---

## Requirements

- The course is carried out by
  - an exam and
  - an assignment.
- The exam requirements consist of the material distributed to the students
- The first exam is on March 8, 2006
- The exam consist of two parts: starting with a closed book part comprising two tasks about general topics followed by an open book part comprising three problem solving tasks.

## Final grade

The final course grade is calculated from the formula:

$$\text{Final grade} = (\text{Exam grade} + \text{assignment grade})/2$$

The student should pass both the exam and assignment with an accepted grade.

---

## Literature

Lecture notes.

Following textbooks and reports can provide background material:

**William C. Jakes:** Microwave Mobile Communications,  
USA 1974, Wiley, 642pp.

**David Parsons:** The Mobile Radio Propagation Channel, Second edition  
Great Britain 2000, Wiley, 418pp.

**Theodore S. Rappaport:** Wireless communications, Principles & practice  
USA 1996, IEEE Press, 641 pp.

**ETSI Technical Report ETR 103, Radio Network Planning Aspects (GSM 03.30),** Second edition, February 1995, 33pp.

**Jukka Lempiäinen, Matti Manninen:** Radio Interface Planning for  
GSM/GPRS/UMTS  
2001. Kluwer Academic Publishers. 292 pp.

**Radio Network Planning and Optimisation for UMTS,** Edited by Jaana Laiho,  
Achim Wacker, and Tomáš Novosad, England 2002, Wiley, 484 pp.

**Jukka Lempiäinen, Matti Manninen (Eds),** UMTS Radio Network Planning,  
Optimization and QoS Management  
Netherlands 2003, Kluwer Academic Publishers, 342 pp.

---

## Lecture plan, Period III 2006

Fri	20.1	10 – 12	Introduction, radio network design approaches for TDMA/CDMA systems
Fri	20.1	12 – 14	Capacity planning: traffic modelling and methods for capacity design
Fri	27.1	10 – 12	Capacity planning: example
Fri	27.1	12 – 14	Coverage planning: radio link budget average path loss models
Fri	3.2	10 – 12	Coverage planning: equipment characteristics and base station design
Fri	3.2	12 – 14	Coverage planning: example
Fri	10.2	10 – 12	Interference modelling for frequency planning
Fri	10.2	12 – 14	Frequency planning: frequency allocation
Fri	17.2	10 – 12	Frequency planning: example
Fri	17.2	12 – 14	Radio network optimisation and planning tools, introduction of the assignment
Fri	24.2		
Fri	24.2		