RADIO INTERFACE SYSTEM PLANNING FOR GSM/GPRS/UMTS

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*To my wife Tia,
to my parents Irene and Keijo,
to my brother Jarmo in memoriam.*

J. Lempiäinen

To my wife Marika.

M. Manninen

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PREFACE

There are plenty of books written for academic courses about the areas of electromagnetics, radio technology or radio communications. In these books all the basic and more of the advanced mathematical and technical engineering principles about the theory of electromagnetics—reflections, diffractions, scattering, coupling-antennas and radio propagation—are explained. There are also many books concerned only radio communications and especially mobile communication systems. These books explain theoretical aspects of mobile communication systems in more detail but do not focus on the connections between different technical details. System level engineering is thus not addressed because it is typically thought only to be a practical issue. However, this system level understanding is a critical issue in today's mobile communications systems in order to achieve cost efficient and high quality radio engineering in mobile systems' radio interface. It is not enough to understand just technical details because these are connected to other technical aspects and these can all be combined in many different ways.

These various technical combinations within this mobile communications branch can be demotivating, particularly to newcomers—new RF engineers—who already know all the basics of radio technology because they have read all the basic books. Moreover, new engineers are often confused with all the different solutions for the different problems when they start learning the mobile communications principles and they can easily feel frustration because system level planning is a new and quite poorly documented topic. Hence, a simple and clear handbook about the radio planning principles and their connections in mobile communications systems is required to explain this system level planning.

This book is a part of the solution to understanding detailed technical radio engineering principles for mobile communication systems where all the details have a straight connection with each other. This book tries to bind very detailed pieces of technical information to the system level of thinking and thus to show the correct path at the junction. Mobile communication is full of these junctures because almost all the products are new, and technical development work is only just started. This handbook has been produced mainly with examples from the Global System for Mobile Telecommunication (GSM) because it is one of the most “global” standards (implemented over 80 countries). There are also many technical topics to be developed for the GSM during the next

decade when GSM as a system is combined together with the Universal Mobile Telecommunication System (UMTS) that will be the next GSM compatible standard. The GSM examples in this book, and most of the technologies utilized in the GSM, can also thus be applied in the UMTS. Clear technical differences in the radio system planning between GSM and UMTS system are explained and discussed in the concluding chapters 10 and 11 but otherwise there is no need to explain the variations between GSM and UMTS in technical detail here because this is covered in several other books. The main purpose of this handbook is to explain the radio interface system planning in the GSM (including GPRS) and to give the main instructions to continue the same work in the UMTS.

The content of this book is based on the radio system planning process that contains different phases that are explained in Chapters 3–9. Before these detailed planning phases Chapter 1 gives an introduction to the radio propagation environment in order to convey the influence of the environment on the radio system planning principles. The whole radio system planning process is also explained separately in Chapter 2 and Chapters 3–9 following the content of Chapter 2 at a detailed level. Radio system planning starts from configuration planning (Chapter 3) and continues with coverage planning (Chapters 4 and 5), capacity planning (Chapter 6), frequency planning (Chapter 7) and optimisation and monitoring (Chapters 8 and 9). Chapter 3 considers the definitions of the power budget calculations; the coverage planning done in Chapters 4 and 5 is based on the defined power budget from Chapter 3. Chapter 6 considers the capacity of the radio interface and Chapter 7 contains the frequency planning aspects. Chapters 8 and 9 give instructions on observing the performance of the planned radio system/network. Finally, Chapters 10 and 11 explain the detailed radio planning differences of the speech orientated GSM radio network and the packet transferred data GPRS/EDGE and the third generation UMTS radio networks.

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