Chapter 5
Optimum Allocation of Transmission Technologies for Solving the BTS Interconnection Problem in Cellular Systems

Marcos Antônio de Sousa
Pontifical Catholic University of Goiás, Brazil & Federal University of Goiás, Brazil

Carlos M. F. Carlson
São José do Rio Preto Technology College, Brazil

Flávio Henrique Teles Vieira
Federal University of Goiás, Brazil

ABSTRACT

The offer of innovative technologies and the growth of demands to new services, especially those with higher transmission rates, make the access network planning an important stage in the evolution of cellular systems. Several technological options of transmission systems are already available and to choose the best among them is a great challenge for network planners. This chapter presents a study for strategic planning of the interconnection of base stations in a cellular mobile network. The allocation and dimensioning of transmission equipment are carried out admitting inexact forecast on service's demand values. The techno-economical evaluation is driven by max-revenue criterion and is based on the concept of triangular fuzzy number. An application of the method is shown and its implications are discussed in this chapter.

INTRODUCTION

The telecommunication systems are currently passing through a phase of big transformation and expansion due to the development of new types of service, especially the multimedia and broadband ones. The competitive context forces energy companies to continuously invest both in technology evolution and in offered service. The system expansion is conditioned to marketing strategies which require service

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demand survey and the study of different technology possibilities to be adopted. High-speed commutation and transmission, low error rates and acceptable delays are some of the essential attractions to conquer and stimulate loyalty of a possible client.

The planning of the system is conditioned to those transformations. On one hand, it is possible to exist selectivity in the demand provisioning, which means that it could be said that potentially the most profitable demands are priority. On the other hand, there is a variety of services to be offered, each one generating a special revenue and eventually requiring equipment, topologies and specific transmission medium.

The budget limitation, naturally, is another factor to be predicted because it is not always possible to implement all the necessary systems for the complete demand provisioning. The dimensioning of the systems need, thus, to contemplate technical and economic factors that go beyond the task of planning the network aiming the lowest cost for implementation, renting, maintenance and/or operation. Implementing solutions that mean guaranteed participation in the market and rewarding revenue is a question of survival. Therefore, the expansion of access systems requires intense planning activity. Where, when, how and how much to invest are questions for which the planning must find answers. The great amount of technical-marketing options to be analyzed requires difficult choices. Moreover, the kind of problems and the speed of transformations require consistent and flexible (able to endure different contexts) planning methodologies supported by computationale tools. Significant values usually involved in that kind of situation make desirable the use of supported decision systems based on mathematical models.

Therefore, in this big technological transformation and global competition in the telecommunication area context, it is extremely important the implementation of decision support tools which can help in the strategic planning of the network access, especially to mobile phone access systems. In this sense, this chapter uses network modeling with oriented graph and fuzzy numbers to introduce a new approach for dimensioning mobile phone access systems with imprecise data of demand services.

The Mobile Cellular System

The Mobile Cellular System is an alternative of access to the user to the telecommunication system. This system consists of a mobile component and a fixed component. The mobile component consists of the user (MS-mobile station), which is connected to the system by the access node via (BTS base transceiver station) the air interface. Currently, the most adopted second-generation technology is the Global System for Mobile Communications (GSM) (Jeszensky, 2004). The fixed part of the network infrastructure, is responsible for the interconnection between BTSs and CO (BSC / MSC-set base station controller / mobile switching center). A mobile phone network is composed by basic elements shown in Figure 1 (Jeszensky, 2004), where:

Mobile Switching Center (MSC): The MSC is the "heart" of the system. It is a high processing capacity machine, which uses a software developed to address specific telecommunication applications. The MSC is responsible for processing the tasks in layers, monitoring, charging, connecting to other telecommunication system, and so forth.

Base Transceiver Station (BTS): The term "Base Transceiver Station" is used to name a set of equipment that make the aerial interface between the subscriber and the system. The radio equipment has limited power, which defines its geographical area of service coverage, named as cell. To assure the access to users, the BTS is composed of energy sources (batteries and generator sets), station control system, radio frequency transceiver, power amplifiers and radiant system.