Chapter XXI
Load Balancing as a Key to Enable Different Services in a Cellular Network

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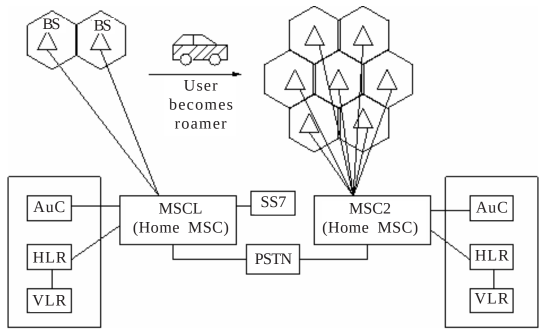
ABSTRACT

This chapter develops the concept of load balancing that plays a key role in providing various advanced application in cellular mobile environment. Load balancing means the efficient distribution of channels among cells in accordance with their requirements to minimise call blocking. As the channels for these services are scarce, load balancing has emerged as a primary issue in today's scenario. Two different prominent schemes of load balancing are elaborated. This chapter is aimed at the researchers and the policy makers making them aware of the different means of efficient load balancing as well as underscoring the problem areas that need further vigorous research.

INTRODUCTION

With the advancement of technology and behavioural change in work patterns/tasks, the world of computing has been experiencing increasing change in several directions. More particularly, the recent advances of cellular systems have rendered geographical distances insignificant. The architecture of a cellular network, as shown in Figure 1, is generally conceived as a collection of geometric areas called cells. Each cell is serviced by a base station (BS) located at its centre. A number of BSs are again linked to a mobile switching centre (MSC) acting as a gateway of the cellular network to the existing wired network, such as PSTN, ISDN, and so forth. The wireless communication takes place only between

Figure 1. Basic cellular network



the BS and the mobile user (MU). Other communications—for example, between BS and MSC or between MSC and MSC—are wire lines (Lee, 1995; Rappaport, 1999; Boucher, 2001).

For the last decade or so, the number of mobile users has grown enormously, and as very limited frequency spectrum is allocated to this service, the efficient sharing of the spectrum among the users has become an important issue. In order to combat the problem arising out of limited allocation of frequency spectrum, the frequency channels are reused as much as possible to support a huge number of simultaneous communicating users. To increase the utilisation of limited frequency, further various schemes of channel allocation are developed (Tajima & Imamura, 1988; Del Re Fantacci, & Giambene, 1995; Das, Sen, & Jayaram, 1998; Das(Bit) & Mitra, 2000; Mitra & Das(Bit), 2000); two are presented here. In these schemes, available frequency channels are efficiently assigned and/or borrowed, which consequently reduces the number of blocked calls in each cell.

Load balancing means the efficient distribution of channels among cells as per their requirement to minimise the call blocking probability. This can be done either by assigning the frequency channels among the cells and/or by borrowing channels from cells having excess channel. In the first scheme (Das(Bit) & Mitra, 2000) presented here, a load balancing technique is described maintaining a few small databases based on the history of traffic for a recent certain period. It is basically a combined approach, marrying a fixed and dynamic channel assignment in load balancing. Initially all the cells get some fixed number of channels. Additionally there is a central reserve pool managing the extra demand of channel (if any). The merit of this semi-dynamic-type channel assignment scheme is that message trafficking among different components of the network is much less with respect to the existing schemes, which are purely based on fixed assignment technique. As the message trafficking is reduced, more channels are made available, reducing call blocking probability.

The second scheme (Mitra & Das(Bit), 2000) is a combination of dynamic channel assignment and channel borrow technique. Channels are assigned dynamically among the cells under each MSC. In cases in which channel demand may increase, the cell that needs excess channels due to the occurrence of event can borrow a channel from one of its compact pattern (CP) cells by exchanging a few number of messages. If the probable lender cell is not available, the MSC can borrow channels from other MSCs that have excess channels.

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