Chapter 17

A GPS Based Deterministic Channel Allocation for Cellular Network in Mobile Computing

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ABSTRACT

The scarcity of the radio channel is the main bottleneck toward maintaining the quality of service (QoS) in a mobile cellular network. As channel allocation schemes become more complex and computationally demanding, alternative computational models that include knowledge-based algorithms and provide the means for faster processing are becoming a topic of research interest. An efficient deterministic technique, capable of handling channel allocation problems, is introduced as an alternative. The proposed model utilizes the Global Positioning System (GPS) data for tracing the hosts' likely movements within and across the cells and allocates the channels to the mobile devices accordingly. The allocation of the channels to the mobile hosts is deterministic in the sense that the decision of the channel allocation is based on the realistic data received from the GPS about the hosts' movements. The performance of the proposed technique has been evaluated by conducting the simulation experiments for the two parameters—call blocking and handoff failures. Also, a comparison of the proposed model with an earlier model has been carried out to estimate the effectiveness of the proposed technique. Experimental results reveal that the proposed technique performs better and is more realistic as well.

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INTRODUCTION

With the emergence of the miniature portable computing devices and efficient wireless technology, mobile computing discipline came into the existence. The technical challenges that the mobile computing discipline must surmount to achieve the potential are hardly trivial. The issues stem from three essential properties of mobile computing: communication, mobility, and portability. The communication in wireless network is done by modulating radio waves or pulsing infrared light. Wireless networks are linked to the wired network infrastructure through stationary transceivers. The area covered by an individual transceiver’s signal is known as a cell. Cell radii vary from tens of meters in buildings to hundreds of meters in cities and tens of kilometers in the countryside. Cellular systems use small cells due to frequency reuse, less transmission power, and thin interference (Maha Patra, Roy, Banerjee, & Vidyarthi, 2006).

Each cell has a base station (BS) responsible for communication with mobile users in that cell. All the base stations are connected with a wired network under the control of a mobile switching center (MSC). MSC is the interface between wireless communication network and the other wireless or wired communication networks (Hac & Chen, 1999).

Radio spectrum, used in cellular network, is a scarce resource and thus the efficient channel allocation is important to the reliability and performance of the system. In order to divide a given radio spectrum into radio channels, many techniques are popular. Three most widely used techniques are frequency division multiple access (FDMA), time division multiple access (TDMA), and code division multiple access (CDMA). Further, a channel cannot be used by the two cells concurrently if the geographical distance between them is less than a threshold distance, called minimum channel reuse distance \( D_{\text{min}} \) (Yang, Jiang, Manivannan, & Singhal, 2005). It is because they may interfere with each other resulting in co-channel interference (Baiocchi, Priscoli, Grilli, & Sestini, 1995; Prakash, Shivaratri, & Singhal, 1995; Prakash, Shivaratri, & Singhal, 1999).

Handoffs technique is significant in any cellular system because it is undesirable for a mobile host to break its call while moving from one cell to another. It is more so in mobile computing as it may sometimes result in starting the computation from scratch. Preferable is to block a new initiated call than to break an existing one. Several techniques are used to implement handoffs in ways that cope well with the traffic variation while maintaining a high level of utilization. Handoff is an important issue particularly in microcellular systems where the cell radius is small (Lauro & Aghvami, 2003; Murthy & Manoj, 2004). Handoff is quite a common phenomenon that arises due to mobility (Maha Patra et al., 2006; Schiller, 2003) and is to be taken care of with utmost priority and great sincerity as any handoff drop may wash off the whole computation in mobile computing.

In addition to the limited number of radio channels, radio interference is another constraint in communications within cellular networks. It may significantly deteriorate the quality of transmission if the channel allocation algorithm does not take this into consideration. Extensive research has been done in the area of channel allocation in wireless networks with these issues (see Boukerche, Tingxue, & Kauther, 2005; Khanbary & Vidyarthi, 2008; Tipper & Teresa, 2002; Yang et al., 2005; Zhang & Yum, 1991).

The objective of channel allocation is to assign a required number of channels to each cell so that the need of the cells toward the mobile devices are satisfied and at the same time efficient frequency spectrum utilization is provided with minimum interference effects. Channel assignment (allocation) is therefore an important activity of resource management and its efficient implementation increases the fidelity, capacity, and the quality of service in cellular systems. The search for better channel allocation methods continues to be one of