Chapter 3
A Novel Strategy for Managing User's Locations in PCS Networks Based on a Novel Hot Spots Topology

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ABSTRACT

As PCS networks aim to provide "anytime-anywhere" cellular services, they enable Mobile Terminals (MTs) to communicate regardless of their locations. However, in order to guarantee a successful service delivery, MTs' real time location should be continuously managed by the network. Location management plays the central role in providing ubiquitous network communications services, which includes two fundamental processes, i.e., registration and paging. Registration is concerned with the reporting of the current locations of the MTs, while paging is used to locate the MT. Both processes incur signaling cost, and due to the scarcity of PCS wireless bandwidth and for more scalable mobile services, it is important to reduce that signaling cost. As The blanket paging in current PCS networks wastes a lot of wireless bandwidth, the author focuses on the subject of paging in attempt to reduce the paging signaling cost under delay bounds. This paper challenges the signaling cost problem and successfully establishes a family of probability based paging strategies. The author will introduce a novel topology for the network registration area, which is called the hot spot topology (HST) and based on HST, a novel location management strategy, which is called "Flower Based Strategy" (FBS) is also introduced.

INTRODUCTION

Recently, due to the exponential growth rate of Personal Communication Service (PCS) subscribers, the research in PCS networks has received a lot of attention (Singh & Karnan, 2010; Biswash & Kumar, 2009; Selvan, Shanmugalakshmi, & Nirmala, 2010). The most salient feature of such networks, as it is built upon an underlying cellular infrastructure, is the mobility support that enables network Mobile Terminals (MTs) to communicate with each others on the move (Singh & Karnan, 2010; Markande & Bodhe, 2009). Roughly speak-

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ing, it is the main target of PCS network to deliver wireless calls among the network MTs on time at the minimal signaling cost. However, such target should be motivated by efficient techniques for managing the run time locations of the network MTs. In the existing PCS networks, a two-tire database structure is used to manage MTs' locations (Kumar & Tripathi, 2008).

The PCS network Service Area (SA), which is managed by a master database called Home Location Register HLR, is divided into a set of Registration Areas (RAs) (Kondepu & Kumar, 2009). HLR is a global database that maintains MTs' identity information including the mobile user information such as directory number, profile information, real-time location, authentication information, and billing information. Each RA is a collection of cells each serviced by a Base Station (BS). Several BSs are usually wired to a Base Station Controller (BSC). Furthermore, a number of BSCs are connected to one Mobile Switching Center (MSC). Usually one MSC is responsible of serving one RA. Another database type called Visitor Location Register (VLR) is attached to each MSC to store the profile information for the MTs currently visit its RA (Biswash & Kumar, 2009). For every MS, there is a permanent record in HLR (each MS is associated with a unique HLR). However, when a MS visits a new RA, a temporary record, for that MT, is created in the VLR serving such RA to reflect the current location of that MT (MT must register to the VLR before receiving any cellular service, and then HRL is also updated to reflect the real time location of that MT). When MT leaves such RA, the corresponding record in the VLR is deleted. When there is a call, PCS network always checks with the HLR to know the current VLR of the target MT, and then the call is delivered to the current VLR. Hence, HLR cooperates with a set of VLRs to track mobile users and find out the location of the target ones (Giner & Escalle, 2009; Zhao, Guo, & Liu, 2010; Bhadauria & Sachan, 2009).

In order to effectively deliver an incoming call to a MT, its precise location must be determined within a certain time limit. Location management is a key issue in PCS networks, which mainly involves two main operations; registration and paging (Zhang, Laurence, Jianhua, & Zheng, 2009; Kim & Choi, 2009). Registration is the process performed by each MT to report its up-to-date location to the network. Such location information is employed to find out the exact location of the MT whenever a new call is directed to it. On the other hand, paging is the process performed by the network to search the called MT (Bar, Feng, & Golin, 2007). It is carried out by sending polling signals to the cells with the highest probability of existence for the called MT. Hence, registration involves a MT initiated procedure, while paging involves a network initiated procedure (Kondepu & Kumar, 2009).

The problem of MT tracking can be considered using different strategies. The first is the "Always-Update" (AU), in which each MT registers itself whenever it crosses a new cell boundary (enters a new cell). According to the AU strategy, the signaling overhead due to transmissions of registration messages is so high. The impact of signaling overhead becomes troubleshooting with a small cell size and a large number of highly-mobile users. Moreover, the huge amount of location update events will significantly consume not only the limited network bandwidth, but also the electronic power of the MTs' battery. However, with the AU strategy, the exact MT location is always known, hence, the paging cost is always zero. The second strategy is the "Never-Update" (NU); in which MT never inform the network about its current location. Clearly, under the NU strategy, no overhead for registration, however, a network-wide search should be performed to find a particular MT. This certainly introduces a very high penalty. The third MTs' tracking strategy is the "Registration Area-Update" (RAU), which is the used by the current PCS networks. RAU is a combination of