Chapter 2.24
Mobility Management in Mobile Computing and Networking Environments

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ABSTRACT

This chapter analyzes and proposes some mobility management models and schemes by taking into account their capability to reduce search and location update costs in wireless mobile networks. The first model proposed is called the built-in memory model; it is based on the architecture of the IS-41 network and aims at reducing the home-location-register (HLR) access overhead. The performance of this model was investigated by comparing it with the IS-41 scheme for different call-to-mobility ratios (CMRs). Experimental results indicate that the proposed model is potentially beneficial for large classes of users and can yield substantial reductions in total user-location management costs, particularly for users who have a low CMR. These results also show that the cost reduction obtained on the location update is very significant while the extra costs paid to locate a mobile unit simply amount to the costs of crossing a single pointer between two location areas. The built-in memory model is also compared with the forwarding pointers' scheme. The results show that this model consistently outperforms the forwarding pointers' strategy. A second location management model to manage mobility in wireless communications systems is also proposed. The results show that significant cost savings can be obtained compared with the IS-41 standard location-management scheme depending on the value of the mobile units' CMR.

INTRODUCTION

Mobile communication networks are made possible by the convergence of several different technologies, specifically computer networking protocols, wireless-mobile communication systems, distributed computing, and the Internet. With the rapidly increasing ubiquity of laptop computers, which are primarily used by mobile users to access Internet services such as e-mail and the World

Wide Web (WWW), support of Internet services in a mobile environment has become a growing necessity. Mobile Internet providers (IPs) attempt to solve the key problem of developing a mechanism that allows Internet protocol (IP) nodes to change physical locations without changing IP addresses, thereby offering Internet users the so-called "nomadicity." Furthermore, advances in wireless networking technologies and portable information devices have led to a new paradigm of computing called *mobile computing*. According to this concept, users who carry portable devices have access to information services through a shared infrastructure regardless of their physical location or movements. Such a new environment introduces new technical challenges in the area of information access. Traditional techniques to access information are based on the assumptions that the host locations' distributed systems do not change during computation. In a mobile environment, these assumptions are rarely valid or appropriate.

Mobile computing is distinguished from classical, fixed-connection computing due to the following elements: (a) the mobility of nomadic users and the devices they use, and (b) the mobile resource constraints such as limited wireless bandwidth and limited battery life. The mobility of nomadic users implies that the users might connect from different access points through wireless links and might want to stay connected while on the move, despite possible intermittent disconnections. Wireless links are relatively unreliable and currently are two to three times slower than wired networks. Moreover, mobile hosts powered by batteries suffer from limited battery life constraints. These limitations and constraints provide many challenges to address before we consider mobile computing to be fully operational. This remains true despite the recent progress in wireless data communication networks and handheld device technologies.

In next-generation systems supporting mobile environments, mainly due to the huge number of mobile users in conjunction with the small cell size, the influence of mobility on the network performance is strengthened. More particularly, the accuracy of mobility models becomes essential to evaluate system design alternatives and network implementation costs. The device location is unknown a priori and call routing in general implies mobility management procedures. The problems which arise from subscriber mobility are solved in such a way that both a certain degree of mobility and a sufficient quality of the aspired services are achieved.

This chapter analyzes the problem of managing users' mobility in the context of mobile computing and networking environments. Mobility management implies two major components: *handover management* and *location management*.

Handover management is the way a network functions to keep mobile users connected as they move and change access points within the network. Generally, there are two types of handover: intracell handover and intercell handover. Intracell handover occurs when a user experiences degradation of signal strength within a cell. This leads to a choice of new channels with better signal strength at the same *base transceiver station* (BTS), also called *base station* (BS). Intercell handover occurs when a user moves from a cell to another. In this case, the user's connection information is transferred from the former BTS to the latter one. The following procedure occurs for both intracell and intercell handovers. First, the user initiates a handover procedure. Then, the network or the mobile unit (depending on the unit that controls the handover operation) provides necessary information and performs routing operations for the handover. Finally, all subsequent calls to the user are transferred from the former connection to the latter one.

Location management is the process used by a network to find the current attachment point of a mobile user for call delivery (Akyildiz & Wang, 2002). The first step of the procedure is the *location registration*. In this phase, the mobile