Chapter 12

IP Paging for Mobile Hosts in Distributed and Fixed Hierarchical Mobile IP

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ABSTRACT

The concept of Paging has been found useful in existing cellular networks for mobile users with low call-to-mobility ratio (CMR). It is necessary for fast mobility users to minimize the signaling burden on the network. Reduced signaling, also, conserves scarce wireless resources and provides power savings at user terminals. However, Mobile IP (MIP), a base protocol for IP mobility, does not support paging concept in its original form. Several paging schemes and micro-mobility protocols, centralized and distributed, have been proposed in literature to alleviate the inherent limitations of Mobile IP. In this paper, the authors propose three paging schemes for Distributed and Fixed Hierarchical Mobile IP (DFHMIP) and develop analytical models for them. Performance evaluations of these schemes have been carried out and results have been compared with DFHMIP without paging and with Dynamic Hierarchical Mobile IP (DHMIP) for low CMR values.

1. INTRODUCTION

Paging is one of the key concepts being used since first generation cellular networks. Most of the cellular network standards are using paging in one form or the other. In cellular networks, mobility management involves two operations. First is tracking the mobile users during their movements. This is called location update. In this operation, a user is required to update its location whenever it moves from one cell to another. Second operation is called as paging. This operation is performed by the network to locate a user on the basis of user’s current location update information for accurate call delivery. Paging process is primarily used for dormant users that cross the
cell boundaries frequently without any ongoing session. The benefit of paging lies in the fact that a dormant user is allowed to move freely within a group of cells without updating its location to the network. This group of cells is called a paging area. The paging area consists of a group of base stations, which are under the same mobile switching center (MSC). Thus, the network has only a coarse knowledge of the user location. When a call arrives, MSC sends a paging message to all the base stations in the paging area to locate the user. The base stations broadcast the paging message in their own cells. The system determines the mobile station’s accurate location after receiving a paging response message from the paged mobile device. The precise location information is then used to establish the call.

Mobile IP (MIP) (Perkins, 1997, 2002) a base protocol for IP mobility, uses only location updates or registrations for the mobility management, and does not support paging concept in its original form. Several paging schemes and micro-mobility protocols, centralized (Ramjee, Varadhan, Salgarelli, Thuel, Wang, & La Porta, 2002; Valko, 1999; Gustafsson, Jonsson, & Perkins, 2005) and distributed (Xie & Akylidiz, 2002; Ma & Fang, 2004; Bejerano & Cidon, 2003) have been proposed in literature to alleviate the inherent limitations of Mobile IP. The paging is beneficial for dormant users that cross the subnet boundaries frequently without an ongoing session. Therefore, the researchers have identified IP paging altogether a different issue. Distributed and Fixed Hierarchical Mobile IP (DFHMIP) also does not distinguish between active and dormant mobility users. Therefore, signaling costs at lower CMR values become significantly high.

This paper endeavors to develop paging schemes for DFHMIP so as to take account of the dormant users differently than the active users. Following this section, the paper is alienated in four major sections. Section 2 provides state-of-art scenario in the area of IP paging. Section 3 explains the system description and three paging mechanisms for DFHMIP. Analytical models have been developed to compute signaling costs for the proposed paging schemes in Section 4. Section 5 evaluates the performance of the paging schemes, in terms of signaling costs, and compares them with DFHMIP without paging and DHMIP for low CMR values. Finally, the conclusion of paper is presented in Section 6.

2. RELATED WORKS

IP paging enables a common infrastructure and protocol to support different wireless interfaces. According to Mobile IP regional paging (Haverinen, 2000), each host can stay in either of the two states: active, or idle, also called as dormant mode. For active hosts, it acts similar to Mobile IP whereas in dormant mode, the hosts can freely move within a paging area, a group of subnets, without any location registration with the network. Thus, the system has only coarse knowledge of whereabouts of the host. A mobile host performs registration only when it changes paging areas. The packets intended for a dormant host are terminated at a paging initiator. The paging initiator buffers the packets and sends the IP paging messages within the paging area. The subnet where the host is currently residing responds to this message. Then, the packets are forwarded to the recipient.

P-MIP (Zhang, Gomez Castellanos, & Campbell, 2002) proposes each subnet to have a base station, similar to a cell in cellular networks, which can act as an FA in its own subnet. P-MIP considers both, overlapping and non-overlapping paging areas, and uses fluid flow model for host mobility. Analytical and simulation studies show that with growing paging area size, the increase in signaling cost is considerably less with P-MIP than with MIP. In Yun, Sung, and Aghvami (2003) authors have shown suitability of P-MIP over MIP for small values of session-to-mobility ratio (SMR), same as CMR. On the contrary, performance of MIP is better for high values of SMR. The authors in
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