Chapter 18

Distributed and Fixed Mobility Management Strategy for IP-Based Mobile Networks

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ABSTRACT

Hierarchical Mobile IP (HMIP) reduces the signaling delay and number of registration messages to home agent (HA) by restricting them to travel up to a local gateway only. It uses centralized gateways that may disrupt the communications, in the event of a gateway failure, between a gateway and the mobile users residing with underlying foreign agents (FAs) in a regional network. Dynamic mobility management schemes, using distributed gateways, proposed in literature, tend to circumvent the problems in HMIP. These schemes employ varying regional network sizes or hierarchy levels that are dynamically selected according to call-to-mobility ratio (CMR) of individual user. In reality, this information cannot be readily available in practice. Also, any unusual alterations in CMR values may hamper the system performance. This paper proposes a new mobility management strategy for IP-based mobile networks, which is independent of individual user history. The proposed scheme uses subnet-specific registration areas and is fully distributed so that the signaling overheads are evenly shared at each FA. The scheme provides a viable alternative to dynamic mobility management schemes for its simplicity, performance, and ease of implementation.

INTRODUCTION

During the last decade, the mobile communication and Internet technologies have gained tremendous popularity among the users throughout the world. This has led towards the convergence of mobile communications and Internet technologies together so as to achieve their fullest advantages. It is forecast that, by the year 2015, the amount of total mobile user traffic will have a 23-fold increase as compared to the amount of present traffic and the multimedia traffic will account for 90% of the total user traffic (Otsu, Umeda, & Yamao, 2001).
Distributed and Fixed Mobility Management Strategy for IP-Based Mobile Networks

Mobile IP (MIP) (Perkins, 1997, 2002), an IETF standard, has laid the foundation stone for IP mobility. It incorporates three additional entities in existing IP network: mobile host, home agent (HA), and foreign agent (FA). The two mobility agents, HA and FA, are used to handle the movement of the mobile hosts in the network. For a mobile host, its HA is fixed whereas the FA changes during its movement from one subnet to another. Therefore, each MH is assigned two addresses, namely a permanent address or home address which is assigned by the HA, and a temporary address or care-of-address (CoA) which is assigned by its visiting FA. Whenever a mobile host moves to a new FA, it obtains a new CoA from the current FA advertisement message. It is mandatory for the host to register its new location information with its HA to facilitate correct data delivery. The HA maintains the current mobility binding of each host, which is one-to-one mapping between home address and CoA of a mobile host. The data packets from a correspondent host, a fixed host on the Internet, are first intercepted by the HA of the mobile host, which, after encapsulation, tunnels them at the last registered CoA of the host. The FA with designated CoA decapsulates the packets and forwards them to intended recipient. Mobile IP provides an elegant solution for macro-mobility. However, it is not suitable for micro-mobility. In Mobile IP, packets addressed to a mobile host are always routed via its home agent. This results in a sub-optimal path for packet routing. This is known as triangular routing problem. Mobile IP incurs heavy registration cost for users with high mobility. This cost may become very significant as the number of mobile hosts increases. Moreover, if a mobile host roams far away from its HA, the signaling delay becomes longer. MIP does not support paging as well. Therefore, for a dormant mobile host, most of the effort to keep its location information up-to-date at its HA is of no use. Only the last location information is needed to establish the data exchange session. Paging is required to save wireless resources and battery life of mobile hosts. MIP also suffers from triangular routing problem which causes longer handoff delay and, hence, the higher packet loss.

In this paper, we propose a new mobility management strategy for IP-based mobile networks. This strategy employs distributed architecture that helps in sharing the gateway responsibilities uniformly on each FA. In the proposed scheme, an FA can act in three modes of operation namely, as a gateway FA (GFA), a regional FA (RFA), or simply as a FA, as explained. Thus, the scheme employs three-tier hierarchy in a regional network or registration area (RA). It considers a subnet or FA-specific RA size, which is fixed for all users registering the current FA either as a GFA, or an RFA. Therefore, the RA sizes are independent of call and mobility patterns of individual user, and can be easily implemented. This scheme is named as Distributed and Fixed Hierarchical Mobile IP, abbreviated as DFHMIP. The proposed scheme uses overlapping RAs, which helps in mitigating the ping-pong (or zig-zag) effect near the RA boundaries.

Following this section, the paper is alienated in four major sections. First we provide state-of-art scenario in the field of IP-based mobility management. Then we describe the network architecture and an algorithm to implement DFHMIP. An analytical model is developed to compute signaling cost for DFHMIP scheme. We present the performance evaluation of DFHMIP and make its comparisons with DDHMIP and DHMIP. Finally, the paper is concluded.

RELATED WORKS

Micro-mobility management schemes for IP-based networks can be broadly classified in two categories: centralized and distributed schemes. Centralized schemes employ a dedicated mobility agent for gateway functionality. HAWAI (Ramjee, La Porta, Thuel, Vardhan, & Salgarelli, 1999; Ramjee, Varadhan, Salgarelli, Thuel, Wang, &