

Efficient Mobility Management Methods for Mobile Communication Networks

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Abstract

Mobile communications are those ways in which users would be able to communicate with mobiles moving from one region to another. As one of the most popular mobile communication networks, personal communication service (PCS) networks enable mobiles to transfer communication calls between any desired locations at any time. When a PCS network receives calls from mobiles or stations, it has to quickly determine the current location of the destined mobiles. However, existing PCS networks suffer high delay in locating the mobile from which the mobile's location has to be always consulted on the location databases. Especially, if a mobile receives a large number of calls from a particular remote network, the calls are routed through the same link several times that will cause extra signaling overhead. By caching the location information of the frequently called mobiles at the calling networks, it prevents calls from routing through unnecessary links, and it then reduces call delivery delay and network traffic. Nevertheless, the longer the useless records caused by the movement of mobiles remains in a cache, the higher the degradation of cache memory utilization and system performance is imposed on a system. This thesis proposes an efficient caching

scheme for PCS networks that each cached record is not allowed to remain over its predefined time, called a time-threshold, in a cache. By compulsively removing the cached records with high chance of obsolescence from the memory, cache memory utilization and network performance can be improved. As a notice of the time-threshold, a long time-threshold may increase the obsolescence of the cached record. In contrast, a short time-threshold may degrade memory utilization. In this thesis, we provide an analytical model and a unique solution for determining the optimal time-threshold to improve cache memory utilization and network performance, and study the effects of changing the important parameters of mobility, calling patterns, and network conditions on the optimal time-threshold. Furthermore, we show that the proposed caching scheme outperforms the existing schemes in terms of the cost for delivering calls.

As another popular mobile communication network, Mobile IP provides a global mobility management method for locating a mobile using a unique IP address. For mobiles with high mobility, however, the global mobility management method may incur significant network overhead in terms of signaling delay and packet loss. As a mobility management extension of standard Mobile IP, local mobility management (LMM) was proposed. It supports local registrations of mobiles for low signaling delay and packet loss. However, existing LMM protocols still suffer high signaling traffic and service delay from which all registrations and packet deliveries on a local network are serviced by a single and central gateway foreign agent (GFA). This thesis also introduces two fully distributed local mobility management methods for Mobile IP networks. Our methods allow every foreign agent (FA) to configure its own network consisting of sev-

eral FAs residing within a distance from itself, and to act as a temporary GFA on its network. By distributing the functions of GFA to all FAs, our methods can provide low signaling traffic and service delay for Mobile IP. We present the specifications and basic protocol operations of our fully distributed methods. Furthermore, simulation studies show clearly the performance of local mobility management methods. We show that our methods outperform the conventional local mobility management methods in terms of traffic distribution, service delay, and the signaling cost.