Chapter 18

LTE Mobility Solutions at Network Level for Global Convergence

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ABSTRACT

One of the research challenges for next generation all-IP-based wireless systems is the design of intelligent mobility management techniques that take advantage of IP-based technologies to achieve global seamless roaming among various access technologies. Since Mobile IPv6 is considered a mature protocol, mobility management at the network layer is the frequent approach for heterogeneous networks. The tendency of future convergent scalable architectures is splitting the mobility management in two domains, global mobility and localized mobility management. This chapter presents the advantages of MIPv6, a global mobility protocol, and its enhancements. A case study based on MIPv6 for UMTS and WiFi convergence is also presented. Proxy MIPv6, the newest protocol of the MIPv6 family, already included in the roadmap of future 4G networks, will be analyzed as a solution for localized mobility management. The main goal of the chapter is describing the way mobility protocols (MIPv6 and PMIPv6) will be implemented for the 3rd Generation Partnership Project (3GPP) Long Term Evolution architecture. The chapter ends with the presentation of the interoperation between different network technologies using global and localized mobility management protocols, which provide flexibility, scalability and independence between mobility domains.

INTRODUCTION

Even if Mobile IP popularity is growing, implementing mobility using these protocols for present mobile networks (GPRS/UMTS) still has some weaknesses. Link layer mobility is wide used in 3G networks (GPRS Tunneling Protocol is a link layer protocol used for mobility management between the core network entities) and is also utilized in 802.11 wireless LANs (a device moving across 802.11 access points within the same distribution system continues to maintain its sessions uninterrupted). But these are

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mobility solutions that are technology-specific. Link-layer mobility solutions for seamless mobility across heterogeneous access media are extremely complex and, since the telecom world is heading to the concept of "all IP", it is necessary for 4'Th generation architectures to develop and deploy network-layer mobility solutions that are independent of the access technology.

Network layer mobility has been applied for a long period for mobility in 3G networks, but has some problems. Instead GTP is mainly used for these networks. The advantage of GTP is supporting micro-mobility through which the mobile station can access the network using one permanent IP address while moving in the area controlled by the same mobility management entity (SGSN for UMTS networks) and without necessity of re-registering to a home agent.

Keeping the same IP address in the mobility domain and not involving the mobile node in the mobility related signaling are two of the reasons that lead to the idea of splitting mobility management in two domains: Local Mobility Management (also called Network Mobility) who's exponent protocol is Proxy Mobile IPv6 and Global Mobility Management (or Host Mobility) represented by Mobile IPv6 and enhancements.

ALL-IP MOBILE NETWORKS: GLOBAL MOBILITY MANAGEMENT

MIPv6 Overview

Mobile IP is a layer 3 host based global mobility protocol that solves the routing problem for mobile users. Two versions of Mobile IP have been standardized for supporting host-based mobility on the Internet: MIPv4 and MIPv6. They support the mobility of IP hosts by allowing them to utilize two IP addresses: a home address (HoA) that represents the fixed address of a mobile node (MN) and a care-of address (CoA) that changes with the IP subnet to which an MN is currently attached. In terms of the fundamental architectural aspects, these two mobility support standards follow the same concept, but the IPv6 header is special designed to support mobility. This is one of the greatest advantages that IPv6 offers. Compared to Mobile IPv4, Mobile IPv6 offers the possibility for route optimizing, thus the tunneling through HA method (triangular routing) can be avoided. Also the MIPv4 protocol has a Foreign Agent, a server similar with the Home Agent, which transmits all the messages, once the MN is attached to that visited network. For IPv6 there is no need for the Foreign Agent, all the messages can be send directly by the MN, without the need of any intermediate router. Besides the advantages for the mobility process, IPv6 offers the possibility of using the Neighbor Discovery Algorithm, the mechanism for address reconfiguration that makes the handover transparent to the user. Mobile IPv6 offers support for multiple Home Agents. Thus a wide distributed network based on IPv6 can be produced, and the HA workload will be fragmented for easier implementation of the protocol for wide distributed networks.

MIPv6 has still revealed some problems: handover delays, excessive signaling and packet loss, involving the mobile node in mobility related signaling so special heavy processing at MN level is required. Signaling related communication with the MN using the air interface lowers the performance.

A typical scenario to reach MIPv6 limits is when the number of hops to reach the MN from the HA is big, so the MN location is far away from its home networks and the connections on the path are slow and unreliable. Furthermore, despite the reputation of this protocol, it has been slowly deployed in real implementations and does not appear to receive widespread acceptance in the market.