Chapter XIII
A Fast Handover Method for Real-Time Multimedia Services

Jani Puttonen
University of Jyväskylä, Finland

Ari Viinikainen
University of Jyväskylä, Finland

Miska Sulander
University of Jyväskylä, Finland

Timo Hämäläinen
University of Jyväskylä, Finland

ABSTRACT

Mobile IPv6 (MIPv6) has been standardized for mobility management in the IPv6 network. When a mobile node changes its point of attachment in the IPv6 network, it experiences a time due MIPv6 procedures when it cannot receive or send any packets. This time called the handover delay might also cause packet loss resulting undesired quality-of-service degradation for various types of applications. The minimization of this delay is especially important for real-time applications. In this chapter we present a fast handover method called the flow-based fast handover for Mobile IPv6 (FFHMIPv6) to speed up the MIPv6 handover processes. FFHMIPv6 employs flow information and IPv6-in-IPv6 tunneling for the fast redirection of the flows during the MIPv6 handover. Also, FFHMIPv6 employs a temporary hand-off-address to minimize the upstream connectivity. We present the performance results comparing the FFHMIPv6 method to other fundamental handover methods with Network Simulator 2 (ns-2) and Mobile IPv6 for Linux (MIPL) network.

INTRODUCTION

In the last few years, the number of mobile devices as well as a variety of possible access technologies have increased. More importantly, the mobile device will have several integrated access technologies. Already, new mobile phones have integrated IEEE 802.11b Wireless

LAN and Bluetooth interfaces, in addition to traditional cellular systems such as GSM (Global System for Mobile Communications) and GPRS (General Packet Radio Service). These different access technologies have different characteristics related to Quality-of-Service (e.g., bandwidth), coverage area, cost, power consumption, etc. (Frodigh, Parkvall, Roobol, Johansson, & Larsson, 2001). The access technologies might also provide their specific link layer handover mechanisms. But, for the mobile terminal to be always globally accessible, some upper layer **mobility management** technique is necessary, such as **Mobile IPv6** (MIPv6) (Johnson, Perkins, & Arkko, 2004). This is emphasized as the IP protocol seems to be the enabling technology to both applications and access networks (Berezdivin, Brenig, & Topp, 2002). IP technology integrates all access technologies to one heterogeneous **All-IP** network (i.e., integration of traditional cellular networks and IP data networks is inevitable).

Although MIPv6 enables the mobility at the IP layer, the processes related to MIPv6 mobility management result in a short period of time when the mobile node (MN) cannot receive or send any packets. This time, called the handover delay, degrades the performance of especially real-time applications such as multimedia or voice over IP (VoIP). In current days, technologies such as **IP-TV** and **VoIP** phone calls are becoming more and more popular because of low prices and integration features of the IP protocol. For example the Skype VoIP call program has 120 million downloads thus far. Also cellular manufacturers constantly introduce more efficient phones with new multimedia software. Mobile TV is shortly becoming reality.

Even though today these VoIP calls and multimedia streaming services are usually used between static desktop machines, the inevitable direction is towards mobile terminals with wireless access. This requires efficient IP-based mobility management when the user is traveling between IP subnets. Thus the mobility management problem has been under heavy research for many years and as a result, several Mobile IPv6 enhancements have been proposed in the academic literature.

In this chapter we present a **flow-based fast handover for Mobile IPv6** (FFHMIPv6) method (Sulander, Hämäläinen, Viinikainen, & Puttonen, 2004) as a solution to the handover delay problem. In FFHMIPv6, the flows of the mobile node (MN) can be redirected to the current location simultaneously with the address registration process by using flow state information and IPv6-in-IPv6 tunneling. The Mobile IPv6 specifies that the MN can send upstream data only after receiving a binding acknowledgment (BACK) to the binding update (BU) from the home agent (HA). In FFHMIPv6, this is solved by assigning a temporary hand-of-address (HofA) to the MN during the handover process (Viinikainen, Kašák, Puttonen, & Sulander, in press).

In this chapter we will present the Mobile IPv6 protocol and its most important enhancements for handover delay minimization, **hierarchical MIPv6** (Soliman, Castellucia, El-Malki, & Bellier, 2004) and fast handovers for Mobile IPv6 (Koodli, 2004), but the main emphasis is on the FFHMIPv6 method. The FFHMIPv6 method is presented and compared mainly against the Mobile IPv6. The idea is to give the reader a glimpse of the Mobile IPv6 protocol and the constant research that is being performed around it.

BACKGROUND

Applications with network usage need to bind themselves a network socket with a specified destination address. When a MN moves and