Improvement in the Handover Latency in Mobile IPv6

Shubhangani Sharma

ABSTRACT: *In this paper, we focus on the improvement in the handoff latency in Mobile IPv6. We introduce Hierarchical MIPv6 to overcome the packet losses and long delays in MIPv6. HMIPv6 reduces handoff latency by employing a hierarchical network structure and reducing the location update signaling with external network. Then we introduce Stealth-HMIPv6 (SHMIPv6) to get the better performance than HMIPv6. Then we introduce an efficient scheme for Fast handover over HMIPv6 (ES-FHMIPv6) to reduce the total handover latency in macro mobility. The proposed schemes improve the total handover latency and minimizing the packet losses during macro-mobility and micro-mobility.*

Keywords: handover latency, macro-mobility, micro-mobility, packet losses, MIPv6, HMIPv6, delay etc.

1. INTRODUCTION

With the invention of new technologies, mobile communication is getting more and more attention. These systems will offer to the users the possibility to roam between different access networks and a multiple of services. Roaming between various network technologies and continuously growing in the heterogeneity and the requirements of their seamless integration Such integration involves all networks that simply co-exist now a days, namely 3G cellular systems, Wireless Local Area Networks (WLANs), Mobile Ad-hoc Networks, Personal Area Networks etc. And it is very important to maintain continuous connectivity when a user moves from one place to another place. But there is main problem arising of failure of handover. Handover is a process, when mobile moves into a different cell while a call in progress; mobile switching center (MSC) automatically transfers the call to a new channel belonging to the new base station. In order to support mobility services, Mobile IP has been proposed. MIP is a location independent protocol which lets IP datagram to route on the internet. It is mostly found in wireless overlay networks. The wireless overlay networks consist of wireless networks with the different wireless access technologies. The handover in the wireless overlay networks can be classified into two kinds, horizontal (micro mobility) handover and vertical (macro mobility) handover. A horizontal handover occurs between two network access points (AP), which the same network technology and the vertical handover occurs between two network access points (AP) that use different network connection technologies. A solution to support the IP-based mobile networks is Mobile IPv4. Basic mobility management mechanisms are stated in Mobile IPv4 to allow a mobile node (MN) to configure IP addresses on the visited networks, while maintaining connections through a home address [1]. Though, Mobile IPv4 has several drawbacks, such as not supporting quality-of-service (QoS) or not enough addresses. Thus Mobile IPv6 is introduced to overcome the problems of Mobile IPv4. We will introduce Mobile IPV6 in section 2, Hierarchical MIPv6 in section 3, Stealth HMIPv6 in section 4, an efficient scheme for Fast handover over HMIPv6 in section 5 and section 6 is conclusion.

• *Shubhangani Sharma is currently pursuing masters degree program in Electronics and communication engineering, Lovely Professional University, India. shubhangani.sharma@yahoo.com*

2. MOBILE IPv6

In order to support the mobility, Mobile IPv6 has been proposed. It is the extension version of IPv6. In this, mobile node should use two addresses; one is home address or permanent address and second is temporary address (the care-of address -CoA, providing the host's actual location). Mobile IPv6 is a location independent protocol which lets IP datagram to route on the internet [3]. When the mobile node moves into a new network (visited network), its movement is detected and a new association is made with mobility agents (visited agents) in the new domain. A mobile node is unable to receive IP packets on its new association point until the handover process finishes. Therefore the handoff latency takes place. The period between the transmission of its last IP packet through the old connection and the first packet through the new connection is the handover latency. The handover latency is affected by several components:

(1) Link Layer Establishment Delay (D_{L2}): The time required by the physical interface to establish a new association. This is the layer 2 handover between access routers (AR).

(2) Movement Detection (D_{RD}): The time required for the mobile node to receive beacons from the new access router, after disconnecting from the old AR.

(3) Duplicate Address Detection (D_{DAD}): The time required to recognize the uniqueness of an IPv6 address.

(4) BU/Registration Delay (D_{REG}): The time elapsed between the sending of the BU (binding update) from the MN to the HA (home agent) and the arrival/transmission of the first packet through the new access router [4].

The handover delay for MIPv6 can analytically be computed as:

$$DMIPv6 = D_{L2} + D_{RD} + D_{DAD} + D_{REG}$$

There is a significant problem in MIPv6 due to its inability to support micro mobility caused by long delays and high packet losses during a handoff.

3. HIERARCHICAL MIPv6

HMIPv6 is introduced to overcome the problems arising in MIPv6. HMIPV6 is to separate mobility into micro mobility (within the same mobility access point (MAP)) and macro mobility (between the different MAPs). MAP is designed to reduce the signaling cost of MIPv6, between the mobile node (or HA (home agent) and CN (corresponding node). HMIPv6 scheme reduces the handover latency by employing a hierarchical network structure and minimizing the location update signaling with the external network [2], [5] and [12]. The two-layer network structure of HMIPv6 is good for supporting the vertical handoff and the horizontal handoff in wireless overlay networks. HMIPv6 has to perform two main operations; **(1)** Registration process which includes location updating in which a mobile node (MN) has to register and update its new location by binding update (BU) process and **(2)** Sending and receiving packets to and from corresponding nodes (CNs) [6] and [7]. As a result shown in *Fig.1*, The Hierarchical Mobile IPv6 supports the fast handover by the influence of duplication address detection (DAD), but we find the DAD time represents a large portion of delay time in a handoff. Therefore HMIPv6 can reduce the delay and the amount of signaling during a handover. This protocol is suitable for micro-mobility management but it still has long delay in managing macro-mobility management.

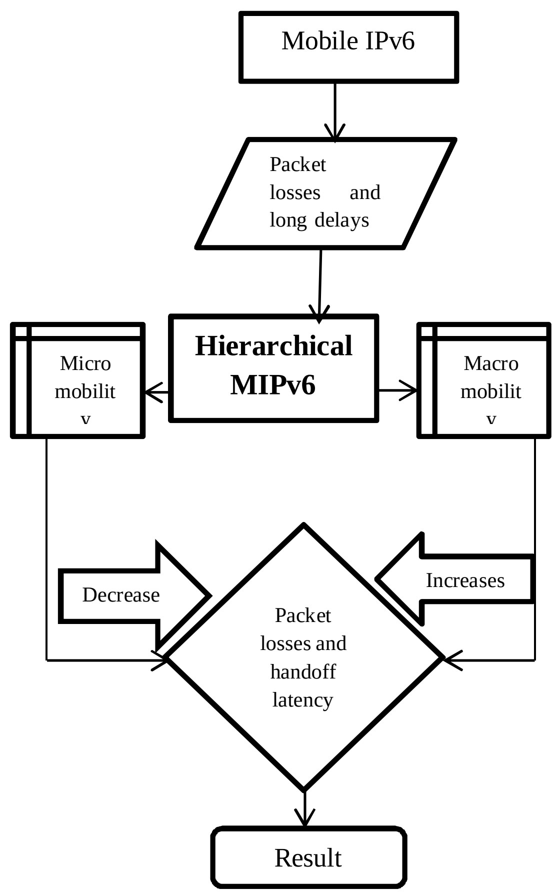

Fig.1 Hierarchical MIPv6 overcomes the losses of MIPv6.

4. STEALTH HMIPv6

We examine the handover latency and find that the DAD time represents a large portion of handover latency. In this way, we propose a Stealth-time HMIP (SHMIP) which can reduce the influence of DAD time and, therefore, decrease the handover time significantly [8] and [9]. We know the delay comes from the transmission time of the signaling and the process of DAD check. In order to perform DAD, the MN has to send one or several neighbor solicitation to its new access router (AR) and wait for a response for as many as 1 s. During this operation, the MN cannot receive any packets. To solve this problem, we have to utilize this period of time waiting for DAD.

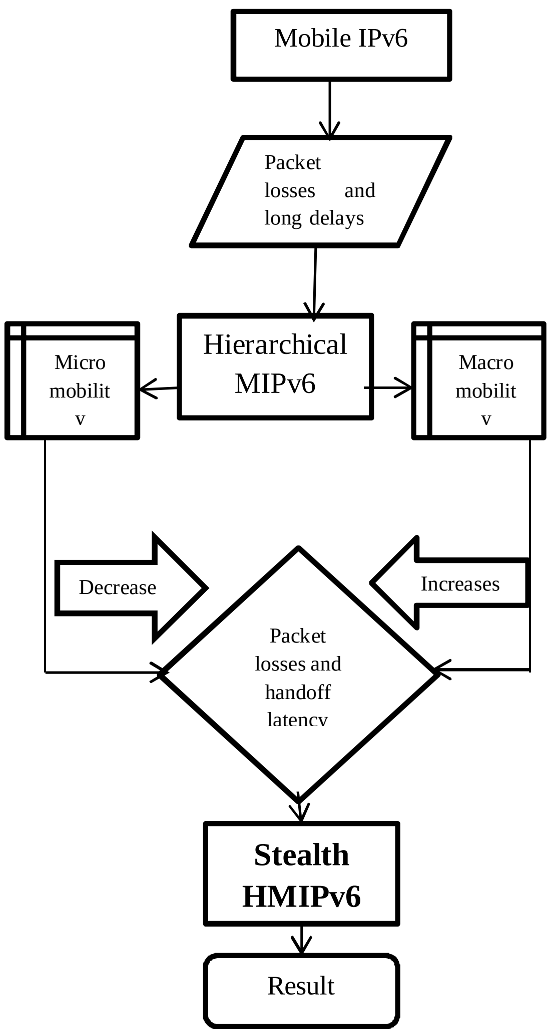

Fig.2 SHMIPv6 is better than HMIPv6.

In mechanism of HMIPv6, we wait for the result of DAD because we cannot confirm the uniqueness of RCoA (regional care of address). But in SHMIPv6 mechanism is when a mobile node sends local binding update (BU) it also sends binding updates to its home agent and correspondent node (CN) at the same time, using LCoA (on-link care of address) instead of RCoA. After DAD for RCoA is confirmed by new MAP, the mobile node sends a binding update (BU) to its home agent and correspondent node again like in HMIPv6. Although registering to home agent and correspondent node by LCoA can reduce DAD time, there are still packet losses before BU. To further reduce packet losses, we adopt “pre handover notification” to request previous mobile access point (pMAP) to buffer packets for the mobile node. When the MN acquires new LCoA, it sends a BU again to previous MAP to inform the MAP to terminate buffering and forward buffered packets to the mobile node. As a result shown in *Fig.2*, SHMIPv6 gives better handover performance than HMIPv6 in macro-mobility management but there is some packet losses and handoff latency.

5. AN EFFICIENT SCHEME FOR FAST HANDOVER OVER HMIPv6 (ES-HMIPv6)

We examine some packet losses and handoff latency in SHMIPv6. To overcome these losses we introduce an efficient scheme for Fast handover over HMIPv6 (ES-HMIPv6) [10] and [11]. It is designed to be efficient with the data transport characteristics. ES-HMIPv6 is designed with the combination of FMIPv6 and HMIPv6 to improve their lacks and to reduce the total handoff latency in macro-mobility of HMIPv6. When a mobile node wants to move from previous access router to new access router in the previous mobile access point and the new access router already has information about the link layer address and network preface, and send the router advertisement to the new access point. The new access point has a dual buffer which stores the received message of access router sent by new access router. A new access point sends a beacon message periodically to mobile node in every

100ms. Mobile node sends the layer2 association request to new access point; new access point sends an association request with stored router advertisement.

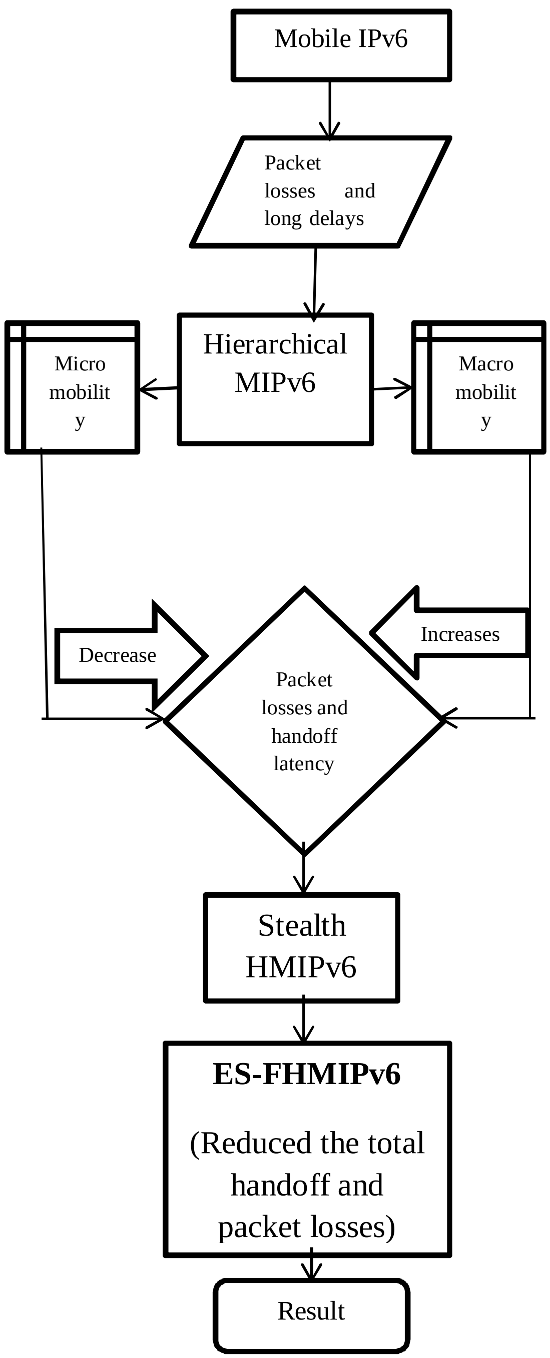

Fig.3 ES-FHMIPv6 reduced the total handoff latency.

Mobile node sends LCoA and RCoA to new access router where address configuration confirmation with 1000ms has been established for RCoA, new enhanced binding update for LCoA and RCoA is performed, then home agent and corresponding node response to mobile node with new enhanced binding acknowledgement is sent.

As a result as shown in *Fig.3*, an efficient scheme for fast handover over HMIPv6 gives the better performance with minimizing the total handoff (handover) latency and packet loss in macro-mobility management. It also minimizes the message transmission latency and reduced the signaling cost in HMIPv6.

6. CONCLUSION

We introduced HMIPv6 to improve the Mobile IPv6's losses. HMIPv6 supports fast handoff by reducing the influence of DAD (duplication address detection). HMIPv6 is good in handling micro-mobility but still have relative long delays in managing macro-mobility. For this SHMIPv6 is introduced, we get better performance than HMIPv6 by utilizing the period of time waiting for DAD (duplication address detection) for RCoA (regional care of address) by switching from two-layer addressing to one-layer addressing in that period. But we have some packet losses and delay in handover. To improve this problem we introduced An efficient scheme for fast handover over HMIPv6 (ES-FHMIPv6), it minimized the total handover latency and packet losses and reduced the signaling cost in HMIPv6. It also enhance and optimize the performance of the mobile services.

REFERENCES

[1] O. Casals, L. Cerda, G.Willems, C. Blondia, and N. Van den Wijngaert, "Performance evaluation of the post-registration method, A low latency handoff inMIPv4," in Proc. IEEE Int. Conf. Commun., vol. 1, May 2003, pp. 522–526.

[2] R. Hsieh, A. Seneviratne, H. Soliman, and K. El-Malki, "Performance analysis on hierarchical mobile IPv6 with fast-handoff over end-to-end TCP," in Proc. IEEE Global Telecommun. Conf., vol. 3, Nov. 2002, pp. 2488–2492.

[3] C. Perkins, D. Johnson, and J. Arkko, "Mobility Support in IPv6", Request for Comment 3775, Internet Engineering Task Force, Jun. 2004

[4] W. K. Lai and J. C. Chiu, "Improving Handoff Performance in Wireless Overlay Networks by Switching Between Two-Layer IPv6 and One-Layer IPv6 Addressing", IEEE Journal on Selected Areas in Communications, vol.23, no.11, November 2005.

[5] R. Koodli, et al.,"Mobile IPv6 Fast Handovers", Request for Comment 5268, Internet Engineering Task Force, Aug 2008.

[6] H. Soliman, C. Castelluccia, K. El-Malki, and L. Bellier, "Hierarchical Mobile IPv6 Mobility Management (HMIPv6)," Request for Comment 5380, Internet Engineering Task Force, Oct. 2008.

[7] G. Daley, B. Pentland, and R. Nelson, "Effects of fast router advertisement on mobile IPv6 handovers," in Proc. 8th IEEE Int. Symp. Comput.Commun., 2003, pp. 557–562.

[8] K. Omae, M. Inoue, I. Okajima, and N. Umeda, "Handoff performance of mobile host and mobile router employing HMIP extension," in Proc. IEEE Wireless Commun. Netw., vol. 2, Mar. 2003, pp. 1218–1223.

[9] K. Baba, J. Cheng, R. Diaz, S. Mahidhara, A. Mehta, V. Pandurangi, and A. Singh, "Fast handoff L2 trigger API,", draft-singh-l2trigger-api- 00.txt, 2002.

[10] Yoo, H., Tolentino, R.S., Park, B., Chang, B., Kim, S.: ES-FHMIPv6, An Efficient Scheme for Fast Handover over HMIPv6 Networks, International Journal of Future Generation Communication and Networking 2(2) (2009)

[11] Nam, S., Hwang, H., Kim, J.: Fast Macro Handover in HMIPv6. In: 8th IEEE international Symposium on Network Computing and Aplications, Cambridge, Massachusetts (2009)

[12] Han, Y., Min, S.: Performance Analysis oh Hierarchical Mobile IPv6: Does it improve Mobile IPv6 in Terms of Handover Speed. Wireless Personal Communications 48,463-483 (2009)