FMIPv6 Handover Procedure Management for Efficient Packet Transmission over Multimedia Networks

Sung-Gyu Kim[1], Byungjoo Park[1] and Byeong-Yun Chang[2*]

[1]*Department of Multimedia Engineering, Hannam University*
133 Ojeong-dong, Daeduk-gu, Daejeon, Korea
sgkim@hnu.kr, bjpark@hnu.kr

[2]*School of Business Administration, Ajou University*
San5, Woncheon-Dong, Yeongtong-Gu, Suwon, Korea
[*]*Correspondent Author: Byeong-Yun Chang[*] (bychang@ajou.ac.kr)*

Abstract

Recently, wireless network user increased drastically due to the fast development and evolution of various mobile devices such as Smart Phone, Tablet PC, and etc. Provider provides good quality of services to the customers by giving them the advance functionality and services. Therefore, wireless network services expanded in various multimedia services such as Voice over IP, Video Call, MMS, Video Sharing, Online Video Streaming, etc. In the past, network environment trend used wired network, but it drastically evolved into wireless network which gives fast and efficient communication, more convenience to the users/consumers. Therefore, it emphasized the importance of Mobile Internet Protocol Version 6(MIPv6) which also challenges the providers to develop advance product services by integrating wireless network services. Many researchers studied new protocols and related technology in order to develop and provide an advance services and good quality of service. Therefore, a lot of developments and enhancement was being studied and develop using standard MIPv6 such as Fast handover for Mobile IPv6, Hierarchical Mobile IPv6 and Proxy Mobile IPv6. But, it has many problems until now. In this paper, we proposed a handover protocol over fast handover for mobile IPv6 which enhanced the handover procedure and reduce the delay time of packet transmission.

Keywords: *MIPv6, FMIPv6, Reverse Binding, Look-Up*

1. Introduction

Nowadays, increase exponentially consumers who use wireless network as development of wireless- terminal technology, for example smart-phone, laptop computer, personal digital assistant (PDA) and so on. For this reason, diverse wireless network technologies like Wibro, Wireless-LAN, 3G cellular system which provide network service to wireless- terminal are developing. When standard Mobile IPv6 [1] moves to other base-station, that is, if handover occurs, it is spent much delay-time to treat this and then happens packet loss and packet reversal phenomenon. Due to this, occur the occasion that cannot properly provide Real Time Service to user. Though it has been developing and studying to resolve delay time of handover and other problems which occurring In MIPv6, There is a lot of something left we still have to improve.

In this thesis, adjust Beacon Messages spacing from based on original Fast MIPv6, it suggested to provide more efficient wireless internet circumstances by using buffer installation to Access Point (AP), Look-Up, and Reverse Binding Message.

2. Related Work

2.1 Mobile Internet Protocol Version 6 (MIPv6)

MN in MIPv6 starts telecommunications with Home Address (HoA) which is its own address in Home Network. In other words, if MN is in Home link, it general communicates with HoA of its own MN and fixed Node. But, when MN move to other link, MN that takes only HoA is unable to hold communication. Because of this, make Care of Address (CoA), new temporary address for showing location of MN, and then lasted communication in link which is new moved. CoA automatically is created through DAD after combination interface-address of MN and Router Prefix value of moved area.

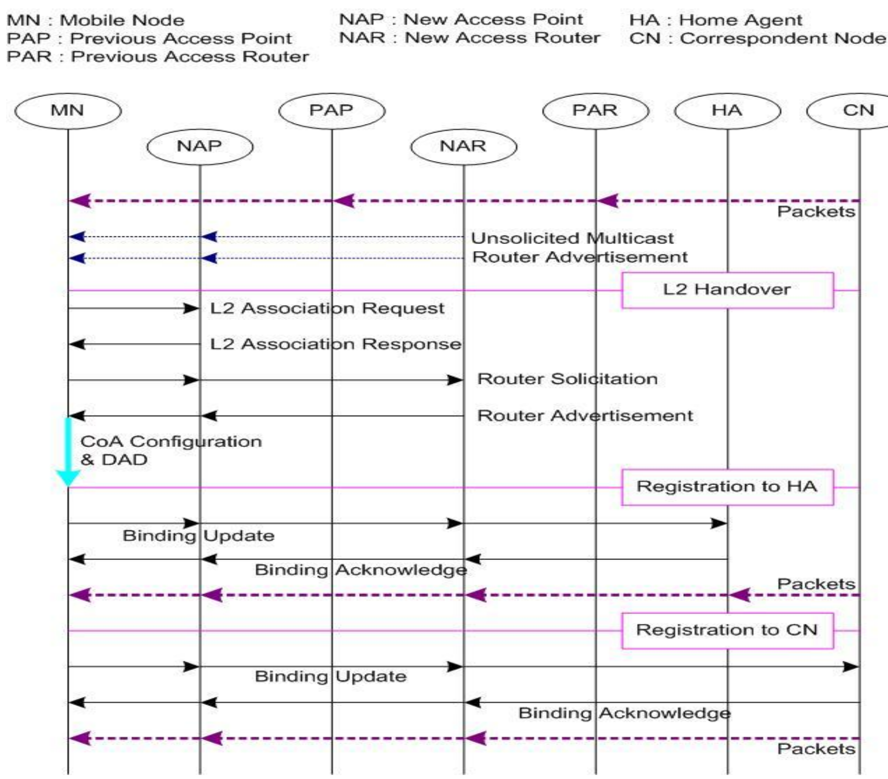

Figure 1. Standard MIPv6 Handover Procedure

Figure 1 shows handover process sequence of standard MIPv6. MN that moves to new network informs its own movement to NEW Access Point (NAP) and New Access Router (NAR), after creating a new CoA (NCoA) through DAD, register its own NCoA to Correspondent Node (CN) and Home Agent (HA) by Binding Update (BU) and receive packet. After MN is registered to CN, CN not through HA, this can send packet to new CoA of MN. As this method, solve triangular Routing problem on Home Network and parts of packet loss.

However, a standard MIPv6 needs long delay time when happen handover. Due to this, MN can lose packet as MN get not temporarily packet and can make switching-phenomenon of packet sequence which is transferred to MN as switching data sequence in registration section of HA and CN.

2.2 Fast Handover for MIPv6 (FMIPv6)

FMIPv6 is suggested to solve high handover delay-time comes from MIPv6. In case of MIPv6, MN transferred to new area to make NCoA should receive Router Advertisement (RA) message. But in case an FMIPv6, it is able to sense Moving of MN in advance by using L2 Trigger on Link Layer. When MN is located in previous network, Using Router Solicitation for Proxy (RtSolPr) message and Proxy Router Advertisement (PrRtAdv) message, conduct Movement Detection (MD) process.

Namely, decreased handover delay time by conducting all of these NCoA creation and DAD process before MN move to new network.

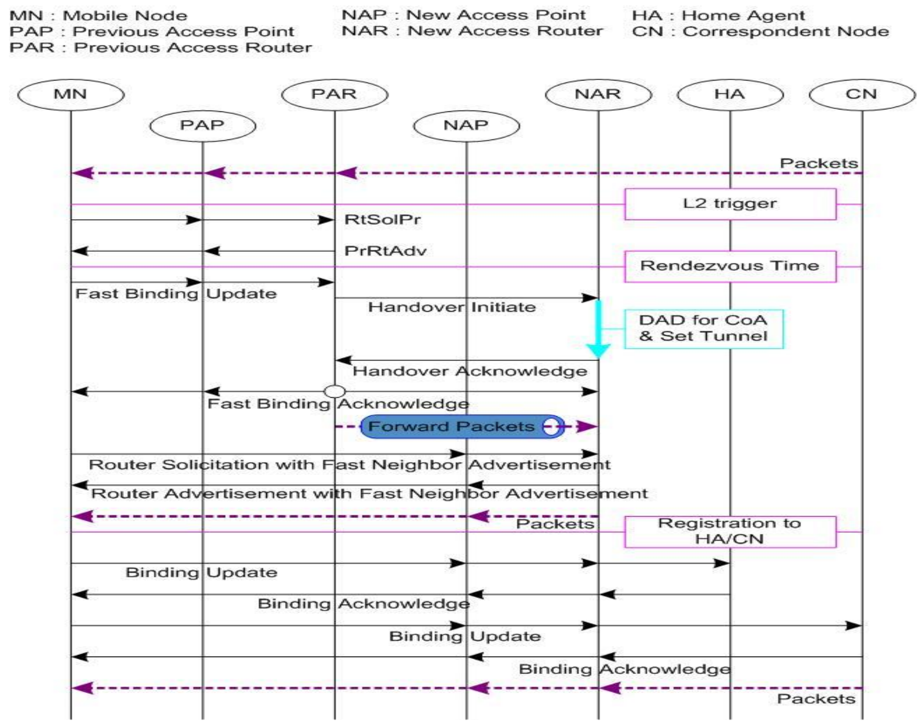

Figure 2. Standard FMIPv6 Handover Procedure

2.3 FMIPv6 Handover Procedure

Figure 2 shows handover processing sequence over FMIPv6. MN receives L2 trigger message from Access Router (AR), before MN move to new link, New Access Router (NAR). Transmit information about AR to Previous Access Router (PAR), including Access Point (AP) identifier to RtSolPr. MN creates NCoA that will use in new link by using information of AR that is found through PrRtAdv message and send Fast Binding Update (FBU) message to PAR. PAR taken this informs NAR of handover occurrence from handover Initiate (HI) and request availability of NCoA. NAR transmit handover Acknowledge (HAck) response message to PAR, PAR taken this informs NCoA to MN through Fast Binding Acknowledge (FBA) message. And then, creating tunnel and NAR, PAR transmits Packet that was receiving from CN to NAR. MN that moved to new area sends immediately Fast Binding Advertisement message to NAR. It must be perceived L2 Trigger signal to do handover in

FMIPv6. But it spends longer handover delay-time, when moved route of MN are significantly different or MN moves with very fast speed from the present network to new network.

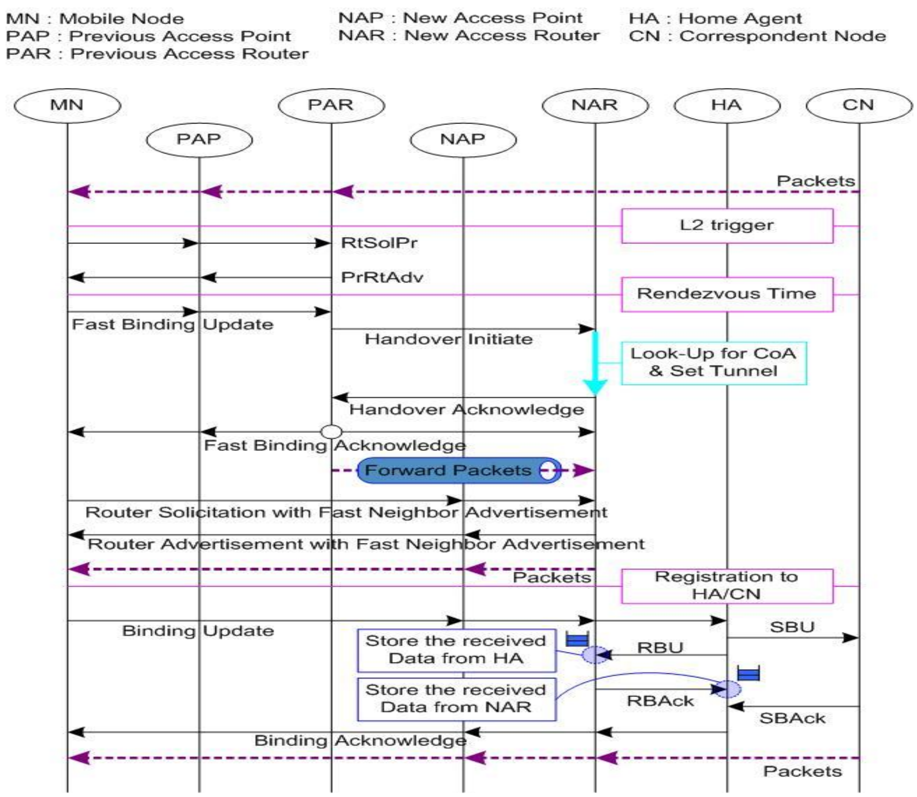

Figure 3. Proposed AK-FMIPv6 Handover Procedure

3. AK-Fast Mobile IPv6 (AK-FMIPv6) Handover Protocol

3.1 Before Movement

Figure 3 shows handover processing sequence on AK-Fast Mobile IPv6 (AK-FMIPv6) which suggests in this thesis. Proposed method is that AR adjusts interval of Beacon Message which informs regularly its own location through AP. And install buffer to each AP, preserve and renew AR information given at regular intervals by Periodic Unsolicited Multicast Router Advertisement message.

3.2 L2 Trigger

MN can predict its move in the overlapping area of near ARs through L2 trigger signals. Before move to new subnet, MN notices move, inform its move to PAR through RtSolPr message, and ask NAP information which takes charge of the new area.

PAR got this message stops packet transmission from CN to MN, saving them in its buffer temporarily, and then transfers PrRtAdv message to MN, informing the NAR information it knows.

3.3 Rendezvous Time

MN transfers FBU message to PAR. PAR got this sends HI message to NAR informing MN information. After NAR creates NCoA, checks if the new created address is usable through Look-Up process, and connects tunnels. PAR got HAck message, a replying message, from NAR transfers FBA message to MN and NAR. When MN creates NCoA to use in the new domain, it should check if the address is usable or not. Standard MUPv6 checked whether it is usable or not through DAD process. But it takes about 1000ms to perform DAD process which takes a large percentage of whole handover delay time. To reduce whole handover delay time, we should reduce the time used to perform DAD process. For this, in this thesis we use double FNDD technique replacing DAD process to Look-Up. In the Look-Up process, MN receives L2 Association Response message and checks Cache when it knows NAR information. If there is no overlapping address, it saves and uses the address in the entry of Cache, or if there is overlapping address, it finds composed address in the address table before. For this, the Look-Up delay = N * t AC. N is the number of Look-Up, t AC is the comparative delay time of RAM in AR and access time. It takes 3.36 μs in case of the best, 5.28 μs in case of the worst to perform the Look- Up process. It is much less figure compared to DAD before. Therefore in this thesis we administer handover more efficiently by using Look -Up instead of DAD process.

PAR transfers the packet it saved its buffer to NAR through tunnel. In the Standard FMIPv6, MN should register it in NAR through NAP using Router Solicitation with Neighbor Advertisement message. But in the AK- FMIPv6 we suggest in this thesis, AR information is already saved in buffer installed in each AP so it is enough to inform its move to NAP. Thus, we can reduce the distance from AP to AR, it is led to decrease of handover delay time. NAP replies to MN through Router Advertisement with Fast Neighbor Advertisement message and transfers packet it was saving in its buffer.

3.4 Registration to HA/CN

MN moved to new area should register NCoA into HA and CN. After MN sends BU message to HA, the HA got this message replies with BA message and at the same time it transfers FBU message to CN, registering NCoA to CN instead of MN. In the Standard FMIPv6, MN had to repeat the same process to CN after registering NCoA into HA. But in AK-FMIPv6 we are suggesting, HA registers NCoA to CN for MN so that the handover delay time can be reduced. HA sends Reverse Binding Update message to NAR and gets Reverse Binding Acknowledge message as a reply. In these two messages, there is NCoA of MN and the packet information received so far. Through these two messages, HA and NAR share MN information and save MN information in each buffer temporarily. After this process, CN, got MN information from HA already, transfers packet to MN and finishes all the handover process on AK-FMIPv6 we are suggesting here. Through Reverse Binding signal, we add in this thesis, MN information is saved in AR and HA temporarily. With this process, if MN goes back to the place it was right before, it does not need to be registered to AR and HA. So we can solve the Ping-Pong problem which happens often in the air ports.

4. Performance Analysis and Comparison

4.1 Total Handover Latency

In case of suggested AK-FMIPv6, it has calculated message that spends longer time than any other the concurrent messages in Registration process to HA, CN. Table 1 is to divide message that happens when conducting handover process, as defining a parameter for Performance Analysis. They are defined as T_{MIPv6} entire handover delay time of MIPv6, T_{FMIPv6} entire handover delay time of FMIPv6, $T_{AK\text{-}FMIPv6}$ entire handover delay time of AK-FMIPv6 by setting of table 1. β is defined as ratio of retransmit amount about packet loss that arises in MIPv6.

Figure 4 is to express Time Diagram of Standard MIPv6, formula 1 is it's mathematical. Figure 5 is to express Time Diagram of Standard FMIPv6, formula 2 is it's mathematical. Figure 6 is to express Time Diagram of Standard AK-FMIPv6 that we are suggesting in this paper, formula 3 is it's mathematical.

Table. 1. Performance Analysis Parameters

Symbol	Description	Value
t_1	MN ↔ AP	50ms
t_2	AP ↔ AR	40ms
t_3	AR ↔ AR	60ms
t_4	AR ↔ HA	50ms
t_5	AR ↔ CN	50ms
t_{CoA}	Form CoA	1000ms
$t_{Look\text{-}Up}$	Best	3.36 μs
	Worst	5.28 μs
α	Signal Weighting Factor	-
β	Packet re-transmission rate	-
t_{Scan}	Beacon Message waiting time	-

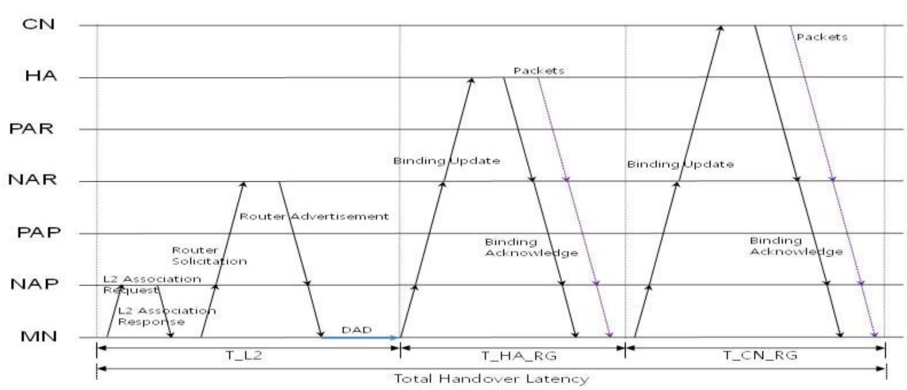

Figure 4. MIPv6 Timing Diagram

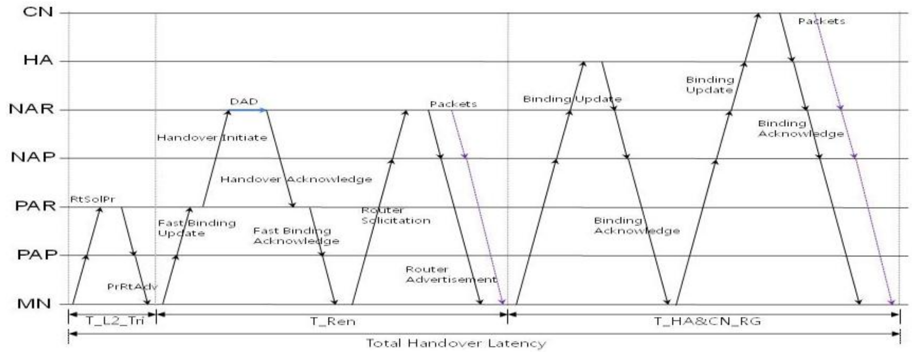

Figure 5. FMIPv6 Timing Diagram

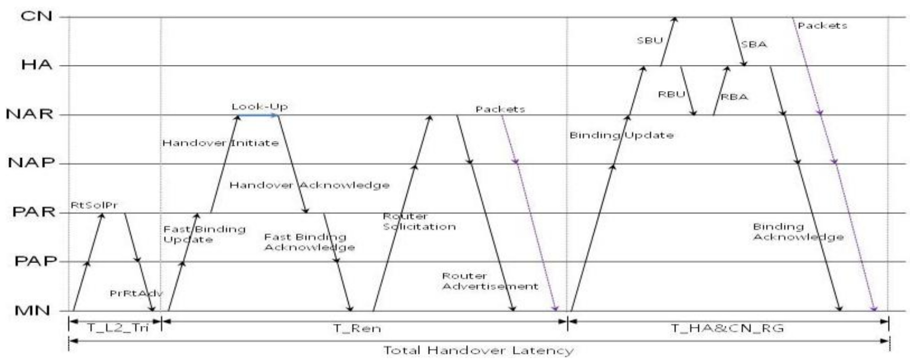

Figure 6. AK-FMIPv6 Timing Diagram

$\mathbf{T_{MIPv6}}$ **(1)**

$= T_{Scan} + \alpha T_{\_L2} + T_{CoA} + T_{\_HA\_RG} + T_{\_CN\_RG}$

$= t_{Scan} + \alpha(4t_1 + 2t_2) + t_{CoA} + 4t_1 + 4t_2 + 2t_4 + 2t_5 + \beta(t_1 + t_2 + t_5)$

$\mathbf{T_{FMIPv6}}$ **(2)**

$= T_{L2\_Tri} + T_{\_Ren} + T_{CoA} + T_{\_HA\_RG} + T_{\_CN\_RG}$

$= 10t_1 + 10t_2 + 3t_3 + 2t_4 + 2t_5 + t_{CoA} + \beta(t_1 + t_2 + t_5)$

$\mathbf{T_{AK\text{-}FMIPv6}}$ **(3)**

$= T_{L2\_Tri} + T_{\_Ren} + T_{Look\text{-}Up} + T_{\_HA\_RG} + T_{\_CN\_RG}$

$= 8t_1 + 6t_2 + 2t_3 + 4t_4 + 2t_5 + t_{Look\text{-}Up} + \beta(t_1 + t_2 + t_5)$

4.2 Total Handover Latency Analysis

Figure 7 shows total handover delay time for the change of the number of handover in the standard MIPv6, FMIPv6 and proposed AK-FMIPv6. Figure 8 is the graph which handover latency comparison in time t_1. Figure 9 is the graph which handover latency comparison in time t_2.

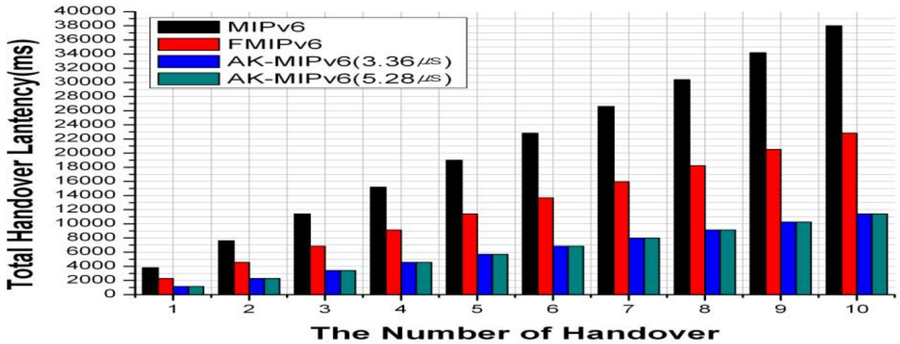

Figure 7. Handover Latency Comparison based on Increasing Number of Handover

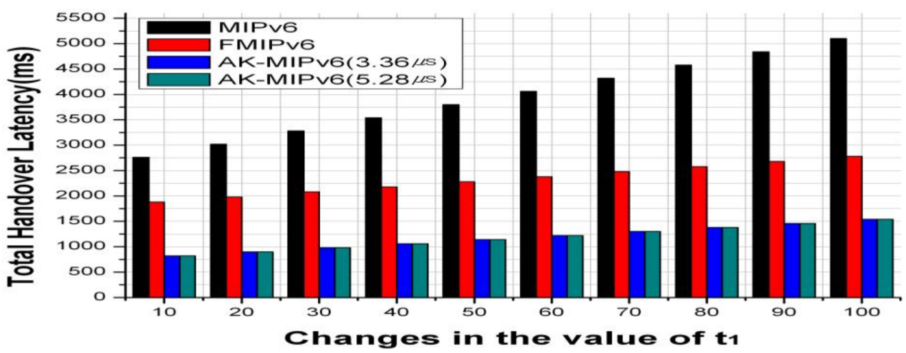

Figure 8. Handover Latency Comparison in time t_1

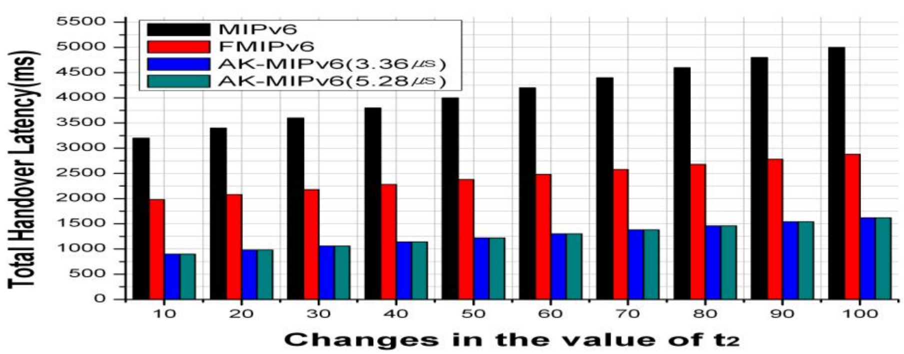

Figure 9. Handover Latency Comparison in time t_2

5. Conclusion

In this paper, we suggested the technique which is able to reduce handover delay time efficiently on base of FMIPv6. Also, we got rid of Ping-Pong problem through AK-FMIPv6 handover handling process we suggested in this thesis. But in reducing handover delay time, more optimized method should be considered through further study.

References

[1] D. Johnson, C. Perkins and J. Arkko, “Mobility Support in IPv6”, IETF RFC 3775, (2004) June.

[2] R. koodli, Ed., “Fast Handovers for Mobile IPv6”, IEFT RFC 4068, **(2005)** July.

[3] H. Soliman, C. Castelluccia, K. El Malki and L. Bellier, “Hierarchical Mobile IPv6 Mobility Management (HMIPv6)”, IETF RFC 4140, **(2005)** August.

[4] B. J. Park, A. H. Latchman, “A Fast Neighbor Discovery and DAD Scheme for Fast Handover in Mobile IPv6 Networks”, ICNICONSMCL 06, 0-7695-2552-0106.