

A Study on the delay of streaming packets during IP handover between heterogeneous networks

Tae_Wan Kim*, Han_Gyoo Kim**

Network R&D Unit, Research Institute of Technology, LG Uplus, 1600 Sangam-dong Mapo-gu Seoul Korea

dm24ks@lguplus.co.kr, hgkim33@lguplus.co.kr

Abstract— In this paper, the delay time of streaming packets was compared with the delay time of 1500 byte test packets during IP handover between heterogeneous networks, and the deployment of equipment and network for this experiment was performed through the BcN 3rd phase project, which was hosted by KCC(Korea Communications Commission), and conducted by NIA(National Information Society Agency) from 2008 to 2010 . By comparing with the delay time during IP handover between the 1500 byte test packets which were transmitted by every 30[ms] from a server and the streaming packets of VOD and real time streaming video which were transmitted from a platform for the trial service of Mobile IPTV in commercial network, we can find out the time differences in a test and real situation, and may define an appropriate service suitable for the delay time. A smart phone was used as a test terminal for 1500 byte test packets during IP handover in 2009, and also for the trial service of Mobile IPTV in 2010.

Keywords— Delay time, IP handover, Heterogeneous network, Smart phone

I. INTRODUCTION

Hereafter, the services provided by WiFi and Wimax(Wibro) to which IEEE 802.11n and IEEE 802.16 are applied would be pervasive, and the technology which can manage and operate heterogeneous networks could be spotlighted to a network provider, which owns various networks, in the end of the year 2012 when the commercial service provided by LTE(Long Term Evolution) starts. That is to say, IP mobility technology would be needed, which can provide a customer with a seamless service even a customer's moving to a media different, heterogeneous network by using one device, and it has been presented by IETF(Internet Engineering Task Force) and the several ways to minimize the delay time during IP handover were presented . [1] [2]

MIH(Media Independent Handover) and xGMIP(X-Generation Mobile IP) for IP handover between heterogeneous networks was applied in a smart phone by the type of a CM(Connection Manager), and the test was performed by the smart phone in 2009 and the upgraded one in 2010.

II. MAIN SUBJECT

MIH CM applied in a smart phone consists of two parts, such as xGMIP developed in 2008 and MIH developed in 2009. xGMIP was originally designed for IP mobility of IPv6

application between different IPv4 CoA(Care Of Address) networks, and ETRI(Electronics and Telecommunications Research Institute) engaged in the development of it. The xGMIP was installed in a UMPC whose OS is Window XP, and the IP handover test was performed in the condition in 2008 that both the WiFi driver and the CDMA driver, type of dongle were on. [3]

To control the drivers of a smart phone whose OS is WinCE and to decrease the power consumption of it, MIH was introduced, and was developed by the type of a CM which combines MIH with xGMIP library by the way of tightly coupling in 2009. It allows MIH to control the resource of a smart phone at layer 2, and xGMIP to handle IP mobility at layer 3. In addition to the above, MIH sends a policy and a point of time for IP handover down to a smart phone, comparing the position of a smart phone with the AP positions already registered in a MIH server.

The network configuration for IP handover test was as in Figure 1, and the 1500 byte test packets which were transmitted by every 30[ms] from a server were used instead of real time steaming packets in 2009.

The reason that the 1500 byte test packets were used by every 30[ms] for IP handover is closely to meet the real situation in which the packets of VoD and real time streaming video were transmitted from a Mobile IPTV platform to a smart phone.

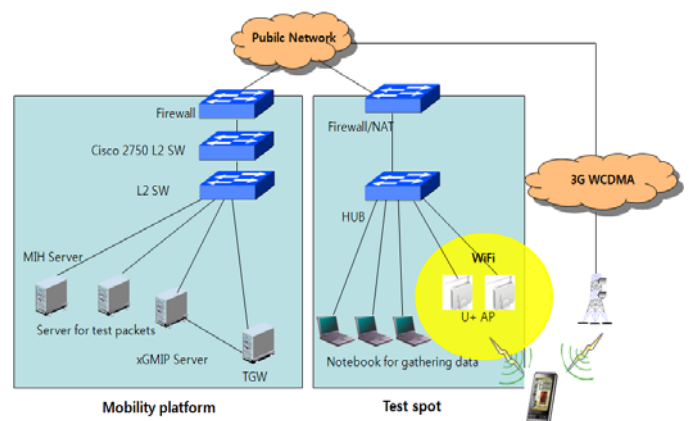


Figure 1. Network configuration for IP handover test in 2009

Currently the trial service for Mobile IPTV was provided to 33 customers for three months from September to November in 2010. The service scheme is as follows :

After the MIH CM goes into operation by a user's touching its icon in a smart phone, the user watches TV soap operas or movies in a WiFi zone (or CDMA EvDO) after running a Mobile IPTV player, and then he moves to CDMA EvDO (or WiFi). Even though the user moves to a heterogeneous network, the picture on the screen such as VOD and real time broadcasting doesn't discontinue.

The network configuration for IP handover test in 2010 is as in Figure 2, and it consists of two parts for Mobile IPTV trial service. One is for VOD service which is provided by a streaming server, an authentication server, and a content server holding the contents of TV series such as soap opera and entertainment, and the other is for real time broadcasting service which is provided by a streaming server, a program server, and an encoding server connected to a live source.

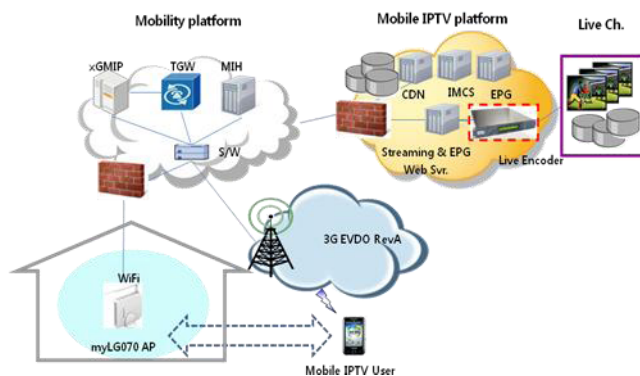


Figure 2. Network configuration for IP handover test in 2010

In this paper, the delay time during IP handover between heterogeneous networks performed in 2009 and 2010 is compared, and the detail is as follows.

A. Handover Procedures

If the signal strength of WiFi reached the threshold level, MIH CM would perform IP handover to CDMA EvDO, and in CDMA area, comparing the position of a smart phone with the AP positions already registered in a MIH server, it performs IP handover to WiFi.[4] And the technique to handover between heterogeneous networks is the type of MBB(Make Before Break), that is to say, before a current session in a current network is closed between a smart phone and TGW, a new session in a new network to be handed over will be made.

The starting point of IP handover is the time that MIH CM sends the message of MIH MN HO Commit Req. to a MIH server, and the end point of it is the time that MIH CM receives the message of MIH MN HO Complete Res. from a MIH server, after its sending the message of MIH MN HO Complete Req. to a MIH server.

For more detail explanation, if MIH CM received the message of MIH MN HO Commit Res. from a MIH server,

after its sending the message of MIH MN HO Commit Req. to a MIH server, xGMIP would send the message of Make Tunnel Req. to a TGW(Tunnel Gate Way) and would receive the message of Make Tunnel Res. from a TGW after a secured tunnel was made between a smart phone and a TGW. Then, the streaming packets pass from an old path into a new path, and after checking this completion of IP handover, MIH CM sends the message of MIH MN HO Complete Req. to a MIH server, and receives the message of MIH MN HO Complete Res. from a MIH server.

The difference of the end point in the IP handover test executed in 2009 and 2010 is caused by it that the test users can move freely for Mobile IPTV trial service period, and by the result of it, a log file which was accumulated in a smart phone couldn't be extracted from it in 2010, but it could be extracted from the MIH server in 2009 test.

The procedure of IP handover is exactly the same regardless of a handover direction, WiFi to CDMA or CDMA to WiFi, and its explanation is in Figure 3.



Figure 3. The procedure of IP handover between heterogeneous networks

B. MIH CM, Mobile IPTV Player, and EMS

When the MIH CM goes into operation by a user's touching its icon in a smart phone, the picture on the screen of a smart phone is as in Figure 4.



Figure 4. The picture on the screen of a smart phone when MIH CM runs

After running the MIH CM like above, the user runs a Mobile IPTV player, and the picture on the screen of a smart phone is as in Figure 5. The right top of the Figure 5 shows the current network to which the user is connected. WiFi is dark green and CDMA is dark red. There are three main icons on the screen of the Mobile IPTV player such as a live broadcasting, TV series, and Movies. And the left part of the screen shows the time schedule of a live broadcasting and right part of the screen shows a popular VOD list for a week selected by the users.



Figure 5. The picture on the screen of a smart phone when Mobile IPTV player runs

The MIH server was managed by MIH EMS(Equipment Management System), and it displays the condition of current CPU occupation, memory usage, process occupation, and interface cards of a MIH server for MIH server's operators. The data The main screen of MIH EMS is as in Figure 6.

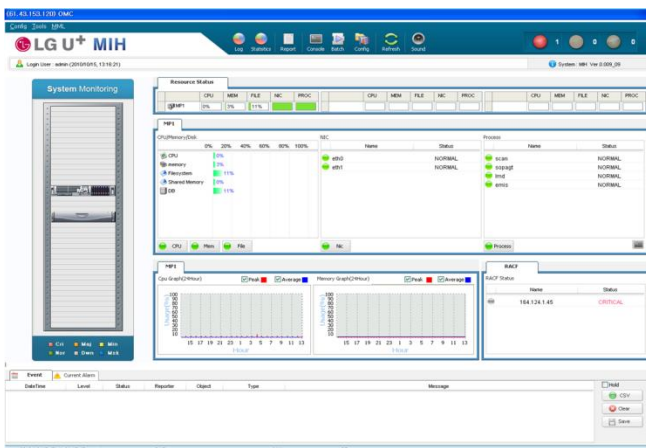


Figure 6. The picture on the screen of MIH EMS

C. Comparison of the delay time during IP Handover

The test result during IP handover between WiFi and WCDMA which was performed in 2009 is as in Table 1, and the test result during IP handover between WiFi and CDMA EvDO which was performed in 2010 is as in Table 2.

The delay time in the table 1 and 2 means the duration time of IP handover at layer 3, that is to say, if the tunnel in the new network to which packets are supposed to be handed over from an old network was made between a smart phone and a TGW, it would mean that the process at layer 2 was done in the new network. And in case of IP handover from CDMA(or WCDMA) to WiFi, the time to make an association between a smart phone and an AP and to receive the CoA by DHCP in a network was excluded in the delay time of below the table. It means a pure IP handover time at layer 3.

In 2009, there was not a smart phone for commercial service which could be tested in a CDMA EvDO in 2009, so MIH CM was installed in a smart phone which could be tested in WCDMA network.

As the network which was used for IP handover test in 2009 was different from it in 2010, the result of delay time in table 1 and 2 might be easily considered as untrustworthy, but it's wrong idea, for the both networks can fully support a bit rate like the 1500 byte test packets in their network capacity. [5]

TABLE 1. THE THE DELAY TIME MEASURED IN 2009

Number of handover	Handover direction	Delay time
100	WiFi to WCDMA	63[ms]
100	WCDMA to WiFi	3.2[ms]

By the users executing IP handover while they watched VOD or real time broadcasting for 44 days from September 1st, 2010 to October 14th, 2010, the delay time in the table 2 was accumulated in a MIH server and the average of it was calculated by the number of IP handover in each direction.

The reason that the number is larger from WiFi to CDMA EvDO than from CDMA EvDO to WiFi is as follows :

- When a user got MIH CM started, it was set up to be automatically connected to WiFi at first, and IP handover from WiFi to CDMA EvDO is easily executed only by the signal strength.
- After the connection with WiFi, a user goes away without coming back to his house.
- He forcefully terminated MIH CM so restless that he couldn't wait for the time to handover from CDMA EvDO to WiFi.
- A smart phone halted suddenly by an unexpected problem on OS and MIH CM in it.

And the reason that the delay time in the year 2010 is larger than one in the year 2009 is as follows :

- In case of VOD and real time broadcasting, the period to send the packets to a smart phone is shorter than

30[ms], so a system load is heavier than the case of the year 2009.

- Even though the CPU capacity of a smart phone used in the year 2010 is larger than one in 2009, there is a CPU limitation of a smart phone to process the packets of VOD and real time broadcasting in comparison with PC.
- And also there is a limitation of mobile network steadily to transport the packets of VOD and real time broadcasting.

TABLE 2. THE DELAY TIME MEASURED IN 2010

Number of handover	Handover direction	Delay time
994	WiFi to CDMA EvDO	1,012.07[ms]
680	CDMA EvDO to WiFi	1,160.29[ms]

The specification of a smart phone which was used during the test for two years is as in Table 3.

TABLE 3. THE SPECIFICATION OF A SMART PHONE TESTED IN 2009 AND 2010

Version	CPU	OS	Test Year
Omnia One	600MHz	WinCE 6.1	2009
Omnia Two	800MHz	WinCE 6.5	2010

III.CONCLUSIONS

This attempt is considered first in the world that the MIH CM which supports IP mobility between heterogeneous networks was not only installed in a smart phone, but also

was utilized as a connection manager for a seamless mobility of Mobile IPTV service in the smart phone for a certain period.

This paper shows that there is difference of IP handover delay time between the test packets and the real streaming packets, and even though MBB technique is applied in a terminal and a server, there is a delay time of almost one second in a real situation.

It's reasonable to assume that a smart phone's CPU capability and a delay by network situation can affect the result of delay time, and by considering the test result, we may define the service suitable for the delay time in commercial network.

And to decrease the delay time for IP handover between heterogeneous networks, we need to enhance the CPU capacity of a smart phone, configure simply the network connection among the servers, and to make mobile access network more stable than now, that is to say, it has to support the steady bit rate for a multimedia service.

Hereafter, IP handover technology such as MIH and xGMIP will be pervasive, and the terminals applied by it will increase, for telecommunications companies need to utilize effectively their heterogeneous networks by offloading a heavy traffic, by the choice of users to be reluctant of staying in expensive network, and by the convenience of users to need a service in the place they want.

REFERENCES

- [1] Y.S. Kim, D.H. Kwon, and Y.J. Seo, *An Implementation and Performance Evaluations of Fast Handovers for Mobile IPv6*, KICS, Oct., 2004
- [2] H.C. Kim, *An Inter-Domain Fast Handover Scheme for Proxy Mobile IPv6*, Donga University, Feb., 2010
- [3] T.W. Kim, I.K. Jo, *A Study on Improvement of a Performance by Preventing the Ping-pong Effect when IP Handover*, KICS, Aug. 2009
- [4] Guidelines of Coordinate Conversion, Geographic Information System Agent, Ministry of Construction and Transportation, Nov., 2009
- [5] T.W. Kim, The test result between heterogeneous networks based on MIH by BcN 3rd project in 2009